3GPP TSG-RAN WG2 Meeting #113-bis-e R2-210xxxx

Electronic Meeting, April 12 – 20, 2021

Agenda: 8.15.2

Source: InterDigital

Title: Summary of [POST113-e][703][V2X/SL] Details of Timer (InterDigital)

Document for: Discussion, Decision

# 1 Introduction

The following email discussion was triggered at RAN2#113[1]:

* [POST113-e][703][V2X/SL] Details of timers (InterDigital)

**Scope:** Discuss details of how to maintain the agreed timers (including exact definition of timers, how to set the timers, when to start/restart/stop the timers, additional consideration due to SL characteristics, considerations of both RX UE and its peer TX UE sides) and FFS parts related to timer operations.

**Intended outcome:** Discussion summary

**Deadline:** Long email discussion

The summary of this email discussion is presented in this document.

# 2 Details of Timers

## 2.1 Parameters Defining the DRX Cycle

In Uu, a number of DRX parameters are used to define the DRX cycle length and starting offset. These are:

- *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*;

- *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX cycle starts;

- *drx-ShortCycle* (optional): the Short DRX cycle;

- *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle;

In addition, the on-duration timer is used to define the minimum guaranteed on period at the UE for each DRX cycle:

* *drx-onDurationTimer*: the duration at the beginning of a DRX cycle;

For SL, it was agreed at RAN2#113[1] to re-use the timer-based approach of Uu to define SL DRX for all cast types. In addition, it was agreed to not support the short DRX cycle for SL. Based on these agreements, similar parameters to the Uu parameters (without considering the short DRX cycle) can be used to define the DRX cycle and the minimum on duration. These parameters can be configured for all cast types.

**Q1) Do you agree to support the following parameters as part of the SL DRX configuration: sl-drx-StartOffset, sl-drx-Cycle, sl-drx-onDurationTimer, and sl-drx-SlotOffset for all casts type?**

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| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | These timers are essential to support DRX functionality. |
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### 2.1.1 RX UE Handling

Assuming the use of similar timers for SL as in Uu in the above question, the behaviour of the RX UE with respect to these timers on SL should likely be similar to that of Uu.

**Q2) Do you agree with similar UE behaviour regarding SL DRX at the RX UE with respect to the timers in Q1 as that of Uu, namely:**

* **The RX UE determines the subframe associated with the start of the DRX cycle using the configured sl-drx-Cycle, sl-drx-StartOffset**
* **The RX UE starts the sl-drx-onDurationTimer after sl-drx-slotOffset from the beginning of the subframe**
* **The RX UE’s active time includes the time in which sl-drx-on-DurationTimer is running**

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| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | Uu behavior should be baseline. |
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### 2.1.2 TX UE Handling

In order to synchronize transmission at the TX UE with the active periods of the RX UE, it would seem natural that the TX UE maintains similar timers defining the SL DRX cycle as the RX UE does.

**Q3) Do you agree that the TX UE also maintains the sl-drxCycle, sl-drx-StartOffset, and sl-drx-onDurationTimer, and considers the RX UE(s) to be active at least during the time in which the sl-drx-onDurationTimer is running?**

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| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | TX UE should be aware of the active time of RX UE to perform appropriate resource selection and logical channel multiplexing.  TX UE should not select logical channels to the inactive Rx UEs. |
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## 2.2 SL Inactivity Timer for Unicast

### 2.2.1 RX UE Handling

In RAN2#113 [1], inactivity timer was agreed for at least sidelink unicast. However, the details of the inactivity timer for sidelink unicast require further discussion.

In Uu, the inactivity timer is used to extend the active time (beyond the on duration) when the UE continues to receive active scheduling by the network. The UE is configured with an inactivity timer per DRX group (if the secondary DRX group is configured). The active time for the serving cells in a DRX group includes the time while at least the drx-InactivityTimer configured for the DRX group is running.

For unicast sidelink, an RX UE can receive from different unicast links or pair of source/destination L2 IDs, which can each be considered as different transmission sources. Based on agreements in RAN2#113 [1], each pair of source/destination L2 IDs can be associated with a different DRX configuration, which may include the value of the inactivity timer itself. There are therefore at least two different options for how the RX UE maintains the inactivity timer:

Option 1: Separate inactivity timers started/maintained for each pair of source/destination L2 IDs

* The UE maintains a separate inactivity timer for each pair of source/destination L2 ID
* The UE starts/restarts the inactivity timer for that pair of source/destination L2 ID when the UE receives a transmission associated with that specific source/destination L2 ID.

Option 2: Single inactivity timer for all pair of source/destination L2 IDs

* The UE maintains a single inactivity timer regardless of the number of unicast links (pair of source/destination L2 IDs)
* The UE starts/restarts the inactivity timer when the UE receives a transmission associated with any unicast link (pair of source/destination L2 ID).
* The timer could be started with different values depending on the received transmission

In option 1, the UE maintains multiple inactivity timers and so the UE’s active time would include the time in which any of the inactivity timers at the UE is running. In option 2, there is only a single inactivity timer at the UE, however, the UE may need to set the value of that inactivity timer differently depending which source/destination L2 ID the data is associated to.

**Q4) For unicast, which option do you prefer for maintenance of the SL inactivity timer:**

1. **Option 1: RX UE maintains a separate SL inactivity timer for each pair of src/dest L2 ID**
2. **Option 2: RX UE maintains a single SL inactivity timer for all pairs of src/dest L2 ID, but the value of the timer can be set to different values**
3. **Other**

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| Company | Response | Comments |
| OPPO | Option 1 | * It was agreed in RAN2 #113 that “SL DRX configuration can be configured per a pair of source/destination“, which means the value of inactivity timer for each link is different. For Tx-UE: The different inactivity timers are not only maintained by the Rx UE for reception, but also maintained by each Tx UE to determine the time for transmission. For Tx-UE, it can only be maintained in a per-link manner, i.e., option-2 cannot be applied anyway for Tx-UE； * For Rx-UE: for option-2, not sure if „The timer could be started with different values depending on the received transmission“ is valid, e.g., if the inactivity timer is started at t1, with length of T1, even though it receives a new grant at t2 which assocates with a length of T2, it does not have to restart as long as t1+T1 > t2+T2.. So option-2 is just a way to mimic option-1, but would lead to unnecessary complexity for spec design.. |
| Xiaomi | Optin 2 | The rantionle of DRX per group in Uu is that Pcell and Scell operates on different frequency and there is two MAC entities correspondingly, which results in UE monitoring on different frequencies. But on sidelink, only one sidelink BWP and only one MAC entity is supported in NR. There is no difference on UE monitoring triggered by which pair of src/dest L2 ID. We see unnecessary complexity in maintaining seperate inactivity timers, considering the number of src/dest pare could be large.  How to maintain single inactivity timer upon MAC PDU reception could be further discussed. |
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In Uu, the network configures the SL inactivity timer. Such configuration may take into account the expected DL traffic pattern associated with the QoS flows established at the UE, as well as the scheduling latency at the network. In SL DRX, unlike Uu DRX, the network may be unaware of the active QoS flows between two sidelink UEs (specifically for the IDLE/INACTIVE or OOC cases). However, the traffic pattern and consequently the inactivity timer, may still depend on the associated SL QoS flows at the TX UE.

**Q5) Do you agree that the value of the SL inactivity timer should have some relation to the QoS of the transmissions associated with pair of src/dest L2 IDs?**

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| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | N | we do not forsee the need of spec impact due to this, i.e., it is up to network / UE implementation to reflect the „relation“. |
| Xiaomi | Y | QoS should be considered when the value of inactivity timer is decided. But this could be done by NW or UE implementation without spec impact. |
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If such an association is assumed, there can be at least two ways to ensure the inactivity timer takes such association into account.

One way would be for a single value of the inactivity timer to be determined for a pair of source/destination L2 ID. This value could be determined based on the active or expected QoS flows established between the TX and RX UE, or on the established SLRBs. This may require that the value of the inactivity timer for the pair of source/destination L2 IDs be changed each time the established flows or bearers are changed. Another way would be for the RX UE to determine the inactivity timer value to be applied based on the QoS of the transmission that started the timer.

**Q6) Does the UE set the SL inactivity timer to:**

1. **a value configured for the pair of source/destination ID**
2. **a value configured for the QoS (e.g. priority) of the transmission that started the timer**
3. **Others**

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| Company | Response | Comments |
| OPPO | A (if the question is not restricted to **Rx** UE set..) | Similar to Uu, a single inactivity timer is sufficient even though there might be multiple QoS flows running. |
| Xiaomi | A | The SL inactivity timer is configured per pair of src/dest ID, which considers overall QoS between source and destination. In Uu, only one inacivity timer is supported even if there are traffic with different QoS for one UE. Furthermore, QoS information is not available in MAC. The LCH priority is not directly related to interval between next data arrival, which is not suitable to decide SL inactivity timer. |
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In Uu, the UE starts or restarts the drx-InactivityTimer for a DRX group if the PDCCH indicates a new transmission on a serving cell in this DRX group. In other words, the inactivity timer is associated with new transmissions from the perspective of the UE, whereas retransmissions are handled using the retransmission timer for each HARQ process. Since both transmissions are retransmissions are possible for sidelink, it would be straightforward to model the inactivity timer in a similar way for sidelink and start the inactivity timer only for new transmissions of a TB from the RX UE perspective.

**Q7) Should the RX UE (re)start the SL inactivity timer upon reception of a new SL data transmission from the RX UE perspective (similar to Uu)?**

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| Company | Response  (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | Uu behavior should be baseline. |
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One potential difference with sidelink is that while the HARQ information (e.g. process ID, NDI, etc.) is in the SCI, the L2 ID is contained in the MAC header and requires successful decoding of the TB. If the decision of whether to start and run the inactivity timer is based only on the L1 ID, a UE may start an inactivity timer for transmissions which are associated with a matching L1 ID but non-matching L2 ID. Furthermore, sidelink transmissions may not always contain data transmissions. Specifically, a MAC PDU can contain a SL CSI report MAC CE only, and whether starting/running the inactivity timer at the reception of a SL CSI MAC CE is beneficial needs to be considered. Considering information in the MAC header/MAC PDU would therefore result in a more efficient use of the inactivity timer.

**Q8) What information should the UE consider when handling the SL inactivity timer?**

1. **Information in the SCI only**
2. **Information in both SCI and MAC header**

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| Company | Response | Comments |
| OPPO | B | We share the same view with the rapporteur that if we adopt option A the UE may start inactivity timer unnecessarily, i.e., lead to power waste.  As for option B, before starting inactivity timer, there is a latency due to data channel decoding, i.e., HARQ retransmission and PSSCH decoding plus MAC subheader reading, which brings a further issue, i.e., how to ensure the inactivity timer alignment between Tx and Rx UE discussed considering this HARQ and decoding latency. This issue should also be discussed if going towards option-B. |
| Xiaomi | B | Option A would result in false alarm. |
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In Uu, the drx-InactivityTimer is started in the first symbol after the end of the PDCCH reception. If only information in the SCI is considered when handling the inactivity timer, a similar approach to Uu may be used for sidelink, and the inactivity timer may be started in the first slot after the end of the SCI reception. If information in the MAC header is considered for inactivity timer handling, the UE may either start the inactivity timer immediately following reception of SCI, and stop it later, or the UE could instead start the inactivity timer in the first slot after the MAC PDU is decoded, or at some pre-defined slot following SCI reception. Finally, as discussed in section 2.2.2 (Q11), half-duplex, for example, may motivate the use of starting the inactivity timer based on HARQ feedback in some cases.

**Q9) When should the RX UE (re)start the SL inactivity timer?**

1. **In the first slot after the end of SCI reception**
2. **In the first slot after MAC PDU header is decoded**
3. **A configured or pre-defined number of slots after the end of SCI reception**
4. **Following transmission of PSFCH (if the transmission is HARQ enabled)**
5. **Others?**

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| Company | Response | Comments |
| OPPO | A), D) and E) for different cases | Option A) if “ Information in the SCI only“ is concluded for Q8.  For the case that “ Information in both SCI and MAC header“ is used, as our comments above, both Tx-UE and Rx-UE have to take into account of additional latency due to HARQ retransmission and PSSCH decoding, therefore:   * Option D) if HARQ **enabled**. * For HARQ **disabled** case, even though the time for PSSCH decoding plus MAC subheader reading can be bounded by UE processing capability, the time for HARQ retransmission is environment-dependent, and thus cannot be pre-judged. So either we leave this to UE implementation, or to prevent inactivity timer (re)start for FB disabled case => either 1) up to UE implementation when to (re)start inactivity timer, or 2) not (re)start inactivity timer at all. |
| Xiaomi | A | We prefer a common solution to all scenarioes. Option D is not preferred, since only HARQ enable is supported. Option B may result in miscynchronization between TX and RX UE, since the MAC PDU header decoding time is unknown to TX UE. Option C creats gap between SCI reception and SL inactivity timer running, which may result in data loss during gap. |
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### 2.2.2 TX UE Handling

Similar to the onDurationTimer, the TX UE should have a means to know when the RX UE is active as a result of the inactivity timer running at the RX UE. One straightforward way is for the TX UE to maintain a similar inactivity timer associated with that RX UE and ensure that transmissions are performed by the TX UE when the RX UE is active.

**Q10) For unicast, do you agree that the TX UE maintains is own timer associated with the RX UE to be able to determine the active time of that RX UE?**

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| Company | Response  (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | Same as Q3. |
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The TX UE may start the inactivity timer associated to an RX UE upon a new transmission to that RX UE (or at some time after such new transmission). This would align the inactivity timers at the TX and RX UE. One problem is that the RX UE may miss the new transmission from the TX UE for various reasons:

* SCI misdetection
* PSSCH decoding error
* Half-duplex
* Etc.

As a result, the TX UE may (re)start its inactivity timer (with respect to the RX UE) while the RX UE has not (re)started the inactivity timer. This may result in the RX UE not receiving subsequent transmissions of new data sent by the TX UE. RAN2 should discuss whether this issue needs to be handled, and if so, how to handle it. One straightforward way to avoid unsynchronized timers is to rely on HARQ feedback from the RX UE. This can be used for transmissions with HARQ feedback enabled. For transmissions where we cannot rely on HARQ feedback, the TX UE can tailor its transmissions in order to increase the likelihood that the inactivity timer is started at the RX UE. For example, the TX UE may perform multiple retransmissions to avoid that half-duplex plays a role in whether the RX UE restarts the inactivity timer.

**Q11) Which option(s) should RAN2 discuss to reduce the likelihood of having unsynchronized inactivity timers at the TX and RX UEs:**

1. **Use of HARQ feedback**
2. **Rely on retransmissions**
3. **Others**

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| Company | Response | Comments |
| OPPO | A), C) if Q8 is concluded as option-B, otherwise NONE | We assume alignment is needed in Q11 and Q8/9, i.e., if Q8 is concluded to option-B   * A) for HARQ **enabled** case * Either 1) up to UE implementation to (re)start inactivity timer or 2) not (re)start inactivity timer at all for HARQ **disabled** case.   Otherwise, if Q8 is concluded as option-A   * We can rely on TX-UE implementation to solve the DRX un-sync issue, i.e., no spec impact |
| Xiaomi | A, B, C | Option A and B can help reduce the likelihood of unsynchronization. But there is limitation for both options. Option A only works in HARQ enable transmission. Option B could not resolve the problem due to half-duplex. If RX UE performs Uu UL or sidelink transmission in the active time, sidelink retransmission can not be received. In this case, RX UE should extend the active time to provide further reception opportunity. |
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The starting time of the inactivity timer at the TX UE can depend on whether/which option is chosen to avoid the issue of unsynchronized timers. If multiple options are supported, then the TX UE may start its inactivity timer at different times depending on which option is used at a given time.

**Q12) Given the option(s) preferred in Q11, which of the following should be considered as valid time(s) in where the SL inactivity timer at the TX UE (with respect to a specific RX UE) is (re)started?**

1. **At the slot following an SCI (re)transmission to the RX UE**
2. **A (pre)configured/pre-defined number of slots following a (re)transmission to the RX UE**
3. **Following reception of HARQ feedback on PSFCH (e.g. ACK or NACK) for a (re)transmission**
4. **Others**

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| Company | Response | Comments |
| OPPO | A), D) and E) for different cases | Please refer to the comments for Q9. |
| Xiaomi | A | Same as Q9 |
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## 2.3 Inactivity Timer for Groupcast/Broadcast

The need for inactivity timer for groupcast was discussed in RAN2#113[1] and was left FFS. On the one hand, some companies argued that it should be supported because it allows the transmission opportunities associated with groupcast to be extended beyond the guaranteed-on period (defined by the on duration timer). On the other hand, some companies argued that it should not be supported for groupcast because of the inherently unstable topology of groupcast.

One potential issue with groupcast is how to ensure all RX UE’s have started their inactivity timers. This is similar to the problem of unsynchronized inactivity timers for the unicast case. Specifically, the TX UE may start its inactivity timer and perform further transmissions outside the on duration, but one or more of the RX UEs may not have started their inactivity timer(s). These UEs may miss all subsequent transmissions which occur (until the next on duration) while the TX UE continues to perform transmissions. As in the case of unicast, some possible solutions (e.g. use of HARQ feedback, or adaptation of the transmissions at the TX UE) can be used to solve the problem for the groupcast case.

Another issue is that a UE in a group may join the group (or be able to receive the groupcast transmissions) at a time when the on duration timer is not running but one or more TX UEs are transmitting (due to a running inactivity timer). In this case, these new UEs joining the group may not receive transmissions until the next on duration. If companies feel this is an issue, one way to avoid it is by limiting the usage of the inactivity timer to the case of stable group topology (e.g. group member ID and group size provided by upper layers). Inactivity timer may also be limited to transmissions with some QoS only (e.g. corresponding to best effort or low reliability requirements).

Depending on whether the above issues are considered critical for the functioning of groupcast RAN2 may consider limiting the applicability of inactivity timer for groupcast, or not using it at all.

**Q13a) For groupcast transmissions, inactivity timer is:**

1. **Always supported**
2. **Supported only for some groupcast transmissions**
3. **Not supported**

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| Company | Response | Comments |
| OPPO | C) | Except for the potential issues listed by rapporteur, even for the stable group topology and HARQ enabled case, even though the ACK-NACK feedback provides a tool for Tx-UE to be aware of the connection to all RX-UEs, e.g., by receiving A-N feedback from ALL Rx-UE, Tx-UE can be confident on the reachability and thus to start the inactivity timer, but since there is no tool for one RX-UE to know the status of other RX-UEs, one RX-UE A may start inactivity timer even if there are another RX-UE B does not receive the SCI and thus neither the RX-UE B nor the TX-UE start the inactivity timer, and thus lead to power waste of RX-UE A -it is still infeasible to apply inactivity timer for group-cast. |
| Xiaomi | B | We see benefit to support inactivity timer in certain case, i.e. the group member/topology is stable/fixed. This timer could be optional configured. The granularity should be per group, i.e. destinatio id. |
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**Q13b) If the answer to the previous question is B), under which scenarios should groupcast transmissions support inactivity timer:**

1. **Supported for specific groupcast HARQ-enabled transmissions**
2. **Supported for specific group configuration from upper layers (e.g. presence of group size/member ID)**
3. **Supported for certain types of transmissions (e.g. certain QoS/priority)**
4. **Others**

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| Company | Response | Comments |
| Xiaomi | D | As replied to last question, the inactivity timer should be supported in the granularity of group, which has stable/fixed group member/topology. If the group member/topology is dynamically changing, there is a risk of data loss for new members. |
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A similar question can be asked for broadcast. Although in the case of broadcast, the specific conditions (if any) where we may/may not want to support inactivity timer may be limited since neither HARQ feedback, nor group information is available from upper layers.

**Q14) For broadcast transmissions, inactivity timer is:**

1. **Always supported**
2. **Supported for certain conditions (please specify)**
3. **Not supported**

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| Company | Response | Comments |
| OPPO | C | Without HARQ feedback, there is no tools for TX-UE to detect reachabity at all. |
| Xiaomi | C | It’s impossible for TX UE and all RX UEs to maintain synchronized inactivity timer in broadcast. |
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### 2.3.1 RX UE Handling

Similar to the case of unicast, the RX UE may maintain one or multiple inactivity timers associated with groupcast and/or broadcast. If a single inactivity timer is maintained, and we support inactivity timer for both groupcast and broadcast, then each cast may also possibly be associated with its own inactivity timer. If multiple inactivity timers are maintained, then the RX UE may maintain one for each L2 destination ID, or QoS. Alternatively, multiple inactivity timers can be maintained within a groupcast/broadcast transmission, where each inactivity timer is associated to a specific TX UE. In this case, the inactivity timer is maintained per pair of source/destination L2 ID (as in the case of unicast).

**Q15) For groupcast/broadcast, if SL inactivity timer is supported, which of the following is assumed for the RX UE:**

1. **Single inactivity timer for groupcast/broadcast**
2. **Separate inactivity timer for groupcast vs broadcast**
3. **Separate inactivity timer for each L2 destination ID associated with groupcast/broadcast**
4. **Separate inactivity timer for each QoS associated with groupcast/broadcast**
5. **Separate inactivity timer for each pair of source/destination L2 ID**
6. **Other**

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| Company | Response | Comments |
| OPPO | NONE | As reply to Q13a/14, we don’t support inactivity timer for SL groupcast and broadcast. |
| Xiaomi | A | Same as Q4 |
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Depending on the answer to question Q4 and Q15, the UE may start/maintain multiple inactivity timers for unicast/groupcast/broadcast. Since active time is defined as the time in which the UE monitors SCI1 and SCI2, it would seem that the UE should be active whenever any of its maintained inactivity timers are running.

**Q16) Assuming the RX UE maintains multiple SL inactivity timers for unicast/groupcast/broadcast do you agree that the RX UE should be active whenever any of its SL inactivity timers are running?**

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| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
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### 2.3.2 TX UE Handling

Similar to the case of unicast, if inactivity timer is supported for groupcast/broadcast, RAN2 should discuss which time/times are applicable for the TX UE to start/(re)start the inactivity timer. In addition to the options associated to unicast, an additional option specific to groupcast/broadcast is to start the inactivity timer when the TX UE receives a transmission (from another UE) associated with the same L2 destination ID or QoS, and therefore tied to the same inactivity timer. In this case, the TX UE may profit from the transmission performed by another UE which results in starting the inactivity timers associated with the other RX UEs associated with the same L2 destination ID, for example.

**Q17) For groupcast/broadcast transmissions, if inactivity timer is supported, what time(s) should the TX UE (re)start its SL inactivity timer with respect to the RX UE(s)**

1. **At the slot following an SCI (re)transmission by the TX UE**
2. **A (pre)configured/pre-defined number of slots following the SCI for a (re)transmission by the TX UE**
3. **Following reception of HARQ feedback on PSFCH (e.g. ACK or NACK) from one or more RX UE(s)**
4. **Following reception (from another UE) of a new transmission that is associated with that inactivity timer (e.g. L2 destination ID, QoS)**
5. **Others**

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| Company | Response | Comments |
| OPPO | NONE | As reply to Q13a/14, we don’t support inactivity timer for SL groupcast and broadcast. |
| Xiaomi | A | To align with Q9, Tx UE should have the same behavior as RX UE. |
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## 2.4 HARQ RTT and Retransmission Timer for SL DRX

HARQ RTT timer and retransmission timer in Uu DRX are meant to provide the UE with opportunities to perform DRX in between retransmissions of one or more HARQ process. The timers take into account the minimum delay and uncertainty of NW scheduled assignments/grants for retransmissions of that HARQ process. The UE maintains separate HARQ RTT timers and retransmissions timers for each HARQ process. For DL, the UE starts the drx-HARQ-RTT-TimerDL for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback. For UL, the UE starts the drx-HARQ-RTT-TimerUL for the corresponding HARQ process in the first symbol after the end of the first transmission of the corresponding PUSCH. When the timer expires, the UE starts the drx-RetransmissionTimerDL or drx-RetransmissionTimerUL, and actively monitors PDCCH while this timer is running.

In sidelink, an RX UE maintains reception SL HARQ processes associated with transmissions from a TX UE. A SL HARQ RTT and SL retransmission timer can be maintained for a reception SL HARQ process at the RX UE, similar to Uu. These timers, if used/supported, can be maintained on a per reception SL HARQ process basis, as in Uu.

**Q18) Do companies agree that a SL HARQ RTT timer and SL HARQ retransmission timer (if supported) are maintained per SL HARQ process at the RX UE?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | Uu design should be baseline. |
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In Uu DL, the end of the HARQ RTT timer/start of the retransmission timer represents the earliest time in which the NW can schedule the retransmission, and the expiry of the retransmission timer represents the latest time. This accounts for the NW delay associated to scheduling the assignment while ensuring that the UE will be able to receive it (and not be performing DRX). It also provides flexibility to the network for scheduling the retransmission resource.

In SL, the TX UE also exhibits some scheduling delay/flexibility/uncertainty. However, the source of this delay/flexibility/uncertainty can depend on different factors related to SL. Specifically, it would depend if the TX UE uses mode 1 or mode 2. Furthermore, SL SCI can schedule upto 2 retransmission resources. Following a specific (re)transmission by the TX UE, whether the timing of the next retransmission can have some uncertainty will depend on whether retransmission resource is present or not in the SCI for the specific (re)transmission, and whether the TX UE uses mode 1 or mode 2. This is summarized in the table below.

Table – Different Scenarios for timing of the SL Retransmission

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario | Mode1/  Mode2 | Retransmission resource present/not present in SCI | How can SL retransmission be scheduled following the SCI | Source of Uncertainty in the timing of the next retransmission following the SCI |
| A | Mode 1 | Not present | NW may schedule a new SL grant for a retransmission | NW delay in scheduling next retransmission resource for the HARQ process and NW choice of the scheduled location of the SCI |
| B | Mode 1 | Present | TX UE uses retransmission resource in the SCI to send the retransmission | No uncertainty – retransmission expected at the next retransmission resource indicated in SCI |
| C | Mode 2 | Not present | TX UE decides to use a new grant for the retransmission | Time location of the retransmission resource determined by resource selection procedure |
| D | Mode 2 | Present | TX UE triggers resource reselection for the retransmission resource due to UL/SL prioritization, CBR, or pre-emption | Time location of the retransmission resource determined by resource selection procedure |

Specifically, in each scenario, a retransmission by the TX UE can be sent due to the following reasons:

* Scenario A: Following SCI sent by the TX UE indicating no retransmission resources, the network may decide to schedule further retransmission resources for the same PDU (e.g. after reception of SL HARQ feedback from the TX UE on PUCCH).
* Scenario B: If the network schedules both transmission and retransmission resources and these are included by the TX UE in the SCI, the retransmission by the TX UE (if performed) will occur in the time location indicated by the SCI
* Scenario C: A TX UE may send SCI with no retransmission resources, and then send the retransmission in a new grant following the SCI
* Scenario D: A TX UE may send SCI with retransmission resources. It may send the retransmission in the announced retransmission resources, or perform resource (re)selection for the retransmission resource (e.g. due to UL/SL prioritization, congestion control, or pre-emption)

### 2.4.1 SL HARQ RTT

Scenarios A and C (i.e. the SCI does not indicate the next retransmission resource) are very similar to Uu. The RX UE can start a HARQ RTT timer following reception of the (re)transmission (in SCI) and the HARQ retransmission timer can be started upon expiry of the HARQ RTT timer if the decoding failed. The value of the HARQ RTT timer in this case can be explicitly configured.

For the case where the retransmission resource is present in the SCI (scenarios B and D), the HARQ RTT time (i.e. the time when the UE does not expect to be scheduled for the HARQ process) can be calculated, for the most part, from the timing of the retransmission resource in the SCI. One possible exception would be when mode 2 is used but pre-emption occurs. RAN2 should confirm whether it is possible, in this case, that the new selected resource occurs prior to the resource initially indicated in SCI. In this case, the HARQ RTT cannot be derived directly from the timing of the retransmission in the SCI.

**Q19) In which cases can SL HARQ RTT (i.e. the period in which the UE does not expect to be scheduled for retransmission of the same HARQ process) be derived directly from the timing of the retransmission resource in the SCI?**

1. **(Scenario B) Mode 1, Retransmission resource present in the SCI**
2. **(Scenario D) Mode 2, Retransmission resource present in the SCI, pre-emption disabled**
3. **(Scenario D) Mode 2, Retransmission resource present in the SCI, pre-emption enabled**
4. **Others?**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | Fail to understand this question and scenario-B/D cannot justify disabling RTT either | We do not think this question goes into a correct direction, i.e., this question seems to lead to a result that for specific cases, the RTT timer may or may not be used. The result would be that some indication is needed in order for Rx-UE to be aware of the different cases, which unnecessarily leads to complexity, and more importantly, will introduce RAN1 impact, which is of zero-TU for the DRX bullet in this WI..  Furthermore   * For scenario-B (option-A), if the UE experiences a RLF, the resources will be discarded (due to that the SL grant / pool being abandoned), so the re-tx resource may not always valid. * For sceanrio-D (option-B/C), we fail to understand, since rapporteur arleady described that „TX UE triggers resource reselection for the retransmission resource due to UL/SL prioritization, CBR, or pre-emption“, i.e., the re-tx resource will be discarded/reselected due to the reasons above..   So We support RTT timer for all the cases. |
| Xiaomi | A, B |  |
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For the cases identified in Q19, the use of a timer may be unnecessary due to the knowledge of the timing of the retransmission resource. Alternatively, to align behaviour at the UE, a SL HARQ RTT timer can still be used and be set using the timing of the retransmission resource in the SCI.

**Q20) What is the preferred approach to handle SL HARQ RTT in the cases identified in Q19?**

1. **Use/start a HARQ RTT timer with value determined using the timing of the retransmission resource in the SCI**
2. **Do not use/start a HARQ RTT timer**
3. **Other**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | C | As our comments for Q19, we do not think case differentiation is needed, and we believe HARQ RTT timer is needed for all the scenarios. |
| Xiaomi | C | We prefer a common solution to simplify the UE behavior. UE just follow the configuration. If RTT timer is not configured, UE would not start the timer. If it is configured, UE start the timer with configured value. |
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For the other cases (i.e. those not identified in Q19), HARQ RTT timer can be configured explicitly to the UE. However, the value of the HARQ RTT may differ because the uncertainty depends on different factors, as illustrated in table 1. For example, for mode 1, NW delay/scheduling is involved, while in mode 2, the delay/scheduling is fully upto the TX UE.

**Q21) Which of the following factors can be used to determine the value of the SL HARQ RTT timer when it is explicitly configured at the UE?**

1. **Scheduling mode at the TX UE (mode 1 or mode 2)**
2. **HARQ enabled/disable**
3. **Priority/PDB of the transmission**
4. **Availability of PUCCH resources at the RX UE**
5. **Pre-emption at the TX UE is enabled/disabled (mode 2 case)**
6. **Others**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | NONE with comment | As rapporteur said, the uncertainty of RTT timer may depend on the NW delay/scheduling for mode 1 and Tx UE delay/scheduling for mode 2, but the length of RTT timer should be configurable and determined by network or the Tx UE implementation, taking all the related factors into account, so there should be no spec impact due to this. |
| Xiaomi | All | All the factors should be considered by NW in mode 1 or UE in mode 2. But we don’t see spec impact. It should be up to implementation to decide appropriate value. |
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In Uu, the drx-HARQ-RTT-TimerDL is started following transmission of HARQ feedback by the UE. The equivalent behaviour in SL would be to start the timer following transmission of PSFCH by the RX UE. However, this does not cover the cases where PSFCH is not transmitted by the RX UE, either because HARQ feedback is disabled for that transmission, or because the RX UE does not transmit the PSFCH (e.g. due to UL/SL prioritization).

Firstly, It would be best to confirm whether SL HARQ RTT timer and SL HARQ retransmission timer are applied to HARQ disabled transmissions in SL.

**Q22) Should SL HARQ RTT Timer and SL HARQ retransmission timer be supported for HARQ disabled transmissions?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (please explain/motivate your answer) |
| OPPO | See comments | HARQ RTT Timer   * Should be supported at least when PSFCH is configured for the pool and HARQ feedback is enabled, and can be disabled when PSFCH is not configured for the pool * For the case where the pool is configured with PSFCH but HARQ feedback is disabled, due to that the Tx-UE may be in mode-1, and the network may provide SL grant in a conservative way due to network being not aware of HARQ FB enable/disable decision by Tx-UE, i.e., always assuming FB being enabled and the gap between new/re-transmission needs to be secured, further discussion is needed.   Retransmission Timer should be supported for both HARQ enabled and disabled case, since the usage of retransmission does not restricted by FB enabled/disabled case. |
| Xiaomi | Comments | UE would not transmit PSFCH for HARQ disabled transmssion. Therefore, RTT timer and retransmission timer would not be triggered. We don’t need special handling. |
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If SL HARQ RTT timer is supported for transmissions without HARQ feedback, when the RX UE starts the HARQ RTT timer should therefore be discussed, as there is no Uu equivalent for this case.

**Q23) If the answer to Q22 is yes, when should the RX UE start the SL HARQ RTT timer for HARQ disabled transmissions?**

1. **In the symbol immediately following SCI reception/decoding**
2. **A (pre)configured or predefined number of symbols after reception of a SCI**
3. **Other**

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| Company | Response | Comments |
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For transmissions with HARQ feedback, whether to follow a similar definition as Uu, or also to use a new starting point compared to Uu (if we support HARQ RTT for HARQ disabled transmissions) should be discussed.

**Q24) For transmission with HARQ feedback, when should the RX UE start the HARQ RTT timer?**

1. **In the symbol following the end of PSFCH transmission**
2. **In the symbol immediately following SCI reception/decoding**
3. **A (pre)configured or predefined number of symbols after reception of a SCI**
4. **Other**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | A | Align with Uu legacy. |
| Xiaomi | A | Uu design should be baseline. |
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Finally, if the preferred solution for Q24 is aligned with Uu, RAN2 should discuss whether the UE still starts the HARQ RTT timer when it does not transmit PSFCH.

**Q25) If the RX UE does not transmit the PSFCH (e.g. due to UL/SL prioritization) should the UE still start the HARQ RTT timer?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y | Since anyway Tx-UE will monitor the PSFCH before generating re-transmission. |
| Xiaomi | Y | If TX UE doesn’t receive HARQ feedback, it would perform retransmission. Even RX UE decodes MAC PDU successfully, it still need to monitor retransmission and send ACK to avoid TX UE trigger RLF due to reaching max retransmission number. |
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### 2.4.2 SL HARQ Retransmission Timer

In RAN2#103, the need for retransmission timer was left FFS. Referring again to the table 1, scenario B may have no uncertainty in the timing of the retransmission resource. For the other scenarios, it is expected that the retransmission resource may come at any time following the expiry of the HARQ RTT timer, or following an SCI which is not received at the previously announced slot. This seems to lend itself well to the use of a retransmission timer to ensure the UE is monitoring for SCI.

**Q26) Can a retransmission timer be used in cases A, C, and D of Table 1?**

|  |  |  |
| --- | --- | --- |
| Company | Response (Y/N) | Comments (if no, indicate what behaviors at the RX UE is preferred to ensure the RX UE receives the retransmission resource) |
| OPPO | Y | As our comments for Q19, there is always some uncertainty. |
| Xiaomi | Y |  |
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Scenario B may not require the use of a HARQ RTT timer (as pointed out in the previous section). To monitor sidelink for the retransmission, this can be handled by the RX UE in two ways. A UE could not use/start the retransmission timer in this case and rely simply on the indication in the SCI to determine its active time. Specifically, the RX UE’s active time would include the slot(s) associated with the next retransmission resource in the SCI. Alternatively, the UE could start the retransmission timer (e.g. after expiry of the HARQ RTT timer) so that it is running on the slot associated with the retransmission resource indicated in the SCI.

**Q27) How Should monitoring of the planned retransmission resource in scenario B of table 1 be handled by the RX UE in DRX?**

1. **By starting a retransmission timer prior to the planned retransmission resource**
2. **No retransmission timer: UE always monitors SCI at the slot associated with the retransmission resource**
3. **Other**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | NONE | As we have explained in Q19, we do not think this effort to differentiate cases is feasible, so the usage of re-transmission timer should be of no difference compared to other cases. |
| Xiaomi | C | We prefer common solution to simplify UE implementation, i.e. retransmission timer triggered by RTT timer expiry. |
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Scenario D may also not require on the use of a HARQ RTT timer. This would depend on companies’ understanding of the pre-emption case pointed out in Q19. If this is the case, the UE may need to start the retransmission timer to handle TX UE reselection in the case of UL/SL prioritization (for example).

**Q28) Should the RX UE start the SL retransmission timer in scenario D if the expected retransmission SCI is not decoded?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | See comments | Fail to understand the intension of this question, isn’t that so that for case-D, the re-transmission resource may be re-selected due to various reasons as captured by rapporteur (i.e., „TX UE triggers resource reselection for the retransmission resource due to UL/SL prioritization, CBR, or pre-emption“)? |
| Xiaomi | Comments | UE should start retransmission timer. But the timing should be further discussed. We prefer common solution to simplify UE implementation, i.e. retransmission timer triggered by RTT timer expiry. |
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Similar to HARQ RTT timer, retransmission timer value may have dependencies on the scenarios presented in table 1. For instance, the total amount of time the UE should continue to monitor for the retransmission resource could further depend on a number of other factors such as mode 1/2, HARQ enabled/disabled, priority/PDB, the availability of PUCCH resources at the RX UE, whether pre-emption is enabled/disabled at TX UE, etc. Companies are therefore asked which of these factors should be considered when determining the retransmission timer.

**Q29) Which of the following factors can be used to determine the SL retransmission timer?**

1. **Scheduling mode at the TX UE (mode 1 or mode 2)**
2. **Presence of retransmission resource in the SCI**
3. **HARQ enabled/disable**
4. **Priority/PDB of the transmission**
5. **Availability of PUCCH resources at the RX UE**
6. **Pre-emption at the TX UE is enabled/disabled**
7. **Others**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | NONE | The length of re-tx timer should be configurable and determined by network or the Tx UE implementation, taking all the related factors into account, so there should be no spec impact due to this. |
| Xiaomi | All | All the factors should be considered by NW in mode 1 or UE in mode 2. But we don’t see spec impact. It should be up to implementation to decide appropriate value. |
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### 2.4.2 SL HARQ RTT and Retransmission Timers for Broadcast

In RAN2#113[1], no agreements were made for HARQ RTT timer and HARQ retransmission timers for broadcast. Depending on company feedback thus far, the need for these timers may not necessarily be dependant on the presence of HARQ feedback, which would make it possible to support these timers also for broadcast.

**Q30) Do companies support the use of SL HARQ RTT timer and SL retransmission timer also for broadcast?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (please motivate your answer) |
| OPPO | N | Without feedback, the power saving gain from RTT timer vanishes, and by restricting both new/re-transmission into active-time due to on-duration timer, there is no need for re-transmission timer either |
| Xiaomi | N | There is no feedback in broadcast. |
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## 2.5 Overall Aspects Related to DRX Active Time

In Uu, the active time includes the time when the drx-onDuration or drx-InactivityTimer, or drx-RetransmissionTimerDL or drx-RetransmissionTimerUL are running.

**Q31) Can the SL active time at the RX UE include the time when any of the sl-drx-OnDuration(s), sl-DRXInactivityTimer(s), or sl-drx-RetransmissionTimer(s) are running, as in Uu?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (if no, please explain why) |
| OPPO | Y |  |
| Xiaomi | Y | Uu design should be baseline. |
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In addition to the above, some companies also proposed to include periodic transmissions into the active time. This could allow the TX UE to perform periodic transmissions to a UE in DRX without the need to consider the DRX period of the RX UE. To handle the possibility of pre-emption, some companies further suggested to add some additional slots to the active time in the event of pre-emption. Also, some companies mentioned that active time should also consider reception of CSI reports from a peer UE. Specifically, if a UE in DRX requires CSI reports from its peer UEs, it should also monitor SL to be able to receive CSI reports from the peer UE without being constrained to active time defined by the DRX timers.

**Q32) Should the active time at the RX UE also include:**

1. **the slots associated with announced periodic transmissions by the TX UE (i.e. in the SCI)?**
2. **Additional slots to those associated with periodic transmissions (e.g. to handle pre-emption)**
3. **The slots when the UE is expected CSI reports following a CSI request**
4. **Others**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | C, D | For A, the periodic transmission can be covered by on duration timer / inactivity timer by appropriate DRX configuration.  For B, the effect of premeption should not be handled by Rx-UE DRX pattern extension, but should be handled by Tx-UE, i.e., to ensure the reselected resource due to preemption (and further revaluation/congestion control/prioritization) should fall into the DRX active time of Rx-UE.  The UE should be active when it sends some message that needs reply from peer UE, like CSI request or inter-UE coordination message which is pending RAN1 conclusion in the future. |
| Xiaomi | N | All these cases could be covered by DRX timer controlled wake up time with appropriate UE implementation and configuration. |
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In general, TX UE transmissions to an RX UE in SL DRX should be aligned to DRX active time of the RX UE. This can be achieved if the TX UE maintains a similar/synchronized set of DRX timers with the RX UE. RAN2 can study a number of impacts at the TX UE transmission procedures to achieve this alignment, including impacts to LCP and resource selection.

**Q33) Which of the following should be studied further by RAN2 to align transmissions by the TX UE with the active time of the RX UE?**

1. **LCP enhancements to avoid TX UE transmitting data in a grant to a non-active RX UE**
2. **LCP enhancements to prioritize transmissions to DRX RX UEs for grants which fall in the active time of these RX UEs**
3. **Resource selection enhancements taking into account the active time of the RX UE**
4. **Others**

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| --- | --- | --- |
| Company | Response | Comments |
| OPPO | A | C can be up to UE implementation.  Literally, we wonder what is the difference between A and B? We did not choose B since we assume the gap is option-B can still allow transmitting to Rx-UE in non-active state (i.e., if there is no active Rx UE to prioritize..) |
| Xiaomi | A | Option C has impact in RAN1 not RAN2. Option A is preferred than optin B. LCH with higher priority should not be down prioritized if there is available transmission resource. |
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## 2.5 Other Aspects related to DRX Timers

**Q34) Are there any other aspects related to DRX Timers that RAN2 should discuss in the scope of this email discussion?**

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| Company | Comments |
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# 4 Agreements from RAN2#103 [1]

Agreements on SA2’s questions:

1: For Q1, RAN2 reply AS layer can determine DRX parameters and no additional input from V2X layer other than the currently available QoS is needed.

2: RAN2 confirms that for unicast, the PC5 DRX may be negotiated between the UEs in AS layer. We can also include this RAN2 confirmation into the response LS.

3: For Q2, RAN2 further reply that for SL unicast, other than DRX parameter negotiation/sharing reason, AS layer can provide the PC5 DRX related information to the V2X layer, and RAN2 is working on the detailed DRX parameter that applies to each cast type. RAN2 would keep SA2 being update on the RAN2 progress.

4: For Q3, RAN2 reply that RAN2 does not think it is beneficial for broadcast and groupcast to share the PC5 DRX related information amongst UEs in the vicinity in V2X layer.

5: For Q4, RAN2 reply that RAN2 is working on this aspects following the WID bullet of “Specify mechanism aiming to align sidelink DRX wake-up time with Uu DRX wake-up time in an in-coverage UE”, RAN2 would keep SA2 updated on related working progress.

Agreements on high-level principles for SL DRX

1: For SL unicast (after SL unicast link is established), SL DRX configuration can be configured per a pair of source/destination. FFS whether SL DRX operates per direction or for both directions.

2: For SL groupcast/broadcast, SL DRX configuration can be configured in common. FFS on granularity of SL DRX configuration.

3: Short DRX cycle is not introduced for SL unicast, groupcast and broadcast in Rel-17.

4: For data reception, RAN2 defines the behaviour for monitoring the SCI reception (i.e., PSCCH and 2nd SCI on PSSCH) during the SL active time for SL DRX. For data reception, the UE may skip monitoring of PSCCH and 2nd SCI on PSSCH during inactive time for SL DRX. Sensing aspect is not considered in this agreement.

5a: At least, On-duration timer and Inactivity timer are supported in SL unicast.

5b: HARQ RTT is supported in SL unicast. FFS for the detailed condition when it is supported. FFS whether HARQ RTT is explicitly configured or can be based on SCI. FFS on the need of HARQ retransmission timer.

6a: At least, on-duration timer is supported for SL groupcast. FFS for the need and detailed condition when inactivity timer is supported.

6b: HARQ RTT is supported in SL groupcast. FFS for the detailed condition when it is supported. FFS whether HARQ RTT is explicitly configured or can be based on SCI. FFS on the need of HARQ retransmission timer.

7: At least, on-duration timer is supported for SL broadcast.

8: SL DRX Command MAC CE is introduced for SL DRX operation in unicast. FFS on the need of groupcast. FFS on the detailed UE behaviour (including relation to inactivity timer).

9: In mode 1, when in RRC\_CONNECTED, if DRX is configured, the MAC entity monitors the PDCCH for the MAC entity's SL-RNTI, SLCS-RNTI and SL Semi-Persistent Scheduling V-RNTI in Uu DRX Active Time. MAC entity does not need to monitor the PDCCH for the MAC entity's SL-RNTI, SLCS-RNTI and SL Semi-Persistent Scheduling V-RNTI in Uu DRX in-active Time.

Agreements on SL DRX configurations

1: For broadcast/groupcast, for out-of-coverage case, TX-UE/RX-UE obtain DRX configuration from pre-configuration.

2: For broadcast/groupcast, for in-coverage case, RRC\_IDLE/INACTIVE TX-UE/RX-UE obtain DRX configuration from SIB. It is up to network implementation how to coordinate active time between different cells.

3: For broadcast/groupcast, for in-coverage case, for RRC\_CONNECTED TX-UE/RX-UE can obtain DRX configuration from SIB. FFS on whether dedicated-RRC is also used.

4: For unicast, for OOC scenario, the UE who sends out the DRX configuration decides on the DRX configuration. FFS on whether pre-configuration and/or the assistance information from the peer UE is also taken into account when determining the DRX configuration.

5: For unicast, for OOC scenario, adopt per-direction DRX configuration is as baseline. FFS on whether it is TX-centric or Rx-centric, i.e. TX UE or RX UE decides it.

Agreements on granularity of SL DRX operation for groupcast/broadcast

1: RAN2 kindly agree that for groupcast and broadcast communication further granularity to multiple sets of DRX configurations (beyond just cast type) is required i.e. more than two DRX Cycle configurations should be supported in specification.

2: RAN2 will study/discuss how PQI and/or L2 destination ID is used to derive groupcast and broadcast DRX configuration.

Agreements on SL DRX on groupcast/broadcast

1: Timer-based SL DRX is also applied to SL groupcast/broadcast.

# 5 References

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7. R2-2101245 – Discussion on Sidelink DRX, Qualcomm Finland RFFE Oy
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9. R2-2101725 – General aspects of SL DRX for unicast, Huawei
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14. R2-2101333 – Transmission UE behaviors for SL DRX, Samsung Research America
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