**3GPP TSG-RAN WG1 Meeting #113R1-23xxxxx**

**Incheon, Korea, May 22 – 26, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.211** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **17.4.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](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:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SL\_enh2-Core | | | | |  | ***Date:*** | | | 2023-06-04 |
|  |  | | | |  | |  | | |  |
| ***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:*** | | Defining details for NR sidelink evolution. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Incomplete support for NR sidelink evolution. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  |  | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  |  | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  |  | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

### 5.3.1 OFDM baseband signal generation for all channels except PRACH and RIM-RS

The time-continuous signal  on antenna port and subcarrier spacing configuration for OFDM symbol  in a subframe for any physical channel or signal except PRACH is defined by

where at the start of the subframe,



and

-  is given by clause 4.2;

-  is the subcarrier spacing configuration;

- is the largest value among the subcarrier spacing configurations by *scs-SpecificCarrierList* for each of uplink and downlink and by *sl-SCS-SpecificCarrierList* for sidelink.

The starting position of OFDM symbol for subcarrier spacing configuration in a subframe is given by

In case of cyclic prefix extension of the first OFDM symbol allocated for PUSCH, SRS, PUCCH, PSCCH, or PSCCH+PSSCH transmission, the time-continuous signal for the interval preceding the first OFDM symbol for PUSCH, SRS, PUCCH, PSCCH, or PSCCH+PSSCH is given by

where refers to the signal in the previous subframe and

- for dynamically scheduled PUSCH, SRS, and PUCCH transmissions

where is given by Table 5.3.1-1 with for , for , and and given by the higher-layer parameters *cp-ExtensionC2* and *cp-ExtensionC3*, respectively, and given by clause 4.3.1. For contention-based random access, or in absence of higher-layer configuration of and , the value of shall be set to the largest integer fulfilling for each of the values of . *Text* is applied to the first UL transmission scheduled by the scheduling DCI.

- for a PUSCH transmission using configured grant

where is given by Table 5.3.1-2 with the index given by the procedure in [6, TS 38.214].

- for PSCCH and PSCCH+PSSCH transmission

where is given by Table 5.3.1-3 with the index given by the procedure in [6, TS 38.214].

Table 5.3.1-1: The variables and for uplink cyclic prefix extension

|  |  |  |
| --- | --- | --- |
| index |  |  |
| 0 | - | - |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |

Table 5.3.1-2: The variable for uplink cyclic prefix extension with configured grants.

|  |  |
| --- | --- |
| index |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |

Table 5.3.1-3: The variables and for sidelink cyclic prefix extension

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Index |  | |  | |  | |
|  |  |  |  |  |  |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 |  | 1 |  | 1 |  |
| 2 | 1 |  | 1 |  | 2 |  |
| 3 | 1 |  | 2 |  | 2 |  |
| 4 | 1 |  | 2 |  | - | - |
| 5 | 1 |  | 2 |  | - | - |
| 6 | 1 |  | 2 |  | - | - |
| 7 | - | - | 2 |  | - | - |
| 8 | - | - | 2 |  | - | - |

# 8 Sidelink

## 8.1 Overview

### 8.1.1 Overview of physical channels

A sidelink physical channel corresponds to a set of resource elements carrying information originating from higher layers. The following sidelink physical channels are defined:

- Physical Sidelink Shared Channel, PSSCH

- Physical Sidelink Broadcast Channel, PSBCH

- Physical Sidelink Control Channel, PSCCH

- Physical Sidelink Feedback Channel, PSFCH

### 8.1.2 Overview of physical signals

A sidelink physical signal corresponds to a set of resource elements used by the physical layer but does not carry information originating from higher layers.

The following sidelink physical signals are defined:

- Demodulation reference signals, DM-RS

- Channel-state information reference signal, CSI-RS

- Phase-tracking reference signals, PT-RS

- Sidelink primary synchronization signal, S-PSS

- Sidelink secondary synchronization signal, S-SSS

## 8.2 Physical resources

### 8.2.1 General

The OFDM symbol immediately following the last symbol used for PSSCH, PSFCH, or S-SSB serves as a guard symbol.

The first OFDM symbol of a PSSCH and its associated PSCCH is duplicated as described in clauses 8.3.1.5 and 8.3.2.3. The first OFDM symbol of a PSFCH is duplicated as described in clause 8.3.4.2.2

### 8.2.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 8.2.2-1 where and the cyclic prefix for a sidelink bandwidth part are obtained from the higher-layer parameter *sl-BWP*.

Table 8.2.2-1: Supported transmission numerologies.

|  |  |  |
| --- | --- | --- |
|  | [kHz] | Cyclic prefix |
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |

### 8.2.3 Frame structure

#### 8.2.3.1 Frames and subframes

The frame and subframe structure for sidelink transmission is defined in clause 4.3.1.

#### 8.2.3.2 Slots

The slot structure for sidelink transmission is defined in clause 4.3.2.

### 8.2.4 Antenna ports

An antenna port is defined in clause 4.4.1.

The following antenna ports are defined for the sidelink:

- Antenna ports starting with 1000 for PSSCH

- Antenna ports starting with 2000 for PSCCH

- Antenna ports starting with 3000 for CSI-RS

- Antenna ports starting with 4000 for S-SS/PSBCH

- Antenna ports starting with 5000 for PSFCH

For DM-RS associated with a PSBCH, the channel over which a PSBCH symbol on one antenna port is conveyed can be inferred from the channel over which a DM-RS symbol on the same antenna port is conveyed only if the two symbols are within a S-SS/PSBCH block transmitted within the same slot, and with the same block index according to clause 8.4.3.1.

For DM-RS associated with a PSSCH, the channel over which a PSSCH symbol on one antenna port is conveyed can be inferred from the channel over which a DM-RS symbol on the same antenna port is conveyed only if the two symbols are within the same frequency resource as the scheduled PSSCH and in the same slot.

For DM-RS associated with a PSCCH, the channel over which a PSCCH symbol on one antenna port is conveyed can be inferred from the channel over which a DM-RS symbol on the same antenna port is conveyed only if the two symbols are within the same frequency resource as the transmitted PSCCH and in the same slot.

### 8.2.5 Resource grid

The resource grid for sidelink transmission is defined in clause 4.4.2.

For sidelink, the carrier bandwidth and the starting position for subcarrier spacing configuration are obtained from the higher-layer parameter *sl-SCS-SpecificCarrierList*.

For the sidelink, the higher-layer parameter *sl-TxDirectCurrentLocation* indicates the location of the transmitter DC subcarrier in the sidelink for each of the configured bandwidth parts. Values in the range 0 – 3299 represent the number of the DC subcarrier, the value 3300 indicates that the DC subcarrier is located outside the resource grid, and the value 3301 indicates that the position of the DC subcarrier in the sidelink is undetermined. The DC subcarrier location offset relative to the center of the indicated subcarrier is given by if *frequencyShift7p5khzSL* is provided and by otherwise, where is given by the higher-layer parameter *valueN*.

### 8.2.6 Resource elements

Resource elements are defined in clause 4.4.3.

### 8.2.7 Resource blocks

Resource blocks are defined in clause 4.4.4.

Point A for sidelink transmission/reception is obtained from the higher-layer parameter *sl-AbsoluteFrequencyPointA*.

### 8.2.8 Bandwidth part

Configuration of the single bandwidth part for sidelink transmission is described in clause 16 of [5, TS 38.213].

## 8.3 Physical channels

### 8.3.1 Physical sidelink shared channel

#### 8.3.1.1 Scrambling

For the single codeword , the block of bits , where is the number of bits in codeword transmitted on the physical channel as defined in [4, TS 38.212], shall be scrambled prior to modulation.

Scrambling shall be done according to the following pseudo code

set

set

while

if // SCI placeholder bits

else

end if

*i* = *i* + 1

end while

where the scrambling sequence is given by clause 5.2.1 and

- for

-

- The scrambling sequence generator shall be initialized with

where and the quantity equals the decimal representation of the CRC on the PSCCH associated with the PSSCH according to with and given by clause 8.3.2 in [4, TS 38.212].

- for

-

- The scrambling sequence generator shall be initialized with

where and the quantity equals the decimal representation of the CRC on the PSCCH associated with the PSSCH according to with and given by clause 8.3.2 in [4, TS 38.212].

#### 8.3.1.2 Modulation

For the single codeword , the block of scrambled bits shall be modulated, resulting in a block of complex-valued modulation symbols where .

Modulation for shall be done as described in clause 5.1 using QPSK, where .

Modulation for shall be done as described in clause 5.1 using one of the modulation schemes in Table 8.3.1.2-1 where .

Table 8.3.1.2-1: Supported modulation schemes.

|  |  |
| --- | --- |
| **Modulation scheme** | **Modulation order** |
| QPSK | 2 |
| 16QAM | 4 |
| 64QAM | 6 |
| 256QAM | 8 |

#### 8.3.1.3 Layer mapping

Layer mapping shall be done according to clause 7.3.1.3 with the number of layers , resulting in , .

#### 8.3.1.4 Precoding

The block of vectors shall be precoded according to clasue 6.3.1.5 where the precoding matrix equals the identity matrix and .

#### 8.3.1.5 Mapping to virtual resource blocks

For each of the antenna ports used for transmission of the PSSCH, the block of complex-valued symbols shall be multiplied with the amplitude scaling factor in order to conform to the transmit power specified in [5, TS 38.213] and mapped to resource elements in the virtual resource blocks assigned for transmission, where is the first subcarrier in the lowest-numbered virtual resource block assigned for transmission.

The mapping operation shall be done in two steps:

- first, the complex-valued symbols corresponding to the bit for the 2nd-stage SCI in increasing order of first the index over the assigned virtual resource blocks and then the index , starting from the first PSSCH symbol carrying an associated DM-RS and meeting all of the following criteria:

- the corresponding resource elements in the corresponding physical resource blocks are not used for transmission of the associated DM-RS, PT-RS, or PSCCH;

- secondly, the complex-valued modulation symbols not corresponding to the 2nd -stage SCI shall be in increasing order of first the index over the assigned virtual resource blocks, and then the index with the starting position given by [6, TS 38.214] and meeting all of the following criteria:

- the resource elements are not used for 2nd-stage SCI in the first step;

- the corresponding resource elements in the corresponding physical resource blocks are not used for transmission of the associated DM-RS, PT-RS, CSI-RS, or PSCCH.

The resource elements used for the PSSCH in the first OFDM symbol in the mapping operation above, including any DM-RS, PT-RS, or CSI-RS occurring in the first OFDM symbol, shall be duplicated in the OFDM symbol immediately preceding the first OFDM symbol in the mapping.

#### 8.3.1.6 Mapping from virtual to physical resource blocks

Virtual resource blocks shall be mapped to physical resource blocks according to non-interleaved mapping.

For non-interleaved VRB-to-PRB mapping, virtual resource block is mapped to physical resource block .

### 8.3.2 Physical sidelink control channel

#### 8.3.2.1 Scrambling

The block of bits , where is the number of bits transmitted on the physical channel, shall be scrambled prior to modulation, resulting in a block of scrambled bits according to

where the scrambling sequence is given by clause 5.2.1. The scrambling sequence generator shall be initialized with

#### 8.3.2.2 Modulation

The block of scrambled bits shall be modulated as described in clause 5.1 using QPSK, resulting in a block of complex-valued modulation symbols where .

#### 8.3.2.3 Mapping to physical resources

The set of complex-valued modulation symbols shall be multiplied with the amplitude scaling factor in order to conform to the transmit power specified in [5, TS 38.213] and mapped in sequence starting with to resource elements assigned for transmission according to clause 16.4 of [5, TS 38.213], and not used for the demodulation reference signals associated with PSCCH, in increasing order of first the index over the assigned physical resources, and then the index on antenna port.

The resource elements used for the PSCCH in the first OFDM symbol in the mapping operation above, including any DM-RS, PT-RS, or CSI-RS occurring in the first OFDM symbol, shall be duplicated in the immediately preceding OFDM symbol.

### 8.3.3 Physical sidelink broadcast channel

#### 8.3.3.1 Scrambling

The block of bits, where is the number of bits transmitted on the physical sidelink broadcast channel, shall be scrambled prior to modulation, resulting in a block of scrambled bits according to

where the scrambling sequence is given by clause 5.2.1. The scrambling sequence generator shall be initialized with at the start of each S-SS/PSBCH block.

#### 8.3.3.2 Modulation

The block of bits shall be QPSK modulated as described in clause 5.1.3, resulting in a block of complex-valued modulation symbols where .

#### 8.3.3.3 Mapping to physical resources

Mapping to physical resources is described in clause 8.4.3.

### 8.3.4 Physical sidelink feedback channel

#### 8.3.4.1 General

#### 8.3.4.2 PSFCH format 0

##### 8.3.4.2.1 Sequence generation

The sequence shall be generated according to

where is given by clause 6.3.2.2 with the following exceptions:

- is given by clause 16.3 of [5, TS 38.213];

- is given by clause 16.3 of [5, TS 38.213];

- ;

- is the index of the OFDM symbol in the slot that corresponds to the second OFDM symbol of the PSFCH transmission in the slot given by [5, TS 38.213];

- and with given by the higher-layer parameter *sl-PSFCH-HopID* if configured; otherwise, .

- with given by the higher-layer parameter *sl-PSFCH-HopID* if configured; otherwise, .

##### 8.3.4.2.2 Mapping to physical resources

The sequence shall be multiplied with the amplitude scaling factor in order to conform to the transmit power specified in [5, TS 38.213] and mapped in sequence starting with to resource elements assigned for transmission of the second PSFCH symbol according to clause 16.3 of [5, TS 38.213] in increasing order of the index over the assigned physical resources on antenna port.

The resource elements used for the PSFCH in the OFDM symbol in the mapping operation above shall be duplicated in the immediately preceding OFDM symbol.

## 8.4 Physical signals

### 8.4.1 Reference signals

#### 8.4.1.1 Demodulation reference signals for PSSCH

##### 8.4.1.1.1 Sequence generation

The sequence shall be generated according to

where the pseudo-random sequence is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialized with

where is the OFDM symbol number within the slot, is the slot number within a frame, and where the quantity equals the decimal representation of CRC on the PSCCH associated with the PSSCH according to with and given by clause 7.3.2 in [4, TS 38.212].

##### 8.4.1.1.2 Mapping to physical resources

The sequence shall be mapped to the intermediate quantity according to clause 6.4.1.1.3 using configuration type 1 without transform precoding, and where , , and are given by Table 8.4.1.1.2-2, and is specified in clause 8.4.1.1.1.

The patterns used for the PSSCH DM-RS is indicated in the SCI as described in clause 8.3.1.1 of [4, TS 38.212].

The intermediate quantity shall be precoded, multiplied with the amplitude scaling factor specified in clause 8.3.1.5, and mapped to physical resources according to

where

- the precoding matrix is given by clause 8.3.1.4,

- the set of antenna ports is given by clause 8.3.1.4, and

- the set of antenna ports is given by [6, TS 38.214];

and the following conditions are fulfilled:

- the resource elements are within the common resource blocks allocated for PSSCH transmission.

The quantity is defined relative to subcarrier 0 in common resource block 0 and the quantity is defined relative to the start of the scheduled resources for transmission of PSSCH and the associated PSCCH, including the OFDM symbol duplicated as described in clauses 8.3.1.5 and 8.3.2.3.

The position(s) of the DM-RS symbols is given by according to Table 8.4.1.1.2-1 where the number of PSSCH DM-RS is indicated in the SCI, and is the duration of the scheduled resources for transmission of PSSCH and the associated PSCCH, including the OFDM symbol duplicated as described in clauses 8.3.1.5 and 8.3.2.3.

Table 8.4.1.1.2-1: PSSCH DM-RS time-domain location.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| in symbols | DM-RS position | | | | | |
| PSCCH duration 2 symbols | | | PSCCH duration 3 symbols | | |
| Number of PSSCH DM-RS | | | Number of PSSCH DM-RS | | |
| 2 | 3 | 4 | 2 | 3 | 4 |
| 6 | 1, 5 |  |  | 1, 5 |  |  |
| 7 | 1, 5 |  |  | 1, 5 |  |  |
| 8 | 1, 5 |  |  | 1, 5 |  |  |
| 9 | 3, 8 | 1, 4, 7 |  | 4, 8 | 1, 4, 7 |  |
| 10 | 3, 8 | 1, 4, 7 |  | 4, 8 | 1, 4, 7 |  |
| 11 | 3, 10 | 1, 5, 9 | 1, 4, 7, 10 | 4, 10 | 1, 5, 9 | 1, 4, 7, 10 |
| 12 | 3, 10 | 1, 5, 9 | 1, 4, 7, 10 | 4, 10 | 1, 5, 9 | 1, 4, 7, 10 |
| 13 | 3, 10 | 1, 6, 11 | 1, 4, 7, 10 | 4, 10 | 1, 6, 11 | 1, 4, 7, 10 |

Table 8.4.1.1.2-2: Parameters for PSSCH DM-RS.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | CDM group |  |  | |  |
|  |  |  |  |  |  |
| 1000 | 0 | 0 | +1 | +1 | +1 |
| 1001 | 0 | 0 | +1 | -1 | +1 |

#### 8.4.1.2 Phase-tracking reference signals for PSSCH

##### 8.4.1.2.1 Sequence generation

The precoded sidelink phase-tracking reference signal for subcarrier on layer is given by

where

- antenna ports or associated with PT-RS transmission are given by clause 8.2.3 of [6, TS 38.214];

- is given by clause 8.4.1.1.1 at the position of the first PSSCH symbol carrying an associated DM-RS.

##### 8.4.1.2.2 Mapping to physical resources

The UE shall transmit phase-tracking reference signals only in the resource blocks used for the PSSCH, and only if the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used.

The PSSCH PT-RS shall be mapped to resource elements according to

when all the following conditions are fulfilled

- is within the OFDM symbols allocated for the PSSCH transmission;

- resource element is not used for PSCCH, nor DM-RS associated with PSSCH;

- and correspond to

The precoding matrix is given by clause 8.3.1.4*.*

The set of time indices  defined relative to the start of the PSSCH allocation is defined by

1. set and

2. if any symbol in the interval overlaps with a symbol used for DM-RS according to clause 8.4.1.1.2

- set

- set to the symbol index of the DM-RS symbol

- repeat from step 2 as long as is inside the PSSCH allocation

3. add to the set of time indices for PT-RS

4. increment by one

5. repeat from step 2 above as long as is inside the PSSCH allocation

where is given by clause 8.4.3 of [6, TS 38.214].

For the purpose of PT-RS mapping, the resource blocks allocated for PSSCH transmission are numbered from 0 to from the lowest scheduled resource block to the highest. The corresponding subcarriers in this set of resource blocks are numbered in increasing order starting from the lowest frequency from 0 to . The subcarriers to which the PT-RS shall be mapped are given by

where

-

- is given by Table 8.4.1.2.2-1 for the DM-RS port associated with the PT-RS port according to clause 8.2.3 in [6, TS 38.214].

- is the number of resource blocks scheduled;

- is given by [6, TS 38.214];

- where the quantity equals the decimal representation of CRC on the PSCCH associated with the PSSCH according to with and given by clause 7.3.2 in [4, TS 38.212].

PSSCH PT-RS shall not be mapped to resource elements containing PSCCH or PSCCH DMRS by puncturing PSSCH PT-RS.

A UE is not expected to receive sidelink CSI-RS and PSSCH PT-RS on the same resource elements.

Table 8.4.1.2.2-1: The parameter .

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DM-RS antenna port |  | | | |
|  | *resourceElementOffset* | | | |
|  | offset00 | offset01 | offset10 | offset11 |
| 0 | 0 | 2 | 6 | 8 |
| 1 | 2 | 4 | 8 | 10 |

#### 8.4.1.3 Demodulation reference signals for PSCCH

##### 8.4.1.3.1 Sequence generation

The sequence shall be generated according to

where the pseudo-random sequence is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialized with

where

- is the OFDM symbol number within the slot,

- is the slot number within a frame, and

- is given by the higher-layer parameter *sl-DMRS-ScrambleID*.

##### 8.4.1.3.2 Mapping to physical resources

The sequence shall be multiplied with the amplitude scaling factor in order to conform to the transmit power specified in [5, 38.213] and mapped in sequence starting with to resource elements in a slot on antenna port according to

where the following conditions are fulfilled

- they are within the resource elements constituting the PSCCH

The quantity is given by Table 8.4.1.3.2-1 and shall be randomly selected by the UE.

The reference point for is subcarrier 0 in common resource block 0.

The quantity is the OFDM symbol number within the slot.

Table 8.4.1.3.2-1: The quantity .

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | | |
|  |  |  |
| 0 | 1 | 1 | 1 |
| 1 | 1 |  |  |
| 2 | 1 |  |  |

#### 8.4.1.4 Demodulation reference signals for PSBCH

##### 8.4.1.4.1 Sequence generation

The reference-signal sequence for an S-SS/PSBCH block is defined by

where is given by clause 5.2. The scrambling sequence generator shall be initialized at the start of each S-SS/PSBCH block occasion with

##### 8.4.1.4.2 Mapping to physical resources

Mapping to physical resources is described in clause 8.4.3.

#### 8.4.1.5 CSI reference signals

##### 8.4.1.5.1 General

##### 8.4.1.5.2 Sequence generation

The sequence shall be generated according to

where the pseudo-random sequence is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialised with

at the start of each OFDM symbol where is the slot number within a radio frame, is the OFDM symbol number within a slot, and where the quantity equals the decimal representation of CRC for the sidelink control information mapped to the PSCCH associated with the CSI-RS according to with and given by clause 7.3.2 in [4, TS 38.212].

##### 8.4.1.5.3 Mapping to physical resources

Mapping to resource elements shall be done according to clause 7.4.1.5.3 with the following exceptions:

- only 1 and 2 antenna ports are supported, ;

- only density is supported;

- zero-power CSI-RS is not supported;

- the quantity is an amplitude scaling factor to conform with the transmit power specified in clause 8.2.1 of [6, TS 38.214].

### 8.4.2 Synchronization signals

#### 8.4.2.1 Physical-layer sidelink synchronization identities

There are 672 unique physical-layer sidelink synchronization identities given by

where and . The sidelink synchronization identities are divided into two sets, id\_net consisting of and id\_oon consisting of .

#### 8.4.2.2 Sidelink primary synchronization signal

##### 8.4.2.2.1 Sequence generation

The sequence for the sidelink primary synchronization signal is defined by

where

and

##### 8.4.2.2.2 Mapping to physical resources

Mapping to physical resources is described in clause 8.4.3.

#### 8.4.2.3 Sidelink secondary synchronization signal

##### 8.4.2.3.1 Sequence generation

The sequence for the sidelink secondary synchronization signal is defined by

where

and

##### 8.4.2.3.2 Mapping to physical resources

Mapping to physical resources is described in clause 8.4.3.

### 8.4.3 S-SS/PSBCH block

#### 8.4.3.1 Time-frequency structure of an S-SS/PSBCH block

In the time domain, an S-SS/PSBCH block consists of OFDM symbols, numbered in increasing order from 0 to within the S-SS/PSBCH block, where S-PSS, S-SSS, and PSBCH with associated DM-RS are mapped to symbols as given by Table 8.4.3.1-1. The number of OFDM symbols in an S-SS/PSBCH block for normal cyclic prefix and for extended cyclic prefix. The first OFDM symbol in an S-SS/PSBCH block is the first OFDM symbol in the slot.

In the frequency domain, an S-SS/PSBCH block consists of 132 contiguous subcarriers with the subcarriers numbered in increasing order from 0 to 131 within the sidelink S-SS/PSBCH block. The quantities and represent the frequency and time indices, respectively, within one sidelink S-SS/PSBCH block.

For an S-SS/PSBCH block, the UE shall use

- antenna port 4000 for transmission of S-PSS, S-SSS, PSBCH and DM-RS for PSBCH;

- the same cyclic prefix length and subcarrier spacing for the S-PSS, S-SSS, PSBCH and DM-RS for PSBCH,

For operation with shared spectrum channel access, if the higher-layer parameter XXX is configured, the S-SS/PSBCH shall be repeated in the frequency domain.

Table 8.4.3.1-1: Resources within an S-SS/PSBCH block for S-PSS, S-SSS, PSBCH, and DM-RS.

|  |  |  |
| --- | --- | --- |
| Channel or signal | OFDM symbol number  relative to the start of an S-SS/PSBCH block | Subcarrier number  relative to the start of an S-SS/PSBCH block |
| S-PSS | 1, 2 | 2, 3, …, 127, 128 |
| S-SSS | 3, 4 | 2, 3, …, 127, 128 |
| Set to zero | 1, 2, 3, 4 | 0, 1, 129, 130, 131 |
| PSBCH | 0, 5, 6, …, | 0, 1,…, 131 |
| DM-RS for PSBCH | 0, 5, 6, …, | 0, 4, 8, …., 128 |

##### 8.4.3.1.1 Mapping of S-PSS within an S-SS/PSBCH block

The sequence of symbols constituting the sidelink primary synchronization signal in one OFDM symbol shall be scaled by a factor to conform to the S-PSS power allocation specified in [5, TS 38.213] and mapped to resource elements in increasing order of in each of the symbols , where and are given by Table 8.4.3.1-1 and represent the frequency and time indices, respectively, within one S-SS/PSBCH block.

##### 8.4.3.1.2 Mapping of S-SSS within an S-SS/PSBCH block

The sequence of symbols constituting the sidelink secondary synchronization signal in one OFDM symbol shall be scaled by a factor to conform to the S-SSS power allocation specified in [5, TS 38.213] and mapped to resource elements in increasing order of in each of the symbols , where and are given by Table 8.4.3.1-1 and represent the frequency and time indices, respectively, within one S-SS/PSBCH block.

##### 8.4.3.1.3 Mapping of PSBCH and DM-RS within an S-SS/PSBCH block

The sequence of complex-valued symbols constituting the physical sidelink broadcast channel shall be scaled by a factor to conform to the PSBCH power allocation specified in [5, TS 38.213] and mapped in sequence starting with to resource elements which meet all the following criteria:

- they are not used for PSBCH demodulation reference signals

The mapping to resource elements not reserved for PSBCH DM-RS shall be in increasing order of first the index and then the index, where and represent the frequency and time indices, respectively, within one S-SS/PSBCH block and are given by Table 8.4.3.1-1.

The sequence of complex-valued symbols constituting the demodulation reference signals for the S-SS/PSBCH block shall be scaled by a factor of to conform to the PSBCH power allocation specified in [5, TS 38.213] and mapped to resource elements in increasing order of first and then where and are given by Table 8.4.3.1-1 and represent the frequency and time indices, respectively, within one S-SS/PSBCH block.

#### 8.4.3.2 Time location of an S-SS/PSBCH block

The locations in the time domain where a UE shall monitor for a possible S-SS/PSBCH block are described in clause 16.1 of [5, TS 38.213].

## 8.5 Timing

Transmission of a sidelink radio frame number from the UE shall start seconds before the start of the corresponding timing reference frame at the UE. The UE is not required to receive sidelink or downlink transmissions earlier than the value of , which is given in [12, TS 38.133], after the end of a sidelink transmission.

For sidelink transmissions:

If the UE has a serving cell fulfilling the S criterion according to clause 8.2 of [13, TS 38.304]

- The timing of reference radio frame equals that of downlink radio frame in the cell with the same uplink carrier frequency as the sidelink and

- is given by clause 4.3.1 of [TS 38.211],

Otherwise

- The timing of reference radio frame *i* and value are given by clause 12.2.2, 12.2.3, 12.2.4 or 12.2.5 of [12, TS 38.133].



Figure 8.5-1: Sidelink timing relation

The quantity equals to 0.