**[103-e-NR-Rel-16-V2X-05] Email discussion/approval regarding indication/derivation of TDD configuration.**

* **Issue SY-1-1: TDD configuration derivation**
* **Issue SY-1-2: TDD configuration for OoC UEs**

**till 10/29, with a potential CR by 11/4 – Teng (CATT)**

For the discussion on SL SYNC in this meeting, companies are encouraged to follow the steps:

* 10/26-10/27: 1st round to discuss the technical details.
* 10/27-10/28: 2nd round to discuss the proposal based on the discussion and contributions.
* 10/28-10/29: Conclusion for consensus.
* Till 11/4: CR after the consensus is reached.

**Issue SY 1-1 TDD configuration derivation**

This issue was discussed during last meeting but did not reach any consensus. The uncertainty part is whether the TDD configuration derivation can be aligned between Tx side and Rx side. Some companies thought it can be avoided by network implementation, while some other companies proposed to have further enhancement on the derivation equations to guarantee the alignment. During last meeting, the following potential options as candidates were discussed. The discussion during this meeting can start with the following options.

Based on Round 1 discussion, the 3 options are updated as follows, and more companies are added to support the corresponding option. Option 1 is agreeable by majority companies but 2 companies still have concerns on the first sentence that how the same UL slots understanding aligned between InC UEs and OoC UEs. Option 2 is similar to the second sentence of option1. Option 3 is to be considered as too restricted by majority companies and one company also thinks the ambiguous issue does not exist. Please provide your further views in Round 2 table.

* **Option 1**: For TDD configuration carried in PSBCH, the ambiguous issue between InC and OoC UEs can be eliminated up to network implementation. For TDD configuration for resource pool determination, *sl-TDD-Config* in PSBCH is used for OOC UE, if the UE selected a SyncRef UE.
* **Option 2**: Tx UEs (InC) and Rx UEs (OoC) use the same UL slots resources calculated for or indicated by PSBCH.
* **Option 3**: To restrict the number of UL slots configured in tdd-UL-DL-ConfigCommon as integer multiple of granularity *w*.

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| **Options** | **Supportive companies** |
| Option 1 | [LGE] [Ericsson] [Huawei, HiSilicon] [OPPO] [Samsung] [Nokia] |
| Option 2 | [vivo] [Qualcomm] [Sharp] |
| Option 3 | [ZTE, Sanechips] |

***FL proposal: A little bit more discussion in technical and clarification is needed before making the decision.***

**Round 2 comments 10/27-10/28**

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| **Company** | **Views** |
| FL | For Option1, ZTE has concerns that how the InC and OoC guarantee the same understanding on the UL slots, because it cannot be realized according to current specification. Besides, Qualcomm think Opt 1 and Opt 3 both have too restriction on the TDD configuration.For Option 2, I change it by following the suggestion from Qualcomm. Vivo’s change suggestion is similar with the second sentence of option 1, so I think vivo can also accept the current option 2.For Option 3, Sharp thinks the issue does not exist according to Qualcomm and Sharp’s analysis. Besides, Opt 3 does have restrictions on TDD configuration for InC and OoC UEs. |
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**Round 1 comments 10/26-10/27**

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| **Company** | **Views** |
| LGE | First of all, based on the FL summary document (R1-2009241), option 1 should also include TDD configuration derivation for resource pool determination. So we suggest to change the sentence for option 1 as follows:**Option 1**: For TDD configuration carried in PSBCH, the ambiguous issue between InC and OoC UEs can be eliminated up to network implementation. For TDD configuration for resource pool determination, sl-TDD-Config in PSBCH is used for OOC UE, if the UE selected a SyncRef UE.The reason for supporting option 1 is as follows. Regarding the SL slot derivation from sl-TDD-Config, from the beginning of the relevant discussions, it was a common understanding that only when a group indicated by sl-TDD-Config is composed of UL slots, it is counted as sl-TDD-Config. If there is any DL or flexible slots in a group, those slots may cause unwanted interference to DL communication, which was not acceptable. As a result, if there are UL slots less than the grouping factor, those UL slots are not used for SL slots. With this understanding, there is no ambiguity in current specification regarding the SL slot derivation from sl-TDD-Config.When RX UE is out-of-coverage UE, S-SSB needs to be used to support synchronization and the same understanding on the TDD pattern. To be specific, the in-coverage UE transmits synchronization signals based on DL slot timing of the serving cell and PSBCH containing TDD pattern based on the higher layer parameter tdd-UL-DL-ConfigurationCommon of the serving cell. Once the RX UE successfully receives S-SSB, both UEs can be synchronized each other and have the same understanding on the TDD pattern. As a result, if the OOC UE has selected SyncRef UE, sl-TDD-Config provided by the received PSBCH is used to derive the TDD pattern, to which a SL resource pool bit map is applied. |
| vivo | First of all, we agree with LG that if a OoC UE selects a SyncRef UE as its sync source, it should use the SL-TDD-Config received from the sync source for pool derivation. This is exactly how an OoC UE who synchronized to a SyncRef UE derives the resource pool in LTE, and we think NR should follow this principle. The second sentence in option1 proposed by LG is fine (i.e., *For TDD configuration for resource pool determination, sl-TDD-Config in PSBCH is used for OOC UE, if the UE selected a SyncRef UE*.).Secondly, for the IC UE, there may be a mismatch between the UL slots indicated by TDD-ConfigurationCommon in SIB1 and that based on the derived PSBCH, in this case, if IC UE determines pool based on the resource indicated by SIB1 while OoC UE uses the SL-TDD-Config transmitted by the IC UE, they will fail to communicate with each other. Either limiting the number of UL slots in SIB1 to multiples of w or allowing IC UE to use SL-TDD-Config in its PSBCH for pool determination could solve this problem, and we prefer the latter one because it does not impose further constraints on the Uu configuration. So we revised the option2 as below* **Option 2**: For TDD configuration for resource pool determination, *sl-TDD-Config* in PSBCH is used for IC UE and OOC UE that selected a SyncRef UE.
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| Ericsson | We are supportive of Option 1. If a UE is in-coverage the potential ambiguity between the TDD configuration between in-coverage and out-of-coverage UEs can be taken care by the network implementation. For out-of-coverage UEs, they should follow the configuration carried in the PSBCH if SyncRefUE has been selected. Therefore, there is no need to have specification impact. |
| Qualcomm | We support Option 2 with some text changes described here.For Option 1 to work, it would be a restriction on TDD signaling as in Option 3.While Option 3 works, we think Option 2 is the most robust and flexible as it ensures communications between in-coverage and out-of-coverage UEs without placing restrictions on Uu TDD configuration. Some wording update is needed to state the value derived for PSBCH would be used instead of only the value indicated in PSBCH to cover the case where the UE has not received PSBCH.**Option 2**: Tx UEs (InC) and Rx UEs (OoC) use the same UL slots resources calculated for or indicated by PSBCH. |
| Huawei/HiSilicon | **We can live we option 1 and option 2 and slightly prefer to option 1.**For sl-TDD-Config, 38.331 as stated that the content of sl-TDD-Config is the same tdd-UL-DL-ConfigurationCommon if UE is in coverage. The issue from the beginning is that, even indicated by SIB1, the tdd-UL-DL-ConfigurationCommon can be changed which up to the network configuration and operation consideration. While for the purely OoC UE, only pre-configuration can be relied which cannot updated as quick as signaling in SIB1. Hence the PSBCH is used to indicate the sl-TDD-Config to align with InC UE, if the OoC UE can hear InC UE. For option 2, we all know that this issue only occur in shared TDD band/carriers, for this band/carriers, one simplest way is to set the InC and OoC UE has the same TDD configuration. But this will put strong limitation to the operators since as pointed above the tdd-UL-DL-ConfigurationCommon cannot be updated if this carrier is also used for ITS service.  |
| OPPO  | **Option 1.** |
| ZTE, Sanechips | For the second sentence in option 1 added by LGE, we are fine. For TDD configuration for resource pool determination, sl-TDD-Config in PSBCH is used for OOC UE, if the UE selected a SyncRef UE. But for the first sentence in option 1, it seems to be unclear how to realize the same understanding on the TDD pattern between InC UE and OoC UE. From the sentence that “if there are UL slots less than the grouping factor, those UL slots are not used for SL slots.” , it is understood that only the UL slots equals to the grouping factor configured in ***tdd-UL-DL-ConfigCommon*** can be indicated in PSBCH. It obviously belongs to option 2. In our view, if the common understanding on the TDD pattern should be guaranteed between InC UE and OoC UE, the UL slots configured in tdd-UL-DL-ConfigCommon equal to the integer multiple w should be ensured. to reach this target, the following two equations should be included in spec accordingly.$$mod\left(u\_{slots,2}\*2^{μ-μ\_{ref}}+\left⌊\frac{u\_{sym,2}\*2^{μ-μ\_{ref}}}{L}\right⌋+I\_{2}, w\right)=0$$$$mod\left(u\_{slots}\*2^{μ-μ\_{ref}}+\left⌊\frac{u\_{sym}\*2^{μ-μ\_{ref}}}{L}\right⌋+I\_{1}, w\right)=0$$For option 2, we agree the analysis from vivo, but It does not accord with the current spec description in section 8 in 38.214 as following. This would make the SL resource pools between InC UE and OoC UE different.

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| The set of slots that may belong to a sidelink resource pool is denoted by $(t\_{0}^{SL},t\_{1}^{SL},\cdots ,t\_{T\_{max}-1}^{SL})$ where- $0\leq t\_{i}^{SL}<10240×2^{μ}, 0\leq i<T\_{max},$ - the slot index is relative to slot#0 of the radio frame corresponding to SFN 0 of the serving cell or DFN 0,- the set includes all the slots except the following slots, - $N\_{S\\_SSB}$ slots in which S-SS/PSBCH block (S-SSB) is configured,- $N\_{nonSL}$ slots in each of which at least one of *Y-th*, *(Y+1)-th*, …, *(Y+X-1)-th* OFDM symbols are not semi-statically configured as UL as per the higher layer parameter *TDD-UL-DL-ConfigCommon*, where *Y* and *X* are set by the higher layer parameters *sl-StartSymbol* and *sl-LengthSymbols*, respectively.... |

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| Samsung | We support Option 1. |
| Sharp | We have a similar view as Qualcomm.* For InC UE, for determination of “UL” slots, always interpret *tdd-UL-DL-ConfigCommon* in the form of *sl-TDD-Config* in PSBCH (i.e. the UE first derives “*sl-TDD-Config*” from *tdd-UL-DL-ConfigCommon* as specified in 213, and then follows the indication in the derived “*sl-TDD-Config*”, rather than in the received *tdd-UL-DL-ConfigCommon*), regardless of whether the UE transmits S-SSB or not.
* For OoC UE, always follow the configuration it received from another UE (e.g. *sl-TDD-Config* in PSBCH), if any.

With the above, the issue as claimed in Option 3 does not exist. |
| Nokia | We support Opt 1. |

**Issue SY 1-2 TDD configuration for OoC UEs**

1 company proposed to consider the case when OoC UEs to obtain TDD configuration information, since there is no network for OoC UEs to receive *tdd-UL-DL-ConfigurationCommon*. A pre-configuration parameter is defined and used when UEs are OoC to derive TDD information.

According to the Round 1 views feedback, majority companies agree with the TP proposed by LG, and the following TP can be considered as a consensus.

***FL proposal:***

* ***Adopting the following TP for TS 38.213.***

--------------------------------------------------Start of draft TP of TS 38.213----------------------------------------------

16.1 Synchronization procedures

--------------------------------------------------<Unchanged parts 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, where

- $a\_{0}=0$ 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-SL* = “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]

--------------------------------------------------<Unchanged parts omitted>----------------------------------------------

--------------------------------------------------End of draft TP of TS 38.213----------------------------------------------

**Round 2 comments 10/27-10/28**

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| **Company** | **Views** |
| FL | The above TP proposed by LGE is acceptable by majority companies.Vivo suggests adding more specific indication wording for the parameter definitions. From my perspective based on the current responses from the companies, the current version of TP is fine and clear. |
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**Round 1 comments 10/26-10/27**

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| **Company** | **Views** |
| LGE | In Section 16.1 of 38.213 spec, there is no description how to derive sl-TDD-Config carried by PSBCH when OOC UE has no SyncRef UE and becomes a source of synchronization. In this case, for OOC UE’s transmission of an S-SS/PSBCH block, *sl-TDD-Configuration* in *SL-PreconfigurationNR* can be used for sl-TDD-Config generation. Suggest TP is as follows.

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| 16.1 Synchronization procedures<Unchanged parts 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, where- $a\_{0}=0$ if *pattern1* is provided by *sl-TDD-Configuration or tdd-UL-DL-ConfigurationCommon*; $a\_{0}=1$ if both *pattern1* and *pattern2* are provided by *sl-TDD-Configuration* *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-SL* = “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 as defined in [9.3, TS 38.331]- $μ=0, 1, 2, 3$ corresponds to SL SCS as defined in [4, TS 38.211] |

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| Vivo | We also proposed a description regarding the PBSCH content derivation in the OoC case in our paper R1-2008668. The wording suggested by LG is generally fine. But the definition of $μ\_{ref}$, $u\_{slots}$, $u\_{sym}$, $u\_{slots,2}$, $u\_{sym,2}$ for OoC case is not clear, we suggest completing the description as below- $μ\_{ref}$, $u\_{slots}$, $u\_{sym}$, $u\_{slots,2}$, $u\_{sym,2}$ are the parameters of TDD-UL-ConfigurationCommon as described in Clause 11.1, or are provided by *referenceSubcarrierSpacing*, *nrofUplinkSlots* in *pattern1*, *nrofUplinkSymbols* in *pattern1*, *nrofUplinkSlots* in *pattern2*, *nrofUplinkSymbols* in *pattern2* according to sl-TDD-Configuration as defined in [9.3, TS 38.331] |
| Ericsson | We are supportive of the current TP by LGE. The exact wording of the parameters of the TDD-UL-ConfigurationCommon can be left up to CR phase if needed. |
| Qualcomm | We’re ok with the text proposed by LG. |
| Huawei/HiSilicon | We are supportive of the current TP by LGE. As stated in the SY1-1, this is natural way to derive sl-TDD-Config when OoC UE cannot detect PSBCH. |
| OPPO | We are fine with LGE’s text proposal |
| ZTE,Sanechips | OK |
| Samsung | We are generally O.K for LGE’s text proposal but ‘*sl-TDD-Configuration-r16’* needs to be used instead *of ‘sl-TDD-Configuration’* in order to align higher layer parameter. |
| Sharp | Fine with the TP from LGE. |
| Nokia  | We are OK with LGE proposal. |