3GPP TSG-RAN WG2 #116e R2-xxxxxxx

Electronic meeting, November 1st – 12th 2021

Agenda Item: 8.x.x

Source: vivo

Title: Summary of [POST115-e][715][V2X/SL] (vivo)

Document for: Discussion, Decision

# Introduction

This document is to kick off the following email discussion:

* [POST115-e][715][V2X/SL] (Vivo)

**Scope:** Discuss 1) how to calculate/determine SL DRX timer length (SL DRX cycle, SL DRX on-duration timer, SL DRX inactivity timer, HARQ RTT and retransmission timer), e.g. equation based on DFN, equation based on number of SL logical slots, etc., 2) how to calculate SL DRX start time (time where the first SL DRX on-duration timer starts) for UC and GC/BC, e.g. equation for UC, how to take L2 destination id into account for GC/BC, etc.

**Intended outcome:** Discussion summary

**Deadline:** Long email discussion. 1st phase: check companies’ views for the simple/general question, collect candidate options from the companies for the question including multiple options before checking all companies’ views for each option. 2nd phase: check companies’ views for all questions (no restriction). Checking the rapporteur summary is done from the end of 2nd phase to tdoc submission.

The above email discussion is divided in three phases:

* **Phase I**: Companies are invited to check the questions and provide your option for each question if it is not included in the candidate options by 30th Sep 04:00 UTC. Rapporteur will reshape the questions and options in this email discussion based on companies’ comments.
* **Phase II:** During this phase, a complete questionnaire will be published and companies are invited to provide feedback on the questions by 15th Oct 9:00 UTC.
* **Phase III:** Rapporteur submits a summary based on phase II’s feedback, and companies can comment on the summary by 21th Oct 9:00 UTC.

# Discussion

## How to calculate/determine SL DRX timer length

### Unit to configure SL DRX timer length

In Uu, the units to determine the length of DRX related timers are summarized as follows[1]:

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| Timer | Unit |
| *drx-onDurationTimer* | Value in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond) |
| *drx-InactivityTimer* | Value in multiple integers of 1 ms |
| *drx-HARQ-RTT-TimerDL*  *drx-HARQ-RTT-TimerUL* | Value in number of symbols of the BWP where the transport block was received/ transmitted |
| *drx-RetransmissionTimerDL*  *drx-RetransmissionTimerUL* | Value in number of slot lengths of the BWP where the transport block was received/ transmitted |
| *drx-ShortCycle* | Value in ms. |
| *drx-LongCycle* | Value in ms. If *drx-ShortCycle* is configured, the value of *drx-LongCycle* shall be a multiple of the *drx-ShortCycle* value. |
| *drx-SlotOffset* | Value in 1/32 ms |

The related issue(s) is discussed in the following contributions:

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| Tdoc Number | Company | Proposal |
| R2-2107242 | LG Electronics Inc. | Proposal 2. RAN2 to confirm that SL DRX timers take the units as follow:   * *sl-drx-LongCycle* and *sl-drx-StartOffset* in millisecond. * *sl-drx-onDurationTimer* in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond). * *sl-drx-SlotOffset* in multiples of 1/32 ms. * *sl-drx-InactivityTimer* in multiple integers of 1 ms. * *sl-drx-HARQ-RTT-Timer* in number of physical slot where the transport block was received. * *sl-drx-RetransmissionTimer* in number of physical slot lengths where the transport block was received. |
| R2-2105352 | vivo | Proposal 5 RAN2 to confirm that SL DRX timers take the units of Uu DRX timers as baseline:  - sl-drx-LongCycle and sl-drx-StartOffset in millisecond.  - sl-drx-onDurationTimer in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond).  - sl-drx-SlotOffset in multiples of 1/32 ms.  - sl-drx-InactivityTimer in multiple integers of 1 ms.  - sl-drx-HARQ-RTT-Timer in number of symbols where the transport block was received, if configured.  - sl-drx-RetransmissionTimer in number of slot lengths where the transport block was received. |

Rapporteur understand for the parameters except *sl-drx-HARQ-RTT-Timer* and *sl-drx-HARQ-RTT-Timer* which are related to number of symbol/slot, the other parameters can reuse the configuration of Uu DRX to value in millisecond. For *sl-drx-HARQ-RTT-Timer* and *sl-drx-HARQ-RTT-Timer*, it can be further discussed whether physical/logical symbol/slot should be applied to these timers.

#### Timer value in ms

**Q2.1-1a: Do you agree that SL DRX timers/parameters including *sl-drx-LongCycle, sl-drx-StartOffset, sl-drx-onDurationTimer, sl-drx-SlotOffset, sl-drx-InactivityTimer*, would take the units of Uu DRX timers as baseline? i.e.**

* *sl-drx-LongCycle* and *sl-drx-StartOffset* in millisecond.
* *sl-drx-onDurationTimer* in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond).
* *sl-drx-SlotOffset* in multiples of 1/32 ms.
* *sl-drx-InactivityTimer* in multiple integers of 1 ms.

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#### Timer value in number of symbol/slot

For *sl-drx-HARQ-RTT-Timer* and *sl-drx-RetransmissionTimer*, the granularity of timing to start them (i.e. symbol or slot) was also discussed previously but no conclusion, e.g. for HARQ RTT timer:

22: For transmissions with HARQ feedback, the RX UE starts the SL HARQ RTT timer in the symbol/slot following the end of PSFCH transmission.

23: If the RX UE does not transmit PSFCH for a HARQ enabled transmission (e.g. due to UL/SL prioritization) the RX UE still starts the HARQ RTT timer in the symbol/slot following the end of PSFCH resource.

Although this email discussion scope aims at the DRX timer length discussion, rapporteur understands that this is also coupled with the granularity of timing to start these two timers, and the reason is that we usually align the unit of start time and timer length and it would be strange that we agree e.g. *drx-HARQ-RTT-Timer* start in slot level but the timer length is defined as symbol level.

Therefore, we would have a discussion of the timer length as well as the start of this two timers.

*Note: The question in this section is just about symbol or slot level for the timer length and start time, whether it should be physical/logical symbol/slot is discussed in next section.*

**Q2.1-1b: For *sl-drx-HARQ-RTT-Timer*, which do you think should be the unit for the timer length?**

Option-1: In number of symbols where the transport block was received

Option-2: In number of slots where the transport block was received

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| Company | Option | Comments |
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**Q2.1-1c: Based on answer to Q2.1-1b, do you think the start of *sl-drx-HARQ-RTT-Timer* should be at a symbol level or a slot level?**

Option-1: Start in symbol level

Option-2: Start in slot level

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**Q2.1-1d: For *sl-drx-RetransmissionTimer*, which do you think should be the unit for the timer length?**

Option-1: In number of symbols where the transport block was received

Option-2: In number of slots where the transport block was received

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**Q2.1-1e: Based on answer to Q2.1-1d, do you think the start of *sl-drx-RetransmissionTimer* should be at a symbol level or a slot level?**

Option-1: Start in symbol level

Option-2: Start in slot level

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### Physical or logical slot to calculate SL DRX timer length

During the first two meetings of the WI, whether we should consider the logical slots in resource pool when designing SL-DRX has been discussed based on R2-2009210 (InterDigital) (Proposal 3)[2] and it was agreed that the timer based solution is adopted for unicast. The same story happens for groupcast/broadcast. Rapporteur understands this already implies that we should use physical symbol/slot as the unit for SL-DRX related timers.

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| **RAN2 #112e agreements**  6: As baseline, for Sidelink DRX for SL unicast, it is proposed to inherit and use timers similar to what are used in Uu DRX. FFS for SL broadcast/groupcast. FFS on detailed timers.  **RAN2 #113e agreements**  Agreements on SL DRX on groupcast/broadcast  1: Timer-based SL DRX is also applied to SL groupcast/broadcast. |

There are also some contributions which touched this topic, such as:

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| Tdoc Number | Company | Proposal |
| R2-2107190 | OPPO | …since the TX-pool and RX-pool may be different for TX-UE and RX-UE, it is hard to define DRX configuration based on the resource type-1/2/3 above which is per-pool resources…  **Proposal 20** For SL DRX, UE bases on all time resources to calculate the length of DRX cycle, offset and timers. |
| R2-2107242 | LG Electronics Inc. | …In SL DRX operation, alignment between SL DRX timer and Uu DRX timer is supported. Since the Uu DRX timer is calculated in the unit of physical slot, if the SL DRX timer is calculated as the logical slot, it may be difficult to align the Uu DRX timer and the SL DRX timer…  **Proposal 1.** The SL DRX timer should be calculated in the unit of physical slot like Uu DRX. |
| R2-2105352 | vivo | …In SL, resource pools are usually not consecutive. Some companies proposed that only subframes/slots within the configured resource pools will be calculated into SL DRX timers and total valid subframes/slots of DRX timers kept constant, i.e. non-consecutive SL DRX timers counting. But we think these non-consecutive calculations for SL DRX timers will increase big complexity for both TX UE and RX UE without obvious benefits…  **Proposal 7** RAN2 to confirm that SL DRX timers counting are consecutive and only consider the valid subframes/slots within the configured resource pools. |

All the contributions listed suggest to use physical slots/ consecutive slots to define the SL-DRX timer length. Therefore, it should be checked with companies whether physical or logical slot should be used for SL-DRX timers.

For timers discussed in 2.1.1.1, rapporteur understands that if one timer value in millisecond, it already implies that physical time (instead of sidelink logical slots) is used to define the timer. But anyway this question is applied to all timers discussed in 2.1.1.1 and 2.1.1.2. If one thinks some of the timers should be in the unit of physical slot and some others are based on logical slot, it could be clearly expressed in the comments.

**Q2.1-2a: Do you think the SL DRX timers should be calculated in the unit of physical slot or logical slot?**

Option-1: Physical slot

Option-2: Logical slot

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## How to calculate SL DRX start time

### SFN or DFN to calculate SL DRX timer length

In legacy Uu DRX operation, SFN of the cell would be used to determine when to start *drx-onDurationTimer*, as follows[1]:

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| **TS 38.321**  5.7 Discontinuous Reception (DRX)  <omitted…>  1> if the Short DRX cycle is used for a DRX group, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*):  2> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.  1> if the Long DRX cycle is used for a DRX group, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*:  2> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3:  3> if DCP indication associated with the current DRX cycle received from lower layer indicated to start *drx-onDurationTimer*, as specified in TS 38.213 [6]; or  3> if all DCP occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last DCP occasion, or during a measurement gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4); or  3> if *ps-Wakeup* is configured with value *true* and DCP indication associated with the current DRX cycle has not been received from lower layers:  4> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe.  2> else:  3> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe.  NOTE 2: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration. |

However, in sidelink operation, the sidelink transmissions are organized in frames identified by DFN (Direct Frame number). For UEs in network coverage, the DFN can be equal to SFN, and when the UE selects GNSS as the synchronization reference source, we also have a formula with the parameter *sl-OffsetDFN* to derive the DFN as defined in section 5.8.12 in TS 38.331.

Several companies suggested to calculate SL-DRX duration based on DFN, as discussed in the following contributions:

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| Tdoc Number | Company | Proposal |
| R2-2107355 | Spreadtrum Communications | Proposal 1: The start of the DRX cycle is determiend according to the fomula: [(DFN × 10) + subframe number] modulo (sl-drx-Cycle) = sl-drx-StartOffset. |
| R2-2108223 | vivo, Xiaomi, ZTE corporation | Proposal 1: In sidelink operation, DFN is used to calculate the DRX duration instead of SFN, for both IC and OOC UEs.  Proposal 2: For SL unicast/groupcast/broadcast, the TX UE and RX UE use its own DFN to calculate the DRX duration respectively. |

Rapporteur understands that it is straightforward to apply DFN to calculate the SL-DRX duration for OOC UEs, and for IC case, we can also use DFN because DFN is for sidelink communication and anyway the value of DFN is equal to SFN when UE is synchronized to gNB. Otherwise, two formulas may be needed for IC case and OOC case while the parameters within are literally the same. Therefore, it can be confirmed by companies that whether SFN/DFN is used to determine when to start *sl-drx-onDurationTimer*.

**Q2.2-1a: Do you think SFN should be replaced by DFN in the formula to calculate the SL-DRX duration? (i.e. to determine when to start on-duration timer)**

Option-1: Yes, for all cases no matter what the synchronization reference source is actually used.

Option-2: Yes, only for the case when the synchronization reference source used is not gNB (i.e. SFN would be used instead when synchronized to gNB)

Option-3: To be added

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Then it can be further confirmed whether the similar formula to Uu DRX should be reused in sidelink DRX or not, when SFN/DFN is used to calculate the SL-DRX duration.

**Q2.2-1b: No matter option-1 or option-2 is selected in Q2.2-1a, what is the formula to calculate the SL-DRX duration when DFN is used?**

*Note: how to get the value of sl-drx-StartOffset for different cast types is discussed in 2.2.2 and 2.2.3*

Option-1: Similar to the Uu DRX, i.e. [(DFN × 10) + subframe number] modulo (sl-drx-Cycle) = sl-drx-StartOffset

Option-2: to be added

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**Q2.2-1c: If option-2 is selected in Q2.2-1a, what is the formula to calculate the SL-DRX duration when SFN is used?**

*Note: how to get the value of sl-drx-StartOffset for different cast types is discussed in 2.2.2 and 2.2.3*

Option-1: Same to the Uu DRX, i.e. [(SFN × 10) + subframe number] modulo (sl-drx-Cycle) = sl-drx-StartOffset

Option-2: to be added

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| Company | Option | Comments |
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Another issue which should be pointed out is that while both TX and RX UE would maintain DRX timers, each UE derives DFN(or SFN when IC) from its own synchronization reference source, so the case of DFN(or SFN when IC) mismatch between the Tx and the Rx UE due to different synchronization reference source should also be considered. E.g., TX UE and RX UE are synchronized to cells with different SFN, or TX UE and RX UE are synchronized to a cell and GNSS respectively, which may not be synchronized to each other. This issue is also discussed in above two contributions:

* In R2-2107355, it is suggested not to consider synchronization issue in determination of the DFN used for SL DRX. The synchronization of multiple synchronization sources should be left to regional or global regulation institution or policy maker;
* In R2-2108223, it is suggested the TX UE and RX UE use its own DFN to calculate the DRX duration respectively, and as long as TX UE and RX UE have same TX-sync (or the Sync difference is within CP), there would be no problem, and for different sync resource case, the TX UE and RX UE may fail to communicate with each other, similar to R16.
  + *RAN2 #113bis-e meeting chairman notes: RAN2 understands in Rel-16, there may be some cases where R16 NR-V2X UEs having different Tx-Sync may fail to communicate with each other for both FB enabled and disabled cases. There will be no specification impacts in this release.*

For the different TX-sync case, rapporteur understands that if companies would like to solve the issue, there can be possible solutions e.g. a single DFN/SFN is used for both TX and RX UE to calculated DRX duration. However, it should first be confirmed by companies that whether different TX-sync case is needed to be considered in this release.

**Q2.2-2a: Do you agree the case may happen that TX UE and RX UE can derive different Frame number (SFN/DFN) when calculating SL-DRX start time, if TX UE and RX UE have different synchronization reference source?**

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**Q2.2-2b: Do you think solutions are needed for the case mentioned in Q2.2-2a?**

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**Q2.2-2c: If the answer for Q2.2-2b is yes, what is your proposed solution?**

Solution-1: A single DFN/SFN is used for both TX and RX UE to calculated DRX duration.

Solution-2: to be added

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| Company | Solution | Comments |
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### Offset for unicast

Another two factors to determine the start of on-duration timer is the *sl-drx-StartOffset* and *sl-drx-SlotOffset*.

**For unicast,** the TX-centric manner has been agreed for the TX UE to configure DRX configuration for RX UE. And we agreed in RAN2 #113bis-e that *sl-drx-StartOffset* and *sl-drx-SlotOffset* are just part of the SL DRX configuration for all cast types.

Therefore, rapporteur understands that *sl-drx-StartOffset* and *sl-drx-SlotOffset* can be part of the DRX configuration which can be left to TX UE/ TX UE’s gNB implementation. It can be confirmed by the companies:

**Q2.2-3a: For unicast, for CONNECTED TX UE, do you agree that *sl-drx-StartOffset* and *sl-drx-SlotOffset* are part of DRX configuration and are configured to RX UE by TX UE based on gNB configuration?**

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For IDLE/INACTIVE/OOC TX UE, in RAN2 #115e meeting, we agreed that

* *TX UE derives the value of the inactivity timer based on its implementation.*

We can check with companies that whether the same principle can be applied to the configuration of *sl-drx-StartOffset* and *sl-drx-SlotOffset*.

**Q2.2-3b: For unicast, for** **IDLE/INACTIVE/OOC TX UE, do you agree that *sl-drx-StartOffset* and *sl-drx-SlotOffset* are part of DRX configuration and are configured to RX UE by TX UE implementation?**

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### Offset for Groucast and Broadcast

**For groupcast and broadcast,** it was agreed in RAN2 #114e that

5a: For GC/BC, RAN2 understands that sl-drx-startoffset does not take QoS requirement into consideration.

5b: For GC/BC, For GC/BC, sl-drx-startoffset is set based on DST L2 ID.

In RAN2 #115-e meeting there are some contributions to discuss the equation, e.g.

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| Tdoc Number | Company | Proposal |
| R2-2107155 | Huawei | Proposal 4: the sl-drx-startoffset can be determined with the following equation:  n=DST L2 ID MODE N  , where N is the total number of sl-drx-startoffset values, and n is an index in the N sl-drx-startoffset values. |
| R2-2107190 | OPPO | In order for load balancing, one can simply use a formula to distribute the load of each L2 ID in time domain evenly, similar to what was designed for PO calculation, e.g.,  *Offset = L2-destination-address* ***MOD*** *Number-slots-in-a-DRX-cycle* |
| R2-2107242 | LG Electronics Inc | Proposal 3. SL DRX cycle offset can be randomized based on the following equation.  *sl-drx-startOffset* = L ∙ {S modulo floor (N / L)}  S: Service type (i.e., L2 Destination ID)  L: Interval between SL DRX cycles applied to different service types (i.e., different L2 Destination ID)  N: Length of SL DRX cycle |
| R2-2108822 | MediaTek Inc. | Proposal 3: For GC/BC, RAN2 specify the equation to derive sl-drx-startoffset using L2 DST SID and the SL DRX cycle derived from QoS profile(s) mapped to the L2 DST ID. |
| R2-2108224 | vivo | Proposal 14: For GC/BC, SL DRX offset is set based on DST L2 ID in a derivation way, i.e., DST L2 ID applied as an input to some equation in the determination of SL DRX offset. FFS on the details of the equation. |

Among all the contributions which has been reviewed yet, all of them proposes an equation to take DST L2 ID as input to derive the sl-drx-startoffset, instead of other forms of configuration, e.g.

* Based on a mapping table between destination L2 ID(s) and sl-drx-startoffset value(s) (R2-2107155)
* Explicit mapping configuration, e.g. SL DRX start offset is configured per DST L2 ID (R2-2108224)

Therefore, it can first be asked to companies that how to consider DST L2 ID when setting *sl-drx-startoffset*.

**Q2.2-4a: For groucast and broadcast, how to consider DST L2 ID when setting *sl-drx-startoffset*?**

Option-1: Based on an equation

Option-2: Based on explicit mapping configuration

Option-3: to be added

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As for the concrete equation, it seems that the majority would consider a modulo calculation to be the function of the equation but with different input parameters. Based on the proposed equations so far, rapporteur would like to simply check with companies’ views that whether one of the proposed equation can be agreed.

**Q2.2-4b: If option-1 is selected in Q2.2-4a, which should be the equation used to determine the *sl-drx-startoffset*?**

Option-1:

* n=DST L2 ID ***MOD*** N, where N is the total number of sl-drx-startoffset values, and n is an index in the N *sl-drx-startoffset* values.

Option-2:

* *sl-drx-startoffset = L2-destination-address* ***MOD*** *Number-slots-in-a-DRX-cycle*

Option-3:

* s*l-drx-startOffset* = L {S modulo floor (N / L)}
* S: Service type (i.e., L2 Destination ID)
* L: Interval between SL DRX cycles applied to different service types (i.e., different L2 Destination ID)
* N: Length of SL DRX cycle

Option-4: to be added

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For *sl-drx-SlotOffset*, it is also related to the start time of the SL DRX, but there is no agreement to set this parameter based on DST L2 ID. But rapporteur do see contributions to propose to set this parameter based on DST L2 ID as well. e.g.

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| Tdoc Number | Company | Proposal |
| R2-2107433 | ZTE | Proposal 11 drx-SlotOffset is suggested to be set based on DST L2 ID for SL groupcast/broadcast. |

In rapporteur’s understanding the distributed DRX for GC/BC based on *sl-drx-StartOffset* which is the granularity of subframe level may already be enough, and the *sl-drx-SlotOffset* can be explicitly configured e.g. per QoS profile, just like other parameters. To make a progress, rapporteur would like to quickly check whether sl-drx-SlotOffset should also be based on DST L2 ID.

**Q2.2-4c: For groucast and broadcast, do you agree *sl-drx-SlotOffset* is also set based on DST L2 ID (i.e., similar to *sl-drx-StartOffset*)?**

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# Conclusion

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