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

**E-meeting, January 2021**

Agenda Item: 8.15.2.1

Source: OPPO

Title: Summary of [AT113-e][707]

Document for: Discussion, Decision

# Introduction

This is for the following email discussion

* [AT113-e][707][V2X/SL] Who will decide SL DRX pattern? (OPPO)

**Scope:** discuss who (TX UE, RX UE or gNB) will decide SL DRX pattern or configuration in various scenarios (scenario by scenario) considering whether SL DRX is for SL unicast, groupcast or broadcast, TX and RX UEs’ RRC state (including OOC), and whether TX and RX UE’s in the same or different serving cells (including IC and OOC).

**Intended outcome:** discussion summary and proposals in R2-2102183

**Deadline:** Feb 02 1245 (UTC)

# Discussion

## Group-cast/Broadcast

Based on the discussion in [702], rapporteur observes that (see the observation in Annex) the majority view seems to be

* For in-coverage case: rely on gNB;
* For out-of-coverage case: rely on Pre-configuration

The reason is that w/o PC5 signaling, there seems no much options available, i.e., the UEs have to rely on (pre)configuration for DRX/DTX alignment.

**Q1-1: For broadcast/groupcast, for out-of-coverage case, do you agree that TX-UE/RX-UEobtain DRX configuration from pre-configuration?**

|  |  |  |
| --- | --- | --- |
| Company | Agree / Not-agree | Comment |
| OPPO | Agree |  |
| Xiaomi | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Q1-2: For broadcast/groupcast, for in-coverage case, do you agree that RRC\_IDLE/INACTIVE TX-UE/RX-UE obtain DRX configuration from SIB?**

|  |  |  |
| --- | --- | --- |
| Company | Agree / Not-agree | Comment |
| OPPO | Agree |  |
| Xiaomi | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |

For RRC\_CONNECTED UE, there seems two opinions:

* One is to follow the legacy manner for Tx pool configuration, i.e., to rely on dedicated RRC;
* The other is to follow the legacy manner for Rx pool configuration, i.e., to rely on SIB;

The point of the latter one is that since for B-cast/G-cast, the DRX configuration cannot be per-UE decision (i.e., otherwise, there is no way to notify the neighbouring UEs who may be in another cell, or in RRC\_IDLE/INACTIVE state, or out of coverage), common configuration via SIB is sufficient.

**Q1-3: For broadcast/groupcast, for in-coverage case, for RRC\_CONNECTED TX-UE/RX-UE, how to obtain DRX configuration?**

* **Option-1: from SIB;**
* **Option-2: from dedicated RRC;**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | 1 | We have not identified feasible solution to support per-UE configuration via dedicated RRC for B-/G-cast. |
| Xiaomi | 1 and 2 | In R16, sidelink UE has to apply the sidelink configuration via dedicated RRC, even if there is sidelink configuration included in SIB. We think the same principle should be followed. Furthermore, it’s allowed for gNB to only provide sidelink configuration via dedicated RRC, not via SIB. Option 1 seems to unnecessarily preclude this option. |
|  |  |  |
|  |  |  |
|  |  |  |

## Unicast

Based on the discussion in [702], rapporteur observes that (see the observation in Annex), the view seems diverse in terms whether it is Rx-UE or the Tx-UE to decide on the DRX configuration.

Furthermore, based on the online discussion today, there seems an unclear aspect w.r.t whether it is per-link configuration or per-direction configuration.

Proposal 2.2-2. 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.

So before going towards solution down-selection, it might be helpful to clarify the options on the table.

But to look into the core issue, rapporteur suggest the following simplification for the scenario:

* Start from OOC scenario to avoid the discussion on gNB involvement as a start point;
* Do not touch the failure handling or the negotiation procedure (i.e., in case the DRX configuration is not preferred by the peer UE) in this discussion;
* Do not touch the assistance information (information from peer UE to assist the DRX configuration decision) in this discussion;

Based on the assumption above, firstly we can look at the options on the table.

**Option-A: Per-direction DRX configuration**

Option-A1: Per-direction DRX configuration + Tx-centric manner, i.e., it is the Tx-UE who decide the DRX configuration of Rx-UE, and send it to Rx-UE.

NOTE: in the figure below, the timing for UE1/2 send out the configuration is not restricted.



Figure 1 Per-direction DRX configuration + Tx-centric manner

Option-A2: Per-direction DRX configuration + Rx-centric manner, i.e., it is the Rx-UE who decide the DRX configuration of Rx-UE, and send it to Tx-UE.

NOTE: in the figure below, the timing for UE1/2 send out the configuration is not restricted.



Figure 2 Per-direction DRX configuration + Rx-centric manner

**Option-B: Per-link DRX configuration**

It is one UE who decide the DRX configuration of both UEs, i.e., the DRX of itself and the peer UE.

NOTE: the figure below does not touch which UE should be the controlling UE.



Figure 2 Per-link DRX configuration

**Q2-1: Is there any other options which cannot be categorized as one of the options above?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| OPPO | No |  |
| Xiaomi | No |  |
|  |  |  |
|  |  |  |
|  |  |  |

Besides, it is helpful to understand how for the UE who sends out the DRX configuration, i.e.,

* UE1 and UE2 in option-A1/2 (who sends out the DRX configuration for different directions respectively);
* UE1 in option-B (who sends out the DRX configuration for both directions);

To decide on the DRX configuration (NOTE that we are limited to OOC scenario for unicast case in this discussion), the available options seem to be

* Either up to the UE itself;
* Or rely on the pre-configuration of the UE;

**Q2-2: Regardless of the preference on the options (as listed above, option-A1/A2/B), for OOC scenario, how for the UE who sends out the DRX configuration to decide on the DRX configuration?**

* **Option-1: Decided by the UE itself;**
* **Option-2: Rely on pre-configuration;**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | 1 | Although theoretically can be per-UE configuration, in practice, pre-configuration can only achieve common configuration. So option-2 means there is no need for PC5-RRC signalling.  And even if pre-configuration is per-UE, it cannot work since it means the same DRX configuration would be used for all involved unicast links for this UE. |
| Xiaomi | 2 | In our understanding, the DRX could be pre-configured per destination or QoS for unicast, which doesn’t mean all involved unicast links for this UE is the same. |
|  |  |  |
|  |  |  |
|  |  |  |

Before going into down-selection, rapporteur would like to point out that in R16 (where there is no DRX configuration), the PC5-RRC procedure is designed in a way like option-A1 above, i.e.,

* The AS-layer configuration signalling from UE1 is for UE1 => UE2 direction;
* While the AS-layer configuration signalling from UE2 is for UE2 => UE1 direction;



Figure 1 Per-direction DRX configuration + Tx-centric manner

**Q2-3a: Within the 3 options above, which option(s) you prefer?**

* **Option-A1**
* **Option-A2**
* **Option-B**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | A1 | To align with R16 signalling framework.  In other words, if for a same direction (e.g., for UE2 => UE1), some parameters are decided by UE2 (as in R16) while others are decided by UE1 (e.g., as in option-A2 or option-B), it may bring configuration collision since AS parameters are implicitly coupled with each other, and thus it is preferred to rely on a single entity to decide on it. |
| Xiaomi | A1 | The DRX configuration would restrict the transmission resource selection in TX UE, which means only the transmission resource overlapped with wake-up time of RX side could be selected. RX UE is not aware of the resource allocation of TX UE, so sidelink DRX should be decided by TX UE. |
|  |  |  |
|  |  |  |
|  |  |  |

**Q2-3b: Within the 3 options above, which option(s) you cannot accept?**

* **Option-A1**
* **Option-A2**
* **Option-B**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | B | This brings asymmetric role to PC5, which breaks the design principle/premise since LTE.. The reason we started from symmetric framework is to avoid deadlock type thing in distributed network: e.g.,  Issue-1: for a triangle topology (where one UE as the controlling UE, the other as the controlled UE,   * Unicast link between UE1 and UE2; * Unicast link between UE1 and UE3; * Unicast link between UE2 and UE3;   This would lead to circular decision chain, i.e., the decision power is that UE1 > UE2 > UE3 > UE1..  Issue-2: for a same unicast UE pair, it could happen that there are multiple logical PC5-S connection running at the same time:   * Connection-1 where UE1 as the initiating UE; * Connection-2 where UE2 as the initiating UE;   Option-B would lead to separate decision entity even for the same direction |
| Xiaomi | B | Option B is not preferred for following reasons,   1. The traffic characteristic may be different on different directions, which require different DRX configuration. 2. It’s possible only one of the pair UEs require DRX. For example, in V2P, only the pedestrian requires DRX. |
|  |  |  |
|  |  |  |
|  |  |  |

1. xxx.

# Conclusion

We have the following proposals

[Proposal 1 xxx.](#_Toc62216175)

# Reference

1. R2-2101727 Summary of [POST112-e][702][SLe] High-level principles for SL DRX LG Electronics France discussion Rel-17 NR\_SL\_enh-Core Late

# Annex:

Based on the comments, rapporteur understands as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company | Options | Comments | Group/Broadcast | Unicast |
| CATT | Option 1) for IC Tx UE in RRC\_CONNECTED state;  Option 2) for other cases. | Tx UE centric SL DRX configuration is preferred (Option 1 and Option 2).   * If the Tx UE is in RRC\_CONNECTED, in order to align the Uu and SL DRX configurations, the gNB can determine the SL DRX configuration for Tx UE; * If the Tx UE is IC but in RRC\_IDLE or inactive, since there is no interactivity between UE and gNB, gNB can’t aware the SL service requirement in UE, hence it had better let Tx UE determine the SL DRX configuration by itself; * If the Tx UE is OOC, there is no need to align the SL DRX configuration between Uu and SL, hence Tx UE can determine the SL DRX configuration. |  | Tx-centric manner |
| Lenovo, MotM | 4) and 5)  2) for UC based later adjustments of DRX configuration only. | 1) does not work since peer UEs where one is in coverage of a gNB and the other is not (another gNB or OOC). This problem applies for already other configurations in SL and so instead of solving this, we should not make it any further critical.  2) for UC based later adjustments of DRX configuration.  5): Specified might be useful as well if the DRX patterns are to be known universally. | Pre-configuration/Specified-configuration? | Tx-centric manner |
| OPPO | For broadcast/groupcast, option-1/4  For unicast, option-1/2 | For broadcast and groupcast, we believe a common DRX configuration is feasible (FFS it is per-QoS or not), for which UE can rely on SIB/pre-configuration for in/out-of-coverage case.  For unicast, for the DRX after link establishment, we believe a link/direction-specific DRX configuration is necessary (as replied to Q2.2-2), for which the decision can be by TX-UE or the serving gNB of the TX-UE (depending on whether the TX-UE is in RRC\_CONNECTED or not). | SIB/Pre-configuration | Tx-centric manner |
| Xiaomi | Option 2 + 1 for IC UE  Option 2+4 for OOC UE  FFS for option 3 | In Uu, the DRX is configured by gNB, since gNB is aware of the traffic pattern and in charge of resource scheduling. gNB could provide appropriate DRX configuration to fulfil the QoS without much delay.  On sidelink TX UE is aware of the traffic pattern. TX UE’s gNB and pre-configuration is in charge of sidelink resource allocation.  But I also see some benefit of RX determined DRX configuration. Maybe we could have some further discussion on how to harmony these two options. |  | Tx-centric manner (but also point of Rx-centric manner) |
| ASUSTeK | See comment  Different options for different scenarios | **For In-Coverage unicast UEs:**  Option 1) gNB (e.g. UE-specific configuration to peer UEs)  Option 2) UE performing the SL TX  Option 3) UE performing the SL RX  **For in-Coverage broadcast/groupcast UEs:**  Option 1) gNB (e.g. for common SL DRX configuration per resource pool)  Option 6) Upper layer (e.g. V2X layer)  **For out-of-coverage unicast UEs:**  Option 2) UE performing the SL TX  Option 3) UE performing the SL RX  Option 4) Use pre-configuration SL DRX parameters (e.g. for common SL DRX configuration per resource pool)  **For out-of-coverage broadcast/groupcast UEs:**  Option 4) Use pre-configuration SL DRX parameters (e.g. for common SL DRX configuration per resource pool)  Option 6) Upper layer (e.g. V2X layer) | IC:  gNB  OOC:  Preconfiguration | Tx-centric or Rx-centric |
| HW | 3 for unicast  1 or 4 for broadcast/groupcast | For unicast, we slightly prefer UE performing the SL RX determines the SL DRX configuration as this is the most power-saving mechanism and based on some coordinated information between the TX UE(s) and the RX UE, the RX UE can determine a proper DRX configuration applying to all the connected TX UEs or determine multiple DRX configurations applying to different TX UEs.  For broadcast/groupcast, we think it should be the NW (dedicated RRC signalling for connected mode and SIB for idle/inactive mode) to configure the dedicated resource pool(s) or the mapping relationship between different service/QoS profile and the corresponding dedicated resource pool for the UEs IC and for UEs that are OOC, they should use predefined dedicated resource pool configuration for SL DRX operation. | IC:  gNB:  OOC:  Pre-configuration | Rx-centric manner |
| Apple | 3 for unicast DRX configurations  1 & 4 for common DRX configuration | We agree with Huawei that RX UE is more suitable to determine how to achieve power saving from SL-DRX. We prefer RX-driven decisions for each PC5 link.  Common DRX configurations are provided via SIB or pre-configurations. | IC:  gNB:  OOC:  Pre-configuration | Rx-centric |
| InterDigital | Option 1 & 4 for groupcast/broadcast  Option 3 for unicast (with comments) | Similar to other groupcast/broadcast parameters on SL, gNB should configure DRX for in coverage, and preconfiguration should be used for OOC.  For unicast, the RX UE should select the final DRX configuration(s) to ensure efficient power savings for multiple active unicast links (with different UEs). However, since the TX UE is aware of the characteristics of the data to be transmitted, and could also be an RX UE for other unicast links, the TX UE should be involved in such decision (e.g. by sending a suggested configuration(s) or other information used by the RX UE for selection). | IC:  gNB:  OOC:  Pre-configuration | Rx-centric |
| vivo | Option 1, 2, 4  see comments | For groupcast and broadcast, the UE common DRX configuration can be part of the SLRB configuration as in Rel-16 V2X, i.e., by **Option 1** for In-Coverage UEs and **Option 4** for Out-of-Coverage UEs.  For unicast, as we replied in Section 2.2**,** there may be UE common DRX Configuration before unicast link establishment and link specific DRX after unicast link establishment. Therefore:  - Before unicast link establishment, the DRX configuration can simply follow the method for groupcast and broadcast as above.  - After unicast link establishment, the link specific DRX configuration is defined by **Option 2**, i.e., the Tx UE sets up the initial DRX configuration and the Rx UE may decide whether to accept/reject/modify the initial DRX configuration from TX UE. This DRX negotiation between TX and RX can reuse similar QoS negotiation procedure defined in Rel-16 V2X. | IC:  gNB:  OOC:  Pre-configuration | Tx-centric |
| Ericsson (Min) | Option 1+2 for IC UE  Option 2+4 for OOC UE | For IC UE in RRC CONNECTED, it is the gNB of TX UE or TX UE that determine the SL DRX configuration.  For IC UE in RRC IDLE and INACVIVE, it is TX UE that determines the SL DRX configuration.  For OOC UE, it is TX UE that determines the SL DRX configuration based on preconfigured DRX configurations. |  | Tx-centric manner |
| Fujitsu | Option 1, 2, 3, and 4 with comments | Option 1 works in IC, with RRC-CONNECTED.  Option 2 and 3 work for unicast in OOC. Once a unicast link is established, the pair-UEs should negotiate their DRX parameters.  Option 4 works for groupcast and broadcast in OOC. | OOC:  Preconfiguration | Tx-centric or Rx-centric |
| MediaTek | Option 2 or 3 for unicast;  Option 1 for IC RRC connected UE  Option 4 for OOC UE  Option 6 for groupcast/broadcast | In our view, option 2 and option 3 have their own benefit and we suggest more discussion on how to balance the performance between latency and power saving.  For a UE in RRC connected, the SL DRX configuration can be configured either by NW (option 1) or determined by UE itself (option 2 or 3).  For a OOC UE, its SL DRX configuration could be based on option 4, or be based on the exchanged SL DRX configuration from peer UEs (option 2 or 3).  For groupcast/broadcast, the SL DRX configuration may also come from higher layer, which satisfy the QoS requirement of this groupcast/broadcast service. |  | Tx-centric or Rx-centric |
| Intel | Option 1, 2, 3 and 4 with comments | For in coverage CONNECTED case, we can rely on gNB to provide the SL DRX configuration for both unicast and groupcast/broadcast cases.  For unicast case out of coverage, both option 2 and 3 can be applicable once the unicast link has been established and whether we go with a TX UE or RX UE centric approach needs to be further discussed. Regardless of whether it is TX UE or RX UE centric, PC5-RRC signalling can be used to exchange the DRX configuration to be used for the SRC/DST pair (once the link is established).  For groupcast/broadcast out of coverage case, since we cannot rely on PC5-RRC, option 4 can be applicable. | IC:  gNB:  OOC:  Pre-configuration | Tx-centric or Rx-centric |
| Samsung | Option 2. | Traffic pattern is determined in TX UE. | OOC:  Pre-configuration | Tx-centric manner |
| Fraunhofer | Options 1,2,4 | In case of in-coverage, UE in RRC-CONNECTED state gNB can determine the DRX configuration. While for the UEs in RRC IDLE or INACTIVE state, the initiating UE can determine the DRX configuration.  While for an out of coverage scenario the UEs can use a pre-configured DRX configuration.  Additionally, for groupcast UEs, a UE within the group can also provide the DRX configuration. |  |  |
| Qualcomm | 1, 2, and 4 | IC UEs: 1 & 2  OOC UEs: 2 & 4 |  | Tx-centric manner |
| LG | Option 1 or Option 3 for UE specific SL DRX (e.g., unicast)  Option 1 or option 4 for Common SL DRX (e.g., groupcast/broadcast) | UE specific SL DRX can be determined by the gNB or the UE. In RRC Connected state, the gNB can decide UE specific SL DRX, and in RRC Idle/Idle state or OOC, the UE can determine UE specific SL DRX (in this case, we prefer that the SL DRX configuration can be determined by the RX UE.). Also, we prefer the Common SL DRX configuration to be determined by the gNB or pre-configuration parameters are used. | IC:  gNB  OOC:  Pre-configuration | Rx-centric |
| ITL | See comments | For in coverage UE, Option 1 could be considered for SL DRX configuration decision.  For out of coverage UE, Option 2, 3, 4 could be considered for SL DRX configuration decision for different case. | IC:  gNB  OOC:  Pre-configuration | Tx-centric or Rx-centric |
| Spreadtrum | Option 1, 2 and 4 | Option 1 for IC UE  Option 2 and 4 for OOC UE | IC:  gNB  OOC:  Pre-configuration | Tx-centric or Rx-centric |
| Nokia | Option 2 and 6 | Although we see the benefit of using 1 for in-coverage UEs, we think that specifying two different behaviours now may not be the best move. Therefore, it does make sense to allow the UE(s) to coordinate internally based on i.e. service, or maybe let higher layer provide requests for certain DRX parameters |  | Tx-centric? |
| Convida Wireless | Option 1,4 for common SL DRX configuration  Option 3 for UE specific SL DRX configuration | For common SL DRX configuration, the UEs should know the SL DRX configuration without peer UE communication. In-Coverage UEs could determine the SL DRX parameters from the gNB/scheduler (for example through dedicated signaling or through system information). Out-of-Coverage UEs could determine the SL DRX parameters through pre-configuration.  For UE specific SL DRX configuration, our preference is that the SL DRX parameters be determined by the RX UE.  We do think that a negotiation step prior to the SL DRX configuration could help optimize the configuration for the QoS requirements of the traffic, as well as maximize the potential power savings. For example when a UE has multiple parallel unicast links (with different UEs). |  | Rx-centric |
| Philips | Option 1, 2, 3, 4 or 6 depending on the case | For IC UE:   * Unicast: option 1 if in RRC connected, otherwise option 2 or 3 after some negotiation between TX and RX UE. * Groupcast/broadcast: option 1, i.e. via SIB   For OoC UE:   * Unicast: option 2 or 3 after some negotiation between TX and RX UE. * Groupcast/Broadcast: option 4   On top of all the above, the upper layer i.e. the application layer, can always suggest DRX configurations as it occurs in LTE-M or NB-IoT for the eDRX negotiation | IC:  gNB  OOC:  Pre-configuration | Tx-centric or Rx-centric |
| SONY | 1) for broadcast when UEs are in coverage  2 or 3) for unicast   1. For broadcast when UEs are out of coverage   FFS for Groupcast | For Broadcast there should be a common configuration for all UEs, which could be changed through RRC signalling/SIB from gNB. For Unicast the SL DRX should be decided between the UEs.  For Groupcasts there are several aspects, therefore this should be studied further |  | Tx-centric or Rx-centric |
| ZTE | Option 1) for dedicated SL DRX configuration for UE in RRC\_CONNECTED state; and default DRX configuration for IC UE.  Option 4) for default DRX configuration for OC UE.  Option 3) for dedicated SL DRX configuration for UE in RRC\_idle and inactive state | Option 1 or 4 can be used to configure common DRX configuration for broadcast/groupcast.  In addition, for the UE in RRC\_CONNECTED state,the network shall be responsible for the SL DRX configuraion.  for dedicated SL DRX configuration for UE in RRC\_idle and inactive state, we think RX UE is more suitable to determine how to achieve power saving from SL-DRX . | IC:  gNB  OOC:  Pre-configuration | Tx-centric or Rx-centric |