**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. |
| Apple | Agree |  |
| MediaTek | Agree | This allows UE to communicate with/ access other UE even before PC5 link establishment. |
| Xiaomi | Not-agree | We understand the time period of not transmit data and the time period of not wake up to receive data may be controlled by different DRX configuration and may not be the same. We don’t need to re-define the DRX active since for GC/BC, since there was already an agreement. |
| Huawei, HiSilicon | Agree with the principle, but with comments | The principle of this question seems to mean that all parties in Bcast/Gcast may need to be aligned regarding whether a period of time is “Inactive” or “Active” for SL transmission and reception. This principle is agreeable.  However, whether there is **“a” minimum “deterministic” time period** depends on the granularity of the Bcast/Gcast DRX configurations. For example, if there is just one DRX cycle configuration in a resource pool, applying to any UE using this pool for TX/RX, then maybe there is “a” minimum time period deterministic for every UE. But as another example, if there is per service/QoS flow DRX configuration, TX/RX UE may depend on some criteria to determine its own DRX (DTX) cycle to use, as per services/QoS flows it is really to transmit or receive; in this case, it is hard to say that only “a” minimum “deterministic” time period of “Inactive/Active” applies to all UEs.  Hence, we propose to agree the basic principle we showed above, and leave the further details to the conclusions of later questions. |
| Philips | Agree |  |
| Qualcomm | Agree |  |
| Nokia | Agree |  |
| Fraunhofer | Agree |  |
| Spreadtrum | Agree |  |
| vivo | Agree |  |
| Intel | Agree |  |

## 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. |
| Apple | C | We think this can be viewed in two different points:  1) whether the NW can provide multiple different DRX configurations for BC/GC?  2) whether the UE can use multiple different DRX configuraitons at the same time for BC/GC or just choose to follow only one of them?  At least for point 1), RAN2 need to support the flexibility of NW configurarion of SL-DRX. We can further discuss point 2. |
| MediaTek | c) | We prefer c to allow more configuration granularity. We don't think one or two DRX cycle configuration can satisfy QoS requirement of diverse GC/BC services. |
| Xiaomi | c | At least, DRX configuration could be different among different groups. We don't see necessity to align DRX configuration for all groups. |
| Huawei, HiSilicon | c) | We think the DRX cycle configuration should be first *per resource pool* configuration, with multiple resource pools for both mode-1 and 2 having been enabled in Rel-16.  On top of that, we think there is no need to force Bcast and Gcast to have to be with completely the same DRX cycle configurations. Therefore, we think DRX cycle configurations for Bcast and Gcast can be *per cast type*.  Then, from the service/QoS perspective, we think it may be better to support per QoS flow or per QoS profile DRX cycle configuration for Bcast and for Gcast respectively, in each resource pool. |
| Philips | C | Agree with InterDigital |
| Qualcomm | c | Multiple DRX configurations may be formed based on service or group, or QoS. |
| Nokia | C | Obviously option a and option b are rather inflexible and having only one DRX configuration for broadcast means that the service type with the most stringent QoS requirements (requiring long DRX ON periods) determines the DRX cycle for all UEs (leading to bad power saving). |
| Fraunhofer | c | We share the view with majority companies. |
| Spreadtrum | c | Agree with InterDigital |
| vivo | a or c | One set of SL DRX configuration is simple for broadcast&groupcast. Considering the diversity of service type/QoS requirement, we can also support more sets of SL DRX configuration. |
| Intel | c | At this early stage, we have to be general enough to consider whether service type, group or QoS/PQI specific DRX configurations can be supported for both groupcast and broadcast operation. All options should be possible. |

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. |
| One way to reduce a huge number of SL DRX configuration corresponding to L2 destination IDs is to allow TX UE to distribute its SL DRX configuration for broadcast/groupcast way. Although it requires new signaling (because currently PC5-RRC message is for unicast only), this allows a more flexible SL DRX configuration for broadcast/groupcast. | 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. | If the SL-DRX configuraiton (cycle/offset) is determined based on the numerical values of Dest L2 ID. Then the DRX cycle will be distributed in the time domain arbitrary and UE will need to be wake up multiple different times, each for a different Destination L2 ID. This is not going to be beneficial for power savings. Thus, SL-DRX config cannot “per Dest L2 ID”. |
| Destination ID or an ID derived from destination ID if too many destination IDs to support. | For SIB-configured/preconfigured DRX configuration (if agreed), it is unknown how to divide the DST L2 IDs, so as to associate DRX configurations respectively to each group of DST L2 IDs. Especially considering the many DST L2 ID values available, i.e. 2^24 ID values, potentially many groups of DST L2 IDs need to be exhausted, thus impractical for configuration. |
|  | The granularity is overrefined. The DRX configuraiton singnaling overhead may be large especially in SIB, and it is also hard how to divide groups. |
|  |  |

**Position for Question Q3a:**

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| --- | --- |
| **Support:** | InterDigital, Fujitsu, Ericsson, MediaTek, Xiaomi, Huawei, HiSilicon (OK for RRC\_CONNECTED UEs), Qualcomm, Intel |
| **Do not support:** | OPPO, LG, Apple, Fraunhofer, Spreadtrum, vivo |
| **Neutral/ flexible:** | Philips, Nokia |

**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. |
| SL UEs may not be general-purpose UEs, but a customized unit only for certain use cases (e.g, public safety), One of the advantages per service configuration is to allow a customized SL-DRX configurations to be supported only for such a service. | 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). |
|  | Due to the function split, AS shall not be allowed to see “service type information” directly, which is a principle not able to be broken. |

**Position for Question Q3b:**

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| **Support:** |  |
| **Do not support:** | OPPO, InterDigital, Fujitsu, LG, Ericsson, Xiaomi, Huawei, HiSilicon, Philips, Fraunhofer,vivo |
| **Neutral/ flexible:** | Apple, MediaTek, Qualcomm, Nokia, Spreadtrum, Intel |

**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. |  |
| Regarding the concern of RX UE monitoring multiple SL-DRX cycles in different PQI levels, I think this can be sovled by design the DRX cycle to be in [T, T/2, T/4…] with overlapping onDuraiton, so that the UE only choose one cycle to follow all traffic for all PQIs above a threshold level. |  |
| Able to make DRX operation adaptive to the QoS requirements of the Bcast/Gcast data actually transmitted/received. |  |

**Position for Question Q3c:**

|  |  |
| --- | --- |
| **Support:** | InterDigital, LG, Apple, Huawei, HiSilicon, Philips, Nokia, Fraunhofer, vivo, Intel |
| **Do not support:** | Fujitsu, Xiaomi |
| **Neutral/ flexible:** | OPPO, Ericsson, MediaTek, Qualcomm, Spreadtrum |

**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.  Zone based resource pool configurations are no longer supported in R16. We think this only work for a very big geographical area, not for small-size zones. But for OOC UE, geographica area concept is already supported, there is no need to do any extra granaualrity in a smaller scale. |
| For broadcast and groupcast the UE can adapt its DRX configuration based on overlapping zones/areas, where each zone may adapt to a DRX configuration that corresponds to the vehicular risk level of the zone. The geo-location based SL DRX configuration is especially suitable for vulnerable road user and/or pedestrian-type UEs (those types of UEs for which DRX is relevant). Here the DRX related zone can be different from the already defined terminology “zone” in LTE V2X and NR SL for resource selection in ooc/mode 2. | It is just a solution from which, however, no obvious benefits are foreseen. |
| DRX ON-durations can be pre-configured considering geo-location. For example, if different DRX configurations are associated to a geo-location e.g. a zone ID, the number of UEs simultaneously transmitting in the same active time is reduced. This way reliability could be improved due to less interference. In addition, this could help in saving battery power for P-UEs in locations where they are not interacting with V-UEs. |  |

**Position for Question Q3d:**

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| --- | --- |
| **Support:** | Fujitsu, Nokia, Fraunhofer |
| **Do not support:** | OPPO, LG, Ericsson, Apple, MediaTek, Huawei, HiSilicon, Qualcomm. Spreadtrum, vivo, Intel |
| **Neutral/ flexible:** | InterDigital, Xiaomi, Philips |

**Q3e: Additional Option**

Please explain briefly here:

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| --- | --- |
| **Arguments in favour** | **Arguments opposing** |
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**Position for Question Q3e:**

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































# 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: