3GPP TSG-RAN WG2 Meeting #116 Electronic R2-211xxxx

**Online, 1st – 12th November, 2021**

**Agenda item: 8.15.2**

**Source: NEC**

**Title: [AT116-e][704][V2X/SL] Need of additional new considerations (NEC)**

**WID/SID: NR\_SL\_enh-Core - Release 17**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

* [AT116-e][704][V2X/SL] Need of additional new considerations (NEC)

 **Scope:** Discuss the need of additional new aspects proposed in P1/R2-2109722, P4/R2-2109812, P1/R2-2109937, P1/R2-2110062, P12/R2-2110155, P8/R2-2110938, P1-P2/R2-2111119, and possible solutions if the need is agreed.

 **Intended outcome:** Discussion summary in R2-2111421

 **Deadline:** 11/8, 17:00 UTC

# 2 Summary of proposals in contributions

This email discussion is to summarize the Tdocs and proposals listed below with an intention to come up with a list of proposals that are agreeable during the related online discussion.

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| Tdoc# | Proposals |
| [R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) | Proposal 1 RAN2 to discuss to introduce a new MAC CE to indicate DRX operation suspend/resume. |
| [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip) | Proposal 4: RAN2 to consider the SL DRX configuration for SL groupcast may include one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle. |
| [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) | Proposal 1: RAN2 to define the inactivity timer maintenance rules for groupcast transmissions with MCR |
| [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip) | Proposal 1 RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations. |
| [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip) | Proposal 12. The solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation should be discussed in RAN2. |
| [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip) | Proposal 5: For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it.  |
| [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip) | Proposal 1: An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB. Proposal 2: In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration. |

Rapporteur would like to encourage companies especially the proponents of the above (and other, if any) potential solutions to comment and explain more on motivations if the rapporteur’s summary of each proposal is insufficient.

# 3 Discussion

Since contributions/proposals have a wild variety, so we discuss them one by one.

## 3.1 [R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) P1

[R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) focused on the following scenarios and discussed the DRX suspend/resume mechanism.

1. a RX-UE is involved into more than two SL unicast communications in which individual TX-UEs deliver contradictory DRX configurations
2. a RX-UE is involved into SL unicast and groupcast/broadcast communication having contradictory DRX configurations

For simplification, we only show Figure 2 of scenario (2) here. The contribution proposed

**Proposal 1 RAN2 to discuss to introduce a new MAC CE to indicate DRX operation suspend/resume.**

Procedure with DRX operation suspend/resume indication is illustrated in Fig.3.



Figure 2 A RX-UE is involved into SL unicast and groupcast/broadcast communication having contradictory DRX configurations



Fig.3. Procedure with DRX operation suspend/resume indication

**Question 1:** As stated in the contribution, when the RX-UE cann’t harmonize DRX configuration 1 and 2 to find out a compromised configuration (e.g., from Uu and sidelink DRX configuration alignment pespectives), the only thing RX-UE can do is to quit from sidelink DRX operation and monitor PSCCH continuesly. Do companies agree with the above observation?

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| Company | Responses  | Comments |
| Ericsson | No | If there are multiple DRX configurations which are not overlapping, it can be either due to bad configuration or it is infeasible to enable DRX. In our mind, how to align DRX configurations can be up to TX UE’s gNB or TX UE implementation. No further enhancement is needed in this release.  |
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**Question 2:** As stated in the contribution, in the above case, a DRX configuration suspend/resume indication from RX-UE to TX-UE illustrated in Fig.3 is beneficial for optimization of both QoS (i.e., service performance) and power saving performance. Do companies agree with the above observation? If companies have other pontential solutions in their mind, please state them in the Comments column.

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| --- | --- | --- |
| Company | Responses  | Comments |
| Ericsson | No | If there are multiple DRX configurations which are not overlapping, it can be either due to bad configuration or it is infeasible to enable DRX. In our mind, how to align DRX configurations can be up to TX UE’s gNB or TX UE implementation. No further enhancement is needed in this release.  |
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**Question 3:** If the answer of Question 2 is “Yes”, the next issue is how to send the DRX configuration suspend/resume indication from RX-UE to TX-UE. Do companies agree with P1 to introduce a new MAC CE? If companies have other pontential solutions in their mind, please state them in the Comments column.

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## 3.2 [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip) P4

------Quote from [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip)-----

## Congestion issue related to SL DRX configuration

### SL groupcast

It has been agreed in RAN2 that the SL DRX configuration including SL DRX cycle and ON duration for SL groupcast is per QoS profile of the SL groupcast. This means that different SL groups, regardless of the group size or traffic demands aggregated from all Tx UE members of a SL group during the SL DRX ON duration of a given SL DRX cycle, may have the same SL DRX configuration. On the one hand, the SL DRX configuration with the SL DRX ON duration as short as possible is preferred from the power saving perspective. On the other hand, as the need for SL transmissions of a SL group for SL groupcast may vary from one SL DRX cycle to another SL DRX cycle depending on, e.g., how many UE members of the SL group and how much each of these UE members need to transmit to the SL group in a given SL DRX cycle, the shorter the SL DRX ON duration the higher the congestion is for the SL group. The congestion here may include possible collisions of SL transmissions from different UE members of the SL group, either with each other within the SL group or with other UEs in proximity outside the SL group. This is caused by using the same or at least overlapping time-frequency resources for the SL transmissions. The half-duplex issue within the SL group that different UE members of the SL group transmit to the SL group simultaneously and miss to receive each other transmissions may be considered as part of the congestion. Therefore, the SL DRX configuration for SL groupcast may need to be adaptable to cope with the congestion issue specific to a SL group while maximizing power saving for the SL group. One option is to have the SL DRX configuration per QoS profile, as agreed so far in RAN2, but with one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle.

**Proposal 4:** RAN2 to consider the SL DRX configuration for SL groupcast may include one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle.

------Quote from [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip)-----

**Question 4:** Do companies agree with P4 to include one or more settings for the SL DRX ON duration in SL DRX configuration for SL groupcast? If companies have other pontential solutions in their mind, please state them in the Comments column.

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| Company | Responses  | Comments |
| Ericsson | No | Allowing multiple settings of ON duration in the SL DRX configuration, would cause additional design efforts for RAN2. The issue elaborated is relevant, however it can be categorized as optimization issue. No need to address it in Rel-17 given RAN2 has limited time. |
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## 3.3 [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) P1

------Quote from [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) -----

## SL DRX Timers

Details for the inactivity timer have, for the most part, been addressed by RAN2. Another groupcast specific issue related to the inactivity timer is the handling of transmissions with MCR. In NR V2X, transmissions outside of the MCR are assumed to be treated as best effort by the system (e.g. RX UE sends HARQ feedback only when it is within the MCR). Along the same lines, whether an RX UE should consider receptions where it is outside the MCR when deciding whether to (re)start the inactivity timer should be further discussed by RAN2. From a power savings perspective, there may be no benefit in restarting the inactivity timer when the UE is outside the MCR for a transmission. On the other hand, the UE may quickly fall within the MCR of additional transmissions after this if the UE is moving. A safer approach may therefore be to allow the UE to ignore transmissions with respect to resetting of the inactivity timer only when the UE is well outside the MCR.

Proposal 1: ***RAN2 to define the inactivity timer maintenance rules for groupcast transmissions with MCR***

------Quote from [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) -----

**Question 5:** Do companies agree with P1 to define the inactivity timer maintenance rules for groupcast transmissions with MCR?

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| Company | Responses  | Comments |
| Ericsson | No | The issue elaborated is relevant, however it can be categorized as optimization issue. No need to address it in Rel-17 given RAN2 has limited time. |
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**Question 6:** If the answer of Question 4 is “yes”, what is the preferred rule? Please provide details in the following table.

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## 3.4 [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip) P1

-----Quote from [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip)-----

## 2.1 Traffic filtering based on SL DRX configuration in RX UE

SL DRX is not designed as legacy Uu to have one SL DRX configuration per MAC. Instead, there are multiple active SL DRX configurations supported by a single UE. If a UE supports different cast-types, there are different SL DRX configurations for each cast type. If a UE communicates with multiple peer UEs, then there are different SL DRX configurations for each of those peer UE. Each of these SL DRX configurations is also associated with its own drx-inactivity timer. Hence, the overall DRX ACTIVE time is made up of each of those “exclusive DRX active periods” which is configured separately.

**Observation 1 The overall RX UE DRX Active time in SL interface is the union superset of individual active periods created by individual exclusive SL DRX configurations.**

Therefore, from an RX UE perspective, instead of receiving any traffic in which the RX UE is interested at any DRX active time, the RX UE could filter incoming traffic based on the “exclusivity“ of SL DRX configuration.

For example, in each of “exclusive DRX active period”, the UE can

1. Decode SCI cast type, and only continue to decode TB if the cast-type matches the cast-type associated with SL DRX configuration(s) of the current active period.
2. Decode the MAC address and only pass the received packet to upper layer if the destination address or <src, dst> address pair matches the address(es) associated with current SL DRX configuration(s) of the current active period.

The above RX UE filtering behavior assumes that sender will always precisely track the active time of a receiver according to SL-DRX configuration(s). However, different from Uu interface, this kind of tracking is proven to be difficult if communication involves multiple parties. TX UE may not always track and follow RX UE’s SL DRX. For example:

1. SL groupcast may involve multiple sender and multiple receiver, and not all the transmissions are correctly received by all group members. So, the DRX ACTIVE time of a particular group member UE is not always in sync among other group members.
2. Mode 1 UE may be allocated SL grants (DG or CG) which are not in sync with SL DRX active time of the SL destinations, as it is hard to sync among three-party <TX UE, RX UE, gNB> on-the-fly without introducing heavy Uu and SL RRC signaling overhead. So, occasionally, TX UE may need to use the SL grant in a time which does not match DRX of RX UE. This could also be true for mode 2 TX UE because resource selection will be more challenging when SL-DRX in RX UE is considered.

**Observation 2 RX UE filtering with SL DRX is based on ideal assumption that TX UE will always track DRX ACTIVE time of RX UE(s) precisely, but that put an overly restrictive requirement for TX UE implementation and resource usage.**

If RX UE enforces packet filtering based on SL DRX configuration, then occasional “outlier” traffic which does not match SL DRX configuration will be dropped by RX UE. That will hurt both latency and reliability performance, from the perspective of QoS. Also, this filtering behavior provides little benefits to RX UE power saving because RX UE has already decoded PSCCH and/or PSSCH for this slot. Anyway, the overall sidelink DRX ACTIVE time for a RX UE is always a superset of “exclusive DRX active periods” and would like to be longer than each TX UE is configured to be known. While TX UE tries its best to follow its perceived DRX active time of RX UE, RX UE shall be more forgiving on this aspect so that the overall system performance is not unnecessarily impacted. Thus, we propose:

**Proposal 1 RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations.**

-----Quote from [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip)-----

**Question 7** Do companies agree with Observation 1 “ The overall RX UE DRX Active time in SL interface is the union superset of individual active periods created by individual exclusive SL DRX configurations”?

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| Company | Responses  | Comments |
| Ericsson | Yes |  |
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**Question 8** Do companies agree with Observation 2 “RX UE filtering with SL DRX is based on ideal assumption that TX UE will always track DRX ACTIVE time of RX UE(s) precisely, but that put an overly restrictive requirement for TX UE implementation and resource usage**.**”?

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| Company | Responses  | Comments |
| Ericsson | Yes |  |
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**Question 9** Do companies agree with Proposal 1 “RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations.”?

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| Company | Responses  | Comments |
| Ericsson | Yes | Share the same understanding as in this paper. We shall focus on the core functionalities, rather than optimization. |
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## 3.5 [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip) P12

----Quote from [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip)----

## 2.7 HARQ combining & SL DRX

If Rx UE performs HARQ combining under SL DRX operation, there could be a case where Rx UE performs combining the different packets, so that the decoding performance is degraded. In groupcast option 2 (NACK-only HARQ feedback mode), when Rx UE fails to decode a packet #A received in Rx UE’s SL DRX On duration and Tx UE retransmits the packet #A in the Rx UE’s extended SL DRX Active duration based on the HARQ NACK reception, if Rx UE fails to decode PSCCH/PSSCH of the retransmission (DTX case), TX UE considers the retransmission as successful because there is no HARQ ACK response, Then TX UE tries to transmit the next packet #B in the expected Rx UE’s extended Active duration based on the previous successful transmission. But Rx UE didn’t extend its SL DRX Active duration as it didn’t successfully receive the retransmitted packet, therefore again didn’t receive the packet #B, which in turn makes Tx UE mistake it as a successful transmission (due to no NACK transmission). At the Rx UE’s SL DRX On duration of the next SL DRX cycle, it’s possible that Tx UE transmits a new packet #C with HARQ process number and NDI as same as those for the packet #A transmission. In this case, Rx UE may tries HARQ combining both the packet #A and the packet #C, which totally destroys decoding.

One of the solution to the above situation is to use a PDB that was known from the QoS profile of the associated previous transmission. After decoding failure on the received packet, if Rx UE didn’t receive a retransmission packet until the PDB, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission. The other solution is to use a specific timer associated to the destination ID of the transmission. If Rx UE receives a new packet regardless of its success or failure in decoding, Rx UE starts to run the timer and if Rx UE didn’t receive any retransmission packet until the timer ends, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission.

**Observation 8. In SL DRX operation, DTX case may cause a wrong HARQ combining especially in groupcast option 2 (NACK-only HARQ feedback mode).**

**Proposal 12. The solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation should be discussed in RAN2.**

----Quote from [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip)----

**Question 10:** Do companies agree with Observation 8 “In SL DRX operation, DTX case may cause a wrong HARQ combining especially in groupcast option 2 (NACK-only HARQ feedback mode)?

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| Company | Responses  | Comments |
| Ericsson | Yes |  |
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**Question 11:** Do companies agree with P12 to discuss the solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation? If the answer is “yes”, please also provide considerations/views on the potential solutions.

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| Company | Responses  | Comments |
| Ericsson | Yes | The issue is mainly due to misaligned active state between UEs in case of GC and BC. The misalignment is mainly due to the conditional timers (inactivity timer, HARQ RTT, HARQ retransmission timer etc).In our mind, the issue is relevant, however, the issue is rather complex. RAN2 shall aim for a simplified option, e.g., TX UE only allows to initiate an initial transmission during ON-duration. Alternatively, RAN2 down-prioritizes the issue in Rel-17, which is also ok to us. |
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## 3.6 [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip) P5

----Quote from [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip)----

Additional consideration on SL DRX on-duration timer and inactivity timer

At RAN2#115-e, it was agreed for GC/BC, SL DRX on-duration timer and inactivity timer are configured per QoS profile. On top of this agreement for GC, we think the number of group members should be considered in the determination of SL DRX on-duration timer and SL DRX inactivity timer lengths. For example, shorter SL DRX on-duration and inactivity timers for GC with the small group members while longer SL DRX on-duration and inactivity timers for GC with the big group members. Otherwise small SL DRX on-duration and inactivity timer would bring much collisions in the resource allocation for GC with the big group members or large SL DRX on-duration and inactivity timer would bring much power consumption for GC with the small group members. Note in Rel-16 SL, the scenario where the UE knows the number of group members in GC is already supported.

[Proposal 5]: For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it.

---Quote from [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip)----

**Question 12:** Do companies agree with P5 “For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it.”?

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| Company | Responses  | Comments |
| Ericsson | comments | Basically, the issue can be categorized as optimization/implementation. For the UEs in coverage, the gNB can provide configurations considering the load situation, i.e., the number of group members. As a conclusion, we don’t think RAN2 shall spend efforts to discuss this issue. |
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## 3.7 [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip) P1-P2

----Quote from [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip)-----

# Configuration of On Duration

**Start of SL DRX On duration**

When SL TX UE operates in mode 1, it receives SL grant from gNB first, then initiates the SL transmission to SL RX UE. In general, it takes some time for SL TX UE to process the SL grant and data before the transmission. During this time, SL RX UE doesn’t need to monitor SL channel, as SL TX UE is unable to start transmission during the processing of SL grant and data. As shown in Figure 1, there is an Offset between the start of SL TX UE’s On duration on Uu and the start of SL RX UE’s On duration on SL. The value of the Offset depends on SL TX UE’s capability, i.e., how long it takes to process the SL grant and data. Starting the SL DRX On duration after the Offset from the Uu DRX On starting point would be beneficial to SL Rx UE for power saving.



**Figure 1 Offset between SL TX UE's On duration and SL RX UE's On duration**

***Observation 1: An offset between SL TX UE’s On duration start and SL RX UE’s On duration start is needed, which may be based on UE’s capability for processing a grant and preparing a transmission.***

***Proposal 1: An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB.***

***Length of SL DRX On duration***

It is possible that an SL TX UE unicasts with multiple SL RX UEs, and the SL RX UEs’ On durations may not be overlapped and should be aligned with SL TX UE’s On duration on Uu link.

Useful information for SL TX UE’s gNB to determine an appropriate On duration for SL may include:

* Traffic characteristics: packet size may be used to determine the length of the On duration. If a UE gets large packets for transmission, then it may require longer active time.
* QoS requirement: On duration should be selected based on QoS requirement.

***Observation 2: gNB may optimize SL RX UE’s SL DRX On duration based on traffic characteristics, QoS requirement.***

***Proposal 2: In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration.***

----Quote from [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip)-----

**Question 13:** Do companies agree with P1 “An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB.”?

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| Company | Responses  | Comments |
| Ericsson | No | This is an optimization issue, the additional gain would be rather marginal. |
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**Question 14:** Do companies agree with P2 “*In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration.*”?

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| Company | Responses  | Comments |
| Ericsson | yes | But TX UE can use the existing *SidelinkUEInformationNR* to report the information to the gNB. no additional spec change is needed. |
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# 4 Conclusion

TBD

# 5 References

[1] R2-2109722, “Discussion on DRX suspend/resume mechanism”, NEC

[2] R2-2109812, “Further issues on SL DRX”, Nokia, Nokia Shanghai Bell

[3] R2-2109937, “Remaining aspects on SL DRX Timers”, InterDigital

[4] R2-2110062, “Discussion on Remaining issues of SL DRX”, Apple

[5] R2-2110155, “Discussion on remaining issues and further consideration on SL DRX”, LG Electronics France

[6] R2-2110938, “Open issues on SL DRX operation in groupcast”, Samsung Research America

[7] R2-2111119, “Discussion on Uu DRX and SL DRX Alignment”, Qualcomm Finland RFFE Oy