**3GPP TSG RAN WG1 Meeting #104-e R1-200xxxx**

e-Meeting, January 25th – February 5th, 2021

Source: Moderator (CATT)

Title: Feature lead summary #1 on AI 7.2.4 Sidelink synchronization mechanism

Agenda Item: 7.2.4

Document for: Discussion and Decision

# Introduction

This feature lead summary document captures the remaining issues of sidelink synchronization mechanism aspects for Rel-16 NR V2X based on the submitted contributions [1]-[7]. The issue list with priorities can be found as following subsection.

It is suggested that SY-4 and SY-6 can be discussed during this meeting by an email thread. SY-1 and SY-2 can be discussed during CR preparation phase.

## Issue list

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue#** | **Descriptions** | **Type** | **Tdocs** |
| SY-1 | Correction on SL-BCH | Draft CR | [Ericsson] [Huawei, HiSilicon] |
| SY-2 | Corrections/clarifications on S-SSB and SL-SSID | Discussion with TPs | [CATT, GOHIGH] |
| SY-3 | NR SL-TDD-Config in the coverage of eNB | Discussion with TPs | [vivo] |
| SY-4 | Determination of slots including S-SSB transmission | Discussion with TPs | [ZTE, Sanechips] |
| SY-5 | Indication of the non-TDD case in sl-TDD-Config | Discussion with TPs | [Sharp] |
| SY-6 | Restriction of S-SSB slot | Discussion with TPs | [NTT DOCOMO] |

# Issues/corrections proposed in contributions

## Correction on SL-BCH

2 draft CRs proposed to correct SL-BCH processing and PSBCH payload generation in TS 38.212.

The reason for change is that all content for PSBCH is provided from RRC, and there is no need to populate section 8.1.1 in TS 38.212 on PSBCH payload generation in the physical layer. The changes for TS 38.212 are voiding section 8.1.1 and not apply section 7.1.1 from the processing for SL-BCH.

***FL Proposal:***

**Contribution Proposals:**

[Huawei, HiSilicon] Draft CR on TS 38.212

|  |
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| **<Unchanged parts are omitted>**8.1 Sidelink broadcast channelThe processing for SL-BCH transport channel follows the BCH according to clause 7.1, with the following changes:- In Clause 7.1, ‘maximum of one transport block every 80ms’ is replaced with ‘maximum of one transport block’.- Clause 7.1.1 for PBCH payload generation is not performed.- Clause 7.1.2 for scrambling is not performed.- In clause 7.1.5, the rate matching output sequence length E = 1386 when higher layer parameter *cyclicPrefix* is configured, otherwise, E = 1782.8.1.1 (void)**<Unchanged parts are omitted>** |

[Ericsson] Draft CR on TS 38.212

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| **<Unchanged parts omitted>**8.1 Sidelink broadcast channelThe processing for SL-BCH transport channel follows the BCH according to clause 7.1, with the following changes:- Clause 7.1.1 for PBCH payload generation is not performed.- Clause 7.1.2 for scrambling is not performed.- In clause 7.1.5, the rate matching output sequence length E = 1386 when higher layer parameter *cyclicPrefix* is configured, otherwise, E = 1782.~~8.1.1 PSBCH payload generation~~8.2 Sidelink shared channel**<Unchanged parts omitted>** |

## Corrections/clarifications on S-SSB and SL-SSID

* Some parameters’ names in TS 38.213 are not aligned with that in TS 38.331, and some corrections are proposed.
* In TS 38.211, a clarification is added to clarify that the identities are synchronization identities.

***FL Proposal:***

**Contribution Proposals:**

[CATT, GOHIGH] Discussion with TP

* Adopt the following text proposal for synchronization procedures in 38.213.

|  |
| --- |
| *--------------------------------------------Start of Text Proposal for 38.213-----------------------------------------------*16.1 Synchronization proceduresA 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, 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 ~~absoluteFrequencySSB-SL~~*. 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 ~~numSSBwithinPeriod-SL~~*, a number $N\_{period}^{S-SSB}$ 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 $N\_{offset}^{S-SSB}$+$N\_{interval}^{S-SSB}⋅i\_{S-SSB}$, where- index 0 corresponds to a first slot in a frame with SFN satisfying $(SFN mod 16)=0$- $i\_{S-SSB}$ is a S-SS/PSBCH block index within the number of S-SS/PSBCH blocks in the period, with $0\leq i\_{S-SSB}\leq N\_{period}^{S-SSB}-1$- $N\_{offset}^{S-SSB}$ is a slot offset from a start of the period to the first slot including S-SS/PSBCH block, provided by *sl-TimeOffsetSSB ~~timeOffsetSSB-SL~~*- $N\_{interval}^{S-SSB}$ is a slot interval between neighbouring S-SS/PSBCH blocks, provided by *sl-TimeInterval ~~timeIntervalSSB-SL~~* <Unchanged parts omitted>*----------------------------------------------------End of Text Proposal -----------------------------------------------------* |

* Adopt the following text proposal for synchronization signals in 38.211.

|  |
| --- |
| *--------------------------------------------Start of Text Proposal for 38.211-----------------------------------------------*8.4.2 Synchronization signals8.4.2.1 Physical-layer sidelink synchronization identitiesThere are 672 unique physical-layer sidelink synchronization identities given by $N\_{ID}^{SL}=N\_{ID,1}^{SL}+336N\_{ID,2}^{SL}$where $N\_{ID,1}^{SL}\in \left\{0,1,…,335\right\}$ and $N\_{ID,2}^{SL}\in \left\{0,1\right\}$. The sequences are divided into two sets, id\_net consisting of $N\_{ID}^{SL}=0,1,…,335$ and id\_oon consisting of $N\_{ID}^{SL}=336,337,…,671$.*----------------------------------------------------End of Text Proposal ----------------------------------------------------* |

## NR SL-TDD-Config in the coverage of eNB

In inter-RAT deployment, eNB provides NR SL configurations. NR UE in coverage of eNB should use the LTE TDD configuration for PSBCH determination. It is not clear in current spec that how to determine the *SL-TDD-Config* in PSBCH in this case. The rules should be defined.

***FL Proposal:***

**Contribution Proposals:**

[vivo] Discussion with TP

* The uplink resources of LTE TDD configurations are not always placed at the end of a period, therefore directly reusing the formulae agreed for NR TDD configuration conversion to determine SL-TDD-Config in the inter-RAT case is impossible.
* The codepoints 9~15 of $a\_{1}, a\_{2}, a\_{3},a\_{4}$ when $a\_{0}=0$ can be used for LTE TDD configuration indication in PSBCH as follows, $a\_{5}, a\_{6}, a\_{7},a\_{8}, a\_{9}, a\_{10}, a\_{11}$ are set to ‘1’.

***Indication of LTE TDD Configuration (X=0)***

|  |  |
| --- | --- |
| $$a\_{1},a\_{2}, a\_{3}, a\_{4}$$ | ***LTE TDD configuration*** |
| ***1, 0, 0, 1*** | ***0*** |
| ***1, 0, 1, 0*** | ***1*** |
| ***1, 0, 1, 1*** | ***2*** |
| ***1, 1, 0, 0*** | ***3*** |
| ***1, 1, 0, 1*** | ***4*** |
| ***1, 1, 1, 0*** | ***5*** |
| ***1, 1, 1, 1*** | ***6*** |

TP#1 for 38.213: PSBCH content

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **------------------------------------------------------ Start of Draft TP of 213---------------------------------------------****16.1 Synchronization procedures**For transmission of an S-SS/PSBCH block, a UE includes a bit sequence $a\_{0}, a\_{1}, a\_{2}, a\_{3}, …, a\_{11}$ in the PSBCH payload to indicate *sl-TDD-Config-r16* 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], - $a\_{0}, a\_{1}, a\_{2}, a\_{3},a\_{4}, a\_{5}, a\_{6}, a\_{7},a\_{8}, a\_{9}, a\_{10}, a\_{11}$ are set to '1';else- when UE determines *sl-TDD-Config* based on *tdd-UL-DL-ConfigurationCommon* or *sl-TDD-Configuration-r16* according to clause 5.8.9.4.3 in [TS 38.331]- $a\_{0}=0$ if *pattern1* is provided by *sl-TDD-Configuration-r16* or *tdd-UL-DL-ConfigurationCommon*; $a\_{0}=1$ if both *pattern1* and *pattern2* are provided by *sl-TDD-Configuration-r16* or *tdd-UL-DL-ConfigurationCommon* as described in Clause 11.1- $a\_{1}, a\_{2}, a\_{3},a\_{4}$ are determined based on- $P$ in *pattern1* as described in Table 16.1-1 for $a\_{0}=0$ - $P$ in *pattern1* and$P\_{2}$ *in pattern2* as described in Table 16.1-2 for $a\_{0}=1$where $P$ and $P\_{2}$ are as described in Clause 11.1- $a\_{5}, a\_{6}, a\_{7},a\_{8}, a\_{9}, a\_{10}, a\_{11}$ are the 7th to 1st LSBs of $u\_{slots}^{SL}$, respectively- for $a\_{0}=0$, $u\_{slots}^{SL}=u\_{slots}\*2^{μ-μ\_{ref}}+\left⌊\frac{u\_{sym}\*2^{μ-μ\_{ref}}}{L}\right⌋+I\_{1}$- for $a\_{0}=1$, $u\_{slots}^{SL}=\left⌊\frac{u\_{slots,2}\*2^{μ-μ\_{ref}}+\left⌊\frac{u\_{sym,2}\*2^{μ-μ\_{ref}}}{L}\right⌋+I\_{2}}{w}\right⌋\*\left⌈\frac{P\*2^{μ}+1}{w}\right⌉+\left⌊\frac{u\_{slots}\*2^{μ-μ\_{ref}}+\left⌊\frac{u\_{sym}\*2^{μ-μ\_{ref}}}{L}\right⌋+I\_{1}}{w}\right⌋$where- $L$ is the number of symbols in a slot: $L=12$ if *cyclicPrefix* = "ECP"; else,$L=14$- $I\_{1}$ is 1 if $u\_{sym}\*2^{μ-μ\_{ref}} mod L\geq L-Y$, else $I\_{1}$ is 0- $I\_{2}$ is 1 if $u\_{sym,2}\*2^{μ-μ\_{ref}} mod L\geq L-Y$, else $I\_{2}$ is 0 - $Y$ is the sidelink starting symbol index provided by *sl-StartSymbol*- $w$ is the granularity of slots indication as described in Table 16.1-2- $μ\_{ref}$, $u\_{slots}$, $u\_{sym}$, $u\_{slots,2}$, $u\_{sym,2}$ are the parameters of *TDD-UL-ConfigurationCommon* as described in Clause 11.1, or the parameters of *sl-TDD-Configuration-r16* as defined in [9.3, TS 38.331]- $μ=0, 1, 2, 3$ corresponds to SL SCS as defined in [4, TS 38.211]- If *tdd-Config* asdescribed in [12, TS 36.331] is provided- $a\_{0}=0$ - $a\_{1}, a\_{2}, a\_{3},a\_{4}$ are determined based on Table 16.1-3- $a\_{5}, a\_{6}, a\_{7},a\_{8}, a\_{9}, a\_{10}, a\_{11}$ are set to '1'Table 16.1-1: Slot configuration period when one pattern is indicated

|  |  |
| --- | --- |
| $$a\_{1}, a\_{2}, a\_{3},a\_{4}$$ | Slot configuration period of *pattern1*$P$ (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 |

 **<Unchanged parts are omitted>****Table 16.1-3: Indication of LTE TDD Configuration**

|  |  |
| --- | --- |
| $$a\_{1},a\_{2}, a\_{3}, a\_{4}$$ | **LTE TDD configuration** |
| 1, 0, 0, 1 | 0 |
| 1, 0, 1, 0 | 1 |
| 1, 0, 1, 1 | 2 |
| 1, 1, 0, 0 | 3 |
| 1, 1, 0, 1 | 4 |
| 1, 1, 1, 0 | 5 |
| 1, 1, 1, 1 | 6 |

**--------------------------------------------------------- End of Draft TP ----------------------------------------------------** |

## Determination of slots including S-SSB transmission

Based on current specification description in TS 38.331 and 38.213, the value of the interval parameter $N\_{interval}^{S-SSB}$ is provided by *sl-timeInterval*, i.e., *sl-TimeInterval-r16* in IE *SL-SyncConfig-r16 in* TS 38.331. If *sl-TimeInterval-r16* is configured with value 0, it means there would be no interval between neighboring sidelink SSBs and  S-SSBs which transmit in the same slot corresponding to the value of $N\_{offset}^{S-SSB}$. But based on RAN1’s agreement, it is not intended to transmit multiple S-SSBs in a slot, which have no obvious difference with transmitting one S-SSB in a slot since the multiple S-SSBs are same and the Tx power is restricted by the max power in a slot. So it is should be avoided.

***FL Proposal:***

**Contribution Proposals:**

[ZTE, Sanechips] Discussion with TP

* To adopt the following TP for TS 38.213.

|  |
| --- |
| A UE is provided, by *sl-NumSSB-WithinPeriod*, a number $N\_{period}^{S-SSB}$ 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 $N\_{offset}^{S-SSB}$+$N\_{interval}^{S-SSB}⋅i\_{S-SSB}$, where- index 0 corresponds to a first slot in a frame with SFN satisfying $(SFN mod 16)=0$- $i\_{S-SSB}$ is a S-SS/PSBCH block index within the number of S-SS/PSBCH blocks in the period, with $0\leq i\_{S-SSB}\leq N\_{period}^{S-SSB}-1$- $N\_{offset}^{S-SSB}$ is a slot offset from a start of the period to the first slot including S-SS/PSBCH block, provided by *sl-TimeOffsetSSB*- $N\_{interval}^{S-SSB}$ is a slot interval between S-SS/PSBCH blocks, which is equal to , where,  is provided by *sl-timeInterval* |

## Indication of the non-TDD case in sl-TDD-Config

In latest version of TS 38.213, the description does not consider supplementary uplink band. It is proposed to add the case of shared SL carrier and SUL carrier as another “non-TDD” case in deriving *sl-TDD-Config*.

***FL Proposal:***

**Contribution Proposals:**

[Sharp] Discussion with TP

|  |
| --- |
| -------------------------------------------- Start of TP -------------------------------------------< Unchanged parts are omitted >For transmission of an S-SS/PSBCH block, a UE includes a bit sequence $a\_{0}, a\_{1}, a\_{2}, a\_{3}, …, a\_{11}$ in the PSBCH payload to indicate *sl-TDD-Config* and provide a slot format over a number of slots.For paired spectrum or supplementary uplink band, 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], - $a\_{0}, a\_{1}, a\_{2}, a\_{3},a\_{4}, a\_{5}, a\_{6}, a\_{7},a\_{8}, a\_{9}, a\_{10}, a\_{11}$ are set to '1';else- $a\_{0}=0$ if *pattern1* is provided by *sl-TDD-Configuration-r16* or *tdd-UL-DL-ConfigurationCommon*; $a\_{0}=1$ if both *pattern1* and *pattern2* are provided by *sl-TDD-Configuration-r16* or *tdd-UL-DL-ConfigurationCommon* as described in Clause 11.1< Unchanged parts are omitted >-------------------------------------------- End of TP -------------------------------------------- |

## Restriction of S-SSB slot

An agreement in RAN1#101-e meeting is missed in the latest TS 38.213. The agreement is copied as follows.

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| --- |
| RAN1#101-eAgreements:* S-SSB transmission/reception slots are in cell-specific UL resources in Uu.
 |

***FL Proposal:***

**Contribution Proposals:**

[NTT DOCOMO] Discussion with TP

Test proposal:

|  |
| --- |
| **-------------------------- Start of Text Proposal for TS 38.213 --------------------------****<Unchanged parts omitted>**16.1 Synchronization proceduresA 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, 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*. 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 $N\_{period}^{S-SSB}$ 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 $N\_{offset}^{S-SSB}$+$N\_{interval}^{S-SSB}⋅i\_{S-SSB}$, where- index 0 corresponds to a first slot in a frame with SFN satisfying $(SFN mod 16)=0$- $i\_{S-SSB}$ is a S-SS/PSBCH block index within the number of S-SS/PSBCH blocks in the period, with $0\leq i\_{S-SSB}\leq N\_{period}^{S-SSB}-1$- $N\_{offset}^{S-SSB}$ is a slot offset from a start of the period to the first slot including S-SS/PSBCH block, provided by *sl-TimeOffsetSSB*- $N\_{interval}^{S-SSB}$ is a slot interval between S-SS/PSBCH blocks, provided by *sl-timeInterval*A S-SS/PSBCH block can be transmitted/received in a slot of which all OFDM symbols are semi-statically configured as UL as per the higher layer parameter *tdd-UL-DL-ConfigurationCommon-r16* of the serving cell if providedor *sl-TDD-Configuration-r16* if provided or *sl-TDD-Config-r16* of the received PSBCH if provided.**<Unchanged parts omitted>****-------------------------- End of Text Proposal for TS 38.213 --------------------------** |

# References

* 1. R1-2100333, “Discussion and TPs on sidelink synchronization mechanism and physical layer structure in NR V2X”, CATT, GOHIGH, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	2. R1-2100412, “Maintenance on NR sidelink synchronization and procedures”, vivo, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	3. R1-2100936, “Remaining issues on sidelink synchronization”, ZTE, Sanechips, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	4. R1-2101534, “Remaining issues on synchronization mechanism for NR sidelink”, Sharp, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	5. R1-2101582, “Maintenance for sidelink synchronization and mode 2”, NTT DOCOMO, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	6. R1-2101707, “Draft\_CR\_TS38.212”, Ericsson, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.
	7. R1-2101732, “Correction on PSBCH payload generation”, Huawei, HiSilicon, e-Meeting, 3GPP RAN1#104-e, January 25th – February 5th, 2021.