**[100b-e-NR-5G\_V2X\_NRSL-SYNC-04]**

**Email discussion/approval related to sync timing**

[100b-e-NR-5G\_V2X\_NRSL-SYNC-04] Email discussion/approval related to

* Slot number/sidelink timing derived from GNSS
* Resource sets for S-SSB transmission
* Timing determination of S-SSB

(a,k.a. issues 5,6,7) by 4/24, with potential TPs by 4/29 (CATT, Teng)

**Issue 5 Slot number/sidelink timing derived from GNSS**

According to the responses 4/23-4/24, the views on the two alternatives are summarized as follows.

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| **FL Proposal** | **Supporting companies** |
| Alt 1 | [LGE] [Sharp] [Qualcomm] [ZTE, Sanechips] [Fujitsu] [OPPO] [Ericsson] [Samsung] [Nokia, NSB] |
| Alt 2 | [MediaTek] [vivo] [Huawei, HiSilicon] [Futurewei] |

FL comments:

* The slot number determination description should be captured in Rel-16 V2X spec, no matter it is in RAN1 spec or RAN2 spec. RAN2 did not discuss this issue in last meeting, but the notes was added in the latest version of 38.331 after last meeting.
* As FL, I prefer to have it in RAN2’s spec, i.e. 38.331. As we can see the formula in my proposal (also mentioned by some companies), the parameters used are all higher layer related that are in 38.3331. Therefore, it is logical and reasonable to put all related timing parameters together in the same subclause.
* I agree with that it is not up to RAN1 but RAN2 on how to capture it in 38.331, but there is already a note in current 38.331 that RAN2 leave it to RAN1 to determine. If we agree nothing or reply nothing to RAN2, then slot number determination will never be done in Rel-16 V2X.
* I rewording the Alt 1 with following, and a draft LS will be spread if the following proposal is agreed.

***FL proposal:***

* ***RAN1 expects RAN2 to capture slot number determination in subclause 5.8.12 in TS 38.331. An LS is needed to inform RAN2 about this information.***

**Comments 4/24**

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| **Company** | **Views** |
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**Email responses in 4/23-4/24**

***FL proposal:***

* ***Alt 1: Slot number determination should be captured in subclause 5.8.12 in TS 38.331. An LS should be sent to RAN2 to add slot number determination.***
* ***Alt 2: Slot number determination is captured as follows***

**------------------------------------------------------ Start of Draft TP of 38.211--------------------------------------------------**

8.2.3.2 Slots

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

When the UE selects GNSS as the synchronization reference source, the slot number used for NR sidelink communication is derived from the current UTC time, by the following formulae:

*SlotNumber=* Floor ( (*Tcurrent – Tref – OffsetDFN*)\*2μ) mod 2μ

Where:

***Tcurrent*** is the current UTC time that obtained from GNSS. This value is expressed in milliseconds;

***Tref*** is the reference UTC time 00:00:00 on Gregorian calendar date 1 January, 1900 (midnight between Thursday, December 31, 1899 and Friday, January 1, 1900). This value is expressed in milliseconds;

***OffsetDFN*** is the value *sl-OffsetDFN* if configured, otherwise it is zero. This value is expressed in milliseconds.

***μ***=0/1/2/3 corresponding to the 15/30/60/120 khz SCS for SL respectively.

**-------------------------------------------------------- End of Draft TP of 38.211-------------------------------------------------**

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| **Company** | **Views** |
| MediaTek | Alt. 2. Because it has been clearly mentioned as the Ran1 issue in TS 38.331. No need to send LS for such trival issue. Actually, most companies also did not have the concern on TP (still using ms) itself. We also realized that there is no need of using us.  |
| vivo | To make progress, we are fine with using ms if the majority is in favor of keeping an ms-level unit for the NR V2X, although we didn't see there would be big problems if NR V2X allows a more precise time unit than LTE. The formula provided by FL looks fine.  |
| Huawei, HiSilicon | We support Alt 2 given by the feature lead with the following modification: *SlotNumber = Floor ((Tcurrent –Tref–offsetDFN)\*2μ) mod (10\*2μ)*Some clarification: * First we support to define the slot number.
* Second, why we need add the number 10. Because the slot number has been defined within a radio frame not a subframe in NR Uu link. For example there would be 80 slots for 120k SCS. Please note, the unit for Tcurrent etc are ms does not mean the value should be within 1 ms.

For Alt1, we think it is not enough since RAN2 also very busy, we need give then the answer how to capature the slot number.  |
| Futurewei | Alt 2 |
| LGE | Alt.1 is supported. |
| Sharp | Our preference is Alt 1. In Alt 2, most parts of the proposed TP are just verbatim copy of the whole section 5.X.12 of TS 38.331 with just a slight difference of replacing DFN/subframe derivation with slot derivation. Such a copy of large block of text across specs looks very messy to start with. Furthermore, in our view TS 38.211 is a place for describing physical channels/resources/frame structures, not for deriving an exact frame/subframe/slot number in a specific feature (which fits more in a “procedure”), e.g. in LTE/NR Uu the SFN is derived in MIB in TS 36.331/38.331 and we never say a word on how the SFN is derived in TS 38.211.Regarding the RAN2 work load we really don’t think there is any issue to worry about. RAN1 will anyhow send some LSs to RAN2 after this e-meeting and the RAN2 running CR on V2X for TS 38.331 will be updated according to RAN1 inputs. In fact, Sharp participated in the email discussion of the running CR on TS 38.331 and commented on section 5.X.12 (previously the RAN2 running CR referred to TS 38.21**2** for slot number derivation which we felt a little strange), and the moderator of the RAN2 running CR said the slot number derivation was a RAN1 issue and details should be discussed and determined in RAN1, so our understanding is that, just like e.g. RAN1 inputs on MIB-SL contents / RRC parameters, there is no problem for RAN2 to pick up the slot number derivation information in a RAN1 LS and update it in TS 38.331, along with other contents from RAN1. |
| Qualcomm | Alt 1. This belongs in RAN2 spec and was captured there for LTE V2X. It discusses items not dealt with in RAN1 spec. |
| ZTE,Sanechips | Alt 1. This belongs to RAN2 spec.As we proposed in the 1st round and also re-iterated by some other company earlier and here again, the following should be captured in RAN2 spec DFN= Floor (0.1\*(Tcurrent –Tref–offsetDFN)) mod 1024~~SubframeNumber= Floor (Tcurrent –Tref–offsetDFN) mod 10~~SlotNumber= Floor ((Tcurrent –Tref–offsetDFN)\*2μ) mod (10\*2μ), |
| Fujitsu | Alt 1 |
| OPPO | Alt 1 |
| Ericsson | It is not up to RAN1 to decide how to capture things in the RAN2 specifications. If a statement is to be captured, then Alt 1 should be reworded to something like “RAN1 expects RAN2 to capture slot number determination in their specification”. |
| Samsung | Alt 1 but we are not sure whether sending an LS to RAN2 is necessary. |
| Nokia, NSB | Alt 1, but it is up to RAN2 to decide how to capture it in their specifications |

**Email responses in 4/20-4/23**

***Proposal 7: When UE selects GNSS as the synchronization reference and offsetDFN is provided, the following TP is supported.***

**------------------------------------------------------ Start of Draft TP of 38.331--------------------------------------------------**

**5.8.12 DFN derivation form GNSS**

When the UE selects GNSS as the synchronization reference source, the DFN used for NR sidelink communication is derived from the current UTC time, by the following formulae:

*DFN*= Floor (0.1\*0.001\* (*Tcurrent* – *Tref – offsetDFN*)) mod 1024

*SubframeNumber*= Floor (0.001\*(*Tcurrent* –*Tref – offsetDFN)*) mod 10

*SlotNumber=* Floor (0.001\*(*Tcurrent – Tref – OffsetDFN*)\*2μ) mod 2μ

Where:

***Tcurrent*** is the current UTC time that obtained from GNSS. This value is expressed in ~~milliseconds~~ microseconds;

***Tref*** is the reference UTC time 00:00:00 on Gregorian calendar date 1 January, 1900 (midnight between Thursday, December 31, 1899 and Friday, January 1, 1900). This value is expressed in ~~milliseconds~~ microseconds;

***OffsetDFN*** is the value *sl-OffsetDFN* if configured, otherwise it is zero. This value is expressed in ~~milliseconds~~ microseconds;

μ=0/1/2/3 corresponding to the 15/30/60/120 khz SCS for SL respectively.

**-------------------------------------------------------- End of Draft TP of 38.331-------------------------------------------------**

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| **Company** | **Views** |
| Sharp | The unit of Tcurrent/Tref/offsetDFN should be millisecond (i.e. same as in LTE V2X) rather than microsecond. The reason is that Tcurrent, Tref and offsetDFN are decimal values in LTE V2X, with offsetDFN corresponding to values from {0, 0.001, 0.002, …} (and these offsetDFN values would have make no difference to the calculation and thus make no sense if Tcurrent and Tref would have only taken integer values). Therefore, changing the unit to microsecond and multiplying 0.001 does not make the calculation any more precise. Another reason not to change the unit is to maintain the compatibility with LTE V2X, e.g. a UE obtaining the “offsetDFN” parameter from either a gNB or an eNB should be able to derive the timing with the same formulae. |
| Vivo | Support this proposal.In NR V2X, the slot duration in microseconds scales with the subcarrier spacing and it can be smaller than 1ms. Therefore, we need to change *Tcurrent*, *Tref* and *OffsetDFN* to microsecond accuracy. The slot index within a subframe can be further specified to help UE to derive the slot level boundary.For the gNB controlling LTE V2X case, as SL-V2X-ConfigCommon-r14 (IE including offsetDFN) of LTE V2X is implemented as a container in NR SIB Y, the ms accuracy can be maintained for inter-RAT/intra-RAT LTE V2X. For intra-RAT/inter-RAT NR V2X, the same time unit (i.e., us) can also be maintained similarly.  |
| ZTE,Sanechips | We disagree. This modification would require a different value of T\_current, T\_ref, OffsetDFN measured in microseconds from that measured in milliseconds defined in 36.331 5.10.14. This may require two sets of values in case of GNSS as sync source to both NR and LTE V2X.As specified in TS38.212, slot index within frame is indicated in PSBCH. Considering consistency, it is suggested deriving slot number within a frame based on GNSS. Subframe number can be determined based on slot number within a frame and thus unnecessary. We feel a better modification to reflect the same rationale would be the following DFN= Floor (0.1\*(Tcurrent –Tref–offsetDFN)) mod 1024~~SubframeNumber= Floor (Tcurrent –Tref–offsetDFN) mod 10~~SlotNumber= Floor ((Tcurrent –Tref–offsetDFN)\*2μ) mod (10\*2μ), |
| OPPO | We don’t support the proposal. There is no need to change it based on microsecond. We tend to agree with the proposal from ZTE.  |
| Ericsson | Do not agree. There is no need to provide a TP. This is a RAN2 specification. If necessary, RAN1 can send an LS asking RAN2 to implement the changes in their spec. RAN1 can also describer any required changes (like adding SlotNumber) if considered necessary. |
| Qualcomm  | We agree with Sharp/ZTE/OPPO/Ericsson that, 1) there is no need to change time unit from millisecond to microsecond; 2) this is something to be specified by RAN2. |
| LGE | FL proposal is not supported.We don’t need to specify the *SlotNumber* calculation. *SlotNumber* calculation is not specified in LTE-V2X. Current CR 38.331 text, which defined *DFN* and *SubframeNumber* as in LTE-V2X, does not need further clarification. |
| Nokia, NSB | This can be discussed in RAN2. We think that from RAN1 point of view the proposed changes are not necessary. |
| Apple | We do not support the proposal. The approach mentioned by ZTE seems to work.  |
| Samsung | We share the view with Sharp, ZTE, OPPO, Ericsson, Qualcomm, LGE, Nokia, and Apple. Since this will be captured into RAN2 specification (e.g., TS38.331), we don’t need to provide a TP. Also, there is no need to change the time unit to microsecond. |
| Fujitsu | We do not support the proposal, and share the similar view as that of ZTE, only DFN and slot number need to be specified for NR sidelink. |
| Huawei, HiSilicon | We do not need to define subframe number anymore in NR-V2X since the slot number expresses all the timing information within 10ms. We can directly define the slot number. Since the unit of Tcurrent, Tref and offsetDFN is milliseconds, then the number of slot can be defined as: DFN= Floor (0.1\*(Tcurrent –Tref–offsetDFN)) mod 1024SlotN = Floor ((Tcurrent –Tref–offsetDFN)\*2μ) mod (10\*2μ) |
| MediaTek | Support the proposal. Firstly, in LTE V2X, the value is expressed in milliseconds doesn’t necessarily means that the value is only measured in milliseconds. Secondly, if the granulariy is only expressed in milliseconds, it may not be able to derive the slot number which has the time duration less than 1 ms for the subcarrier spacing larger than 15khz.  |

**Issue 7 Resource sets for S-SSB transmission**

I see all of the companies agreed with the FL summary. So I keep it as follows wording.

***FL summary:***

* ***The previous agreements includes that the synchronization resource set is following LTE-V2X mechanism.***

RAN1#98bis

Agreements**:**

* The procedure for signalling, identifying priority for one or more synchronization references and selecting the synchronization reference from the LTE is re-used (as a working assumption) for NR SL
	+ FFS SSIDs used for each priority
	+ FFS other potential impacts due to P3/P4/P5
* FFS whether there is an issue with prioritization among references of the same priority

Send an LS to RAN2 regarding the above – Teng (CATT), **R1-1911710,** which is approved (by adding cc-ing to RAN4) with final LS in R1-1911718.

**Email responses in 4/23-4/24**

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| **Company** | **Views** |
| MediaTek | Agree. Or it can be made as the conclusion. |
| Vivo | agree |
| Huawei, HiSilicon | Support the feature lead summary. Previous agreements are enough.  |
| Futurewei | Agree. Suggest to capture as a conclusion (note: two typos, should be ‘include’ and ‘mechanism) |
| LGE | FL summary is agreed. |
| Sharp | Agree to capture it as a conclusion. |
| Fujitsu | Agree |
| OPPO | Agree |
| Ericsson | Agree with the FL summary. There is no need to have an explicit agreement for the resource set. In our view, the previous agreement in RAN1#98bis already indicates that the resource set determination follows the same principle as in LTE-V2X. |
| Samsung | Agree with the FL summary which can be the conclusion of this discussion |
| Nokia, NSB | Agree with the FL summary/conclusion |

**Email responses in 4/20-4/23**

***Proposal 9: The number of synchronization resource set is same as LTE-V2X. How to use the sync resource set follows the same mechanism as LTE-V2X.***

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| **Company** | **Views** |
| Sharp | Fine with the proposal. |
| Vivo | Fine with this proposal |
| ZTE, Sanechips  | Agreed |
| OPPO | Agree.  |
| Ericsson | This proposal is not necessary as it is already agreed. We already have the agreement below. The LTE procedures include the synchronization resources and how to use them. There is no need to agree to this again. Agreements**:*** The procedure for ignaling, identifying priority for one or more synchronization references and selecting the synchronization reference from the LTE is re-used (as a working assumption) for NR SL
	+ FFS SSIDs used for each priority
	+ FFS other potential impacts due to P3/P4/P5
* FFS whether there is an issue with prioritization among references of the same priority

Send an LS to RAN2 regarding the above – Teng (CATT), [R1-1911710](http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_98b/Docs/R1-1911710.zip)**,** which is approved (by adding cc-ing to RAN4) with final LS in [R1-1911718](http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_98b/Docs/R1-1911718.zip) |
| Qualcomm | Agree. |
| LGE | FL proposal is supported. |
| Nokia, NSB | Agree |
| Apple | Agree |
| Samsung | We are fine with the proposal but we don’t think it is necessary as Ericsson commented. |
| Fujitsu | Agree |
| Huawei, HiSilicon | The same view as Ericsson, no need to agree it in RAN1 again.  |
| MediaTek | Same view as Ericsson. |

**Issue 8 Timing determination of S-SSB**

According to the responses 4/23-4/24, majority companies think that there is no issue left for determining the timing of S-SSB. The current spec can fully support on determination of S-SSB index, as well as the mapping relationship between S-SSB index and slot index. So there is no necessary to have further clarification in the spec.

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| **FL Proposal** | **Companies views** |
| Support | [MediaTek] [vivo] [Huawei, HiSilicon] [LGE] [Sharp] [OPPO] [Ericsson] [Samsung] [Nokia, NSB] |
| NOT support | [Fujitsu] |

FL comment:

* It is quite clear and comment understanding that there is no necessary to have extra definition on S-SSB timing. I keep my previous FL summary as follows for this issue.

***FL summary***

* ***There is no more clarification is needed, since the current S-SSB timing determination mechanism has no issue left.***

**Email responses in 4/23-4/24**

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| **Company** | **Views** |
| MediaTek | Agree. |
| Vivo | agree |
| Huawei, HiSilicon | Agree the feature lead summary.  |
| Futurewei | Agree. Capture in a conclusion with suggested wording as follows” No clarification needed for S-SSB timing determination” |
| LGE | FL summary is agreed. |
| Sharp | Agree to capture it as a conclusion. |
| Fujitsu | Disagree, as explained in the previous comments:Firstly, there is no description in 38.213 for a UE to determine the timing of receiving S-SSB. We think it is OK, since a UE can derive the slot index and the DFN of the receiving S-SSB directly.Secondly, there is description in 38.213 for a UE to determine the timing of transmitting S-SSB. It said “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 $N\_{offset}^{S-SSB}$+$N\_{interval}^{S-SSB}⋅i\_{S-SSB}$,…”. But in RAN1, we never defined “slot index” for a 160ms period, and 7-bit slot index in a frame is decided in PSBCH payload.Thus, we’d better to correct it and make the “slot index” have the same meaning in the reception of S-SSB and transmission of SSB, and keep the consistence of that part in TS 38.213 and the TS 38.212. The revision would be very simple and straightforward:the UE decides the DFN that include S-SSB as: $$DFN mod 16=\left⌊(N\_{offset}^{S-SSB}+N\_{interval}^{S-SSB}⋅i\_{S-SSB})/(10∙2^{μ})\right⌋ $$and decides the slot index that include S-SSB in the DFN as:$$(N\_{offset}^{S-SSB}+N\_{interval}^{S-SSB}⋅i\_{S-SSB} )mod(10∙2^{μ})$$ |
| OPPO | Agree |
| Ericsson | Agree with the FL summary. There is no need to have any further clarification for the S-SSB timing. |
| Samsung | Agree with the FL summary |
| Nokia, NSB | Agree |

**Email responses in 4/20-4/23**

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| **Company** | **Views** |
| Sharp | We don’t think there is any unsolved issue here. The SFN and slot index are already carried in MIBSL, and with these two parameters the UE can derive the slot index (denoted by $x$ here) within the S-SSB period containing the received S-SSB, and then determines $i\_{S-SSB}$ according to $x=N\_{offset}^{S-SSB}+N\_{interval}^{S-SSB}⋅i\_{S-SSB}$. The proposed equation for $i\_{S-SSB}$ is redundant and unnecessary. |
| vivo | If I remember well, this topic is proposed by some companies to introduce additional text on the determination of the S-SSB index. However, provided with the (pre-)configured S-SSB interval and the S-SSB offset, UE can determine the mapping between S-SSB index and slot index and therefore UE can derive the index of a received S-SSB after obtaining DFN and slot index. There is no need to introduce additional formula.  |
| ZTE,Sanechips | We think it would be good that the slot index in PSBCH payload specified in TS 38.212 is consistent with that specified in TS 38.213. This would require additional description in TS 38.213 16.1 as follows:A UE is provided, by *numSSBwithinPeriod-SL*, a number C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8F3C.tmp.jpg 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 SFNs ~~indexes of slots~~ that include S-SS/PSBCH block by using ~~as~~ C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8F7B.tmp.jpg+C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8F9B.tmp.jpg, with the SFN satisfying,- C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8FBC.tmp.jpgand the UE determines the slot indexes in the frame with the SFN including S-SS/PSBCH block according to - C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8FCC.tmp.jpgwhere,~~- index 0 corresponds to a first slot in a frame with SFN satisfying~~ C:\Users\10217598\AppData\Local\Temp\ksohtml\wps8FED.tmp.jpg- C:\Users\10217598\AppData\Local\Temp\ksohtml\wps900D.tmp.jpg is an ~~a~~ S-SS/PSBCH block index within the number of S-SS/PSBCH blocks in the period, with C:\Users\10217598\AppData\Local\Temp\ksohtml\wps902D.tmp.jpg- C:\Users\10217598\AppData\Local\Temp\ksohtml\wps903E.tmp.jpg is a slot offset from a start of the period to the first slot including S-SS/PSBCH block, provided by *timeOffsetSSB-SL*- C:\Users\10217598\AppData\Local\Temp\ksohtml\wps905E.tmp.jpg is a slot interval between S-SS/PSBCH blocks, provided by *timeIntervalSSB-SL* - C:\Users\10217598\AppData\Local\Temp\ksohtml\wps906F.tmp.jpg is the slot number within a frame for subcarrier spacing configuration μ  |
| OPPO | Disagree. We think there is no left issue.Based on the configuration of synchronization resource, UE can determine the slot position of each S-SSB. Based on DFN and slot index in PSBCH, UE can determine the time position within a DFN period of current S-SSB. |
| Ericsson | Do not agree. In our view the current PSBCH includes all the necessary information to determine the frame (DFN), slot timing (slot index as WA) and the symbol timing which can be determined from the structure of PSBCH and the pool/carrier configuration. Moreover, the symbol-boundary timing can be obtained upon S-PSS/S-SSS reception. |
| Qualcomm | We do not see any remaining issues here. |
| LGE | FL proposal is not supported.Current CR 38.213 does not need further clarification. |
| Nokia, NSB | We think that all the needed information to determine timing from S-SSB has already been specified. We think that the additional equation proposed by some companies is not needed.  |
| Apple | We do not agree. The relation between S-SSB index and slot index is obtained by configuration. Hence, the S-SSB index can be obtained by receiving DFN in PSBCH and the slot index of S-SSB.  |
| Samsung | We are not supportive of this proposal because no further clarification is necessary |
| Fujitsu | We support this proposal, this issue should be clarified in 16.1 of 38.213.1. For reception of an S-SSB, a UE is able to detect the DFN and the slot index of the S-SSB from the PSBCH of this S-SSB, and determine the timing of the S-SSB directly. If needed, such kind of descpriton can be added in this section.
2. Current text “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…” seems for a UE transmitting an S-SSB. The problem is this “slot index” is an index in 160ms period. But the slot index in PSBCH payload is 7-bit, which is a slot index in a frame. Thus the text should be revised as, for transmission an S-SSB,

the UE decides the DFN of the S-SSB by: $$DFN mod 16=\left⌊(N\_{offset}^{S-SSB}+N\_{interval}^{S-SSB}⋅i\_{S-SSB})/(10∙2^{μ})\right⌋ $$and decides the slot index in the DFN by:- $(N\_{offset}^{S-SSB}+N\_{interval}^{S-SSB}⋅i\_{S-SSB} )mod(10∙2^{μ})$Where μ is the SCS of the sidelink, for 15kHz, μ=0, for 30/60120kHz, μ= 1, 2, 3, respectively. If it is not clarified, a UE would have different understanding on the “slot index” in the reception and the transmission. |
| Huawei, HiSilicon | Not needed. Since the slot number can be obtained from the SL-MIB, the receiving UE can obtain the S-SSB index according to the (per-)configuration information for S-SSB. |
| MediaTek | No need. There is the resource sets and the configuration of the offset/interval for the mapping between S-SSB index and the timing (SFN/subframe/slot number). |