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

**E-meeting, January 2021**

Agenda Item: 8.15.2.1

Source: Lenovo, Motorola Mobility

Title: Summary of [AT113-e][708]

Document for: Discussion, Decision

# Introduction

This is for the following email discussion

* [AT113-e][707][V2X/SL] Granularity of SL DRX operation for groupcast/broadcast (Lenovo)

**Scope:** discuss options identified above (including some level of understanding on how it works, e.g. what information can represent QoS level to differentiate SL DRX operation, how geo-location can work, etc., challenges, pros, and cons for each option) and check companies’ views. Note companies can add additional option if the option proposed in the contribution was missed.

**Intended outcome:** discussion summary and proposals in R2-2102184

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

# Requested Input format

*Some questions request your input in a new format in the hope of a different, clear outcome than what is possible to conclude from our pre-meeting email discussion [1]. Therefore, for certain questions, to encourage technical discussion, your input is requested the following format:*

**Question 0: Do you support solution#1**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Example 1: This works well in in-coverage situation (Optional: company name) | Example 5: Does not work for Out of coverage UE (Optional: company name) |
| Example 2: This is efficient since…(Optional: company name) |  |
| Example 3: ~~Works excellent in in-coverage~~ (the argument has already been made, no need to repeat) |  |
| Example 4: Actually, works for Out of coverage cases as well since/ when/ if… |  |

**Position for Question 0:**

|  |  |
| --- | --- |
| **Support** | Company A, Company B |
| **Do not support** | Company C |
| **Neutral/ flexible** | Company D |

Please take note of the following guidelines:

* Please **do not repeat arguments** already presented by someone [Example 3]
* One may (and should) however present a **counterargument to an argument** already made [Example 4 arguing against Example 5].
* Please make **meaningful** but **short arguments** for readability purpose.

# Discussion

## Basic question

It is important that all members of a groupcast as well as broadcast communication have **a** **minimum deterministic time period** where SL communication can take place (“active” time in Figure 1) and in the remaining time the devices may sleep i.e. will not transmit data and will not wake up to receive data. **The layer-1 sensing operation related discussion and the DRX approach (resource pool or timer-based) is not addressed in this part (separately addressed later in this paper)**.



Figure 1: DRX (DTX) Cycle

How this can be realized, is discussed subsequently.

**Question 1:** Do you agree that for BC and GC, **“a** **minimum deterministic time period** where SL communication can take place and in the remaining time the devices may sleep i.e. will not transmit data and will not wake up to receive data”?

|  |  |  |
| --- | --- | --- |
| Company | Agree/ not-agree | Comments |
| OPPO | Agree | We assume this question does not touch upon granularity, but just to ask whether DRX is needed for B/G-cast? It seems more than clear since it motivates all the discussion here.. |
| InterDigital | Agree |  |
| Fujitsu | Agree |  |
| LG | Agree |  |
| CATT | Agree |  |
| Ericsson (Min) | Agree | This question is not needed. The answer is clear. |

## Granularity of DRX Cycle configuration

Having minimum number of DRX configurations ease design but can cause congestion as well as lead to half duplex issues especially at the start of active time: as data may have accumulated in the potential transmitter devices of a GC or BC communication during the DRX sleep time. Half duplex issues may occur if many UEs start to transmit at the same time and are not able to receive. These issues are dependent on RAN1 sensing solution design as well, but it is not easy to expect power efficient sensing outcomes that may completely avoid any potential collisions.

**Question 2: What is your expectation on how many DRX cycles configurations may be required for GC and BC communication:**

1. Just One DRX Cycle configuration for all Broadcast as well as Groupcast SL communication
2. Two DRX Cycle configurations: One all Broadcast and another for all Groupcast SL communication
3. Further granularity is required i.e. more than two DRX Cycle configurations should be supported in specification.

|  |  |  |
| --- | --- | --- |
| Company | Option (a, b or c) | Comments |
| OPPO | a, b or c | We are open to all the 3 options. |
| InterDigital | c | A single DRX cycle for all broadcast and/or all groupcast would limit the amount of power savings for UEs interested in services that can be run with infrequent DRX wakeup pattern, since all UEs would wakeup according to a “worst case” DRX pattern which is tailored to the service requiring the most frequent wakeups. |
| Fujitsu | c | In a and b, the resource collision and half-duplex issues could be severe. More granularity is necessary. |
| LG | C | Same view as InterDigital. |
| CATT | 1. or b) | We are open to a) or b).  Compared with option a), option b) can be benefit for power saving in case of UE is only interested in broadcast or only interested in groupcast.  In addition, since the following agreements have been agreed:  *RAN2 reply AS layer can determine DRX parameters and no additional input from V2X layer other than the currently available QoS is needed.*  Since no more information is needed from SA2, it is hard to further introduce more than two DRX cycles. Hence option c) is not preferred. |
| Ericsson (Min) | c | Number of DRX configurations depend on service types, number of groups, or QoS classes. In case of mixed service types, groups or QoS classes, single DRX configuration is obviously not sufficient. |

If you chose c) above, then please provide your input to the Q3, otherwise (a or b), you “**may**” skip Q3 and answer Q4 directly:

Following are the possible candidates (based on [1]) for defining further granularity of DRX cycle configurations:

**Q3a: DRX cycles configurations per L2 destination ID:**

The assumption here is that the transmitter and receiver belonging to a group (for groupcast communication) or involved in broadcast communication know a destination ID and therefore can use a corresponding DRX configuration provided by means of (pre)configuration. A potential receiver access stratum will know a list of destination IDs (provided by upper layer) that it is supposed to listen to (e.g. for L1 filtering).

Since, there is literally huge number (2^24) of L2 destination IDs, therefore to configure/ derive DRX configuration some grouping of destination IDs may be used (e.g. destination IDs X1 to Y1 use DRX\_Configuration\_1; destination IDs X2 to Y2 use DRX\_Configuration\_2 and so on). **Proponents please explain your solution, if necessary, here.**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Destination Id is known to the transmitter and to the receiver. | A device may have communication with tens of group or broadcast destination IDs.  L2 destination IDs change due to security reasons. |
| This is a simple approach and we see no issues with it. Multiple groups at a UE should not be an issue, since it is expected that DRX configurations will have some commonality. L2 destination ID change can be limited to IDs that map to the same DRX configuration.  Unlike L2 source ID, in general, L2 destination ID is not changed during the broadcast/groupcast session. Therefore, it is quite reliable and unique. DRX cycles can be configured per L2 destination ID, after the session is established. In other words, only L2 destination IDs with ongoing services can be used for DRX configuration. | Although one point for adopting this per-destination-ID configuration is for load balance, the feasibility is doubtable since 1) for B-cast, the load on the default destination L2 ID is not known, for 2) for G-cast, due to the usage of SHA-256 hashing algorithm, the load on all destination L2 ID is not known. |
|  | When configuring SL DRX for each destination ID, there is a problem that the UE should use too many SL DRX configurations for gropcast/broadcast. Therefore, it is desirable to configure DRX configuration per QoS class (e.g., per PQI or per grouping of PQIs) for groupcast/broadcast. |
| This is a feasible option when the configured/preconfigured destination IDs for groupcast and broadcast is not big. |  |

**Position for Question Q3a:**

|  |  |
| --- | --- |
| **Support:** | InterDigital, Fujitsu, Ericsson |
| **Do not support:** | OPPO, LG |
| **Neutral/ flexible:** |  |

**Q3b: DRX cycles configurations per service ID/ ITS-AID:**

The assumption here is that any device (receiver or transmitter) will have only a limited number of service ID/ ITS-AID interesting for it at any point in time – at least from GC, BC point of view, even if there can be huge number of service IDs/ ITS-AIDs in the world outside of 3gpp. Some grouping of service IDs can be done (e.g. service IDs X1 to Y1 use DRX\_Configuration\_1; service IDs X2 to Y2 use DRX\_Configuration\_2 and so on). **Proponents please explain your solution, if necessary, here.**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Known to a device. | The value is not known to access stratum and needs to be fetched from upper layers somehow.  Not clear if this is straight-forward if even the format of IDs (service, ITS-AID etc.) is not completely under 3gpp control.  ITS-AID/PSID is not of a fixed length, but of an extendable length, i.e., beyond the capability of ASN.1 definition and capacity of configuration (e.g., considering limited SIB size)  Typically, service ID is not visible to the AS layer, and we should keep that principle. Also, L2 destination ID can have a mapping service ID, so that solution is a superset of this one.  In most cast, UE determines L2 destination ID based on the configuration of mapping between V2X service type (e.g., PSID/ITS-AID) and Layer-2 ID in V2X layer. It does not make much difference in between. Furthermore, the value is not known to AS layer.  it would be better to base on other granularity factor which is known to AS, such as Destination ID or QoS classes. In this way, the standardization efforts for AS can be minimized. |
|  | RAN2 considers determining the SL DRX configuration at the AS layer, but the service ID is not visible to the AS layer. Thus, SL DRX configuration for groupcast/broadcast can be configured per QoS class (e.g., per PQI or per grouping of PQIs). |

**Position for Question Q3b:**

|  |  |
| --- | --- |
| **Support:** |  |
| **Do not support:** | OPPO, InterDigital, Fujitsu, LG, Ericsson |
| **Neutral/ flexible:** |  |

**Q3c: DRX cycles configurations per QoS level (PQI or a group of PQIs):**

PQI is signalled from the upper layer to AS already and since only limited PQIs (15 including the 5 new values – and not all of these may apply to a GC/ BC) are defined (in TS 23.287 table 5.4.4-1), it is possible to (pre)configure a table mapping between PQIs and their corresponding DRX configuration. Transmitter device knows the PQI and the receiver access stratum needs to either get this information from upper layer or be prepared to receive for any PQI’s corresponding DRX configuration. Some grouping of PQIs can be done (e.g. PQIs X1 to Y1 use DRX\_Configuration\_1; PQIs X2 to Y2 use DRX\_Configuration\_2 and so on). **Proponents please explain your solution, if necessary, here.**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Known at Access stratum level.  Not too many PQIs – thus only a limited number of corresponding DRX Cycle configurations: allowing sleep time.  Not too few PQIs – this avoiding congestion/ HD issues. | Receiver comes to know of a PQI only upon receiving the first transmission. Therefore, needs to be prepared to receive on any of the applicable DRX configurations – some PQI grouping can be done to mitigate this. |
| Even for the L2 ID solution in 3a, the DRX configuration for an L2 ID would need to be defined based on the worst case PQI expected for that L2 ID (group or service). The receiver can still be aware of the mapping of PQI to L2 ID (e.g. from upper layers), but this would required involvement by SA2. | If DRX cycle is configured per PQI, UEs have to be awake to monitor PSCCHs in all PQI-based On-durations, before the GC and BC session. It could significantly reduce the efficiency of power saving. |
| It is necessary to reflect the QoS characteristic of the groupcast/broadcast service in the SL DRX configuration. Thus, SL DRX configuration for groupcast/broadcast can be configured per QoS class (e.g., per PQI or per grouping of PQIs).  Regarding the PQI acquisition of the AS layer, 23.287 generally describes that V2X layer transfers PQI to AS layer when creating or modifying or removing the PC5 QoS Flow. It is not limited to Tx UEs only. |  |

**Position for Question Q3c:**

|  |  |
| --- | --- |
| **Support:** | InterDigital, LG |
| **Do not support:** | Fujitsu |
| **Neutral/ flexible:** | OPPO, Ericsson |

**Q3d: DRX cycles configurations per Geo-location:**

The assumption here is that the legacy zone-based technique is used and then for a zone (or a group of zones/ bigger zone sizes) a corresponding DRX configuration is (pre)configured. **Proponents please explain your solution, if necessary, here.**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Assuming a zone-based Geo-location concept: Known technology (specified, implemented). | The receiver device locations are not known to the transmitter. How the transmitter ensures that it uses a DRX configuration that the potential receivers are also using?  Multiple transmitters and receivers of a GC/ BC communication may be in different zones. |
| Sidelink is designed for vicinity UEs to communicate each other. The DRX On-durations can be pre-configured and partially overlapped for UEs who are in the neighbour zones. This ensures the UEs to make the reception from the Tx-UEs in proximity. At least, the Geo-location based DRX configuration can be performed for the UEs who are involved in broadcast communication. For groupcast, the UEs can start Geo-location based DRX configuration before the groupcast session establishment. After the establishment, the UEs in the group can refine DRX configuration based on L2 destination ID or service type. | In addition, the solution doesn’t work in case UE moves around. |

**Position for Question Q3d:**

|  |  |
| --- | --- |
| **Support:** | Fujitsu |
| **Do not support:** | OPPO, LG, Ericsson |
| **Neutral/ flexible:** | InterDigital |

**Q3e: Additional Option**

Please explain briefly here:

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
|  |  |
|  |  |

**Position for Question Q3e:**

|  |  |
| --- | --- |
| **Support:** |  |
| **Do not support:** |  |
| **Neutral/ flexible:** |  |

## Approach for GC, BC communication:

While input [2] proposes to use a resource pool based mechanism to achieve power saving by having TDM based resource allocation – automatically inserting “resource gaps” where no SL communication would be possible; other option is to reuse Uu based mechanism where the DRX start offset from a reference time, on-duration and DRX cycle periodicity is defined (shown in Figure 1). Paper [3] details further the use of Inactivity timer in the SL context for groupcast communication. Companies are requested to provide their inputs separately for GC and BC – assuming HARQ feedbacks continue to be supported for groupcast communication but not for broadcast communication.

**Q4a: Do you support Resource Pattern based approach for GC and/ or BC?**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| [For both GC and BC] Eases or even obviates specification and implementation of timers. | [For both GC and BC] The real time extension (further SL communication by way of extending on duration using inactivity timer) is not possible or at least not easy to realize. |
| [For both GC and BC] The doubt on feasibility of inactivity timer (first bullet in “**Arguments opposing**”) is not relevant to the question here on “**Do you support Resource Pool based approach**”, i.e., the usage of inactivity timer is not the premise of resource-pool approach.  We don’t agree with the opposing argument, since an inactivity timer can be configured even in the pool based approach. The UE changes from the DRX pool to the normal pool (i.e. monitoring resources continually) when the inactivity timer is running, where the normal pool would define continual resources. In essence, we see no difference between pool-based approach and timer-based approach if the inactivity timer is implemented this way. | It has less flexibility for extending On-duration, especially for groupcast once HARQ mechanism is enabled.  If resource pattern based approach is adopted, the resource pattern should be splitted amongst unicast, broadcast and groupcast, which is not benefit for the sidelink resource efficiency.  Regarding to the inactivity timer issue, for the solution proposed by InterDigital, it will introduce pool switching mechanism, which will introduce more specification effort compared with the timer-based mechanism which can follow Uu DRX.  The UE would have to maintain multiple specific resource configurations in case there are multiple resource pools configured for broadcast and groupcast. This would sacrifice configuration flexibility with increased management complexity on resource pools. In addition, a resource pool may be shared among cast types (as in Rel-16). In that case, it will be infeasible to enable DRX for broadcast or groupcast based a specific resource pool configuration in the resource pool. Therefore, RAN2 should aim for a unified DRX solution for SL DRX regardless of cast types. In other words, the timer based approach as in Uu DRX should be also adopted for broadcast and groupcast |
|  | The DRX Timer concept is useful not only for UC but also for GC/BC. When DRX Timer is also applied to GC/BC, the main issues to be discussed by RAN2 are how to define the Slot to monitor the PSCCH before expiring the SL DRX Timer and how to define SL DRX Timer value. From this point of view, it is difficult to understand the introduction of pool configuration to define a separate PSCCH monitoring slot for GC/BC, different from UC. |

**Position for Question Q4a-Groupcast:**

|  |  |
| --- | --- |
| **Support:** | OPPO, InterDigital |
| **Do not support:** | Fujitsu, LG,CATT, Ericsson |
| **Neutral/ flexible:** |  |

**Position for Question Q4a-Broadcast:**

|  |  |
| --- | --- |
| **Support:** | OPPO, InterDigital |
| **Do not support:** | Fujitsu, LG,CATT, Ericsson |
| **Neutral/ flexible:** |  |

**Q4b: Do you support Uu timer-based approach for GC and/ or BC?**

|  |  |
| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
| Already specified, implemented, and tested for Uu. | Would need one of the methods as in Q3 to start/ align the timers (i.e. for DRX configuration). |
| We prefer to define the unified mechanism using the timer-based approach for all cast types. |  |

**Position for Question Q4b-Groupcast:**

|  |  |
| --- | --- |
| **Support:** | LG,CATT, Ericsson |
| **Do not support:** |  |
| **Neutral/ flexible:** | OPPO, InterDigital, Fujitsu |

**Position for Question Q4b-Broadcast:**

|  |  |
| --- | --- |
| **Support:** | LG,CATT, Ericsson |
| **Do not support:** |  |
| **Neutral/ flexible:** | OPPO, InterDigital, Fujitsu |

**Q4c: With respect to individual timers in GC and BC, please indicate if you support the two timers:**

|  |  |  |
| --- | --- | --- |
|  | Support need for On-duration timer | Support need for Inactivity timer |
| Groupcast | Company A1 because…, Company A2  InterDigital – only if we support timer-based (not needed with pool-based),  LG  CATT – support  Ericsson since we shall use unified DRX concept regardless of cast type | Company B,  InterDigital – without inactivity timer, all transmissions would be limited to transmissions within the “on duration”,  LG  CATT - Slightly prefers No. Because if inactivity timer is needed, how to keep the alignment between Tx and Rx UE should be further considered, since some Rx UE can receive the SCI while others may cannot.  Ericsson since we shall use unified DRX concept regardless of cast type, in addition, inactivity timer is beneficial to handle burst traffic |
| Broadcast | Company C,  InterDigital – only if we support timer-based (not needed with pool-based),  LG  CATT – support  Ericsson since we shall use unified DRX concept regardless of cast type | InterDigital – without inactivity timer, all transmissions would be limited to transmissions within the “on duration”,  LG  CATT - Slightly prefers No. Because if inactivity timer is needed, how to keep the alignment between Tx and Rx UE should be further considered, since some Rx UE can receive the SCI while others may cannot.  Ericsson since we shall use unified DRX concept regardless of cast type, in addition, inactivity timer is beneficial to handle burst traffic |

## Sensing

Q5: Should RAN2 work on including sensing impact in SL DRX or should we first wait for RAN1 progress (using LS)? RAN1 discussions are already underway on this. In the comments, please also write if RAN2 can share some important inputs to help RAN1 in designing a sensing solution.

|  |  |  |
| --- | --- | --- |
| Company | Wait for RAN1 (Yes, No) | Comments |
| InterDigital | No | We should at least send an LS to RAN1 based on some further discussions in RAN2. For example, it would be necessary that the potential transmission opportunities to which the sensing slots are tied are aligned with the on-duration of the peer UE(s). |
| LG | Yes | We should wait for RAN1 discussion. |
| CATT | Yes |  |
| Ericsson | Yes | Sensing is in RAN1 scope. RAN1 is already informed of the potential interaction between DRX and sensing. Therefore, RAN2 shall wait for RAN1 outcome to see if there is any impact to RAN2. |

# 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
2. R2-2101723 Consideration on sidelink DRX for groupcast and broadcast; Huawei, HiSilicon
3. R2- 2101192 Issue with SL DRX Inactivity Timer for SL groupcast; Nokia, Nokia Shanghai Bell

# Annex: