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

**E-meeting, April 2021**

Agenda Item: 8.15.2.1

Source: OPPO

Title: Summary of [POST113-e][704][V2X/SL] TX UE centric or RX UE centric DRX configuration determination (OPPO)

Document for: Discussion, Decision

# Introduction

This is for the following email discussion

**[POST113-e][704][V2X/SL] TX UE centric or RX UE centric DRX configuration determination (OPPO)**

**Scope:** Continue the discussion the remained issues regarding who will determine DRX configurations (including TX UE centric vs RX UE centric DRX configuration determination), covering both in and out of coverage scenario.

**Intended outcome:** Discussion summary

**Deadline:** Long email discussion

# Discussion

## For OOC scenario

In this email discussion, we will limit to unicast case.

Base on online discussion at RAN2#113

4: For unicast, for OOC scenario, the UE who sends out the DRX configuration decides on the DRX configuration. FFS on whether pre-configuration and/or the assistance information from the peer UE is also taken into account when determining the DRX configuration.

5: For unicast, for OOC scenario, adopt per-direction DRX configuration is as baseline. FFS on whether it is TX-centric or Rx-centric, i.e. TX UE or RX UE decides it.

As discussed in R2-2102183, the per-direction DRX configuration is something as follows:

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

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

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

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

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

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

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

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

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

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

**NOTE: In the following, the discussion is for a single direction, i.e., UE1 as TX-UE and UE2 as RX-UE. The other direction is not shown in the figure by assuming a symmetric procedure is applied to UE2 as TX-UE and UE1 as RX-UE.**

On the one hand, based on the discussion in RAN2#113, rapporteur understand there is no clear majority on either TX or RX centric manner.

* TX-centric: UE1 send out the DRX configuration to UE2 for UE1=>UE2 direction;
* Rx-centric: UE2 send out the DRX configuration to UE1 for UE1=>UE2 direction;

On the other hand, for each option, there are companies proposing assistance information from the counterpart UE, to avoid unilateral decision, which (assistance information) is in the scope of RAN2#113 discussion in R2-2102183.

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| InterDigital | Yes | […]To the above options, we should add:* **Option A3**: Per direction DRX configuration, TX centric, using information from the RX UE. Here, the TX UE first receives information from the RX UE, decides the DRX configuration for the RX UE based on the information provided, and sends the DRX configuration to the RX UE.
* **Option A4:** Per direction DRX configuration, RX centric, using information from the TX UE. Here the RX UE first receives information from the TX UE, decides its DRX configuration from the received information, and sends its DRX configuration to the TX UE.

[…]  |

* Assistance information for TX-centric: UE2 send out the DRX configuration to UE1 for UE1=>UE2 direction;
* Assistance information for RX-centric: UE1 send out the DRX configuration to UE2 for UE1=>UE2 direction;

So rapporteur suggests we ignore the form of signalling for a while, and if merge

* The two as signalling from UE2 as RX-UE on the DRX configuration;
* The two as signalling from UE1 as TX-UE on the DRX configuration;

**Q1: For the direction of UE1 as Tx-UE and UE2 as Rx-UE, if define**

* **Signaling-1: As signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration;**
* **Signaling-2: As signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration;**

**which signalling should be supported (regardless of the signalling form, e.g., as configuration, or as assistance information or etc.)**

**Option-1: Both signalling-1 and signalling-2;**

**Option-2: Signalling-1 only;**

**Option-3: Signalling-2 only;**

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| Company | Option | Comment |
| OPPO | Option-1 or Option-3 | Considering the legacy signalling framework on PC5, signalling from Tx-UE to Rx-UE for the configuration of direction from Tx-UE to Rx-UE is necessary.While the assistance signalling from Rx-UE to Tx-UE can be used additionally to take preference from Rx-UE into account. |
| CATT | Option-1 or Option-3 | Signalling 2 should be used as the baseline for configuring DRX parameter and Signalling 1 can be used as assistant information for determining the DRX configuration for the direction from UE1 to UE2. We support that the assistance information can be involved but as an optional choice. |
| Nokia | Option-1 | As the Tx-UE is in principle the one setting up the connection, we think the precedence should in principle lie at this entity. However, given the fact that the Tx-UE may not have any other connections to which it would like to coordinate for the best power savings, at least the Rx-UE should be allowed to send assistance information.As to the above coordination, we also foresee that in such a case as above, the Tx-UE may not care as much on the actual setting, and hence the Rx-UE could make the final decision. In order to make such operation less complex, but Tx assistance information would be beneficial in this case as well, as the Rx UE then will know why it is allowed to set the configuration.We could potentially discuss in RAN113-b when it would be optimal for either the UE performance that the Rx/Tx decides the configuration. |
| vivo | At least Option-3 FFS for Option-1 | Option-3 is preferable since legacy PC5 configuration is from Tx-UE to Rx-UE. We think option-3 is the baseline.Furthermore, the assistance signalling from Rx-UE to Tx-UE can be considered additionally to achieve better power saving performance of Rx-UE. |
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Then the next question is in which form the signalling-1/2 is to be delivered, possible signalling includes:

Option-A: Using *RRCReconfigurationSidelink;*

Option-B: Using *RRCReconfigurationFailureSidelink*, e.g., this message is used to suggest a DRX configuration that is different from the one included in *RRCReconfigurationSidelink*;

Option-C: Using a new PC5-RRC message, e.g., one can mimic the UAI message as used in Uu-RRC;

**Q2a: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-1 (i.e., signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration), which PC5-RRC message can be used to carry signaling-1?**

**Option-A: Using *RRCReconfigurationSidelink;***

**Option-B: Using *RRCReconfigurationFailureSidelink*, e.g., this message is used to suggest a DRX configuration that is different from the one included in *RRCReconfigurationSidelink*;**

**Option-C: Using a new PC5-RRC message, e.g., one can mimic the UAI message as used in Uu-RRC;**

**Option-D: Other**

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| Company | Option | Comment |
| OPPO | Option-B or Option-C | Comparing the two approaches, i.e., TX-centric and RX-centric

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| Disadvantage | If rely on Rx-UE to control the DRX configuration | If rely on Tx-UE to control the DRX configuration |
| 1 | Two RX-UE may require a TX-UE to send data on the same resource, but that is infeasible since TX-UE can only perform one single transmission at one slot. | different TX-UE may require a same RX-UE to wake up at different time, so increase the power consumption. |
| 2 | It violates the sidelink design framework of “Tx-centric” since Rel-12, i.e., Tx-UE itself (or the network behind) to decide on the transmission. In more details, the Rx-UE has no information on Tx-side traffic characteristics and resource configuration. Signaling-wise, currently PC5-RRC design is to rely on TX-UE to configure SDAP/PDCP/RLC/MAC/PHY configuration. If DRX configuration becomes an exceptional case, i.e., only this parameter is configured by Rx-UE, then when there is any causality / coupling between DRX and other parameters, it becomes a chicken-and-egg issue, i.e., two related parameters configured by two separate entities (i.e., TX-UE and RX-UE), which may further cause discussion / work on how to coordinate between the two entities |  |
| 3 | Without information of Tx-side traffic characteristics and resource configuration, it is not feasible to rely on Rx-UE to make a final decision on the DRX configuration  |  |

I.e., it seems TX-centric approach have more (less) advantages (disadvantages), especially considering that the only disadvantage can be alleviated by assistance information from RX-UE.For option-B, it allows the Rx-UE to decide on a DRX configuration which is different from the one sent by Tx-UE configuration. For option-C, it allows the Rx-UE to suggest a DRX configuration before the Tx-UE sending a DRX configuration. |
| CATT | Option-C | In our understanding, the signalling sent from Rx UE to Tx UE is a kind of assistant information, we would like to design a new PC5-RRC message for it. |
| Nokia | Option-C, A, B | We think that Option-C may be preferred, but A and B may also work.As a comment to OPPOs described disadvantages;For bullet 2; in our view, an Rx-Centric approach can also been seen as assuming that the assistance information from the Rx-UE is followed completely by the Tx-UE. Hence, the difference between Rx and Tx centric becomes quite vague. Assuming that the Tx-UE provides first assistance information towards Rx-UE, and the Rx-UE then provides back a i.e. subset (single selection) of these configurations to which the Tx-UE follows, then it comes with the advantages of what some call Rx-Centric, but is still compliant with the Tx-Centric nature. Such information could very roughly be seen as the 3 step exchange of UE capabilities.For bullet 3; the information can be made available at the Tx side through assistance information from the Tx-UEFollowing the above, we might need to assume a message flow which is in theory Tx-Centric, but includes transfer of assistance information from both UEs. |
| vivo | Option-C | We share the similar view with OPPO and prefer TX-UE centric DRX configuration procedure.Option-C like Msg can be used for RX-UE to send its preference on DRX like Uu *UEAssistanceInformation* Msg before the Tx-UE sending a DRX configuration, e.g. DRX on/off preference, DRX parameters suggestion.Option-B like Msg can be used for RX-UE to negotiate the detailed DRX parameters with TX-UE after receiving TX-UE’s DRX configuration, e.g. update offset to align between different TX-UEs for better power saving benefits. We understand the intention of Option-B is to reuse the existing PC5 RRC messages. Besides *RRCReconfigurationFailureSidelink*, Option-B like Msg may also be complete Msg (*RRCReconfigurationCompleteSidelink*).Option A is also possible, e.g.,piggybacked in the other directional reconfiguration Msg (*RRCReconfigurationSidelink*).Among the three Options, Option C is the most flexible which can happen without relying on the triggering of PC5 RRC configuration procedure. Therefore, Option C is preferred. |
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**Q2b: If one answer option-1 and/or option-3 for Q1, i.e., agree the necessity of signaling-2 (i.e., signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration), which PC5-RRC message can be used to carry signaling-2?**

**Option-A: Using *RRCReconfigurationSidelink;***

**Option-B: Using *RRCReconfigurationFailureSidelink*, e.g., this message is used to suggest a DRX configuration that is different from the one included in *RRCReconfigurationSidelink*;**

**Option-C: Using a new PC5-RRC message, e.g., one can mimic the UAI message as used in Uu-RRC;**

**Option-D: Other**

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| Company | Option | Comment |
| OPPO | Option-A | Comparing the two approaches, i.e., TX-centric and RX-centric

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| Disadvantage | If rely on Rx-UE to control the DRX configuration | If rely on Tx-UE to control the DRX configuration |
| 1 | Two RX-UE may require a TX-UE to send data on the same resource, but that is infeasible since TX-UE can only perform one single transmission at one slot. | different TX-UE may require a same RX-UE to wake up at different time, so increase the power consumption. |
| 2 | It violates the sidelink design framework of “Tx-centric” since Rel-12, i.e., Tx-UE itself (or the network behind) to decide on the transmission. In more details, the Rx-UE has no information on Tx-side traffic characteristics and resource configuration. Signaling-wise, currently PC5-RRC design is to rely on TX-UE to configure SDAP/PDCP/RLC/MAC/PHY configuration. If DRX configuration becomes an exceptional case, i.e., only this parameter is configured by Rx-UE, then when there is any causality / coupling between DRX and other parameters, it becomes a chicken-and-egg issue, i.e., two related parameters configured by two separate entities (i.e., TX-UE and RX-UE), which may further cause discussion / work on how to coordinate between the two entities |  |
| 3 | Without information of Tx-side traffic characteristics and resource configuration, it is not feasible to rely on Rx-UE to make a final decision on the DRX configuration  |  |

I.e., it seems TX-centric approach have more (less) advantages (disadvantages), especially considering that the only disadvantage can be alleviated by assistance information from RX-UE.By using option-A, it allows a simple two step configuration as the very basic procedure, i.e., *RRCReconfigurationSidelink* + *RRCReconfigurationCompleteSidelink* (in case the DRX configuration is acceptable to Rx-UE). |
| CATT | Option-A | In Uu, RRC reconfiguration is used for DRX configuration. It is reasonable to inherit it in SL, e.g. to use *RRCReconfigurationSidelink* to configure the sidelink DRX parameters. |
| Nokia | Please see answer to Q2a |  |
| vivo | Option-A | Follow the legacy PC5 configuration procedure from Tx-UE to Rx-UE. |
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Then the third question is how for the UE to derive the DRX configuration that is to be included in the signaling, which is the continuation of the agreement from RAN2#113 as follows

4: For unicast, for OOC scenario, the UE who sends out the DRX configuration decides on the DRX configuration. FFS on whether pre-configuration and/or the assistance information from the peer UE is also taken into account when determining the DRX configuration.

**By assuming the questions (Q1 and Q2a/b) above have already covered the FFS point on assistance information**, the only left FFS is on pre-configuration, i.e., whether it is has to be taken into account or not.

**Q3a: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-1 (i.e., signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration), in case of OOC scenario, how for UE2 to derive the DRX configuration that is to be included in signaling-1 (assuming the necessity of assistance information has been covered by Q1/Q2a/Q2b)?**

**Option-A: Decided by UE implementation without relying pre-configuration*;***

**Option-B: Decided by UE implementation taking into account of input from pre-configuration;**

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| Company | Option | Comment |
| OPPO | Option-A | In practice, pre-configuration can only achieve common configuration between UEs (no matter it is one or multiple DRX configuration), which is not aligned with the design spirit of unicast DRX configuration, i.e., per-direction DRX configuration. |
| CATT | Option-A | This signalling should be optional, how to derive the DRX configuration depends on UE implementation, no specification effort is needed. |
| Nokia | Option-A as WA is ok for us | Assuming this is for Unicast, option-A may be the best solution, however, we feel sympathy for option-B since the pre-configuration also holds the resource pool description, and therefore may also contain optimal settings of the DRX.In the end, we may not get the best answer to this question before we agree on how the pre-configuration looks, hence this may be a working assumption which can be further elaborated |
| vivo | Option-A | From our understanding, Tx-UE can decide DRX configuration based on pre-configuration like the legacy PC5 configuration procedure. But Rx-UE assistance information can be based on its preference or alignment requirement, i.e. no need to redundantly consider pre-configuration for RX UE. |
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**Q3b: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-2 (i.e., signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration), in case of OOC scenario, how for UE1 to derive the DRX configuration that is to be included in signaling-1 (assuming the necessity of assistance information has been covered by Q1/Q2a/Q2b)?**

**Option-A: Decided by UE implementation without relying pre-configuration*;***

**Option-B: Decided by UE implementation taking into account of input from pre-configuration;**

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| Company | Option | Comment |
| OPPO | Option-A | In practice, pre-configuration can only achieve common configuration between UEs (no matter it is one or multiple DRX configuration), which is not aligned with the design spirit of unicast DRX configuration, i.e., per-direction DRX configuration. |
| CATT | Option-A | According to the current specification, the pre-configuration is based on sidelink RLC bearer. But it has been agreed that for SL unicast (after SL unicast link is established), SL DRX configuration can be configured per a pair of source/destination. Hence, how to configure the SL DRX configuration based on pre-configuration is questionable (the granularity is mismatched). |
| Nokia | Option-A as WA is ok for us | Please see Q3a |
| vivo | Opiton-B | Same as Q3a. |
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## For IC scenario

For in-coverage scenario, RAN may be involved in the whole procedure, e.g., for a signalling-X from UE-A to UE-B (Please note that UE-A can be either UE-1 or UE-2, i.e., either TX-UE or RX-UE, and similarly for UE-B. The questions below has clarified the applied UE explicitly),

* The first question is how for the UE-A to generate the signalling, taking into account of SIB/dedicated-RRC or not;
* The second question is whether the UE-B needs to reflect the signalling to network using dedicated-RRC or not;



**Q4a: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-1 (i.e., signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration), If UE-2 is in-coverage, in RRC\_IDLE/RRC\_INACTIVE state, how for UE2 to derive the DRX configuration that is to be included in signaling-1?**

**Option-A: Decided by UE implementation without relying SIB*;***

**Option-B: Decided by UE implementation taking into account of input from SIB;**

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| Company | Option | Comment |
| OPPO | Option-A | Same logic as for pre-configuration, i.e., SIB cannot achieve per-UE configuration, so no need to take into account. |
| CATT | Option-A |  |
| Nokia | Option-A as WA is ok for us | Same with Q3b, getting help from SIB may prove beneficial |
| vivo | Option-A | Similar with pre-configuration, i.e. for assistance information no need to redundantly consider SIB. |
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**Q4b: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-1 (i.e., signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration), If UE-2 is in-coverage, in RRC\_CONNECTED state, how for UE2 to derive the DRX configuration that is to be included in signaling-1?**

**Option-A: Decided by UE implementation without relying dedicated RRC or SIB*;***

**Option-B: Decided by UE implementation taking into account of input from SIB;**

**Option-C: Decided by UE implementation taking into account of input from dedicated RRC;**

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| Company | Option | Comment |
| OPPO | Option-A or Option-C | Same logic as for pre-configuration, i.e., SIB cannot achieve per-UE configuration, so no need to take into account. While dedicated-RRC may help the network to take it into control. |
| CATT | Option-C with comment | For RRC\_CONNECTED UE, the sidelink DRX configuration from UE2 to UE1 can be decided by UE2’s serving gNB. But how to derive the assistant information sent from UE2 to UE1 should be UE2 implementation, e.g., taking into account of input from dedicated RRC, but it does not need to specify. |
| Nokia | Option-A, or Option-C |  |
| vivo | Option-A or Option-C | Option A is based on similar logic as the above case of pre-configuration and SIB of PC5 unicast DRX configuration. i.e. the assistance information from UE-2 doesn’t need to consider this.Option-C is useful, e.g. to align between Uu DRX and SL DRX, at least the dedicated RRC including the Uu DRX configuration should be considered |
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**Q4c: If one answer option-1 and/or option-2 for Q1, i.e., agree the necessity of signaling-1 (i.e., signalling from UE2 (RX-UE) to UE1 (TX-UE) including the DRX configuration), if UE-1 is in-coverage, in RRC\_CONNECTED state, whether UE-1 needs to report the DRX configuration received in signaling-1 to the serving network?**

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| Company | Yes/No | Comment |
| OPPO | Yes | As answered for Q5b, since the dedicated-RRC is necessary for network to take DRX configuration into control, the report of signalling-1 is also useful. |
| CATT | Yes | Because the network decides the sidelink DRX configuration for RRC\_CONNECTED UE. |
| Nokia | Yes |  |
| vivo | Not always | UE-1 is TX UE. We support that most of PC5 DRX parameters come from its serving cell via dedicated RRC signaling. So when TX UE receives assistance information from RX, there is no need for TX UE to report.However, there is an exceptional case, i.e. PC5 DRX parameters changed in PC5 negotiation between Tx-UE and Rx-UE, e.g. Rx-UE modified DRX cycle offset. In this case, there is need to report newest PC5 DRX parameters to serving cell.  |
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**Q5a: If one answer option-1 and/or option-3 for Q1, i.e., agree the necessity of signaling-2 (i.e., signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration), If UE-1 is in-coverage, in RRC\_IDLE/RRC\_INACTIVE state, how for UE1 to derive the DRX configuration that is to be included in signaling-2?**

**Option-A: Decided by UE implementation without relying SIB*;***

**Option-B: Decided by UE implementation taking into account of input from SIB;**

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| Company | Option | Comment |
| OPPO | Option-A |  |
| CATT | Option-A |  |
| Nokia | Option-A as WA is ok for us | Same with Q3b, getting help from SIB may prove beneficial |
| vivo | Option-B | Like legacy SLRB configuration acquisition, NW is up to control DRX configuration and responsible for compromise performance between QoS requirements/service experience and power saving gain. |
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**Q5b: If one answer option-1 and/or option-3 for Q1, i.e., agree the necessity of signaling-2 (i.e., signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration), If UE-1 is in-coverage, in RRC\_CONNECTED state, how for UE1 to derive the DRX configuration that is to be included in signaling-2?**

**Option-A: Decided by UE implementation without relying dedicated RRC or SIB*;***

**Option-B: Decided by UE implementation taking into account of input from SIB;**

**Option-C: Decided by UE implementation taking into account of input from dedicated RRC;**

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| Company | Option | Comment |
| OPPO | Option-C | Dedicated-RRC is necessary to take DRX configuration into network control.Same logic as for pre-configuration, i.e., SIB cannot achieve per-UE configuration, so no need to take into account.  |
| CATT | Option-C |  |
| Nokia | Option-A, or Option-C |  |
| vivo | Option-C | Like legacy procedure, the configuration of Connected Tx-UE comes from its serving cell via dedicated RRC. |
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**Q5c: If one answer option-1 and/or option-3 for Q1, i.e., agree the necessity of signaling-2 (i.e., signalling from UE1 (TX-UE) to UE2 (RX-UE) including the DRX configuration), If UE-2 is in-coverage, in RRC\_CONNECTED state, whether UE-2 needs to report the DRX configuration received in signaling-2 to the serving network?**

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| Company | Yes/No | Comment |
| OPPO | Yes | It is necessary for UE2 network to take into account the SL DRX configuration when deciding the Uu DRX configuration. |
| CATT | Yes |  |
| Nokia | Yes |  |
| vivo | Yes | Reporting is useful for cooperation between Uu DRX and SL DRX. |
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# Conclusion

We have the following proposals

[Proposal 1 xxx.](#_Toc62216175)

# Reference