**3GPP TSG-RAN WG2 Meeting #115-e *R2-210xxxx***

**Electronic, 16th – 27th August, 2021**

**Agenda item: 8.15.2**

**Source: Huawei, HiSilicon (Rapporteur)**

**Title: [POST114-e][705][V2X/SL] Discussion on remaining FFSs and open issues in Uu DRX timer impacts (Huawei, HiSilicon)**

**Document for: Discussion and decision**

# Introduction

This is the summary of the following email discussion:

* [POST114-e][705][V2X/SL] Discussion on remaining FFSs/open issues in Uu DRX timer impacts (Huawei)

 **Scope:** Discuss remaining FFSs and open issues in Uu DRX timer impacts and decide the most agreeable option. Good to have two sub-deadlines. First one is to collect companies’ options, and the second one is for the discussion and decision.

 **Intended outcome:** Discussion summary

**Deadline:** Long email discussion

Companies are requested to provide their views on the issues listed in this document.

# Alignment between Uu DRX and SL DRX for unicast

# **Alignment between Uu DRX and SL DRX for the RX UE (up to gNB)**

In last meeting, regarding which entity determines the SL DRX configuration, RAN2 agreed to adopt TX centric mechanism based on the assistance information from RX-UE as a baseline.

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| Agreements on TX-UE centric or RX-UE centric DRX configuration determination1: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other UE as Rx-UE, support signalling exchange including both 1) Signaling-1: signalling from RX-UE to TX-UE, and 2) Signaling-2: signalling from TX-UE to RX-UE.2: For SL unicast, TX-UE centric DRX configuration based on the assistance information from RX-UE is agreed as baseline. 2a: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other as Rx-UE, signaling-1 (Rx->Tx) is carried via a new PC5-RRC message, from Rx-UE to Tx-UE2b: In SL unicast, for DRX configuration of the direction where one UE as Tx-UE and the other as Rx-UE, signaling-2 (Tx->Rx) is carried via RRCReconfigurationSidelink, to deliver DRX configuration from Tx-UE to Rx-UE3: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other UE as Rx-UE, when Tx-UE is in-coverage and in RRC\_CONNECTED state, Tx-UE may report the information received in signaling-1 (Rx->Tx) to the serving network4: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other as Rx-UE, when Tx-UE is in-coverage and in RRC\_CONNECTED state, Tx-UE may obtain DRX configuration from dedicated RRC to generate signalling-2 (Tx->Rx)5: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other as Rx-UE, when Rx-UE is in-coverage and in RRC\_CONNECTED state, Rx-UE report the DRX configuration received in signalling-2 (Tx->Rx) to the serving network |

In addition, RAN2 achieved the following agreements for the alignment of Uu DRX and SL DRX.

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| Agreements on alignment between Uu DRX and SL DRX3: For at least SL RX-UEs in RRC CONNECTED, the alignment of Uu DRX and SL DRX is up to gNB. FFS for SL TX-UE.4: RAN2 to down-scope alignment of Uu DRX and SL DRX for UEs in RRC IDLE and RRC INACTIVE from Rel-17 |

However, it seems not clear which gNB is responsible for the alignment and rapporteur think this should depend on the RRC states of both TX UE and RX UE. As we have already down-scope the alignment of Uu DRX and SL DRX for UEs in RRC IDLE and INACTIVE from Rel-17, for now only RX UE in RRC CONNECTED state will be considered. There are two cases as listed below. Please note Question 1~3 are for these cases and tit is assumed only the gNB is responsible for the alignment.

Case 1: Both TX UE and RX UE are in RRC CONNECTED

Case 2: TX UE is in RRC IDLE/INACTIVE and RX UE is in RRC CONNECTED

#### **Case 1: Both TX UE and RX UE are in RRC CONNECTED**

For case 1, since both UEs are in RRC CONNECTED, it is possible that either the TX UE’s gNB or the RX UE’s gNB can achieve the alignment between the Uu DRX and the SL DRX for the RX UE. The detailed procedure are assumed as below:

TX UE’s connected gNB is responsible for the alignment

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| 1. RX UE sends the assistance information, e.g., RX UE’s Uu DRX configuration to the TX UE
2. TX UE reports the assistance information to its connected gNB
3. TX UE’s connected gNB is responsible for the alignment when determining the SL DRX configuration and sends it to the TX UE
4. TX UE forwards the SL DRX configuration to the RX UE
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RX UE’s connected gNB is responsible for the alignment

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| 1. RX UE sends the assistance information to the TX UE
2. TX UE reports the assistance information to its connected gNB
3. TX UE’s connected gNB determines the SL DRX configuration and sends it to the TX UE
4. TX UE forwards the SL DRX configuration to the RX UE
5. RX UE reports the SL DRX configuration to its connected gNB
6. RX UE’s connected gNB adjusts RX UE’s Uu DRX configuration to achieve the alignment
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**Question 1: When both TX UE and RX UE are in RRC connected, which gNB is responsible for the alignment between Uu DRX and SL DRX for RX UE?**

* **Option 1: Only TX UE’s connected gNB**
* **Option 2: Only RX UE’s connected gNB**
* **Option 3: Either TX UE’s connected gNB or RX UE’s connected gNB**
* **Option 4: Both TX UE’s connected gNB and RX UE’s connected gNB**
* **Option 5: Other**

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| Company | Option | Comment |
| Huawei, HiSilicon | 4 | We think both TX UE’s gNB and RX UE’s gNB can be responsible to achieve the alignment. For example, RX UE sends RX UE’s Uu DRX configuration to the TX UE to assist TX UE’s gNB to achieve alignment as far as possible when determining the SL DRX configuration. However, it is expected when TX UE’s gNB determines the SL DRX, apart from RX UE’s Uu DRX, it will also take the corresponding SL resource configuration, the QoS requirements and/or traffic pattern of the SL service into account to guarantee the transmission performance. Thus, the SL DRX determined by TX UE’s gNB may not aligned completely with the given Uu DRX from the perspective of RX UE power saving. Then, if the SL DRX configuration could be further aligned with RX UE’s Uu DRX, RX UE reports the SL DRX configuration to its connected gNB so that its gNB adjusts RX UE’s Uu DRX configuration to achieve better alignment. Additionally, sometimes RX UE was configured with SL DRX by TX UE when RX UE was not in RRC connected and thus was not configured with Uu DRX. And soon when RX UE enters RRC connected, it is beneficial for RX UE to report the SL DRX to its serving gNB so that the gNB can determine a proper Uu DRX which is aligned with RX UE’s SL DRX from the perspective of RX UE power saving. |
| vivo | Option 4 | We have some different understanding when TX UE’s connected gNB is responsible for the alignment:1. RX UE sends the assistance information, e.g., ~~RX UE’s Uu DRX configuration to the TX UE~~

We believe, it needs to be changed to:RX UE sends the assistance information (e.g., RX UE’s preferred PC5 DRX configuration) to TX UE who considers RX UE’s Uu DRX configuration. |
| Xiaomi | 4 | TX UE’s gNB determines RX UE’s SL DRX and RX UE’s gNB determines RX UE’s Uu DRX. RAN2 has agreed the RX UE would report configured SL DRX to gNB, which enables RX UE’s gNB to adjust Uu DRX to align with SL DRX. On the other hand, RAN2 has agreed TX UE would report assistant information from RX UE to gNB, which enables TX UE’s gNB to adjust SL DRX to align with Uu DRX. Therefore, both sides are able to do the alignment. It is unnecessary to differentiate option 3 and 4, since anyway RAN2 would not restrict gNB’s implementation. RAN2 just specifies necessary signalling to support both options. |
| OPPO | See comments | Not very sure about the intention of this question. For the two solutions listed above (whether Tx/Rx UE’s gNB is responsible for the alignment), the only different procedure from UE perspective is whether the Rx UE reports SL DRX to its serving gNB which was already agreed in RAN2 #114. 5: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other as Rx-UE, when Rx-UE is in-coverage and in RRC\_CONNECTED state, Rx-UE report the DRX configuration received in signalling-2 (Tx->Rx) to the serving networkTherefore, we think maybe there is no need for this question. |
| Lenovo | Option 4 | Agree with Huawei’s view that both gNB will responsible for alignment, but has different role: Tx UE’s gNB is to determine a SL DRX according to Uu DRX of TX UE, and assistance information of Rx UE; while Rx UE’s gNB is to adjust Uu DRX of Rx UE for alignment. Also we have similar view as OPPO that Rx-UE report the SL DRX configuration to the serving network is agreement and no need to revert it. |
| LG | Option 2 | We think that an alignment between Uu DRX and SL DRX for RX UE needs to be performed in RX UE’s gNB. Moreover, we are not sure what TX UE’s gNB performs an alignment for RX UE. |
| Nokia | comments | We are not sure we understand the question (or its intention) correctly. Q1 asks “**which gNB is responsible for the alignment between Uu DRX and SL DRX for RX UE**” Only the RX-UE’s gNB can align the RX-UE Uu-DRX (inline with option 2). For the case that TX-UE and RX-UE are each connected to a separate gNB, then the TX-UE’s gNB aligns TX-UE DRX config and RX-UE’s gNB align RX-UE DRX config (in line with option 4)  |
| Ericsson | Option 4 with comments | Actually, we share the same sympathy as OPPO and Lenovo. The question itself is not needed, since the existing agreements have already defined signalizing interfaces for UE (TX or RX) to report to its gNB. That shall be sufficient. How gNB adjusts/sets DRX configuration is up to gNB’s itself implementation. Therefore, this question doesn’t give useful outcome. |
| CATT | Option 2 | This question is related to the final signalling procedure for alignment which is not easy to reach conscious. For the current case, TX UE’s connected gNB, or RX UE’s connected gNB, or both of TX UE’s connected gNB and RX UE’s connected gNB **can** achieve the alignment operation in principle. The difference is the signaling complexity and alignment effect. Indeed, the question is that which gNB is **responsible for** the alignment but not which gNB **can**, and considering the existing conclusions, we prefer option2. |
| Apple | Option 2 with comment | First, we do not believe RX UE’s Uu DRX need to be aligned with RX UE’s SL DRX unless we assume RX UE use a single RX chain for both interfaces (which RAN2 has not yet agreed to support). If two separate RX chains are used, SL RX and Uu RX can occur independently.Second, I do not think agree with Option 2 means endorsing the procedure listed ahead of this question. If RX UE’s serving gNB determines there is some reason to do alignment, then this is completely up to the RX UE’s gNB to change the Uu DRX configuration to align with SL-DRX configuration of RX UE. The SL-DRX configuration determination shall still follow the Tx-centric agreements which has been reached in the last meeting. |

During last meeting, some companies pointed out that if both TX UE and RX UE communicate with their gNB for alignment, then the gNBs’ behaviour can conflict with each other. In order to avoid this kind of conflict, e.g. Option 1 for Question 1 can be chosen and in this case, in order to only rely on the TX UE’s connected gNB to achieve the alignment, rapporteur think the assistance information from the RX UE should at least contains the RX UE’s Uu DRX configuration and the RX UE should not report the received SL DRX configuration to its connected gNB to avoid that the RX UE’s serving gNB makes conflicting alignment.

**Question 2a: If the answer to Question 1 is Option 1, do companies agree that the assistance information from RX UE should at least contain RX UE’s Uu DRX configuration?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
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**Question 2b: If the answer to Question 1 is Option 1, do companies agree that the RX UE should not report the received SL DRX configuration to its connected gNB?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| OPPO |  | It is already agreed no matter option1 or option2, we do not think there is a need to revert such agreement. |
| Ericsson | comments | Agree with OPPO, this question shall be avoided. Rapporteur shall not create questions to revert existing agreements unless there is clear deficiency observed.  |
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On the other hand, if Option 2 is chosen for Question 1, in order to only rely on the RX UE’s connected gNB to achieve the alignment, rapporteur think the assistance information from the RX UE should not contain the RX UE’s Uu DRX configuration in order to avoid that the TX UE’s serving gNB makes partial alignment when determining the SL DRX configuration. The RX UE should report the received SL DRX configuration to its gNB to adjust the RX UE’s Uu DRX configuration for the alignment.

**Question 2c: If the answer to Question 1 is Option 2, do companies agree that the assistance information from RX UE should not contain RX UE’s Uu DRX configuration?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| LG | Yes | We think that RX UE’s Uu DRX itself is not needed. When a RX UE transmits a recommended SL DRX (via assistance information) to the TX UE, it is simple to convey a recommended SL DRX which is aligned Uu DRX of the RX UE. |
| CATT | Yes | What Rx UE sends to Tx UE is the RX UE’s preferred PC5 DRX configuration, not Rx UE’s Uu DRX configuration. |
| Apple | Yes | Uu DRX of RX UE is only between RX UE’s gNB and RX UE. No need to convey it to the peer UE |
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**Question 2d: If the answer to Question 1 is Option 2, do companies agree that the RX UE should report the received SL DRX configuration to its connected gNB?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| OPPO |  | It is already agreed no matter option1 or option25: In SL unicast, for DRX configuration of each direction where one UE as Tx-UE and the other as Rx-UE, when Rx-UE is in-coverage and in RRC\_CONNECTED state, Rx-UE report the DRX configuration received in signalling-2 (Tx->Rx) to the serving network |
| Ericsson | comments | Agree with OPPO  |
| CATT | Yes | As OPPO mentioned, it's agreed already. |
| Apple | Yes | Agreed in the last RAN2 meeting |
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However, if Option 3 is chosen for Question 1, i.e., only one gNB from two connected gNBs is to determine the alignment, some restriction on the RX UE’s behaviour should be introduced, i.e., the RX UE is not allowed to include the RX UE’s Uu DRX configuration into assistance information and also to report the received SL DRX configuration to its serving gNB.

**Question 2e: If the answer to Question 1 is Option 3, do companies agree that the RX UE is not allowed to include the RX UE’s Uu DRX configuration into assistance information and also to report the received SL DRX configuration to its serving gNB?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
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**Question 2f: If the answer to Question 1 is Option 3, are there any other mechanisms needed to avoid the conflicting alignment from two connected gNBs?**

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| Company | Comment |
| OPPO | Do not think the “conflicting alignment from two connected gNBs” really exist since Tx side gNB only take charge of SL DRX plus Uu DRX of Tx UE and Rx side gNB only take charge Uu DRX of Rx UE:1. The Rx UE send assistance information (may contain both Uu DRX and SL DRX of other links) to Tx UE;
2. The connected Tx UE sends the assistance information to its gNB
3. Tx UE’s gNB decides SL DRX of this link considering assistance information from the Rx side (may achieve full/partial overlapping or fail to achieve overlapping)
4. Tx UE send the SL DRX configuration to Rx UE
5. Connected Rx UE reports SL DRX to its serving gNB
6. Rx UE’s gNB decides whether adjust Uu DRX of Rx UE based on SL DRX
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| Ericsson | Agree with OPPO. There is no conflict between gNB’s configurations. Since they control different configurations. TX side gNB controls TX UE’s Uu DRX plus SL DRX. While RX side gNB may update the Uu DRX of RX UE when RX UE reports the received SL DRX to its gNB. again, how gNB behave is up to gNB’s implementation. RX UE’s gNB is not allowed to update SL DRX since SL DRX shall be determined by TX UE and TX UE’s gNB. This is aligned with TX UE centric option. RAN2 has already agreed TX centric to be the baseline. |
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#### **Case 2: TX UE is in RRC IDLE/INACTIVE and RX UE is in RRC CONNECTED**

For case 2, since the TX UE is in RRC IDLE/INACTIVE, it is not possible to rely on the TX UE’s serving gNB to achieve the alignment, and only the RX UE’s serving gNB should be responsible for the alignment. The detailed procedure are assumed as below:

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| 1. RX UE sends the assistance information to the TX UE
2. TX UE determines the SL DRX configuration
3. TX UE sends the SL DRX configuration to the RX UE
4. RX UE reports the SL DRX configuration to its connected gNB
5. RX UE’s connected gNB adjusts RX UE’s Uu DRX configuration to achieve the alignment
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**Question 3: When TX UE is in RRC IDLE/INACTIVE and RX UE is in RRC CONNECTED, do companies agree that only the RX UE’s serving gNB is responsible for the alignment of Uu DRX and SL DRX for RX UE?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | Since the TX UE is in RRC IDLE/INACTIVE, it is not possible to rely on the TX UE’s serving gNB to achieve the alignment. Therefore, only the RX UE’s serving gNB can be responsible for the alignment.  |
| Vivo | Yes | Same comments as in Q1.If RX UE’s assistance information has considered RX UE’s Uu DRX, TX UE seems to determine the SL DRX configuration based on RX UE’s Uu DRX at least to align offset. |
| Xiaomi | No, both TX UE and RX UE’s serving gNB can achieve the alignment | RAN2 didn’t exclude the TX UE to provide aligned SL DRX. It’s still FFS according to following agreement.

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| For at least SL RX-Ues in RRC CONNECTED, the alignment of Uu DRX and SL DRX is up to gNB. FFS for SL TX-UE |

If assistance information includes RX UE’s Uu DRX information, TX UE can provide aligned SL DRX to RX UE, which can be up to TX UE’s implementation. There is no spec impact for TX UE to do the alignment.Both TX UE and RX UE’s serving gNB could do the alignment. |
| OPPO | Yes |  |
| Lenovo | No, Tx UE can also achieve the alignment | Rx UE can still include Uu DRX into assistance information, and in this case, Tx UE will try to align SL DRX and Uu DRX as much as possible. In this case, the procedure will be very similar to both UE in Connected case, except Tx UE does not report assistance information to its serving gNB. |
| LG | Yes |  |
| Nokia | yes |  |
| Ericsson | No | Agree with Xiaomi and Lenovo. Both TX UE and RX UE’s gNB shall take the responsibility for alignment. |
| CATT | Yes | In our understanding, for simplicity, a unique solution should be used for all cases. That is no matter Tx UE is in which RRC state, the Uu/SL DRX alignment for Rx UE should only be performed by Rx UE’s serving gNB. |
| Apple | Yes with comment | Again, we do not believe the alignment in RX UE side is needed. But if gNB want to adjust its Uu DRX configuration to algin with SL DRX, it is up to gNB implementation. |

**Question 3a: If the answer to Question 3 is yes, do companies agree that the assistance information from RX UE should not contain RX UE’s Uu DRX configuration?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | Since it has been agreed that the alignment is up to gNB, when TX UE is in RRC\_IDLE/INACTIVE, it can only rely on RX UE’s gNB for the alignment. If the RX UE’s Uu DRX configuration is included in the assistance information, the TX UE may perform the alignment when determining the SL DRX configuration which may cause conflict with the RX UE’s connected gNB and should not be allowed.  |
| vivo | No | No need to have the explicit RX UE’s Uu DRX configuration field but implicitly include the preferred PC5 DRX configuration. |
| Xiaomi | No | This question implies RX UE has to differentiate whether TX UE is in CONNCTED or non-CONNECTED to decide the content of assistance information. But the TX UE’s state is not available at RX UE side. We prefer common solution.Besides, we don't think there is conflict. The assistance information including RX UE’s DRX is provided to TX UE during negotiation phase. If TX UE could provide aligned SL DRX, RX UE’s gNB doesn’t need to adjust Uu DRX. If the SL DRX is not aligned with Uu DRX, RX UE’s gNB could adjust Uu DRX to align with SL DRX. There should be no conflicting. |
| Lenovo | No | See response in Q3 |
| LG | Yes | RX UE’s Uu DRX configuration itself is not needed. |
| Nokia | yes |  |
| Ericsson | no | As Xiaomi mentioned, it is not preferred to have a solution for defining assistance information content based on TX UE’s RRC state, which is not known (or is unnecessary to be known) to RX UE. Also, there is no conflict. Since TX UE determines SL DRX, while RX UE’s gNB may decide to update Uu DRX of RX UE, however, RX UE’s gNB shall not update SL DRX, since it shall be determined by TX side.  |
| CATT | Yes | What Rx UE sends to Tx UE is the RX UE’s preferred PC5 DRX configuration, not Rx UE’s Uu DRX configuration.  |
| Apple | Yes | Same as Q2c |

**Question 3b: If the answer to Question 3 is yes, do companies agree that the RX UE should report the received SL DRX configuration to its connected gNB?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | RX UE should report the received SL DRX configuration to its connected gNB so that its gNB can adjust RX UE’s Uu DRX configuration to achieve the alignment. |
| Vivo | Yes | Anyway reporting mechanism is needed. |
| OPPO | Yes | It’s already agreed. |
| LG | Yes |  |
| Nokia | Yes |  |
| Ericsson | Yes | This is already agreed. This question is not needed. |
| CATT | Yes | It’s already agreed. |
| Apple | Yes |  |

# **Alignment between Uu DRX and SL DRX for the RX UE (up to UE)**

During the online discussion of last meeting, it was pointed out for mode 2 operation and when the TX UE is in RRC CONNECTED mode, the TX UE may not need to report the assistance information to its gNB. Instead TX UE can determine the SL DRX configuration by itself. Rapporteur interpreted that’s why “may” was added to some of the related agreements. As achieving the alignment could also be done by TX UE itself, as in determine the SL DRX configuration, rapporteur would like to check companies’ view on this.

**Question 4: When both TX and RX Ues are in RRC CONNECTED, for mode 2 operation, do companies agree that the TX UE is allowed to determine the SL DRX configuration by itself?**

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| Huawei, HiSilicon | No | We think a unified mechanism for mode 1 and mode 2 operation is beneficial for reducing spec complexity. |
| Vivo | No | Furthermore, we should follow the same rule as R16 SL configuration, i.e., SL configuration including DRX of connected TX UE shall be acquired from its serving cell via dedicated signalling. |
| Xiaomi | No | We don’t see the need to differentiate mode 1/2 operation and prefer common solution. |
| OPPO | No | For a connected Tx UE, the Tx configurations should be determined by gNB including SL DRX (DTX from Tx UE side) no matter mode1/2. Besides, even for mode-2 UE, it is the gNB who is in charge of sidelink resource pool configuration, so the DRX configuration which is related to resource pool configuration should be decided by gNB jointly. |
| Lenovo | No | No matter UE is in mode 1 and mode 2, SL UE configuration is preferred to be controlled by network |
| LG | No | We prefer a unified solution. |
| Nokia | No |  |
| Ericsson | No | It is preferred to have a unified solution regardless of Mode 1 or Mode 2. |
| CATT | No | Same view as HW and vivo. |
| Apple | Yes | The agreement which contains “may” in the last meeting has nothing to do with Uu/SL DRX alignment discussion. The agreement is to discuss whether there is a need to send RX UE’s assistance information to TX UE’s serving gNB to determine SL DRX of RX UE. This is not an FFS issue and not sure why this has to be discussed here.We support to keep “may” in the agreement because for mode 2 TX UE, this is not needed. The SL TX UE can determine this based on traffic pattern, mode 2 resource reservation and RX UE’s assistance information. If the SL DRX is mandated to be decided by TX UE’s gNB, as gNB has no idea of current mode 2 resource selection in TX UE, it may configure a SL DRX pattern which force TX UE to perform resource reselection, which is bad for MAC layer performance. Since gNB does not control mode 2 resource selection, it does not have more to contribute in deciding SL DRX configurations for mode 2 TX UE, we prefer to allow UE to decide itself. Regarding the argument of signalling complexity, we do not think put “OPTIONAL” in one of the RRC IE is adding signalling complexity.  |

**Question 5: If the answer to Question 4 is yes, when both TX and RX UEs are in RRC CONNECTED, for mode 2 operation do companies agree that it can be up to the TX UE to achieve the alignment between Uu DRX and SL DRX for RX UE?**

Please note the answer “Yes” is not aligned with the following agreement achieved during last meeting.

=> For at least SL RX-Ues in RRC CONNECTED, the alignment of Uu DRX and SL DRX is up to gNB. FFS for SL TX-UE

* **Yes**
* **No (Please specify the reason)**

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| Company | Yes/No | Comment |
| Apple | NO | The alignment is up to RX UE’s serving gNB . Whether RX UE’s Uu DRX is to be changed to be algined with SL DRX (determined by peer UE) is up to RX UE’s serving gNB.  |
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# **Alignment between TX UE’s Uu DRX and RX UE’s SL DRX**

During last meeting, RAN2 agreed that for mode 1, some alignment between the TX UE’s Uu DRX and RX UE’s SL DRX should be considered to ensure that the SL grant scheduled for the TX UE during its Uu DRX active time falls into the SL DRX active time of the peer RX UE.

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| Agreements on alignment between Uu DRX and SL DRX5: In case of Mode 1 scheduling, the alignment of Uu DRX of Tx UE and SL DRX of Rx UE shall be considered. FFS on how alignment is achieved. |

However, how to achieve the alignment is not clear and rapporteur think this also depends on the RRC states of both TX UE and RX UE. As this is for mode 1 operation, only TX UE in RRC CONNECTED state will be considered. There are two cases as listed below.

Case 1: Both TX UE and RX UE are in RRC CONNECTED

Case 2: TX UE is in RRC CONNECTED and RX UE is in RRC IDLE/INACTIVE

As we have already agreed to adopt TX centric mechanism as a baseline for determining SL DRX configuration, therefore for case 1 and case 2, it is not feasible to rely on the RX UE’s connected gNB or the RX UE itself to achieve the alignment between the TX UE’s Uu DRX and RX UE’s SL DRX. In addition, based on the agreement from last meeting, for mode 1, it is up to the TX UE’s connected gNB to determine the SL DRX configuration (for mode 2, whether it is up to UE to generate the SL DRX configuration relates to the conclusion on Question 4 and 5). Therefore, for case 1 and case 2, rapporteur think it is only possible to rely on the TX UE’s connected gNB to align the TX UE’s Uu DRX and the RX UE’s SL DRX. The assumed procedures are shown below.

TX UE’s connected gNB is responsible for the alignment

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| 1. RX UE sends the assistance information to the TX UE
2. TX UE reports the assistance information to the connected gNB
3. TX UE’s connected gNB is responsible for the alignment when generating the SL DRX configuration and sends it to the TX UE
4. TX UE forwards the SL DRX configuration to the RX UE
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**Question 6: Do companies agree that for mode 1 operation, it is up to the TX UE’s gNB for the alignment between the TX UE’s Uu DRX and the RX UE’s SL DRX?**

* **Yes**
* **No (Please specify the reason)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | Since both TX UE’s Uu DRX and RX UE’s SL DRX are configured by TX UE’s gNB, it is only possible to rely on the TX UE’s gNB to achieve the alignment. |
| Vivo | Yes | It is the only feasible way. |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Lenovo | Yes |  |
| LG | Yes |  |
| Nokia | yes |  |
| Ericsson | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |

# **SL impact on Uu DRX**

#### **Case 1: When sl-PUCCH-Config is configured**

During last meeting, RAN2 discussed the SL impact on Uu DRX with the following agreements achieved.

|  |
| --- |
| Agreements on Uu DRX Impact to Support SL1: SL-specific drx-onDurationTimer is not introduced in Uu.2: SL-specific drx-InactivityTimer is not introduced in Uu.3: For Tx UE configured with sidelink resource allocation mode 1, it should start or restart the Uu drx-InactivityTimer if the UE receives a PDCCH indicating a new SL transmission.4: SL-specific drx-HARQ-RTT-Timer and SL-specific drx-RetransmissionTimer should be introduced in Uu, which are maintained based on sidelink process.5: When sl-PUCCH-Config is configured, SL-specific drx-HARQ-RTT-Timer and SL-specific drx-RetransmissionTimer should be maintained for UE configured with sidelink resource allocation mode 1.6: Adopt the following definitions of SL-specific drx-HARQ-RTT-Timer and drx-RetransmissionTimer (the detailed name of the timers can be further discussed):- drx-RetransmissionTimerSL (per Sidelink process): the maximum duration until a grant for SL retransmission is received;- drx-HARQ-RTT-TimerSL (per Sidelink process): the minimum duration before a SL retransmission grant is expected by the MAC entity.7: When sl-PUCCH-Config is configured (and the PUCCH is transmitted), the UE should start the SL-specific drx-HARQ-RTT-Timer in Uu for the corresponding SL HARQ process in the first slot after the end of the corresponding transmission carrying the SL HARQ feedback via the PUCCH |

During last meeting, some company pointed out that when sl-PUCCH-Config is configured but the PUCCH is not transmitted due to UL/SL prioritization, when to start the HARQ RTT timer should be discussed separately. Rapportuer think it would be similar as for the start of SL HARQ RTT timer (see the agreements from RAN2#113bis-e shown below). That is, when the PUCCH is not transmitted due to UL/SL prioritization, the UE should start the SL-specific drx-HARQ-RTT-Timer in Uu for the corresponding SL HARQ process in the symbol/slot following the end of the corresponding PUCCH resource.

|  |
| --- |
| Agreements on Uu DRX Impact to Support SL22: For transmissions with HARQ feedback, the RX UE starts the SL HARQ RTT timer in the symbol/slot following the end of PSFCH transmission.23: If the RX UE does not transmit PSFCH for a HARQ enabled transmission (e.g. due to UL/SL prioritization) the RX UE still starts the HARQ RTT timer in the symbol/slot following the end of PSFCH resource. |

**Question 7: Do companies agree that when sl-PUCCH-Config is configured but the PUCCH is not transmitted due to UL/SL prioritization, the TX UE should start the SL-specific drx-HARQ-RTT-Timer in Uu for the corresponding SL HARQ process in the first slot after the end of the corresponding PUCCH resource?**

* **Yes**
* **No (Please specify the reason)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | It is the same as what RAN2 agreed in PC5. |
| Vivo | Yes | Time point should not be changed due to UL/SL prioritization. |
| Xiaomi | Comments | On PC5, TX UE would consider lack of feedback as NACK. But on Uu, it’s not clear what gNB’s understanding is about lack of feedback, since gNB’s implementation is not specified. If gNB also consider lack of feedback as NACK, answer is Yes. Otherwise, answer is No. |
| OPPO | Yes |  |
| Lenovo | Yes |  |
| LG | Yes | Depending on whether the dropped PUCCH is SL Feedback “ACK” or “NACK”, there should be an additional discussion on whether to start the retransmission timer or not. For example, if the dropped PUCCH is SL NACK, the retransmission timer may be started, and if the dropped PUCCH is ACK, the retransmission timer may not be started. |
| Nokia | yes |  |
| Ericsson | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |

#### **Case 2: When sl-PUCCH-Config is not configured**

For the case when PUCCH is not configured, a remaining issue is whether or not SL-specific drx-HARQ-RTT-Timer and drx-RetransmissionTimer is needed. During the discussion in last meeting, companies have divergent views on this question. Rapporteur think that even the UE is not configured with PUCCH and blind retransmission is used, the UE still needs to extend the active time to monitor the blind retransmission. However, as there is no HARQ feedback transmitted and when to schedule the blind retransmission is all up to the NW, there might be no need for the drx-HARQ-RTT-Timer since there is no need to consider the processing time of HARQ feedback at the network side. The UE only needs to start the drx-RetransmissionTimer to monitor the blind retransmission.

**Question 8: When sl-PUCCH-Config is not configured, do companies think the SL-specific** **drx-HARQ-RTT-Timer should be supported?**

* **Yes**
* **No (Please specify the reason)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Huawei, HiSilicon | No | In Uu HARQ RTT timer is introduced because the UE need to wait for network processing. In case SL PUCCH is not configured, we don’t think the SL specific drx-HARQ-RTT-Timer is needed, because the gNB knows the end SL resources and if needed, gNB is able to schedule retransmission resources at the end of SL resources scheduled through a prior DCI. |
| Vivo | No | If sl-PSFCH-Config is not configured either in this scenario, it is totally up to network to schedule blind retransmission position, i.e., no SL-specific drx-HARQ-RTT-Timer.If sl-PSFCH-Config is configured in this scenario, it seems that there is no need to limit network scheduling, e.g., the continuous retransmission grants after each PSFCH. |
| Xiaomi | No |  |
| OPPO | Yes | Even if PUCCH is not configured, as long as PSFCH is configured (which is known by network), UE has to wait for a specific processing delay as agreed by RAN1 before re-transmission. Even if one rely on the time gap field (gap between PDCCH and indicated PSSCH) to solve the issue (to ensure the gap between new PSSCH and PSFCH), it is anyway not sustainable considering there could be as many as 32 re-transmission.Therefore, we prefer a unified solution, i.e. have RTT, and the value of RTT timer can be different W/ or W/O PUCCH. |
| Lenovo | No | Similar comments as Huawei, when SL PUCCH is not configured, network does not need to process PUCCH and retransmission can be directly scheduled for both PSFCH case and non-PSFCH case. Thus RTT timer does not needed |
| LG | Yes (In case PSFCH is configured), No (In case PSFCH is not configured) | If PSFCH is not configured, we agree to start only retransmission timer without RTT timer support. When the PSFCH is configured, the power saving gain can be achieved by starting the RTT timer. For example, the UE may not monitor mode 1 DCI by staring the RTT timer during the period from the last PSSCH to the PSFCH resource plus the Min Time GAP (e.g., Minimum processing time to be guaranteed between the PSFCH reception and the retransmission resource). |
| Nokia | comments | Agree with Oppo and LG: depends whether HARQ feedback (PSFCH) is configured or not. |
| Ericsson | No | Agree with Huawei, Vivo, it will be up to gNB’s scheduling, even there is PSFCH resource. No need to restrict gNB’s scheduling behavior. |
| CATT | No | Same view as Huawei and vivo. |
| Apple | Yes | Agree with OPPO and LG |

**Question 9: When sl-PUCCH-Config is not configured, do companies think the SL-specific drx-RetransmissionTimer should be supported?**

* **Yes**
* **No (Please specify the reason)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Huawei, HiSilicon | Yes | The UE needs to extend the active time to monitor PDCCH for blind retransmission  |
| vivo | Yes | For blind retransmission. |
| Xiaomi | No | In this case, DCI scheduling retransmission can occur right after DCI scheduling initial transmission. Inactivity timer can already extend the active time for subsequent PDCCH monitoring. We don’t see motivation to use retransmission timer who’s running time completely overlapping with inactivity timer. |
| OPPO | Yes |  |
| Lenovo | Yes | For potential blind retransmission |
| LG | Yes |  |
| Nokia | yes |  |
| Ericsson | Yes |  |
| CATT | No | There is some misunderstanding about blind retransmission under the current case (no PUCCH configuration).In rel-16 V2X, one scheduling information can include initial and two blind retransmission resources for SL under the current case. And it is not supported any extra blind retransmission at all. We share the same view as Xiaomi, we don’t understand why to introduce unnecessary timer under the current case. |
| Apple | Yes |  |

If the answers to Question 8 and question 9 are yes, the next question is to discuss when to start the SL-specific drx-HARQ-RTT-Timer when sl-PUCCH-Config is not configured. Based on the companies’ contributions, when to start the SL-specific drx-HARQ-RTT-Timer may depend on whether PSFCH resource is configured or not. In addition, one more thing we should keep in mind is that the gNB is able to schedule the UE with up to 3 sidelink resource through one DCI, in this case, there are quite many different candidates to start the SL-specific drx-HARQ-RTT-Timer.

**Question 10: If the answers to Question 8 and question 9 are yes, when sl-PUCCH-Config is not configured but sl-PSFCH-Config is configured, which of the following option is preferred to start the SL-specific drx-HARQ-RTT-Timer?**

* **Option 1:** **the first symbol after the end of PDCCH resource**
* **Option 2: the first symbol after the end of each PSCCH resource**
* **Option 3: the first symbol after the end of each PSSCH resource**
* **Option 4: the first symbol after the end of each PSFCH resource**
* **Option 5: the first symbol after the end of last PSCCH resource scheduled through one DCI**
* **Option 6: the first symbol after the end of last PSSCH resource scheduled through one DCI**
* **Option 7: the first symbol after the end of last PSFCH resource**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | Option 7 or 1 or 6 | Both option 7,1 and 6 are ok for us, with a slight preference on option 7. |
| LG | Option 6 or 7 | Both options are fine, but for both options, we prefer to start the RTT Timer at the time which adds the Min Time GAP (e.g., Minimum processing time to be guaranteed the next resource). Because the next resource will not be scheduled during the Min Time GAP. |
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**Question 11: If the answers to Question 8 and question 9 are yes, when both sl-PUCCH-Config and sl-PSFCH-Config are not configured, which of the following option is preferred to start the SL-specific drx-HARQ-RTT-Timer?**

* **Option 1:** **the first symbol after the end of PDCCH resource**
* **Option 2: the first symbol after the end of each PSCCH resource**
* **Option 3: the first symbol after the end of each PSSCH resource**
* **Option 4: the first symbol after the end of last PSCCH resource scheduled through one DCI**
* **Option 5: the first symbol after the end of last PSSCH resource scheduled through one DCI**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| OPPO | Option 5 or 1 |  |
|  |  |  |
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**Question 12: If the answers to Question 8 and question 9 are yes, when sl-PUCCH-Config is not configured, do companies agree that the TX UE should start the SL-specific drx-RetransmissionTimer in Uu for the corresponding HARQ process in the first symbol after the expiry of the SL-specific drx-HARQ-RTT-Timer, if the data of the corresponding HARQ process was not successfully transmitted in sidelink?**

* **Yes**
* **No (Please specify the reason)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| OPPO | Yes |  |
| LG | Yes with comment | Yes, only if the RTT timer is support.  |
| Apple | Yes |  |
|  |  |  |
|  |  |  |

If the answers to Question 8 is no and the answer to Question 9 is yes, the next question is to discuss when to start the SL-specific drx-RetransmissionTimer when sl-PUCCH-Config is not configured. Similar as the SL-specific drx-HARQ-RTT-Timer, when to start the SL-specific drx-RetransmissionTimer may depend on whether PSFCH resource is configured or not. In addition, one more thing we should keep in mind is that the gNB is able to schedule the UE with up to 3 sidelink resource through one DCI, in this case, there are also quite many different candidates to start the SL-specific drx-RetransmissionTimer.

**Question 13: If the answers to Question 8 is no and the answer to Question 9 is yes, when sl-PUCCH-Config is not configured but sl-PSFCH-Config is configured, which of the following option is preferred to start the SL-specific drx-RetransmissionTimer if the data of the corresponding HARQ process was not successfully transmitted in sidelink?**

* **Option 1:** **the first symbol after the end of PDCCH resource**
* **Option 2: the first symbol after the end of each PSCCH resource**
* **Option 3: the first symbol after the end of each PSSCH resource**
* **Option 4: the first symbol after the end of each PSFCH resource**
* **Option 5: the first symbol after the end of last PSCCH resource scheduled through one DCI**
* **Option 6: the first symbol after the end of last PSSCH resource scheduled through one DCI**
* **Option 7: the first symbol after the end of last PSFCH resource**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| Huawei, HiSilicon | Option 6 | In PC5, even if the sl-PSFCH-Config is configured, it is up to UE whether the current transmission requires SL HARQ feedback or not. That means from the gNB perspective, it does not know whether there will be PSFCH reception/transmission and in addition the gNB is not required to calculate the PSFCH resource according to the Rel-16 design.In general, considering there will be case where sl-PSFCH-Config is not configured, we think it is beneficial to have unified solution. Therefore, PSSCH resource can be a good choice to be reference for alignment between gNB and UE.Further, if UE starts SL specific retransmission timer after each PSSCH resource in case more than one SL grants are scheduled by gNB through one DCI, it is less power efficient for the UE considering it is more reasonable to assume a blind retransmission will not be scheduled before the UE finishes all transmission opportunities. |
| Vivo | Option 6 | From our view, regardless of sl-PSFCH-Config, a unified solution between is preferred. |
| Lenovo | Option 6 | Agree with Huawei and Vivo, that unified solution is preferred for both SL HARQ FB enable/disable case. |
| LG | See the comment | When the PSFCH is configured, the power saving gain can be achieved by starting the RTT timer. For example, the UE may not monitor mode 1 DCI by staring the RTT timer during the period from the last PSSCH to the PSFCH resource plus the Min Time GAP (e.g., Minimum processing time to be guaranteed between the PSFCH reception and the retransmission resource). |
| Ericsson | Option 7 | gNB is able to consider the information on PSFCH resources. In this case, it is beneficial to adopt Option 7. |

**Question 14: If the answers to Question 8 is no and the answer to Question 9 is yes, when both sl-PUCCH-Config and sl-PSFCH-Config are not configured, which of the following option is preferred to start the SL-specific drx-RetransmissionTimer if the data of the corresponding HARQ process was not successfully transmitted in sidelink?**

* **Option 1:** **the first symbol after the end of PDCCH resource**
* **Option 2: the first symbol after the end of each PSCCH resource**
* **Option 3: the first symbol after the end of each PSSCH resource**
* **Option 4: the first symbol after the end of last PSCCH resource scheduled through one DCI**
* **Option 5: the first symbol after the end of last PSSCH resource scheduled through one DCI**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comment |
| Huawei, HiSilicon | Option 5 | See the answer to Q13. |
| Vivo | Option 5 | Same as in Q13. |
| Lenovo | Option 5 |  |
| LG | Option 5 |  |
| Ericsson | Option 5 |  |

If the answers to Question 9 is no, no matter whether the answer to Question 8 is yes or no, the next question is how to ensure the UE is able to receive the scheduled blind retransmission.

**Question 15: If the answers to Question 9 is no, how to ensure the TX UE is able to receive the scheduled blind retransmission?**

|  |  |
| --- | --- |
| Company | Comment |
| CATT | In Uu, only one scheduling information for SL is enough and the scheduling information may include the blind retransmission resources for SL (no PUCCH configuration). We don’t see any technical issue for TX UE to receive the above scheduled blind retransmission. |
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# Alignment between Uu DRX and SL DRX for groupcast/broadcast

During RAN2#113bis-e meeting, RAN2 achieved the following agreement for the alignment of Uu DRX and SL DRX for groupcast and broadcast. Some companies think that for groupcast and broadcast, no additional mechanism is needed compared with that for unicast.

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| --- |
| Agreements on alignment between Uu DRX and SL DRX2: Alignment of Uu DRX and SL DRX for groupcast and broadcast is supported. FFS on whether new mechanisms are needed |

**Question 16: Do companies support to introduce additional new mechanisms for the alignment of Uu DRX and SL DRX for groupcast and broadcast?**

* **Yes (please describe the reason and the detailed solution)**
* **No**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| Huawei, HiSilicon | No with comments | For SL broadcast/groupcast, when the InC/OOC status between TX-UE and RX-UE is not consistent (i.e. the partial coverage case), e.g. RX UE is in RRC connected state while TX UE is in OOC, RX UE may need to use the SL DRX configuration from TX UE in order to make both TX UE and RX UE follow the same SL DRX configuration. Accordingly, in case when the RRC connected RX UE determines to use the SL DRX configuration from TX UE in OOC, the RX UE can send to its serving gNB the SL DRX configuration from TX UE, so that its serving gNB can adjust RX UE’s Uu DRX configuration to achieve the alignment of Uu DRX and SL DRX from the perspective of UE power saving.  |
| Vivo | Yes with comments | It is not clear what’s meaning of new mechanisms.From our understanding, SL DRX for groupcast and broadcast is static and can not be changed since the number of involved Ues may be large. Nevertheless, RX UE and TX UE can report SL DRX to its serving cell for Uu DRX adjustment and make the best effort. |
| Xiaomi | Yes | First, we don’t think this is within the scope of the email discussion.SL DRX for groupcast and broadcast are decided by RX UE based on QoS profile of services interested in receiving. UE need to report the SL DRX information for groupcast/broadcast to gNB, so that gNB can achieve alignment. |
| OPPO | No |  |
| Lenovo | No with comments | SL UE need to report its destination and corresponding QoS to gNB so that gNB can align SL DRX and Uu DRX by implementation.  |
| LG | No |  |
| Nokia | No with comments | Not clear what “new mechanisms” mean in this context. Uu DRX and SL DRX for groupcast/broadcast can be done on best effort basis but nothing should be specified by RAN2. |
| Ericsson | No with comments | For GC/BC, how to achieve alignment will be up to gNB configuration or pre-configuration. No additional mechanism is needed. But, we are also open if a need of additional mechanism is identified. |
| CATT | No |  |
| Apple | yes | We tend to agree that this aspect is not related to Uu timers and need to be out of scope of this email discussion. Also, we are not sure what does new mechanism mean. In our understanding, the unicast t RX UE SL/Uu DRX alignment has no new mechanism, excepting reporting SL DRX configuration to NW which is agreed in the last RAN2 meeting. If RX UE ( in regardless of cast-type) reporting to NW is considered as new mechanism, then the answer is yes. |

# Other

**Question 17: Are there any other aspects that RAN2 should discuss in the scope of this email discussion?**

|  |  |
| --- | --- |
| Company | Comment |
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# Conclusion

# Reference

[1] R2-2104750 Leftover Issues on DRX for Sidelink Unicast CATT

[2] R2-2105024 On DRX wake-up time alignment Intel Corporation

[3] R2-2105132 Discussion on remaining issues of SL DRX Apple

[4] R2-2105493 Remaining aspects of SL DRX Ericsson

[5] R2-2106204 Consideration on SL DRX operation LG Electronics Inc.

[6] R2-2104769 Discussion on network involvement for SL related DRX OPPO

[7] R2-2105297 Further discussion on Sidelink DRX LG Electronics France

[8] R2-2105593 Discussion on SL communication impact on Uu DRX Huawei, HiSilicon

[9] R2-2105458 Coordination between Uu DRX and SL DRX Lenovo, Motorola Mobility

[10] R2-2106073 Coordination between DL DRX and SL DRX Samsung Research America