3GPP TSG-RAN WG2 #118-e R2-2206305

Electronical meeting, 9 May – 20 May 2022

Agenda Item: 6.15.3

Source: Ericsson

Title: Summary of [709][V2X/SL] SL DRX and L2 relay in Rel-17 (Ericsson)

Document for: Discussion, Decision

# Introduction

This document is to summarize the inputs from companies on SL DRX and L2 relay in order to resolving the issues.

* [AT118-e][709][V2X/SL] SL DRX and L2 relay in Rel-17 (Ericsson)

**Scope:** Discuss whether there are real technical blocking issues that cannot apply SL DRX into L2 relay. Companies not supporting SL DRX should identify the technical blocking issues and companies supporting SL DRX can argue why they’re not real technical blocking issues (or if they can be easily solved by CR implementation). Based on each side arguments and analysis, check companies’ views whether there is real technical blocking issue or not.

**Intended outcome:** Summary discussion in R2-2206305.

**Deadline:** 5/16 10:00am UTC

The discussion includes two phases.

– Phase I is to collect companies views on the issues as captured in open issue list. The suggested deadline for companies' feedback: Friday W1, 2022-05-13 0800 UTC.

– Phase II is to summarize the companies’ views and provide a summary report. The deadline is Monday W2, 2022-05-16 1000 UTC.

# Summary

## Contact information

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| --- | --- | --- |
| Company | Name | Email Address |
| Ericsson | Min Wang | min.w.wang@ericsson.com |
| OPPO | Qianxi Lu | qianxi.lu@oppo.com |
| MediaTek | Xuelong Wang | xuelong.wang@mediatek.com |
| InterDigital | Martino Freda | martino.freda@interdigital.com |
| Apple | Zhibin Wu | Zhibin\_wu@apple.com |
| CATT | Shijie | Shijie@catt.cn |
| Huawei, HiSilicon | Tao Cai | tao.cai@huawei.com |
| LG | Seoyoung Back | seoyoung.back@lge.com |
| ZTE | Wei Luo | luo.wei11@zte.com.cn |
| Intel | Rafia Malik | Rafia.malik@intel.com |
| vivo | Xiao XIAO | xiao.xiao@vivo.com |
| Qualcomm | Qing Li | qinli@qti.qualcomm.com |
| Samsung | Hyunjeong Kang | hyunjeong.kang@samsung.com |
| Nokia | Jakob Buthler | Jakob.buthler@nokia.com |
| Xiaomi | Xing Yang | Yangxing1@xiaomi.com |

## Issues to resolve

Regarding to the combination of SL DRX and relay, the following agreements were reached in RAN2#116-e meeting:

**Agreements on SL-DRX for ProSe:**

1: RAN2 confirm R17 SL-DRX design can support non-relay-related ProSe communication directly without additional specific solution discussion / specification effort.

2: RAN2 confirm the R17 SL-DRX design can support non-relay-related ProSe discovery by reusing SL default-DRX configuration used for communication without further additional specific solution discussion / specification effort.

**Agreements on SL-DRX for ProSe:**

1: RAN2 confirms Rel-17 SL-DRX design can be reused for relay-related ProSe communication in layer-3 relay without additional specific solution discussion/specification effort.

2: Keep RAN2 previous agreement (prioritize the non-relay case without consideration of relay specific optimization in Rel-17) but we’re not going to make any conclusion if L2 relay-related ProSe communication is supported or not in Rel-17 now.

3: RAN2 confirms Rel-17 SL-DRX design can be reused for L3 relay-related ProSe discovery without additional specific solution discussion/specification effort (by applying SL default-DRX configuration). No conclusion if L2 relay-related ProSe discovery is supported or not in Rel-17 now. RAN2 does not specify any restriction now.

Contributions and CRs on the issue are summarized in the below table

|  |  |
| --- | --- |
| Source | Proposals/changes |
| R2-2204588 | **Proposal 1:** Rel-17 specifications can support sidelink DRX in Layer-2 UE-to-Network relay with the current specification (which does not exclude the possibility to take small enhancement applied to both L2 relay and L3 relay case). **Proposal 2:** Send an LS to RAN to inform the agreement of Proposal 1  **Rapp->** the proposed changes will be left out from this email discussion. The detailed potential changes can be discussed depending on outcome of this email discussion. |
| R2-2205179 | **Proposal 1:** RAN2 to study SL DRX in R18 to address paging issues. **Proposal 2:** RAN2 to study SL DRX in R18 to address SI issues. **Proposal 3:** RAN2 to study SL DRX in R18 to address issues for initial link setup. |
| R2-2205269 | Changes to TS 38.300 to reflect SL DRX  **Rapp->** the proposed changes will be left out from this email discussion. The detailed potential changes can be discussed depending on outcome of this email discussion. |
| R2-2205272 | Proposal 1: Take the merged draft CR R2-2206047 to implement SL DRX configuration report for Sidelink Relay purpose. |
| R2-2206047 | Changes to 38.331 for the description of the initiation of the SL DRX reporting and its corresponding actions for Tx UE and Rx UE. Changes to ASN.1 that gNB is aware of the accepted or preferred SL DRX configuration for the relay link and then may be able to configure optimal SL DRX parameter the relay communication.  **Rapp->** the proposed changes will be left out from this email discussion. The detailed potential changes can be discussed depending on outcome of this email discussion. |
| R2-2204946 | **Proposal 1:** Suggest RAN2 to discuss whether the combination of SL DRX, discovery and relay-related communication should be reflected in Rel-17 specs. **Proposal 2:** If the combination of SL DRX, discovery and relay-related communication should be reflected in Rel-17 specs, suggest RAN2 to discuss how to handle the L2 U2N relay when modifying the specs since there is no agreement on whether SL DRX can be supported for L2 U2N relay. |

Regarding the issue on whether SL DRX can be applied for L2 U2N relay, both sides have different arguments. In the following sections, arguments of both sides are described respectively.

**Note**

**Given that this is the last meeting of R17 / the WI has completed 100%, all potential spec changes to make the feature to work should be minimal.**

**The intention of this email discussion is to see if we can make consensus on the issues. If possible, we can find a way forward for compromise.**

### Arguments of not supporting SL DRX for L2 U2N relay in R17

As described [2], the following issues are identified to be addressed in order to not support SL DRX for L2 U2N relay in R17.

There was an issue related to setting up the SL DRX for the unicast connection, was raised by some companies during RAN#95.

During the connection establishment procedure, the gNB configures remote UE with proper mapping between Uu RBs and PC5 RLC channels, also configures relay UE with proper channel mapping between Uu RLC channels and PC5 RLC channels.

A natural issue would be whether to support SL DRX for control signaling during RRC connection establishment for remote UE**.** RAN2has studiedthe similar issue for PC5 connection establishment.

**Issue 1: same as the issue of whether SL DRX should be applied for DCR and PC5 RRC signalling, whether to support SL DRX for control signalling during RRC connection establishment for remote UE given the PC5 link is already established?**

**Issue 2: If the answer of Issue 1 is yes, how to set a proper SL DRX configuration for control signalling?**

For DL direction, in case of Mode 2 RA, according to agreements made in R17, it is relay UE that is to determine SL DRX for the direction from relay UE to remote UE.

For UL direction, remote UE supports only Mode 2 RA, according to agreements made in R17, it is remote UE that is to determine SL DRX for relay UE.

In R17, in addition to LCH priority, relay UE are only aware of split PDB has no knowledge of DL traffic pattern for a E2E flow for a certain E2E flow, which is not sufficient for UE to derive SL DRX.

For unicast, TX UE can determine SL DRX for RX UE considering traffic pattern and associated QoS requirement, in addition to assistance information provided by RX UE. This will be challenge for relay UE since relay UE has no knowledge of DL traffic pattern.

**Issue 3: In case of Mode 2 RA, UE (especially relay UE) is only aware of split PDB but has no knowledge of DL traffic pattern for a E2E flow, which is not sufficient for UE to derive SL DRX.**

Meanwhile**,** the gNB is feasible to configure SL DRX regardless of Mode 1 or Mode 2 scheduling since gNB has enforced break down of E2E QoS and therefore has full knowledge of PC5 QoS, however, in order to make it happen, RAN2 needs to make additional agreements, which would lead to additional spec changes.

**Issue 4: in case of Mode 2 RA, given gNB has full knowledge of PC5 QoS, RAN2 needs to agree that gNB can configure SL DRX for UE, which needs additional spec changes.**

Regarding paging, there are the following issues.

**Issue 5: whether to support SL DRX for paging forwarding via PC5-RRC in case of L2 U2N relay?**

**Issue 6: If SL DRX is applied for PC5-RRC carrying paging message, how to set a proper SL DRX configuration for PC5-RRC carrying paging message?**

Similar as paging, in L2 U2N relay, relay UE needs to forward SI to remote UE, it is important to ensure SI to be forwarded to remote UE. Therefore, RAN2 needs to address the following issues for SI forwarding in case of L2 U2N relay

**Issue 7: whether to support SL DRX for SI forwarding via PC5-RRC in case of L2 U2N relay?**

**Issue 8: If SL DRX is applied for PC5-RRC carrying SI message, how to set a proper SL DRX configuration for PC5-RRC carrying SI request/message?**

### Arguments of supporting SL DRX for L2 U2N relay in R17

Meanwhile, arguments of supporting SL DRX for L2 U2N relay in R17 are described in [1],

With regard to SL DRX for L2 Relay scenario, our analysis is as below.

a. For the remote UE in RRC\_CONNECTED case, the relay UE is informed of the PDB split and there is also assistance information from the remote UE.

b. For the remote UE in RRC\_IDLE / RRC\_INACTIVE case, the forwarded traffic only includes SI and paging, which have no QoS profile, but the relay UE is aware of the general CP latency requirements and the remote UE’s paging DRX cycle.

c. For CP forwarding, someone may question that the performance will not be guaranteed for paging, signalling, SI with critical latency requirements (as discussed within Q1 of the intermediate round of RP-220884). However, it should be noted that there’s no guaranteed performance today on Uu. There are some requirements like the maximum paging gap during cell reselection. But there’s no requirement saying that “a signalling message transmitted by the gNB shall be received by the UE within X ms”. Even if one assumes there is some requirement, as stated above, it is not dynamic and thus can be handled by relay UE implementation as stated above.

d. For UP forwarding, based on the understanding above, we think in case of mode 2 operation, the relay UE can determine sidelink DRX based on PC5 QoS configuration directed configured by gNB and the assistance information from the remote UE. In case of mode 1 operation, the sidelink DRX configuration is anyway determined by gNB, which has all the information.

### Companies views on issues

**Issue 1: same as the issue of whether SL DRX should be applied for DCR and PC5 RRC signalling, whether to support SL DRX for control signalling during RRC connection establishment for remote UE given the PC5 link is already established?**

RAN2 has discussed whether to support SL DRX for DCR, PC5-S signaling and PC5-RRC during SL unicast link setup procedure. Similarly, for remote UE in case of L2 U2N relay, remote UE may need to setup its RRC connection to the network via relay UE. RAN2 can discuss the necessity of this issue.

***Q1-1:* same as the issue of whether SL DRX should be applied for DCR and PC5 RRC signaling, do companies agree that RAN2 needs to study whether to support SL DRX for control signaling during RRC connection establishment for remote UE given the PC5 link is already established*?***

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Ericsson | Yes | RAN2 needs to discuss whether SL DRX should be supported or not for control signaling during RRC connection establishment of remote UE. |
| OPPO | No | Basically, we understand the issue can be generalized as how to handle the SL-DRX setting w.r.t the Uu-SRB(s) (carried via SL-RLC for relay traffic). And our understanding is that the SL-DRX setting for UC list does not differentiate between radio bearer(s) / RLC-channels, as in legacy Uu. |
| MediaTek | No | We have the same understanding as OPPO |
| InterDigital | Yes | There is currently no mechanism to avoid delays associated with RRC connection establishment of a remote UE as a result of SL DRX being set up between the relay and the remote UE. |
| Apple | No | MAC layer DRX mechanism does not need to differentiate the SLRBs carrying SL UC traffic after PC5 link established. The only exception is for DCR. |
| CATT | Yes | In the non-relay scenario, RAN2 has agreed that UE should keep active between DCR is sent and RRCReconfigurationSidelink including SL DRX configuration is sent.  In the relay scenario, in our understanding, the SL DRX from remote UE to relay UE should be configured by network by end-to-end RRC signaling. Hence, before the end-to-end RRC reconfiguration signaling is received by the remote UE, remote UE should be kept in active. But this understanding needs to be confirmed by RAN2. |
| Huawei, HiSilicon | No | No need to differentiate radio bearers for applying SL DRX. |
| LG | No | In our understanding the current specifications, if the PC5 link is already established, DRX configuration between relay UE and remote UE is also set for UC. After that, all data regardless PC5 or Uu control data uses the UC SL DRX configuration.  We think there is no special reason not to use already configured UC SL DRX for control signaling during RRC connection establishment for remote UE. |
| ZTE | No | We don’t think the remote UE need be always active during RRC connection establishment. There is no need to differentiate the the RRC connection establishment message with other RRC message after the PC5 link is established. |
| Intel | No | Since PC5 link is already established, the same SL DRX can apply for control signalling during RRC connection establishment for remote UE. The case of some potential delay can be considered as an optimization. |
| vivo | Yes or No | This issue is related to whether initial Uu control signaling must happen before PC5 DRX negotiation or is allowed to happen after the negotiation is finished (especially considering that PC5 DRX negotiation can experience “configure - reject” many times before success). On the other hand, from companies’ replies above, it seems that companies having concerns arguing that relying on existing SL DRX mechanism leads to unexpected additional delay for Uu control signaling, which is unacceptable, whereas companies arguing no problem is of the opinion that the current SL DRX can run procedural-wise even not optimal. This makes the discussion get a bit stuck, as different companies have different tolerance levels on the impacts to Uu singalling transmission performance due to SL DRX.  Having said that, we, from our perspective, now can accept either way below:   * Either we confirm not supporting SL DRX for L2 relay case in this release, to guarantee the L2 relay performance at a maximum level; * Or, we tolerate the performance degradation led by the imperfect direct “reuse” of the existing SL-DRX which has anyway not ever been optimized towards L2 relay case.   We still prefer bullet 1, but considering the situation in RAN, we are fine to compromise to bullet 2. HOWEVER, we want to point out that there is no middle-ground like introducing any L2 relay specific enhancement to SL-DRX in this release (no matter how small the enhancement is), and also arguing that the SL-DRX can be “reused” to support L2 SL-Relay case. Introducing SL DRX enhancements specific to L2 relay *has never been* an option on the table.  In summary, we can go with either way above, but do not accept any enhancements/Spec changes on SL DRX specific to L2 relay. |
| Qualcomm | Yes w, comment | If a directional SL DRX is configured at the end of PC5 link establishment for each direction between Relay UE and Remote UE, all PC5 RRC messages between Relay UE and Remote UE may follow the SL DRX configurations respectively. In this case, the time between two directional SL DRXs may be larger than the timer for relay PC5 RRC message, similar to the issue discussed online “Whether TX UE remains active for RRC reconfiguration complete/failure sidelink reception?”. In our view, the UE may stay active to avoid unnecessary delay or failure (due to timer expiration) to RRC connection establishment procedure which is caused by directional SL DRX. |
| Samsung | No | We do not see a need of further study on this issue. We think that the same DRX procedure for PC5 unicast link can be applied for control signaling in RRC connection establishment. |
| Nokia | No | As argued in previous meetings, we do not see the need for spec changes. The current way of handling RRC messages can be reused as is. As the above analysis, and contributions, states, there are room for improvement, but applicability wise there should be no difference, and those ehancements should be for i.e. Rel-18 or above. |
| Xiaomi | Yes | We understand there is a need to investigate the potential enhancement to ensure the Uu procedure complete in time. For example, the T300/T311 expiry should not be effected due to SL DRX inactive. |

**Issue 2: If the answer of Issue 1 is yes, how to set a proper SL DRX configuration for control signalling?**

If companies think RAN2 needs to discuss whether SL DRX should be applied for control signaling during RRC connection establishment for remote UE, companies can give their views on possible solutions.

***Q1-2: if* support SL DRX for control signaling during RRC connection establishment for remote UE*,* how to set a proper SL DRX configuration for control signaling?**

|  |  |  |
| --- | --- | --- |
| Company | solutions | Comments |
| Ericsson | If SL DRX is supported, RAN2 needs to discuss whether TX profile needs to be configured.  Rapp-> just for correction, TX profile is not relevant here. |  |
| OPPO |  | TX profile is not applicable to UC messages except for UC-based DCR, since we can always rely on UE capability for UC messages after link establishment. |
| MediaTek |  | We have the same understanding as OPPO |
| InterDigital | Solution should be inspired from what was agreed for DCR. |  |
| Apple |  | Not sure why UC SL-DRX is not proper in the first place, we have PC5-RRC signaling to negotiate the SL-DRX configuration. |
| CATT | Remote UE always keep active before end-to-end RRC reconfiguration message is sent from gNB to remote UE. |  |
| Huawei, HiSilicon |  | No need to study TX profile for this case, agree with OPPO and Apple |
| LG |  | After SL DRC configuration for UC, TX profile is not applicable. So the control signaling during RRC connection establishment for remote UE follows the already configured UC SL DRX between remote UE and relay UE. |
| ZTE |  | According to the latest agreement, if the SL DRX is not proper, the RX UE can reject it,then the RX UE can be always in active. |
| Intel |  | If SL DRX is already negotiated among peer UEs upon PC5 connection establishment, it should also be applicable in this case otherwise default SL DRX configuration [(including at least DRX cycle, start offset and on-duration timer)] can be used similar to DCR case. |
| vivo | There can be solutions, but not in this release. | As commented above, we don’t agree any solutions as enhancements to be introduced in this release. If everybody is willing to tolerate the performance degradation with a direct “reuse”, we’re OK to confirm supporting this inter-WI feature in this release. |
| Qualcomm | The remote UE may stay active as a simple solution. Further optimization needs discussion. |  |
| Samsung |  | The same DRX for UC can be applied for control signaling in RRC connection establishment. |
| Nokia | Solution is already in the spec | The agreed DRX for UC can be applied |
| Xiaomi | If Issue in Q-1-1 is confirmed, we may need to study potential solution. |  |

**Rapporteur summary**

Regarding Issue 1, 15 companies have provided comments in total. 6 companies think the issue is valid and therefore, it is necessary for RNA2 to further study the issue in order to make SL DRX to work properly for UE, while 9 companies think that UE does not need to differentiate the SLRBs carrying SL UC traffic after PC5 link established so that no additional spec changes are needed for supporting SL DRX for control signalling during RRC connection establishment for remote UE.

If SL DRX is supported for Uu control signaling, as companies indicated that the issue is related to whether initial Uu control signaling must happen before PC5 DRX negotiation or is allowed to happen after the negotiation is finished (especially considering that PC5 DRX negotiation can experience “configure - reject” many times before success). If Uu signaling is transmitted before the negotiation is finished, remote UE or relay UE may suffer from degraded battery saving, while if Uu signaling is transmitted after the negotiation is completed, remote UE and/or relay UE may suffer from additional latency for establishment of the RRC connection, which may further degrade QoS performance of the relay service.

If SL DRX is not supported for Uu control signalling, remote UE and/or relay UE would suffer from increased battery consumption since it may take some seconds for remote UE to complete the procedure of the RRC connection establishment, especially when relay UE is in RRC IDLE or RRC INACTIVE, this would contradict with the design purpose of SL DRX.

Since both camps have diverse views on the issue, rapporteur would like to suggest further discussions for the issue.

1. RAN2 to discuss how to support SL DRX for RRC signalling after the PC5 link established during RRC connection establishment for remote UE (9/15).

For unicast, TX UE can determine SL DRX for RX UE considering traffic pattern and associated QoS requirement, in addition to assistance information provided by RX UE. This will be challenge for relay UE since relay UE has no knowledge of DL traffic pattern.

Meanwhile, the other side thinks that the relay UE can determine sidelink DRX based on PC5 QoS configuration directed configured by gNB and the assistance information from the remote UE.

**Issue 3: In case of Mode 2 RA, UE (especially relay UE) is aware of split PDB for a E2E flow but has no knowledge of DL traffic pattern, which is not sufficient for UE to derive SL DRX.**

***Q2-1:* do companies agree that in case of Mode 2 RA, UE (especially relay UE) is aware of split PDB for a E2E flow but has no knowledge of DL traffic pattern, this is not sufficient for UE to derive SL DRX*?***

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Ericsson | Yes | Since relay UE has no knowledge of DL traffic pattern, it will be challenging for relay UE to set a proper SL DRX considering only PDB, LCH priority and assistance information from remote UE. |
| OPPO | No | So, the root question is whether traffic pattern would lead to a big difference in terms of DRX setting. While we understand:   1. Nowadays DRX setting is mostly optimized base on assumption of busty traffic (regardless of various traffic types), so traffic pattern info does not play a key role of DRX setting tunning. 2. And relay-UE can anyway get assistance information from remote UE to decide on the cycle/on-duration timer setting (which would reflect the traffic pattern information as well). |
| MediaTek | No | a. For the remote UE in RRC\_CONNECTED case, the relay UE is informed of the PDB split and there is also assistance information from the remote UE.  b. For the remote UE in RRC\_IDLE / RRC\_INACTIVE case, the forwarded traffic only includes SI and paging, which have no QoS profile, but the relay UE is aware of the general CP latency requirements and the remote UE’s paging DRX cycle. |
| InterDigital | Yes | We think the current assumptions of the TX UE deciding the DRX configuration based on UE implementation is unacceptable for Uu traffic. |
| Apple | No | As explained in MTK, we think the UC DRX mechanism is sufficient for this issue. |
| CATT | Yes | For remote UE, we think the current mechanism is sufficient for it to determine the SL DRX used in UL direction.  For relay UE, with the current QoS information, it may be hard for the remote UE to set the inactivity timer length and onduration timer length. |
| Huawei, HiSilicon | No | We don’t think this is blocking issue. Certain DRX configuration would be useable. |
| LG | No | We think relay UE can set SL DRX configuration for remote UE by using the assistance information from remote UE and the split PDB value from gNB. Relay UE does not know the DL traffic pattern, but we don't think this is a blocker in applying the existing SL-DRX procedure to the relay operation. For example, remote UE may estimate the traffic pattern that will receive. Remote UE gives assistance information reflecting the estimated traffic pattern to the relay UE. And the relay UE will set SL DRX by using this assistance information from remote UE and PDB split information from gNB. The configuration of a proper SL DRX can be handled by the implementation of relay UE, including the possibility of selecting a conservative configuration in consideration of the uncertainty of the traffic pattern. |
| ZTE | No | The relay UE can set the SL DRX based on the informed PDB split and the assistance information from the remote UE. The latency requirement can be ensured by configuring a short enough SL DRX cycle even it has no traffic pattern information. Moreover, the gNB does not know the DL traffic pattern, too. It can only estimate the DL traffic pattern by the arrival data. Similarly, the relay UE can also estimate the DL traffic pattern by the arrival data, too. |
| Intel | No | Same view as MediaTek. |
| vivo | Yes or No | Like in Q1-1, the divergence here is still due to different levels of tolerance among companies on performance degradation for related Uu procedure. So, same comments as to above Q1-1. |
| Qualcomm | Yes | For DL relay on PC5, Relay UE (i.e. Tx UE) determines the SL DRX configuration if in RA mode 2 for relay on PC5, based on SL DRX framework. In this case, Relay UE needs to know the PC5 QoS parameters derived from the DL QoS, which is not currently provided by gNB in RRC configuration for Relay UE.  Additionally, Remote UE may optionally provide assistance information with preferred SL DRX based on SL DRX framework, which needs to be added in spec for Remote UE’s behavior. How Remote UE decides preferred SL DRX may be up to UE implementation. |
| Samsung | No | We have some sympathy that gNB controlled DRX configuration could be optimal for RRC\_CONNECTED Remote UE. However we think that existing SL DRX procedure can work for this case since Relay UE can rely on the assistance information from Remote UE. |
| Nokia | No | Same view as OPPO |
| Xiaomi | Yes | Although remote UE can provide assistance information, the preferred SL DRX is derived from many factors, e.g. SL DRX on other SL connection and DL traffic pattern. Relay UE is not aware of which preferred SL DRX is related to SL DRX on other SL connection or DL traffic pattern. |

Companies can give their views on possible solutions on how UE set proper SL DRX for its peer UE in case of Mode 2 RA.

***Q2-2: In case of Mode 2 RA,* how does UE (especially relay UE) set proper SL DRX for its peer UE*?***

|  |  |  |
| --- | --- | --- |
| Company | solutions | Comments |
| Ericsson | 1. For remote UE, when remote UE sets up PC5 connection, remote UE has no information on PC5 QoS breakdown, therefore, SL DRX provided to relay UE may be not suitable. After remote UE has received QoS info for PC5 link, remote UE may have to reconfigure the SL DRX. 2. For relay UE,    1. information on DL traffic pattern may need to provide to relay UE by gNB.    2. Remote UE needs to provide assistance information to relay UE at good time, trigger condition may be updated.    3. Whether relay UE configures SL DRX to remote UE at the time when PC5 link is established or after relay UE has received RRCReconfiguration from gNB carrying DL traffic pattern, and/or QoS parameter for PC5 link |  |
| OPPO |  | W.r.t the additional QoS info to be provided to relay/remote UE, it seems have been discussed in the AI of QoS, and at least in R17, companies only see clear value / benefit from PDB / priority as key QoS input. |
| MediaTek | We think in case of mode 2 operation, the relay UE can determine sidelink DRX based on PC5 QoS configuration directed configured by gNB and the assistance information from the remote UE, which is supported already by Rel-17 SL DRX.  The Relay UE behavior as listed by Ericsson is UE implementation based on the framework of Rel-17 SL DRX . |  |
| InterDigital | We should specify some gNB involvement for mode 2 RA. |  |
| Apple |  | Not sure why this issue is different from L3 relay UE. Do we try to optimize the performance only for L2 relay case? |
| CATT | Same view as Ericsson. |  |
| Huawei, HiSilicon |  | We agree the described UE behavior can be implementation based. |
| LG |  | We can give the same answer of Q2-1. As an example, Relay UE can configure SL DRX in mode 2 RA by using assistance information from remote UE and the PDB split information from gNB. The assistance information may reflect the traffic pattern that remote UE tries to receive. We think the relay UE can choose a conservative configuration in consideration of the uncertainty of the information it has. |
| ZTE | The relay UE can set the SL DRX based on the informed PDB split and the assistance information from the remote UE. |  |
| Intel | Remote UE and relay UE are served by same gNB which directly configures the PC5 QoS configuration for both Relay UE and Remote UE. As previously agreed, in assistance information from Rx UE (I.e Remote UE) to Tx UE (I.e Relay UE), multiple DRX settings can be included. PC5 QoS configuration and assistance information together can be used to determine SL DRX configuration. |  |
| vivo | There can be solutions, but not in this release. | As commented above, we don’t agree any solutions as enhancements to be introduced in this release. If everybody is willing to tolerate the performance degradation with a direct “reuse”, we’re OK to confirm supporting this inter-WI feature in this release. |
| Qualcomm | As least for Relay UE with RA Mode 2, need gNB to provide QoS parameters derived from the DL QoS. Only priority and split PDB in RRC configuration to Relay UE are not enough for determine a SL DRX configuration, e.g., the ON duration.  Additionally, Remote UE may optionally provide assistance information with preferred SL DRX based on SL DRX framework, which needs to be added in spec for Remote UE’s behavior. How Remote UE decides preferred SL DRX may be up to UE implementation. |  |
| Samsung | Relay UE can set the DRX configuration using the assistance information from Remote UE as current SL DRX. |  |
| Nokia |  | Up to UE implementation, no spec changes/solutions needed |
| Xiaomi | Additional info is needed in assistance information to indicate the reasoning of each preferred SL DRX. |  |

Meanwhile**,** the gNB is feasible to configure SL DRX regardless of Mode 1 or Mode 2 RA since gNB has enforced break down of E2E QoS, however, in order to make it happen, RAN2 needs to make additional agreements, which would lead to additional spec changes.

**Issue 4: in case of Mode 2 RA, given gNB has full knowledge of PC5 QoS, RAN2 needs to agree that gNB can configure SL DRX for UE, which needs additional spec changes.**

***Q2-3:* in case of Mode 2 RA, given gNB has full knowledge of PC5 QoS, RAN2 needs to agree that gNB can configure SL DRX for UE, which needs additional spec changes, do companies agree this*?***

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Ericsson | Yes | Since gNB has full knowledge of PC5 QoS, it is more suitable for gNB to provide SL DRX configuration to remote UE or relay UE regardless of RA mode. |
| OPPO |  | When we discussed SL-DRX setting for mode-2, the camp who support UE-based SL-DRX setting decision was more considering that gNB has no info on resource allocation at UE side. So we assume even if we reopen the discussion, the result still is a trade-off taking into account of different factors / concerned aspect. |
| InterDigital | Yes | Given the traffic is Uu traffic, the outcome of this discussion should be different compared to the non-relay case. |
| CATT | Yes | In relay case, all the remote UE and relay UE are connected to gNB, gNB is more proper to provide the SL DRX configuration for relay and remote UE, which can improve the performance of the Uu/SL DRX alignment and UL/DLSL DRX alignment. |
| Huawei, HiSilicon |  | gNB can do doesn’t mean we have to fully specify. If we are trying to find blocking issue then the focus would be what are (are there) minimum necessary specifications, not the full-blown optimal specification. |
| LG |  | Which other information is critical to set SL DRX excluding PDB in QoS? We think UE can set SL DRX by using PDB information among QoS elements. Relay UE gets a split PDB configuration for DL and remote UE gets a split PDB configuration for UL. So, when remote UE is TX UE, it can configure SL DRX by using split PDB and its own traffic pattern for UL. And also, when relay UE is TX UE, it can configure SL DRX by using split PDB and assistance information from remote UE. The assistance information may include traffic pattern implicitly that the remote UE try to receive. |
| ZTE | No | The SL DRX pattern depends on not only traffic pattern but also available resources. |
| Intel | No | For SL, in mode 2, Tx UE determines the SL DRX for Rx UE as per previous RAN2 agreement. We think same decision can be applied here i.e Relay UE can determine SL DRX for Remote UE based on PC5 QoS configuration from gNB, PDB split and assistance information from Remote UE even if DL traffic pattern may not be available for the Rx UE (Remote UE). |
| vivo | Yes or No | In L2 U2N relay, both remote UE and relay UE are in RRC Connected state. NW control for DRX configuration is simpler since the key point of DRX parameter decision is the characteristics of services. But it is a little complex that the legacy DRX decision mechanism (applicable for legacy PC5, L3 U2N relay case etc.) and the one for L2 U2N sidelink relay may not be aligned/unified.  Also, like in Q1-1, the divergence here is still due to different level of tolerance among companies on performance degradation for related Uu procedure. So, same comments as to above Q1-1. |
| Qualcomm | Yes | 1) For RA mode 2, if let Relay UE decide the SL DRX configuration, the IE for PC5 QoS in gNB’s RRC message needs to be specified.  2) For RA mode 2, if let gNB decide the SL RX configuration, then need some specification changes since currently it’s Tx UE deciding the SL DRX. |
| Samsung |  | We think that no additional mechanism e.g., gNB controlled DRX configuration for RRC\_CONNECTED Remote UE is to be specified since current SL DRX procedure can work as is. |
| Nokia | No | The current specification is sufficient, and later enhancements can be for later releases |
| Xiaomi | No | We may not rever the existing agreement. |

**Rapporteur summary**

Regarding Issue 3

**Issue 3: In case of Mode 2 RA, UE (especially relay UE) is aware of split PDB for a E2E flow but has no knowledge of DL traffic pattern, which is not sufficient for UE to derive SL DRX.**

15 companies have provided comments in total. 6 companies think the issue is valid and therefore, it is necessary for RNA2 to further study the issue in order to make SL DRX to work properly for UE, while 9 companies think that it can be fully up to UE implementation to determine SL DRX considering split PDB and assistance information received from the peer UE.

The issue is mainly related to whether DL traffic pattern needs to be provided to relay UE so that relay UE can consider traffic pattern to determine SL DRX configuration for remote UE.

The camp which believes that the issue is relevant, has expressed the following arguments

* Relay UE may be not able to provide suitable SL DRX configuration lacking of knowledge of DL traffic pattern.
* For remote UE, when remote UE sets up PC5 connection, remote UE has no information on PC5 QoS breakdown, therefore, SL DRX provided to relay UE may be not suitable. After remote UE has received QoS info for PC5 link, remote UE may have to reconfigure the SL DRX.
* For relay UE,
  + information on DL traffic pattern may need to provide to relay UE by gNB.
  + Remote UE needs to provide assistance information to relay UE at good time, trigger condition may be updated.

The other camp which doesn’t believe that the issue is relevant has the following arguments

* Nowadays DRX setting is mostly optimized base on assumption of busty traffic (regardless of various traffic types), so traffic pattern info does not play a key role of DRX setting tunning.
* relay UE can set SL DRX configuration for remote UE by using the assistance information from remote UE and the split PDB value from gNB.
* Relay UE does not know the DL traffic pattern, but it is a blocker in applying the existing SL-DRX procedure to the relay operation. For example, remote UE may estimate the traffic pattern that will receive. Remote UE gives assistance information reflecting the estimated traffic pattern to the relay UE. And the relay UE will set SL DRX by using this assistance information from remote

Based on the comments from both camps, it can be concluded that relay UE is indeed not aware of the knowledge of DL traffic pattern. The diverse is mainly arising from whether traffic pattern is important information for relay UE to determine SL DRX. For SL DRX, it is common understanding that setting of on-duration timer and cycle length would require knowledge of traffic pattern.

Since both camps have diverse views on the issue, rapporteur would like to suggest further discussions for the issue.

1. RAN2 to discuss whether it is sufficient that L2 U2N Relay UE configures SL DRX in mode 2 RA only using assistance information from remote UE and the PDB split information from gNB.(9/15)

It is also pointed out by companies (6/15) that it may be beneficial to involve gNB in the decision procedure in case of Mode 2 operation, since gNB has full knowledge of E2E QoS of relay traffic, and QoS breakdown between PC5 and Uu interfaces.

Regarding paging, there are the following issues.

**Issue 5: whether to support SL DRX for paging forwarding via PC5-RRC in case of L2 U2N relay?**

***Q3-1:* do companies agree that RAN2 needs to study whether to support SL DRX for paging forwarding via PC5-RRC in case of L2 U2N relay*?***

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Ericsson | Yes | RAN2 needs to first discuss whether SL DRX will be supported for paging. If the answer is yes, what DRX configuration can be applied. In addition, Remote UE may receive paging in any RRC state. DRX cycles including paging cycle, PC5 SL DRX cycle and/or Uu DRX cycle may need to be aligned. |
| OPPO | No | So similar to Q1-1, basically, we understand the issue can be generalized as how to handle the SL-DRX w.r.t PCCH (carried via SL-SRB3, *UuMessageTransferSidelink*). As replied to Q1-1, our understanding is that the SL-DRX setting for UC list does not differentiate between radio bearer(s), as in legacy Uu. |
| MediaTek | No | We did not see any specific issue for SL DRX with regard to paging forwarding.  The issue can be generated as signaling forwarding. |
| InterDigital | Yes | SL DRX is intended for connected-mode like traffic, and not for paging. RAN2 should at least discuss how to take into account paging when SL DRX is configured. |
| Apple | No | We do not see any special issue specific for L2 Relay case. |
| CATT | Yes | Paging is different from other service data, it has no QoS profile. If there is only paging needs to be forwarded, which SL DRX should be used needs further discussion. |
| Huawei, HiSilicon | No | We don’t see issues here or any specification is needed. |
| LG | No | We cannot help to echo the answer in Q1-1. After SL DRX is configured between relay UE and remote UE for UC, all data should apply the SL DRX configuration for transmitting and receiving regardless TX profile. |
| ZTE | No | Remote UE can send the desired SL DRX assistance info which is aligned with the paging occasion to relay UE. Then the Relay UE or the gNB may configure the SL DRX of the remote UE which are aligned with the remote UE’s paging occasion. |
| Intel | No | Paging/SI forwarding could be treated as for SRB (PC5-RRC) in general sidelink communication. |
| vivo | Yes or No | Like in Q1-1, the divergence here is still due to different levels of tolerance among companies on performance degradation for related Uu procedure. So, same comments as to above Q1-1 |
| Qualcomm | Comment | The SL DRX configuration based on data traffic QoS profile is C-DRX which may not be aligned well with paging occasions, e.g., the SL DRX cycle length and the SL DRX starting point. The current C-DRX based SL DRX may work for paging monitoring, giving less latency requirement for paging.  In our view, it’s further optimization for latency and power saving. |
| Samsung | No with comment | We do not think that additional study is needed for paging for RRC\_IDLE/INACTIVE Remote UE. But we may need some clarification to consider paging occasion of Remote UE for DRX configuration. For example Relay UE can set DRX configuration using Remote UE’s assistance information on paging occasion. |
| Nokia | No | We have sympathy for the potential delay issues, but the most likely the SL DRX configuration is set wrongly |
| Xiaomi | Yes | Similar issue as we reply in Q2-1 |

**Issue 6: If SL DRX is applied for PC5-RRC carrying paging message, how to set a proper SL DRX configuration for PC5-RRC carrying paging message?**

***Q3-2:* If SL DRX is applied for PC5-RRC carrying paging message, how to set a proper SL DRX configuration for PC5-RRC carrying paging message*?***

|  |  |  |
| --- | --- | --- |
| Company | solutions | Comments |
| Ericsson | Procedure texts in RRC may need to update if SL DRX is supported for paging.  Some signaling changes to achieve alignment of DRX cycles may be necessary. |  |
| OPPO |  | Relay UE can already acquire the paging cycle information from remote UE, i.e., sufficient input for SL-DRX setting derivation. Yet we are not sure if there is latency requirement for paging delivery even in legacy network. |
| MediaTek |  | We did not see the need to make the thing complicated and to discuss the specific solution.  It should be noted that there’s no guaranteed performance today on Uu. There’s no requirement saying that “a signalling message transmitted by the gNB shall be received by the UE within X ms”. Even if one assumes there is some requirement, it is not dynamic and thus can be handled by relay UE implementation. |
| InterDigital | Alignment of DRX cycles, and consideration of paging-type DRX. |  |
| Apple |  | No, we do not see a strong need optimize this case. |
| CATT | If only paging message needs to be forward, the SL DRX should consider the paging cycle; otherwise, both the paging requirement and data requirement needs to be considered. |  |
| Huawei, HiSilicon |  | Can be up to implementation. gNB can determine RRC\_IDLE/INACTIVE remote UE’s SL DRX configuration by implementation to control the delay of paging forwarding from RRC\_CONNECTED relay UE to remote UE, and RRC\_IDLE/INACTIVE relay UE can determine RRC\_IDLE/INACTIVE remote UE’s SL DRX configuration by implementation considering alignment with remote UE’s PO. |
| LG |  | Agree with OPPO |
| ZTE |  | Same as comments in Q3-1. |
| Intel |  | We don’t see an issue here. See answer to Q3-1. |
| vivo | There can be solutions, but not in this release. | As commented above, we don’t agree any solutions as enhancements to be introduced in this release. If everybody is willing to tolerate the performance degradation with a direct “reuse”, OK to confirm supporting this inter-WI feature in this release. |
| Qualcomm | To optimize for paging in Idle/Inactivity state, the SL DRX cycle length and starting point may be aligned with the paging occasions. |  |
| Samsung | Some clarification is needed to align DRX configuration with paging occasion for Remote UE. |  |
| Nokia |  | Agree with OPPO |
| Xiaomi | Similar solution as we reply in Q2-2 |  |

Similar as paging, in L2 U2N relay, relay UE needs to forward SI to remote UE, it is important to ensure SI to be forwarded to remote UE. Therefore, RAN2 needs to address the following issues for SI forwarding in case of L2 U2N relay.

On the other side, some companies think that for the remote UE in RRC\_IDLE / RRC\_INACTIVE case, the forwarded traffic only includes SI and paging, which have no QoS profile, but the relay UE is aware of the general CP latency requirements and the remote UE’s paging DRX cycle.

**Issue 7: whether to support SL DRX for SI forwarding via PC5-RRC in case of L2 U2N relay?**

***Q4-1:* do companies agree that RAN2 needs to study whether to support SL DRX for SI forwarding via PC5-RRC in case of L2 U2N relay*?***

|  |  |  |
| --- | --- | --- |
| Company | Yes or No | Comments |
| Ericsson | Yes | RAN2 needs to first discuss whether SL DRX will be supported for SI. If the answer is yes, what DRX configuration can be applied.  With a bad SL DRX configuration, SI delivery may be delayed. |
| OPPO | No | So similar to Q1-1, basically, we understand the issue can be generalized as how to handle the SL-DRX w.r.t BCCH (carried via SL-SRB3, *UuMessageTransferSidelink*). As replied to Q1-1, our understanding is that the SL-DRX setting for UC list does not differentiate between radio bearer(s), as in legacy Uu. |
| MediaTek | No | We did not see any specific issue for SL DRX with regard to SI forwarding.  The issue can be generated as signaling forwarding together with paging forwarding. |
| InterDigital | Yes | Same issues of paging apply to system information. |
| Apple | No | Same as Paging |
| CATT | Yes |  |
| Huawei, HiSilicon | No | Don’t think, as such detailed optimization not even discussed in eSL, we need to consider it here. |
| LG | No | It is similar to the paging delivery case. SI forwarding also follows SL DRX configuration if UC SL DRX is set between relay UE and remote UE. |
| ZTE | No | We don’t see a strong reason to optimize this case. It is not clear whether there is latency requirement for SI delivery. |
| Intel | No | Same answer as Q3-1 |
| vivo | Yes or No | Like in Q1-1, the divergence here is still due to different levels of tolerance among companies on performance degradation for related Uu procedure. So, same comments as to above Q1-1 |
| Qualcomm | Comment | Sime to paging, it’s up to whether further optimization (e.g., for latency or power saving) is needed for L2 U2N relay. |
| Samsung | No with comment | Again we do not think that additional study is needed for SI forwarding for RRC\_IDLE/INACTIVE Remote UE. But we may need some clarification at Relay UE operation to set DRX configuration. |
| Nokia | No |  |
| Xiaomi | Yes | We understand certain SI requires timely delivery, e.g. ETWS. Delivery of these SIs shall not be delayed due to SL DRX. |

Similar as paging, in L2 U2N relay, relay UE needs to forward SI to remote UE.

On the other side, some companies think that for the remote UE in RRC\_IDLE / RRC\_INACTIVE case, the forwarded traffic only includes SI and paging, which have no QoS profile, but the relay UE is aware of the general CP latency requirements and the remote UE’s paging DRX cycle.

**Issue 8: If SL DRX is applied for PC5-RRC carrying SI message, how to set a proper SL DRX configuration for PC5-RRC carrying SI message?**

***Q4-2:* If SL DRX is applied for PC5-RRC carrying SI message, how to set a proper SL DRX configuration for PC5-RRC carrying SI message*?***

|  |  |  |
| --- | --- | --- |
| Company | solutions | Comments |
| Ericsson | Procedure texts in RRC may need to update if SL DRX is supported for SI forwarding.  Some signaling changes to achieve alignment of DRX cycles may be necessary. |  |
| OPPO |  | If the proponents are thinking about *si-Periodicity* as SI-related cycle information, relay UE can get that info by reading SIB1, so this input should be available. Yet we are not sure if there is latency requirement for SI delivery even in legacy network. |
| MediaTek | No | We did not see the need to make the thing complicated and to discuss the specific solution. |
| InterDigital | Same issues of paging apply to system information |  |
| Apple |  | The bottom line is there is no clear latency requirements for SI delivery. If relay UE or remote UE feels some issue, the SL-DRX UC can be updated or turned off easily with existing Rel-17 mechanism. |
| CATT | Similar as the paging, only SI forwarding case and both SI forwarding and other service data case should both be considered. Different SL DRX configurations can be used for these two cases. |  |
| Huawei, HiSilicon |  | “a proper SL DRX” sounds optimization? We can always use a e.g. default DRX configuration and the caused latency for SI, if it were a concern, can be well constrained. |
| LG |  | Maybe relay UE can configure SL DRX by using SI-related cycle information from SIB1. |
| ZTE |  | Relay UE can take the latency requirement of SI forwarding into account when deciding the SL DRX for the remote UE. However, it is not clear whether there is latency requirement for SI delivery. |
| Intel |  | As answered previously. |
| vivo | There can be solutions, but not in this release. | As commented above, we don’t agree any solutions as enhancements to be introduced in this release. If everybody is willing to tolerate the performance degradation with a direct “reuse”, we’re OK to confirm supporting this inter-WI feature in this release. |
| Qualcomm | Similar to paging paging |  |
| Samsung | Some clarification is needed to align DRX configuration with SI forwarding for Remote UE. |  |
| Nokia |  | As answered previously |
| Xiaomi | Additional active time may be started by SI request. |  |

**Rapporteur summary**

Regarding paging and SI forwarding, diverse views are provided by two camps.

On one side (6/15), companies think SL DRX is intended for connected-mode like traffic, and not for paging. RAN2 should at least discuss how to take into account paging and SI forwarding when SL DRX is configured.

On another side (9/15), companies understand the issue can be generalized as how to handle the SL-DRX w.r.t PCCH (carried via SL-SRB3, *UuMessageTransferSidelink*). The SL-DRX setting for UC list does not differentiate between radio bearer(s), as in legacy Uu.

1. RAN2 to discuss whether it is sufficient that L2 U2N Relay UE derives the suitable SL-DRX setting for paging/SI forwarding for Remote UE only based on agreed R17 mechanisms (9/15).

Eventually, since both camps have diverse views, rapporteur would like to suggest that RAN2 should stick to the previous RAN2 agreement before RAN2 has clear conclusion on the issues identified so far.

1. RAN2 to discuss whether the Rel-17 SL DRX applies to L2 U2N Relay.

# Conclusion

We have the following proposal:

[Proposal 1 RAN2 to discuss how to support SL DRX for RRC signalling after the PC5 link established during RRC connection establishment for remote UE (9/15).](#_Toc103599971)

[Proposal 2 RAN2 to discuss whether it is sufficient that L2 U2N Relay UE configures SL DRX in mode 2 RA only using assistance information from remote UE and the PDB split information from gNB.(9/15)](#_Toc103599972)

[Proposal 3 RAN2 to discuss whether it is sufficient that L2 U2N Relay UE derives the suitable SL-DRX setting for paging/SI forwarding for Remote UE only based on agreed R17 mechanisms (9/15).](#_Toc103599973)

[Proposal 4 RAN2 to discuss whether the Rel-17 SL DRX applies to L2 U2N Relay.](#_Toc103599974)

## Proposals in priority order

*[For discussion]*

[Proposal 1 RAN2 to discuss how to support SL DRX for RRC signalling after the PC5 link established during RRC connection establishment for remote UE (9/15).](#_Toc103599971)

[Proposal 2 RAN2 to discuss whether it is sufficient that L2 U2N Relay UE configures SL DRX in mode 2 RA only using assistance information from remote UE and the PDB split information from gNB.(9/15)](#_Toc103599972)

[Proposal 3 RAN2 to discuss whether it is sufficient that L2 U2N Relay UE derives the suitable SL-DRX setting for paging/SI forwarding for Remote UE only based on agreed R17 mechanisms (9/15).](#_Toc103599973)

[Proposal 4 RAN2 to discuss whether the Rel-17 SL DRX applies to L2 U2N Relay.](#_Toc103599974)

# Reference

1. R2-2204588 Discussion on Sidelink DRX for Sidelink Relay MediaTek Inc., APPLE, OPPO discussion Rel-17 NR\_SL\_relay-Core
2. R2-2205179 Issues of SL DRX for L2 U2N relay Ericsson discussion Rel-17 NR\_SL\_enh-Core
3. R2-2205269 Corrections on the Sidelink DRX NEC Corporation CR Rel-17 38.300 17.0.0 0457 - F NR\_SL\_enh-Core
4. R2-2205272 Way forward for Sidelink DRX configuration report for Relay purpose MediaTek Inc. discussion Rel-17 NR\_SL\_relay-Core Late
5. R2-2206047 Correction on SL DRX configuration for SL Relay MediaTek Inc., Huawei, ZTE, OPPO draftCR Rel-17 38.331 17.0.0 NR\_SL\_relay-Core
6. R2-2204946 Combination of SL DRX, Discovery and relay-related Communication CATT discussion Rel-17 NR\_SL\_enh-Core

# Appendix