**3GPP TSG RAN WG1 Meeting #104b-e R1-210xxxx**

e-Meeting, April 12th – 20th, 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]-[4]. The issue list with priorities can be found as following subsection.

## Issue list

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| --- | --- | --- | --- |
| **Issue#** | **Descriptions** | **Type** | **Tdocs** |
| SY-1 | Timing misalignment between eNB/gNB, gNB/gNB | Discussion | [CATT, GOHIGH] [OPPO] |
| SY-2 | NR SL-TDD-Config in the coverage of eNB | Discussion with TP | [vivo] |
| SY-3 | Indication of the non-TDD case in sl-TDD-Config | Discussion with TP | [Sharp] |
| SY-4 | Clarification of the notation of “$u\_{slots}^{SL}$” | Discussion with TP | [Sharp] |

# Issues/corrections proposed in contributions

## Timing misalignment between eNB/gNB, gNB/gNB

2 contributions discussed about asynchronous issues among NBs which lead to timing misalignment between different V2X UEs for SL communication.

* For timing between eNB and gNB

Both gNB and eNB can be selected as sync sources for NR V2X UE. As gNB and eNB have the same priority, RSRP is used for the selection of the sync source from gNB and eNB. However, the timing offset between gNB and eNB is not considered while NR supports different timing between eNB and gNB. In order to let V2X UEs derive a unified timing, the timing offset between gNB and eNB should be configured and informed to V2X UEs.

* For timing between different gNBs

Timing mis-alignment among gNBs leads to PSFCH Tx/Rx issue between two V-UEs which are sync’d to two different gNBs, respectively.

**Contribution Proposals:**

[CATT, GOHIGH] Discussion

* Proposal 1: In order to let V2X UE derive a unified timing, the timing offset between gNB and eNB should be configured and informed to V2X UE.
* Proposal 2: Send an LS to RAN2 regarding the above issue.

[OPPO] Discussion

* Observation 1: Based on the R16 NR-V2X sync procedure, it is possible that two UEs communicating via PC5 adopt different Tx-sync.
* Observation 2: For the transmission of PSFCH, sync difference between Tx-UE and Rx-UE(s) is not feasible.
* Proposal 1: The sync procedure specified in TS 38.331 section 5.8.6 is applicable to PSFCH transmission.

## 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.

**Contribution Proposals:**

[vivo] Discussion with TP

***Observation 1. 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.***

*Proposal 1. 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* 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 ----------------------------------------------------** |

## 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*.

**Contribution Proposals:**

[Sharp] Discussion with TP#1

|  |
| --- |
| -------------------------------------------- Start of TP of 38.213 -------------------------------------------< 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 -------------------------------------------- |

## Clarification of the notation of “$u\_{slots}^{SL}$”

In latest version of TS 38.213 for parameter sl-TDD-Config, “$u\_{slots}^{SL}$” is not clearly explained in any spec text. It is proposed to add clarification for “$u\_{slots}^{SL}$” in section 16.1 of TS 38.213.

**Contribution Proposals:**

[Sharp] Discussion with TP#2

|  |
| --- |
| -------------------------------------------- Start of TP of 38.213 -------------------------------------------< Unchanged parts are omitted >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- $a\_{0}=0$ 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 a number of UL slots $u\_{slots}^{SL}$, respectively< Unchanged parts are omitted >-------------------------------------------- End of TP -------------------------------------------- |

# References

* 1. R1-2102591, “Discussion on timing offset between eNB and gNB in NR V2X”, CATT, GOHIGH, e-Meeting, 3GPP RAN1#104b-e, April 12th – 20th, 2021.
	2. R1-2102795, “Remaining open issues and corrections for procedure”, OPPO, e-Meeting, 3GPP RAN1#104b-e, April 12th – 20th, 2021.
	3. R1-2102942, “Maintenance on NR sidelink synchronization and procedure”, vivo, e-Meeting, 3GPP RAN1#104b-e, April 12th – 20th, 2021.
	4. R1-2103468, “Remaining issues on synchronization mechanism and QoS management for NR sidelink”, Sharp, e-Meeting, 3GPP RAN1#104b-e, April 12th – 20th, 2021.