**3GPP TSG RAN WG1 #106bis-e R1-21xxxxx**

**e-Meeting, October 11 –19, 2021**

**Source: Moderator (InterDigital)**

**Title: Moderator summary for [106bis-e-NR-R17-Sidelink-03] Reply LS to R1-2108710**

**Agenda item: 8.11.1**

**Document for:** **Discussion and Decision**

Introduction

This document provides discussion on the following approved email thread as part of RAN1#106bis-e Release 17 SL enhancement WI discussion.

[106bis-e-NR-R17-Sidelink-03] Discuss incoming LS on resource selection for a possible reply LS by October 18 – Moonil (InterDigital)

Collection of outcomes

To be collected once agreement / conclusion is reached.

Discussion on resource selection with DRX

## Round 1

**Background**: According to the received LS in [1], RAN2 made the following agreements in RAN2#115-e.

Agreements:

When data is available for transmission to one or more RX UE in DRX, TX UE selects the resources taking into account the active time (current or future) of the RX UE(s) determined by the timers maintained at the TX UE. Details are FFS. FFS whether RAN1 or RAN2 implement this restriction.

For unicast, the TX UE selects the resources for the initial transmission associated with any active time (e.g. on duration timer or inactivity timer, or retransmission timer) at the RX UE. How to handle cases when a transmission may cause these timers to be running at the RX UE is FFS. FFS on groupcast. FFS on whether any spec impact.

For unicast, the TX UE can select the resources for the retransmission associated with any active time (e.g. on duration timer or inactivity timer, or retransmission timer) at the RX UE. How to handle cases when a transmission may cause these timers to be running at the RX UE is FFS. FFS on groupcast. FFS on whether any spec impact.

For broadcast, the TX UE can select the resources for the initial transmission associated with any active time supported by broadcast (i.e. on duration) at the RX UE.

For broadcast, the TX UE can select the resources for the retransmission associated with any active time supported by broadcast (i.e. on duration) at the RX UE.

RAN2 also asked RAN1 to provide inputs whether/how to reflect the restriction for the resource selection with DRX [1]:

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| **ACTION:** RAN2 respectfully asks RAN1 to take the above agreements into account and inform RAN2 whether/how RAN1 intends to reflect the restriction in the following RAN2 agreement *“When data is available for transmission to one or more RX UE in DRX, TX UE selects the resources taking into account the active time (current or future) of the RX UE(s) determined by the timers maintained at the TX UE. Details are FFS. FFS whether RAN1 or RAN2 implement this restriction*  |

Based on reviewing the submitted contributions [2-15], we observed the following issues for the discussion to reply the LS:

* Issue #1: whether PHY layer to apply the restriction for resource selection with DRX active time of Rx UE?
	+ Alt-1: RAN1 replies that PHY layer should apply the restriction based on DRX active time of Rx UE provided by MAC layer [E///][Vivo][OPPO][Samsung][CATT][QC][IDCC]
		- If restriction is not performed in PHY layer, the reported candidate resource set may not include any resource within DRX active time of the RX UE
	+ Alt-2: RAN1 replies that PHY layer does not apply the restriction for the resource selection based on DRX active time of RX UE [ZTE][HW][LG][Nokia]
		- Not able to finish the work within the remaining time for Rel-17
		- Too much specification work for RAN1
		- The benefit of providing active time information of Rx UE to PHY layer is unclear
	+ Alt-3: RAN1 replies that both L1 and L2 based solutions may not work [Intel]
		- Both RAN1 and RAN2 solutions may not work if SL-DRX active time is not aligned with traffic generation

**Question #1: please provide preferred alternative. If preferred alternative is not listed, please add/describe in the following table:**

* **Alt-1: RAN1 replies that PHY layer should apply the restriction based on DRX active time of Rx UE provided by MAC layer**
* **Alt-2: RAN1 replies that PHY layer does not apply the restriction for the resource selection based on DRX active time of Rx UE**
* **Alt-3: RAN1 replies that both L1 and L2 based solutions may not work from RAN1 perspective**

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| Company | Alt-1/2/3 | Comments |
| vivo | Alt-1 | Firstly, the benefit of Alt-1 is clear: it is to avoid the case that PHY layer cannot report enough candidate resources to MAC layer for resource selection. Re-evaluation may not help in this case because the problem is not caused by insufficient sensing results.Secondly, we don’t think much difference on the specification effort between Alt-1 and Alt-2 (not sure what changes Alt-3 requires). In fact, Alt-2 may requires more works (either RAN1 or RAN2) to handle the abovementioned issue of insufficient candidate resources reported by PHY layer.Thirdly, the issue of how to align the SL DRX active time and the traffic generation is currently handled by RAN2 (i.e., by provisioning of the DRX timer at TX UE side). We don’t need to discuss it in RAN1. |
| NTT DOCOMO | Either Alt 1 or Alt 2 | If time is allowed, Alt 1 is preferred. |
| OPPO | Alt-1 | As explained in the sub-bullet in Alt-1, if there is no restriction at PHY, the reported S\_A may not include any candidate resource within DRX active time. Then higher layer will trigger phy layer to report S-A again and again which will increase the delay.  |
| Ericsson | Alt-1 | As presented in our contribution and captured above in the question, Alt-1 has a clear advantage of avoiding selecting irrelevant resources to be reported to MAC layer from the beginning. |
| Samsung | Alt-1 |  |
| Fujitsu | Alt 1 | If PHY layer does not apply the restriction, it cannot be guaranteed that there are available resources overlapped with SL DRX active time of Rx UE, which is needed to be reported to MAC layer to perform random selection, then packet loss will not be fully avoided. |
| CATT, GOHIGH | Alt-1 | As mentioned by the FL, if PHY layer doesn’t perform any restrictions, how to ensure that the MAC layer can select resources that are within the DRX active time of the Rx UE? Leaving this restriction completely to RAN2 implementation will lead to potential resource selection issues, such as packet loss due to inappropriate resource selection. Hence, Alt-1 is the most reasonable choice. |
| Xiaomi | Alt 1 | We think RAN1 is able to apply the restriction as this has already been taken into account in the previous agreements in RAN1. |
| Intel | Alt.3 + Alt.1 | In our understanding, both solutions may not work properly if traffic generation by a higher layer is not aware about active time of receivers. Irrespective of the solution RAN1 can agree, we propose to add this observation to reply LS in RAN2 to reflect dependency of the solutions on traffic generation. |
| ZTE, Sanechips | Alt 2 | For Alt 2, Our understanding is that DRX can be taken into account by MAC in the resource selection procedure as a whole. In case Alt 1 is agreed, RAN1 needs to further discuss how to restrict the candidate resource set within DRX active time, which is unknown to PHY in the first place. Even in MAC layer, the active time depend on the timer of retransmission timer and inactivity timer can only be determined based on the selected resources.  |
| Panasonic | Alt-1 or 2 | We prefer alt 1 if time allows. Otherwise, MAC layer should be sufficient.  |
| Fraunhofer | Alt 1 |  |

* Issue #2: how PHY layer applies the restriction for resource selection with DRX active time of Rx UE (if supported)?
	+ Option 1: PHY layer selects and reports candidate resources only within active time of the RX UE [vivo][Samsung][QC][E///]
	+ Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within active time of the RX UE [OPPO][IDCC]
	+ Option 3: PHY layer selects and reports an additional candidate resource set which includes candidate resources within active time of the RX UE [CATT]

**Question #2: please provide preferred option. If preferred option is not listed, please add/describe in the following table**

* **Option 1: PHY layer selects and reports candidate resources only within active time of the RX UE**
* **Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within active time of the RX UE**
* **Option 3: PHY layer selects and reports an additional candidate resource set which includes candidate resources within active time of the RX UE**

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| Company | Option 1/2/3 | Comments |
| vivo | Option 1, Option 2  | We prefer to option 1 or option 2.  |
| NTT DOCOMO | Option 1 or 2 |  |
| OPPO | Option 2 | PHY layer reports resource set which includes candidate resource within active time to higher layer, higher layer can select resource for initial transmission within active time based on RX UE’s DRX configuration. The initial transmission can trigger to start related DRX timer, such as drx-inactivitityTimer or drx-retransmission timer to extend the active time so that TX UE can select retransmission resource.For option 1: if the active time means current active time (related to Q3), such as active time determined by drx-onDurationTimer, that will be very restrictive because RX UE can extend the active time (future active in Q3) which can provide more candidate resources. If the active time means both current and future active time, the future active time which is determined by drx-inactivitityTimer or drx-retransmissionTimer is not known by PHY layer since the resource is selected by MAC. Then we preferred option 2. |
| Ericsson | Option 1 | We prefer Option 1. However, we also see the need to consider future Active Time which may not be visible to PHY until the resources for a transmission (e.g., the initial transmission) is selected. Hence, we are open to discussing Option 2. |
| Samsung | Option 1 |  |
| Fujitsu | See comments | We think the “active time” here should be firstly clarified, and it is related to our answer in Question #3.If it represents only “current active time” in Question #3, our preference is Option 3 here, i.e., an additional candidate resource set which includes candidate resources within “current” active time of the RX UE should be reported to make sure the initial transmission of Tx UE within active time of the RX UE.If it represents “current and future active time” in Question #3, our preference is Option 1 here, but we still think that at least two candidate resource sets should be reported to MAC layer, and one of them should make sure the initial transmission of Tx UE within active time of the RX UE. |
| CATT, GOHIGH | Option 3 (or 2) with comments | It seems that all of the above options are about how PHY layer selects and reports candidate resources. However, in order to have some candidate resources within the DRX active time of the Rx UE, **there is a prerequisite that the resource selection window should at least partially overlap with the DRX active time of the Rx UE**. Under this condition, it can be guaranteed that the PHY layer can find candidate resources corresponding to the DRX active time of the RX UE and perform candidate resource selection and report.Therefore, we support Option 3 with the following modification:**Option 3’: PHY layer adjusts the resource selection window to at least partially overlap with the DRX active time of the Rx UE, and then selects and reports an additional candidate resource set which includes candidate resources within active time of the RX UE**We can also support Option 2 with the same modification above, if it is the majority view, i.e.:**Option 2’: PHY layer adjusts the resource selection window to at least partially overlap with the DRX active time of the Rx UE, and then selects and reports candidate resources in which at least a subset of the candidate resources is within active time of the RX UE**Option 1 is not ok for us. Only select and report candidate resources which are within active time of the RX UE may cause channel congestion leading to reliability decrease. In addition, this option leaves RAN2 no space to select resources that may be within the extended/future active time (e.g. the resources within the activated *drx-retransmission-timer*). |
| Xiaomi |  Option 1 or option 2 | We think option 2 is reasonable as at least the first selected resource should be within the DRX\_active time of Rx UE(s). Later reserved resource(s) for repetition transmissions can be out of DRx\_active time if the Rx UE DRx\_on duration is small.  |
| Intel |  | Among proposed options we prefer Option 1  |
| ZTE, Sanechips | Comment | We don’t think any option works given the reply to Question 1. |
| Panasonic | Option 1 or 2 | We share similar view with Fujitsu that the “active time” needs to be clarified. If PHY layer restriction needs to be applied, we prefer option 1 or 2.  |
| Fraunhofer | Option 1, Option 2 |  |

* Issue #3: whether RAN1 provides preference on which DRX active time should be taken into account for the resource selection (e.g., current active time and/or future active time)
	+ ***[LG]: From the point of view of RAN1, it is preferred that the mechanism for TX UE to select the resources taking into account both the current and future active time of RX UE is supported and the relevant procedure is specified in the RAN2 specification.***

**Question #3: should RAN1 provide preference on which active time has to be taken into account for the resource selection (e.g., current active time vs. current and future active time)?**

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| Company | Yes/No | Comments |
| vivo | comment | The additional information (i.e., current and/or future active time) is useful for resource selection according to RAN2’s agreement. In order to provide candidate resources to MAC layer for resource selection during retransmission timer, the current and future active should be taken into account. |
| NTT DOCOMO | Question | What is expected outcome? RAN1 discusses which active time is preferred? It will be dependent on situations, so how can we conclude which active time is preferred?We would like to get more information to say our preference. |
| OPPO | Yes for current active time | It is up to higher layer for resource selection so that higher layer can control whether to select resource within current or further active time. PHY layer has no info which resource will be selected when determining candidate resource set. Then we propose RAN1 only consider current active time.  |
| Ericsson | Comment | The intention of this question is not very clear to us. Matters related to which Active Time MAC should be considered are part of FFS in RAN2 and we believe it is better to leave it to RAN2’s discussion. |
| Samsung | No | Not sure its benefit. We think this issue go beyond the scope of discussion. |
| Fujitsu  | See comments | Maybe it is needed to clarify what is the meaning of “current active time” and “future active time” firstly. For example, before the initial transmission is received, only OnDuration timer is running, is this duration should be defined as “current active time”? And then, inactivity and/or retransmission timer will be running triggered by the initial transmission, is this subsequent active time should be defined as “future active time”?If the above understanding is correct, we prefer both “current” and “future” active time shall be taken into account for the resource selection of Tx UE. |
| CATT, GOHIGH | Yes for current active time | From our perspective, it would be more clear and help RAN2 make progress better if RAN1 can provide the information that RAN1 performs candidate resources selection based on which kind of active time.Considering that resource selection and DRX timer maintenance are both implemented by MAC, PHY layer may not have the accurate information of the future active time. Thus, RAN1 should select and report the candidate resources based on the current active time, and leave it to RAN2 implementation of selecting resources within the future active time. |
| Xiaomi |  | We think this question is not directly related to RAN2 LS question. And it can be discussed in later RAN1 or RAN2 discussions, but not now for the LS reply. |
| Intel | Comments  | At least current active time should be considered. As for future active time it requires L2 / L1 interactions and can be decided by RAN2 |
| ZTE, Sanechips | Comment | RAN2 agreement made differentiates on duration and other active timer depending on unicast and broadcast. Prefer to leave the discussion regarding future active time in RAN2. |
| Panasonic | Yes | We think at least current time needs to be considered.  |

## Round 2

[TBD]

LS reply to R2-2108997 (R1-2108710) based on outcome of Section 3

Summary of contributions

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| Company | Observations and Proposals |
| Nokia [2] | **Observation 1: It is possible to apply Rx UE active time information into the L1 resource selection procedure.****Observation 2: Tx UE will depend on higher layers to provide the information about Rx UE active time.****Proposal 1: Further study the benefit of introducing new information about Rx UE active time into the L1 resource selection procedure.** |
| ZTE, Sanechips [3] | ***Proposal 1: The restriction on resource selection with DRX should be done by RAN2 instead of RAN1.*** |
| LG [4] | ***Observation 1: When discussing the answer to RAN2’s question, RAN1 should consider the following two cases, and if RAN1 can tell RAN2 which one is preferred, it would be helpful for RAN2 to proceed with the related work.**** ***Case 1: TX UE selects the resources taking into account only the current active time of RX UE***
* ***Case 2: TX UE selects the resources taking into account both the current and future active time of RX UE***

***Observation 2: If the resource selection of TX UE is performed considering both the current and future active time of RX UE, it would be beneficial in terms of satisfying the service-related QoS requirement (e.g., by reducing the probability of occurrence of packet drop/decoding failure).******Observation 3: The following can be considered as options for specifying RAN2 agreement-related restriction:**** ***Option 1: Specify the mechanism to support RAN2 agreement-related restriction in both the RAN1 and RAN2 specifications***
* ***Option 2: Specify the restriction related to RAN2 agreement in the RAN2 specification, i.e., from the point of view of PHY layer, the procedure of TX UE for the packet transmission to RX UE that does not perform the SL DRC operation is reused***

***Observation 4: In case when Case 2 is supported with Option 1, it is expected that the considerable time will be spent discussing the issues that should be addressed/resolved, which is not desirable given the limited time remaining until the end of Rel-17 item.******Proposal 1: The following is adopted as RAN1’s feedback to RAN2’s question in LS [1]:**** ***From the point of view of RAN1, it is preferred that the mechanism for TX UE to select the resources taking into account both the current and future active time of RX UE is supported and the relevant procedure is specified in the RAN2 specification.***
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| HW [5] | ***Observation 1: If RAN1 took the restriction from RAN2 for further design, quite a lot standard efforts would be needed on resource selection window determination, Y candidate slots selection, and candidate resource set determination, etc.******Observation 2: Since the SL DRX active time of RX UE is dynamically changing, PHY layer is difficult to adjust selection window and determine candidate resources precisely based on SL DRX active time of RX UE.*** ***Observation 3: It is more appropriate to reflect the restriction in MAC layer since both the trigger moment for resource selection in PHY layer and SL DRX active time of RX UE are known in MAC layer.******Proposal: Reply to RAN2 as follows:**** ***RAN1 considers that there are a lot of standard efforts and difficulties to reflect the restriction from RAN2 in RAN1 specifications. Considering the limited time budget in RAN1, RAN1 will not take the restriction into account for PHY layer design in Rel-17.***
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| Vivo [7] | it is RAN1’s understanding that MAC would provide the active time of the RX UE to PHY when it triggers resource selection procedure, so that PHY can select and report suitable candidate resources (i.e., within the active time of the RX UE) to MAC. |
| OPPO [8] | **Observation: If DRX restriction for resource selection is not considered at RAN1, it is possible that the reported candidate resource set does not included any resource located within RX UE’s DRX active duration so that higher layer cannot select resource within it.** **Proposal: DRX restriction for resource selection should be implemented at both RAN1 and RAN2.**  |
| CATT [10] | ***Observation 1: If the resource selection window of the TX UE does not include any candidate resource corresponding to the DRX active time of the RX UE(s), transmission reliability cannot be guaranteed.******Proposal 1:*** ***RAN1 can be responsible for implementing the restriction that TX UE selects the resources taking into account the active time (current or future) of the RX UE(s) by adjusting the resource selection window to at least partially overlap with the DRX active time of the Rx UE(s).******Proposal 2: Reply LS to RAN2.**** ***From RAN1’s perspective, RAN1 can be responsible for implementing the restriction that TX UE selects the resources taking into account the active time (current or future) of the RX UE(s)by adjusting the resource selection window to at least partially overlap with the DRX active time of the Rx UE(s).***
* ***Additionally, down-selection can be done between the following two resource selection methods:***
	+ ***RAN1 is responsible for determining the candidate resources corresponding to the DRX active time of the RX UE(s) by reporting an additional candidate resource set.***
	+ ***RAN2 is responsible for determining the candidate resources corresponding to the DRX active time of the RX UE(s) based on the information reported by PHY.***
* ***RAN1 respectfully asks RAN2 to take the above information into account***
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| Samsung [11] | **RAN1 reply on LS:** In order to avoid frequent resource (re-)selection at higher layer based on above RAN2 agreements, RAN1 can implement that the resource selection window of TX UE can be confined within slots corresponding current or future DRX active time of communicating RX UE(s) and specify UE behavior in PHY spec. |
| Qualcomm [13] | RAN1 discussed how the resource selection at the PHY layer should be performed by a Tx UE considering the DRX configuration of the RX UE; RAN1 concluded that the upper layer shall determine the set of slots coinciding with the DRX active time of the RX UE and inform the PHY layer about a set of allowed resources for selection. Consequently, the PHY layer only selects the resources from the intersection of the set of allowed resources indicated by the upper layer and its selection window. The resource selection restriction can be implemented by RAN1, while the signaling mechanism across the layers can be captured in the RAN2 specification.  |
| InterDigital [14] | *Observation 1: If the resource (re)selection window [n+T1, n+T2] extends beyond the active time of the Rx UE(s), providing the set of available resources only within the current active time (i.e., DRX ON duration) of the Rx UE(s) is not desirable since retransmission(s) are allowed outside of the current active time due to RAN2 DRX timers.**Observation 2: PHY layer needs to know the current active time of the Rx UE(s) in DRX to determine the set of available resources (i.e., Set A) to report to MAC layer.**Proposal 1: PHY layer provides a set of available resources (Set A) including at least a minimum number of resources within the current active time (e.g., DRX ON duration) of the Rx UE(s).**Proposal 2: Adopt the following answer to reply LS to RAN2:** *RAN1 consider that both PHY layer and MAC layer can apply the restriction as the following:*
	+ *PHY layer:*
		- *PHY layer provides a set of available resources (Set A) including at least a minimum number of resources within the current active time of the Rx UE(s).*
		- *PHY layer expects to receive the information related to the current active time of the Rx UE(s) from MAC layer to perform this restriction.*
	+ *MAC layer:*
		- *MAC layer selects the resources for at least initial transmission from the resources provided by PHY layer within the current active time.*
		- *MAC layer decides how many retransmission(s) can be made within the current active time of the RX UE(s).*
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References

1. [R1-2108710](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108710.zip) LS to RAN1 on RAN2 Agreements Related to Resource Selection RAN2, InterDigital
2. [R1-2108817](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108817.zip) Discussion on RAN2 LS on RAN2 Agreements Related to Resource Selection Nokia, Nokia Shanghai Bell
3. [R1-2109735](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109735.zip) Discussion on RAN2 LS on resource selection within DRX ZTE, Sanechips
4. [R1-2109859](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109859.zip) Discussion on LS to RAN1 on RAN2 Agreements Related to Resource Selection LG Electronics
5. [R1-2110335](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110335.zip) [Draft] Reply LS on RAN2 Agreements Related to Resource Selection Ericsson
6. [R1-2110365](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110365.zip) Discussion on RAN2 LS on resoruce selection with DRX Huawei, HiSilicon
7. [R1-2108946](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108946.zip) Draft reply LS on RAN2 Agreements Related to Resource Selection vivo
8. [R1-2109062](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109062.zip) Discussion on the relationship between SL DRX and resource selection OPPO
9. [R1-2109063](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109063.zip) Draft reply LS on LS about SL resource selection OPPO
10. [R1-2109181](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109181.zip) Discussion on LS on RAN2 Agreements Related to Resource Selection CATT, GOHIGH
11. [R1-2109461](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109461.zip) Draft Reply LS on RAN2 Agreements Related to Resource Selection Samsung
12. [R1-2109589](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109589.zip) Response to RAN2 LS Related to Resource Selection Intel Corporation
13. [R1-2110156](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110156.zip) Draft reply to RAN2 LS to RAN1 on RAN2 Agreements Related to Resource Selection Qualcomm Incorporated
14. [R1-2109882](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2109882.zip) Discussion on RAN2 LS on RA for transmission to Rx UEs in DRX InterDigital, Inc.
15. [R1-2110338](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2110338.zip) DRX impacts on resource selection procedures Ericsson