**3GPP TSG RAN WG1 #114** **R1-230xxxx**

**Toulouse, France, August 21st – 25th, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.213** | **CR** |  | **rev** |  | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | Introduction of NR sidelink evolution | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_enh2-Core | | | | |  | ***Date:*** | | | 2023-09-01 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of NR sidelink evolution. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Capture NR power control for E-UTRA – NR co-channel coexistence. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | No support NR sidelink evolution. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 16.1, 16.2.0, 16.2.2, 16.2.5 (new), 16.3.0, 16.4, 16.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

\*\*\* Unchanged parts are omitted \*\*\*

# 16 UE procedures for sidelink

A UE is provided by *SL-BWP-Config* or *SL-BWP-ConfigCommon* a BWP for SL transmissions (SL BWP) with numerology and resource grid determined as described in [4, TS 38.211]. For a resource pool within the SL BWP, the UE is provided by *sl-NumSubchannel* a number of sub-channels where each sub-channel includes a number of contiguous RBs provided by *sl-SubchannelSize*. The first RB of the first sub-channel in the SL BWP is indicated by *sl-StartRB-Subchannel*. Available slots for a resource pool are provided by *sl-TimeResource* and occur with a periodicity of 10240 ms. For an available slot without S-SS/PSBCH blocks, SL transmissions can start from a first symbol indicated by *sl-StartSymbol* and be within a number of consecutive symbols indicated by *sl-LengthSymbols*. For an available slot with S-SS/PSBCH blocks, the first symbol and the number of consecutive symbols is predetermined.

The UE expects to use a same numerology in the SL BWP and in an active UL BWP in a same carrier of a same cell. If the active UL BWP numerology is different than the SL BWP numerology, the SL BWP is deactivated.

A priority of a PSSCH according to NR radio access or according to E-UTRA radio access is indicated by a priority field in a respective scheduling SCI format. A priority of a PSSS/SSSS/PSBCH according to E-UTRA radio access is provided by *sl-SSB-PriorityEUTRA* [13, TS 36.213]. A priority of an S-SS/PSBCH block is provided by *sl-SSB-PriorityNR*. A priority of a PSFCH is determined as described in clause 16.2.4.2.

A UE does not expect to be provided search space sets associated with CORESETs on more than one cell to monitor PDCCH for detection of DCI format 3\_0 or DCI format 3\_1.

## 16.1 Synchronization procedures

A UE receives the following SL synchronization signals in order to perform synchronization procedures based on S-SS/PSBCH blocks: SL primary synchronization signals (S-PSS) and SL secondary synchronization signals (S-SSS) [4, TS 38.211].

A UE assumes that reception occasions of a physical sidelink broadcast channel (PSBCH), S-PSS, and S-SSS are in consecutive symbols [4, TS 38.211] and form a S-SS/PSBCH block.

For reception of a S-SS/PSBCH block

- for operation without shared spectrum channel access, or for operation with shared spectrum channel access and when *sl-NumberRepeatedSSB* is not provided for RB-set , a UE assumes a frequency location corresponding to the subcarrier with index 66 in the S-SS/PSBCH block [4, TS 38.211] is provided by

- *sl-AbsoluteFrequencySSB*, for operation without shared spectrum channel access or when RB-set is the anchor RB-set

- *sl-AbsoluteFrequencySSB-r18*, when RB-set *j* is a non-anchor RB-set

- for operation with shared spectrum channel access when *sl-NumberRepeatedSSB* is provided and in RB-set , a UE assumes a frequency location corresponding to the subcarrier with index 66 in the S-SS/PSBCH block [4, TS 38.211] is provided by +, where

- is a frequency location of a lowest S-SS/PSBCH block in RB-set , where is provided by

- *sl-AbsoluteFrequencySSB* when RB-set *j* is the anchor RB-set,

- *sl-AbsoluteFrequencySSB-r18* when RB-set *j* is a non-anchor RB-set;

- is an index of an S-SS/PSBCH block from repeated S-SS/PSBCH blocks in the frequency domain and within the RB-set , where , and is provided by a value in *sl-NumberRepeatedSSB* corresponding to RB-set ;

- is a number of resource blocks, provided by *sl-GapRepeatedSSB*, for a gap between repeated S-SS/PSBCH blocks;

- is a number of resource blocks for a S-SS/PSBCH block transmission with SCS configuration .

For operation with shared spectrum channel access, a UE attempts to transmit at least S-SS/PSBCH blocks in the anchor RB set. The UE applies CP extension to the first symbol of an S-SS/PSBCH block according to an index [4, TS 38.211] provided by *sl-CP-Extension-SSB*.

The UE assumes that a S-PSS symbol, a S-SSS symbol, and a PSBCH symbol have a same transmission power. The UE assumes a same numerology of the S-SS/PSBCH as for a SL BWP of the S-SS/PSBCH block reception, and that a bandwidth of the S-SS/PSBCH is within a bandwidth of the SL BWP. The UE assumes the subcarrier with index 0 in the S-SS/PSBCH block is aligned with a subcarrier with index 0 in an RB of the SL BWP.

A UE is provided, by *sl-NumSSB-WithinPeriod*, a number of S-SS/PSBCH blocks in a period of 16 frames. The UE assumes that a transmission of the S-SS/PSBCH blocks in the period is with a periodicity of 16 frames. The UE determines indexes of slots that include S-SS/PSBCH block as +, where

- index 0 corresponds to a first slot in a frame with SFN of the serving cell satisfying or DFN satisfying (DFN mod 16) = 0

- is a S-SS/PSBCH block index within the number of S-SS/PSBCH blocks in the period, with

- is a slot offset from a start of the period to the first slot including S-SS/PSBCH block, provided by *sl-TimeOffsetSSB*

- is a slot interval between S-SS/PSBCH blocks, provided by *sl-TimeInterval*

For operation with shared spectrum channel access and for each slot that includes S-SS/PSBCH blocks, a UE is provided, by *sl-NumAdditionalOccasionPerSSB*, a number of additional candidate S-SS/PBCH block transmission occasions. When , for S-SS/PSBCH block with index , the UE determines indexes of slots that include the additional candidate S-SS/PBCH block transmission occasions as + +, where

- is a slot gap, provided by *sl-TimeGapAdditionalOccasion*, for determining the additional candidate S-SS/PBCH block transmission occasions, and

- is an index of the additional candidate S-SS/PBCH block transmission occasions, with

For paired spectrum, an S-SS/PSBCH block can be transmitted/received only in a slot of an UL carrier. For unpaired spectrum, an S-SS/PSBCH block can be transmitted/received only in a slot of which all OFDM symbols are configured as UL by *tdd-UL-DL-ConfigurationCommon* of the serving cell if providedor *sl-TDD-Configuration* if provided or *sl-TDD-Config* of the received PSBCH if provided. If *tdd-UL-DL-ConfigurationCommon* and *sl-TDD-Configuration* are not provided for a spectrum indicated with only PC5 interface in Table 5.2E.1-1 in [TS 38.101-1], an S-SS/PSBCH block can be transmitted/received in any slot of the spectrum.

For transmission of an S-SS/PSBCH block, a UE includes a bit sequence in the PSBCH payload to indicate *sl-TDD-Config* and provide a slot format over a number of slots.

For paired spectrum, or if *tdd-UL-DL-ConfigurationCommon* and *sl-TDD-Configuration* are not provided for a spectrum indicated with only PC5 interface in Table 5.2E.1-1 in [TS 38.101-1],

- are set to '1';

else

- if *pattern1* is provided by *sl-TDD-Configuration* or *tdd-UL-DL-ConfigurationCommon*; if both *pattern1* and *pattern2* are provided by *sl-TDD-Configuration* or *tdd-UL-DL-ConfigurationCommon* as described in clause 11.1

- are determined based on

- in *pattern1* as described in Table 16.1-1 for

- in *pattern1* and *in pattern2* as described in Table 16.1-2 for

where and are as described in clause 11.1

- are the 7th to 1st LSBs of , respectively

- for ,

- for ,

where

- is the number of symbols in a slot: if *cyclicPrefix* = "ECP"; else,

- is 1 if , else is 0

- is 1 if , else is 0

- is the sidelink starting symbol index provided by *sl-StartSymbol*

- is the granularity of slots indication as described in Table 16.1-2

- , , , , are the parameters of *tdd-UL-DL-ConfigurationCommon* as described in clause 11.1, or the parameters of *sl-TDD-Configuration* as defined in [12, TS 38.331]

- corresponds to SL SCS as defined in [4, TS 38.211]

Table 16.1-1: Slot configuration period when one pattern is indicated

|  |  |
| --- | --- |
|  | Slot configuration period of *pattern1*  (msec) |
| 0, 0, 0, 0 | 0.5 |
| 0, 0, 0, 1 | 0.625 |
| 0, 0, 1, 0 | 1 |
| 0, 0, 1, 1 | 1.25 |
| 0, 1, 0, 0 | 2 |
| 0, 1, 0, 1 | 2.5 |
| 0, 1, 1, 0 | 4 |
| 0, 1, 1, 1 | 5 |
| 1, 0, 0, 0 | 10 |
| Reserved | Reserved |

Table 16.1-2: Slot configuration period and granularity when two patterns are indicated

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Slot configuration period of *pattern1*  (msec) | Slot configuration period of *pattern2*  (msec) | Granularity in slots with different SCS | | | |
| 15kHz | 30 kHz | 60 kHz | 120 kHz |
| 0, 0, 0, 0 | 0.5 | 0.5 | 1 | | | |
| 0, 0, 0, 1 | 0.625 | 0.625 |
| 0, 0, 1, 0 | 1 | 1 |
| 0, 0, 1, 1 | 0.5 | 2 |
| 0, 1, 0, 0 | 1.25 | 1.25 |
| 0, 1, 0, 1 | 2 | 0.5 |
| 0, 1, 1, 0 | 1 | 3 | 1 | | | 2 |
| 0, 1, 1, 1 | 2 | 2 |
| 1, 0, 0, 0 | 3 | 1 |
| 1, 0, 0, 1 | 1 | 4 |
| 1, 0, 1, 0 | 2 | 3 |
| 1, 0, 1, 1 | 2.5 | 2.5 |
| 1, 1, 0, 0 | 3 | 2 |
| 1, 1, 0, 1 | 4 | 1 |
| 1, 1, 1, 0 | 5 | 5 | 1 | | 2 | 4 |
| 1, 1, 1, 1 | 10 | 10 | 1 | 2 | 4 | 8 |

If a UE would transmit or receive an S-SS/PSBCH block, and the transmission or reception would overlap in time with transmissions or receptions on the sidelink using E-UTRA radio access, the UE transmits or receives the signal/channel with the higher priority.

If a UE would transmit or receive sidelink synchronization signals for E-UTRA radio access, and the transmission or reception would overlap in time with sidelink transmissions or receptions using NR radio access, the UE transmits or receives the signal/channel with the higher priority.

16.2 Power control

### 16.2.0 S-SS/PSBCH blocks

A UE determines a power for an S-SS/PSBCH block transmission occasion in slot , in the anchor RB-set if applicable, on active SL BWP of carrier as

[dBm]

where

- is defined in [8-1, TS 38.101-1]

- is a value of *dl-P0-PSBCH-r17* if using the parameter is supported by the UE and the parameter is provided; else *dl-P0-PSBCH-r16* ifprovided; otherwise,

- is a value of *dl-Alpha-PSBCH*, if provided; else,

- when the active SL BWP is on a serving cell , as described in clause 7.1.1 except that

- the RS resource is the one the UE uses for determining a power of a PUSCH transmission scheduled by a DCI format 0\_0 in serving cell when the UE is configured to monitor PDCCH for detection of DCI format 0\_0 in serving cell

- the RS resource is the one corresponding to the SS/PBCH block the UE uses to obtain MIB when the UE is not configured to monitor PDCCH for detection of DCI format 0\_0 in serving cell

- is a number of resource blocks for a S-SS/PSBCH block transmission with SCS configuration

- is a value of *sl-PowerOffsetAnchor*, if provided; otherwise, .

For operation with shared spectrum channel access, after allocating power for transmission of each S-SS/PBCH block in the anchor RB-set, the UE equally allocates power remaining from , if any, for transmission of each S-SS/PBCH block in non-anchor RB-sets.

\*\*\* Unchanged parts are omitted \*\*\*

### 16.2.2 PSCCH

A UE determines a power for a PSCCH transmission on a resource pool in PSCCH-PSSCH transmission occasion as

[dBm]

where

- is specified in clause 16.2.1

- is a number of resource blocks for the PSCCH transmission in PSCCH-PSSCH transmission occasion

- is a number of resource blocks for PSCCH-PSSCH transmission occasion

For sidelink co-channel coexistence between E-UTRA and NR, and for NR PSCCH/PSSCH transmissions with SCS configuration in slots that overlap with an E-UTRA subframe on the sidelink, the UE transmits NR PSCCH/PSSCH in the earlier overlapping slot with a power that is larger than or equal to the power in the later overlapping slot.

\*\*\* Unchanged parts are omitted \*\*\*

### 16.2.5 SL Carrier Aggregation

If a UE is configured for sidelink operation on multiple carriers, the UE applies the synchronization procedures in Clause 16.1 on each of the multiple carriers.

If a UE would transmit S-SS/PBCH blocks on multiple carriers, the UE determines a power for each S-SS/PBCH block transmission as described in Clause 16.2.0. If the UE would transmit S-SS/PBCH blocks that would overlap in time on respective carriers and a total power for the transmissions of the S-SS/PBCH blocks would exceed , the UE autonomously reduces a power for one or more of the S-SS/PBCH blocks transmissions so that a resulting total power would not exceed .

If a UE would transmit PSSCHs and PSCCHs on multiple carriers, the UE determines a power for each PSSCH and PSCCH transmission as described in Clauses 16.2.1 and 16.2.2, respectively. If the UE would transmit PSCCHs or PSSCHs that would overlap in time on respective carriers and a total power for the transmission of the PSCCHs or PSSCHs would exceed , the UE reduces a power for a transmission of a PSCCH or PSSCH that has the largest priority value as determined by SCI formats provided by the PSCCHs scheduling the respective PSSCHs. If more than one PSCCH/PSSCH transmissions have the largest priority value, the UE autonomously selects one of the more than one PSCCH/PSSCH transmissions to reduce a respective power. If, after the reduction of the power for the transmission of the PSCCH or the PSSCH with the largest priority value, a total power does not exceed , the UE transmits the PSCCHs or the PSSCHs, respectively. If, after the reduction of the power of the PSCCH or the PSSCH with the largest priority value, a total power exceeds , the UE does not transmit the PSCCH or the PSSCH, respectively.

If a UE would simultaneously transmit PSFCHs and receive PSFCHs on multiple carriers, the UE performs the procedures in Clause 16.2.4.2 across all the PSFCHs for transmission and PSFCHs for reception in order to determine PSFCHs to transmit or PSFCHs to receive. If a UE would simultaneously transmit PSFCHs on multiple carriers, the UE performs the procedures in Clause 16.2.3 across all the PSFCHs for transmission in order to determine PSFCHs to transmit and a corresponding power per PSFCH transmission. The UE expects to determine a same time resource and a same power for each of the PSFCH transmissions on multiple carriers.

## 16.3 UE procedure for reporting and obtaining control information in PSFCH

Control information provided by a PSFCH transmission includes HARQ-ACK information or conflict information.

### 16.3.0 UE procedure for transmitting PSFCH with control information

A UE can be indicated by an SCI format scheduling a PSSCH reception 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 *sl-PSFCH-Period*, 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 can be enabled, by *sl-InterUE-CoordinationScheme2*, to transmit a PSFCH with conflict information in a resource pool. The UE can determine, based on an indication by a SCI format 1-A, a set of resources that includes one or more slots and resource blocks that are reserved for PSSCH transmission. If the UE determines a conflict for a reserved resource for PSSCH transmission, the UE provides conflict information in a PSFCH.

A UE expects that a slot ) has a PSFCH transmission occasion resource if , where is defined in [6, TS 38.214], is a number of slots that belong to the resource pool within 10240 msec according to [6, TS 38.214], and is provided by *sl-PSFCH-Period*.

A UE may be indicated by higher layers to not transmit a PSFCH that includes HARQ-ACK information 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/2-B/2-C has value 1 [5, TS 38.212], the UE provides the HARQ-ACK information in a PSFCH transmission in the resource pool. For operation without shared spectrum channel access, the UE transmits the PSFCH in a first slot that includes PSFCH resources and is at least a number of slots, provided by *sl-MinTimeGapPSFCH*, of the resource pool after a last slot of the PSSCH reception. For operation with shared spectrum channel access, the UE can attempt to transmit the PSFCH over a number of first slots, provided by *sl-candidatePSFCH-Occasions*, that include PSFCH resources and are at least a number of slots, provided by *sl-MinTimeGapPSFCH*, of the resource pool after a last slot of the PSSCH reception. The UE attempts to transmit in a slot only when the UE fails to transmit in all previous slots.

For operation without shared spectrum channel access, a UE is provided by *sl-PSFCH-RB-Set* a set of PRBs in a resource pool for PSFCH transmission with HARQ-ACK information in a PRB of the resource pool. A UE can be provided by *sl-RB-SetPSFCH* a set of PRBs in a resource pool for PSFCH transmission with conflict information in a PRB of the resource pool. A UE expects that different PRBs are (pre)configured for conflict information and HARQ-ACK information. For a number of sub-channels for the resource pool, provided by *sl-NumSubchannel*, and a number of PSSCH slots associated with a PSFCH slot that is less than or equal to , the UE allocates the PRBs from the PRBs to 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 *.*

For operation with shared spectrum channel access, when *sl-PSFCH-Type = ‘type1’* and within RB-set , a UE determines, based on *sl-PSFCH-RB-Set*, all PRBs of an interlace for PSFCH transmission with HARQ-ACK information in the resource pool. Within the RB-set , the UE determines all PRBs in an interlace for PSFCH transmission with conflict information in the resource pool based on *sl-RB-SetPSFCH.*  The UE expects that PSFCH transmissions with conflict information use different interlaces than PSFCH transmissions with HARQ-ACK information. For the -th candidate PSFCH transmission occasion, , the UE determines a number of interlaces based on *sl-PSFCH-RB-Set* or *sl-RB-SetPSFCH*. The interlaces are ordered based on respective interlace indexes. All PRBs in the interlaces within RB-set are available for PSFCH transmission*.* For a number of sub-channels in RB-set and a number of PSSCH slots that is not larger than and is associated with a slot for PSFCH transmission, the UE allocates the interlaces from the interlaces to slot and sub-channel , where , , . The allocation starts in an ascending order of and continues in an ascending order of . The UE expects that isa multiple of *.*

For operation with shared spectrum channel access, when *sl-PSFCH-Type = ‘type2’* and within RB-set , a UE determines a subset of PRBs in a first interlace and, based on *sl-PSFCH-RB-Set*, a subset of PRBs in a second interlace for PSFCH transmission with HARQ-ACK information in a resource pool. Within RB-set , the UE determines a subset of PRBs in a first interlace and, based on *sl-RB-SetPSFCH*, a subset of PRBs in a second interlace for PSFCH transmission with conflict information in a resource pool*.* The UE expects that PSFCH transmissions with conflict information use different PRB subsets than PSFCH transmissions with HARQ-ACK information. An index of the first interlace is provided by *sl-PSFCH-Type2-CommonInterlace*. The PRBs in the second interlace are provided by *sl-PSFCH-Type2-DedicatedPRB* where, for the -th candidate PSFCH transmission occasion, , and for each interlace , the UE determines PRB subsets based on *sl-PSFCH-RB-Set* or *sl-RB-SetPSFCH*. The UE expects that is a multiple of . For interlace , the UE determines a PRB subset with index to include PRBs , . The UE determines the PRB subsets by ordering the PRB subsets first in an ascending order of interlace index and second in ascending order of PRB subset index within an interlace. For a number of sub-channels in RB-set and a number of slots for PSSCH transmissions that is not larger than and is associated with a slot for PSFCH transmission, the UE allocates the PRB subsets from the PRB subsets to slot among the slots for PSSCH transmissions that are associated with the slot and sub-channel for PSFCH transmissions, where and , . The allocation starts in an ascending order of and continues in an ascending order of . The UE expects that isa multiple of *.* A PRB in the first interlace is excluded from the resources for a PSFCH transmission, if for or for for any PRB in the PRB subset, and for or for , where PRB and PRB are the largest and smallest PRB indexes, respectively, in the resources for the PSFCH transmission assuming PRB is excluded.

The second OFDM symbol of PSFCH transmission in a slot is defined as .

For operation without shared spectrum channel access, a UE determines a number of PSFCH resources available for multiplexing HARQ-ACK or conflict information in a PSFCH transmission as where is a number of cyclic shift pairs for the resource pool provided by *sl-NumMuxCS-Pair* and, based on an indication by *sl-PSFCH-CandidateResourceType*,

- if *sl-PSFCH-CandidateResourceType* is configured as *startSubCH*, and the PRBs are associated with the starting sub-channel of the corresponding PSSCH

- if *sl-PSFCH-CandidateResourceType* is configured as *allocSubCH*, and the PRBs are associated with the sub-channels of the corresponding PSSCH

- for conflict information, the corresponding PSSCH is determined based on *sl-PSFCH-Occasion*

The PSFCH resources are first indexed according to an ascending order of the PRB index, from the PRBs, and then according to an ascending order of the cyclic shift pair index from the cyclic shift pairs.

For operation with shared spectrum channel access and for the -th candidate PSFCH transmission occasion, a UE determines a number of PSFCH resources available for multiplexing HARQ-ACK or conflict information in a PSFCH transmission as where is a number of cyclic shift pairs for the resource pool provided by *sl-NumMuxCS-Pair* and, based on an indication by *sl-PSFCH-CandidateResourceType*

- if *sl-PSFCH-CandidateResourceType* is indicated as *startSubCH*, , , and the interlaces or PRB subsets are associated with the first sub-channel within the RB-set with smallest index of the corresponding PSSCH

- if *sl-PSFCH-CandidateResourceType* is indicated as *allocSubCH*, and where the sum is over all RB-sets including resources for the corresponding PSSCH, and the interlaces per RB-set or PRB subsets are associated with the sub-channels of the corresponding PSSCH

- for conflict information, the corresponding PSSCH is determined based on *sl-PSFCH-Occasion*

The PSFCH resources are first indexed according to an ascending order of the interlace or PRB subset index, second according to an ascending order of the RB-set index, and then according to an ascending order of the cyclic shift pair index from the cyclic shift pairs. The UE applies CP extension to the first symbol of a PSFCH according to an index [4, TS 38.211] provided by *sl-CP-Extension-PSFCH*.

A UE determines an index of a PSFCH resource for a PSFCH transmission with HARQ-ACK information in response to a PSSCH reception or with conflict information corresponding to a reserved resource as where is a physical layer source ID provided by SCI format 2-A/2-B/2-C [5, TS 38.212] scheduling the PSSCH reception, or by SCI format 2-A/2-B/2-C with corresponding SCI format 1-A reserving the resource from another UE to be provided with the conflict information. For HARQ-ACK information, is the identity of the UE receiving the PSSCH as indicated by higher layers if the UE detects a SCI format 2-A with Cast type indicator field value of "01"; otherwise, is zero. For conflict information, is zero.

For a PSFCH transmission with HARQ-ACK information or conflict information, a UE determines a value, for computing a value of cyclic shift [4, TS 38.211], from a cyclic shift pair index corresponding to a PSFCH resource index and from using Table 16.3-1.

Table 16.3-1: Set of cyclic shift pairs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | | | | |
| **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 |

For a PSFCH transmission with HARQ-ACK information, 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 a SCI format 2-C, 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". For a PSFCH transmission with conflict information, a UE determines a value for computing a value of cyclic shift [4, TS 38.211] as in Table 16.3-4. 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 |

Table 16.3-4: Mapping of conflict information bit values to a cyclic shift, from a cyclic shift pair, of a sequence for a PSFCH transmission

|  |  |
| --- | --- |
| Conflict information | Conflict information for a next in time reserved resource indicated in SCI |
| **Sequence cyclic shift** | 0 |

A first UE determines a second UE for providing the conflict information to in a PSFCH as follows

- if the first UE is an intended receiver of the second UE for a reserved resource of a PSSCH transmission in a slot,

- does not expect to perform reception on the sidelink due to half-duplex operation in the slot,

- the PSFCH occasion for resource conflict information of the second UE is valid,

- the conflict information receiver flag in SCI format 1-A from the second UE is set to 1, if *sl-IndicationUE-B* = 'enabled', and

- determines to transmit to the second UE the PSFCH with the conflict information.

A first UE determines a UE for providing the conflict information to in a PSFCH as follows

- if, for a resource pool, *sl-TypeUE-A* is not provided, the first UE has been indicated a first reserved resource and a second reserved resource as resources for PSSCH reception or, if for a resource pool *sl-TypeUE-A* is provided, has been indicated at least the first reserved resource or the second reserved resource for PSSCH reception,

- detects a first SCI format 1-A that includes a first priority value, , and the first reserved resource for PSSCH transmission from a second UE,

- detects a second SCI format 1-A that includes a second priority value, , and the second reserved resource for PSSCH transmission from a third UE, and

- determines that the first and second resources overlap in time and frequency

- the PSFCH occasions for resource conflict information of the second UE and the third UE are valid

- the conflict information receiver flag in SCI Format 1-A from the second UE and the third UE is set to 1, if *sl-IndicationUE-B* = 'enabled'

- determines the first SCI format 1-A and the second SCI format 1-A are not received later than *sl-MinTimeGapPSFCH* before the PSFCH occasion for conflict information

- determines to transmit to the second UE the PSFCH with the conflict information

- determines to transmit to either the second UE or the third UE the PSFCH with the conflict information, if

The first UE can be provided conditions by *sl-OptionForCondition2-A-1* to determine conflict of reserved resources in a resource pool

- if *sl-OptionForCondition2-A-1* = '0', the first UE can be provided by, *sl-Thres-RSRP-List* , a list of RSRP thresholds for each priority combination [6, TS 38.214]

- if the first UE is an intended receiver for PSSCH in a reserved resource of the second UE, the first UE determines a resource conflict if the RSRP [6, TS 38.214] of the third UE is above a threshold

- if the first UE is an intended receiver for PSSCH in a reserved resource of the third UE, the first UE determines a resource conflict if the RSRP of the second UE is above a threshold

- if *sl-OptionForCondition2-A-1* = '1', the first UE can be provided a value by *sl-DeltaRSRP-Thresh*

- if the first UE is an intended receiver for PSSCH in a reserved resource of the second UE, the first UE determines a resource conflict if , where and are the RSRP measurements from the first UE for the second UE and the third UE, respectively

- if the first UE is an intended receiver for PSSCH in a reserved resource of the third UE, the first UE determines a resource conflict if

If a UE transmits a PSFCH with conflict information corresponding to a reserved resource indicated in an SCI format 1-A, the UE transmits the PSFCH in the resource pool in a slot determined based on *sl-PSFCH-Occasion*

- If *sl-PSFCH-Occasion* = '0', the UE transmits the PSFCH in a first slot that includes PSFCH resources and is at least a number of slots, provided by *sl-MinTimeGapPSFCH*, of the resource pool after a slot of a PSCCH reception that provides the SCI format 1-A. The PSFCH resource is in a slot that is at least slots [6, TS 38.214] before the resource associated with the conflict information; otherwise, the UE does not transmit the PSFCH with conflict information.

- If *sl-PSFCH-Occasion* = '1', the UE transmits the PSFCH in a latest slot that includes PSFCH resources and is at least slots of the resource pool before a slot of the resource associated with conflict information. The PSFCH resource is in a slot that is at least *sl-MinTimeGapPSFCH* slots after a slot of a PSCCH reception that provides the SCI format 1-A; otherwise, the UE does not transmit the PSFCH with conflict information.

\*\*\* Unchanged parts are omitted \*\*\*

## 16.4 UE procedure for transmitting PSCCH

A UE can be provided a number of symbols in a resource pool, by *sl-TimeResourcePSCCH*, starting from a second symbol that is available for SL transmissions in a slot, and a number of PRBs in the resource pool, by *sl-FreqResourcePSCCH*, starting from the lowest PRB of the lowest sub-channel, in an RB-set with a lowest index if applicable, of the associated PSSCH for a PSCCH transmission with a SCI format 1-A.

A UE that transmits a PSCCH with SCI format 1-A using sidelink resource allocation mode 2 [6, TS 38.214] sets

- "Resource reservation period" as an index in *sl-ResourceReservePeriodList* corresponding to a reservation period provided by higher layers [11, TS 38.321], if the UE is provided *sl-MultiReserveResource*

- the values of the frequency resource assignment field and the time resource assignment field as described in [6, TS 38.214] to indicate resources from a set of resources selected by higher layers as described in [11, TS 38.321] with smallest slot indices for such that , where:

- , where is a number of resources in the set with slot indices , , such that , and is provided by *sl-MaxNumPerReserve*

- each resource, from the set of resources, corresponds to contiguous sub-channels and a slot in a set of slots , where is the number of sub-channels available for PSSCH/PSCCH transmission in a slot

- is a set of slots in a sidelink resource pool [6, TS 38.214]

- is an index of a slot where the PSCCH with SCI format 1-A is transmitted.

A UE that transmits a PSCCH with SCI format 1-A using sidelink resource allocation mode 1 [6, TS 38.214] sets

- the values of the frequency resource assignment field and the time resource assignment field for the SCI format 1-A transmitted in the -th resource for PSCCH/PSSCH transmission provided by a dynamic grant or by a SL configured grant, where and M is the total number of resources for PSCCH/PSSCH transmission provided by a dynamic grant or the number of resources for PSCCH/PSSCH transmission in a period provided by a SL configured grant type 1 or SL configured grant type 2, as follows:

- the frequency resource assignment field and time resource assignment field indicate the -th to -th resources as described in [6, TS 38.214].

For decoding of a SCI format 1-A, a UE may assume that a number of bits provided by *sl*-*NumReservedBits* can have any value as described in [4, TS 38.212].

## 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. The UE reports HARQ-ACK information on the primary cell of the PUCCH group, as described in clause 9, of the cell where the UE monitors PDCCH for detection of DCI format 3\_0.

For SL configured grant Type 1 or Type 2 PSSCH transmissions by a UE within a time period provided by *sl-PeriodCG*, 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 PSSCH transmissions scheduled by a DCI format 3\_0, a UE generates HARQ-ACK information in response to PSFCH receptions to multiplex in a PUCCH transmission occasion that is after a last time resource in a set of time resources provided by the DCI format 3\_0.

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

- for one or more PSFCH reception occasions associated with 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 the last PSFCH reception from the number of PSFCH reception occasions corresponding to PSSCH transmissions or, if the UE determines that a PSFCH is not received at the last PSFCH reception occasion and ACK is not received in any of previous PSFCH reception occasions, generate NACK

- for one or more PSFCH reception occasions associated with 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 corresponding to PSSCH transmissions, 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

- for one or more PSFCH reception occasions associated with SCI format 2-B or SCI format 2-A with Cast type indicator field value of "11"

- generate ACK when the UE determines absence of PSFCH reception for the last PSFCH reception occasion from the number of PSFCH reception occasions corresponding to PSSCH transmissions; otherwise, generate NACK

After a UE transmits PSSCHs and receives PSFCHs in corresponding PSFCH resource occasions, the priority value of HARQ-ACK information is same as the priority value of the PSSCH transmissions that is associated with the PSFCH reception occasions providing the HARQ-ACK information.

The UE generates a 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 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 NACK is same as the priority value of the PSSCH transmission.

The UE generates a 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 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 NACK is same as the priority value of the PSSCH that was not transmitted due to prioritization.

For operation with shared spectrum channel access, the UE generates a NACK when, due to a failed channel access procedure [15, TS 37.213], the UE does not transmit a PSSCH with a single TB in any of the resources provided by a DCI format 3\_0 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 NACK is same as the priority value of the PSSCH that was not transmitted due to the failed channel access procedure.

The UE generates an ACK if the UE does not transmit a PSCCH with a SCI format 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 ACK is same as the largest priority value among the possible priority values for the configured grant.

The UE generates an ACK if the UE does not transmit a PSCCH with a SCI format 1-A scheduling a PSSCH in any of the resources provided by a DCI format 3\_0 and for which the UE is provided a PUCCH resource to report HARQ-ACK information. The priority value of the ACK is same as the largest priority value among the possible priority values for the dynamic grant.

For reporting HARQ-ACK information on uplink corresponding to one or multiple PSSCH transmissions with a corresponding SCI format with the field 'HARQ feedback enabled/disabled indicator' set to disabled, the UE generates HARQ-ACK information with the contents instructed by higher layer. The priority value of the HARQ-ACK information is same as the priority value of the PSSCH transmission.

A UE does not expect to be provided PUCCH resources or PUSCH resources to report HARQ-ACK information that start earlier than after the end of a last symbol of a last 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, where

- and are defined in [4, TS 38.211]

- , where is the SCS configuration of the SL BWP and is the SCS configuration of the active UL BWP on the primary cell

- is determined from according to Table 16.5-1

Table 16.5-1: Values of

|  |  |
| --- | --- |
|  |  |
| 0 | 14 |
| 1 | 18 |
| 2 | 28 |
| 3 | 32 |

For DCI format 3\_0, if present, the PSFCH-to-HARQ feedback timing indicator field values map to values for a set of number of slots provided by *sl-PSFCH-ToPUCCH* as defined in Table 16.5-2.

Table 16.5-2: Mapping of PSFCH-to-HARQ feedback timing indicator field values to numbers of slots

|  |  |  |  |
| --- | --- | --- | --- |
| PSFCH-to-HARQ feedback timing indicator | | | Number of slots |
| 1 bit | 2 bits | 3 bits |  | |
| '0' | '00' | '000' | 1st value provided by *sl-PSFCH-ToPUCCH* | |
| '1' | '01' | '001' | 2nd value provided by *sl-PSFCH-ToPUCCH* | |
|  | '10' | '010' | 3rd value provided by *sl-PSFCH-ToPUCCH* | |
|  | '11' | '011' | 4th value provided by *sl-PSFCH-ToPUCCH* | |
|  |  | '100' | 5th value provided by *sl-PSFCH-ToPUCCH* | |
|  |  | '101' | 6th value provided by *sl-PSFCH-ToPUCCH* | |
|  |  | '110' | 7th value provided by *sl-PSFCH-ToPUCCH* | |
|  |  | '111' | 8th value provided by *sl-PSFCH-ToPUCCH* | |

With reference to slots for PUCCH transmissions and for a number of PSFCH reception occasions ending in slot , the UE provides the generated HARQ-ACK information in a PUCCH transmission within slot , subject to the overlapping conditions in clause 9.2.5, where is a number of slots indicated by a PSFCH-to-HARQ feedback timing indicator field, if present, in a DCI format indicating a slot for PUCCH transmission to report the HARQ-ACK information, or is provided by *sl-PSFCH-ToPUCCH* for a transmission scheduled by a DCI format or for a SL configured grant type 2, or by *sl-PSFCH-ToPUCCH-CG-Type1* for a SL configured grant type 1. corresponds to a last slot for a PUCCH transmission that would overlap with the last PSFCH reception occasion assuming that the start of the sidelink frame is same as the start of the downlink frame [4, TS 38.211].

\*\*\* Unchanged parts are omitted \*\*\*