**3GPP TSG RAN WG1 #105-e R1-210xxxx**

**e-Meeting, May 10 – 27, 2021**

**Agenda Item: 8.11**

**Source: Moderator (ZTE)**

**Title: Moderator summary of Email Discussion/approval to rely LS in R1-2100021**

**Document for: Discussion and Decision**

# Introduction

The reply LS to R1-2100021 was discussed during two previous RAN1 meetings. Given the reply is closely related to whether UE is allowed to perform sensing operations including PSCCH monitoring and RSRP measurement during SL DRX inactive time, this document will try to collect companies' views on this topic. Discussion on this topic captured in [2] during RAN1#104b-e is used as a starting point to facilitate smooth progress.

# Discussions

## Round 1 discussion

It's moderator's understanding that the scope of this discussion is limited to the topic whether UE is allowed to perform PSCCH monitoring and RSRP measurement during SL DRX inactive time, while the details should be up to the progress of RAN2 discussion on DRX configuration and RAN1 discussion on 8.11.1.1 resource allocation for power saving if the majority is UE is allowed to perform such operations. Under this consideration, we would like to ask for companies' views on their preference over the following three alternatives on the proposed possible agreement. Alt 1 and Alt 2 were raised as FL proposal from 8.11.1.1 to this topic. Alt 3 is consolidated based on a contribution submitted to this meeting under AI 5 on this topic.

* Alt 1 A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. FFS details
* Alt 2 It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.
* Alt 3 A UE is not required to perform sensing out of the DRX active time

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| Company | View |
| ZTE, Sanechips | Alt 1.  Based on RAN2’s progress, we can get the following observations on SL DRX:   1. The granularity of SL DRX operation could be per a pair of source/destination, or per cast type, or per L2 destination ID. 2. The SL DRX configurations can be obtained from pre-configuration ,SIB ,dedicated-RRC or PC5-RRC. 3. For one UE, more than one SL DRX configurations would be configured. 4. For unicast, the SL DRX for both Tx UE and RX UE can be acquired by one UE.   In case the sensing window or the slots which are expected to be sensed in sensing window (for partial sensing), overlaps the off-duration of SL DRX, the UE is not expected to perform sensing on those slots during the off-duration of SL DRX. This could lead to performance degradation and impact on sensing procedure.  Apart from the concerns of performance/sensing procedure, the following issues should be considered too.  Issue 1: Based on observation 1, which granularity of SL DRX should be applied in current partial sensing?  Issue 2: Based on observation 4, in unicast, whether SL DRX of Tx UE or RX UE should be applied? Which UE is the target RX UE for the current partial sensing?  Issue 3: Based on observation 2, in groupcast/broadcast, for an OoC UE, if its pre-configured SL DRX is applied to sensing, is it feasible for a target RX UE which is in coverage?  Issue 4: Based on observation 3, if more than one SL DRX configurations are configured, one or all of configured SL DRX should be applied for partial sensing?  In addition, according to Rel-16 sensing procedure, PHY doesn’t know the sensed resources would be used for which HARQ process, which destination ID, which cast-type, HARQ enable/disable, etc.  And for V2X, safety is the first priority, the sensing reliability and collision detection are the key points for sensing. Power saving can be mostly obtained by setting sensing parameters reasonably.  Thus it's sensible that UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. |

Outcome of round 1 discussion

From the email replies received from HW/HiSilicon, Ericsson, Samsung, DoCoMo, vivo, Futurewei, Qualcomm, the following categorization received support from 3 companies(HW/HiSilicon, DoCoMo, Futurewei)

   Alt 1 A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.

1. FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation

2. FFS: Other details

 Alt 2 A UE cannot perform sensing out of the DRX active time

The following categorization received support from 2 companies (vivo/Qualcomm)

-       Option 1: UE shall perform sensing during its SL DRX inactivity time.

-       Option 2: UE should~~can~~perform sensing during its SL DRX inactivity time, based on specified rule(s). FFS the rule(s).

-       Option 3: It is up to UE whether to perform sensing during its SL DRX inactivity time.

-       Option 4: UE does not perform sensing during its SL DRX inactivity time.

The following categorization received support from 2 companies (DoCoMo/Qualcomm)

-       Option 1: UE shall perform sensing during its SL DRX inactive time.

-       Option 2: UE can perform sensing during its SL DRX inactive time, based on a rule. FFS what is the rule.

-       Option 3: UE can perform sensing during its SL DRX inactive time, but up to UE implementation.

-       Option 4: UE does not perform sensing during its SL DRX inactive time.

One company (Futurewei) prefer some additional change to option 2 as following as starting point

Option 2: UE can perform sensing during its SL DRX inactive time, based on specified rules and configurations. FFS  the rules and configurations.

The first categorization with modification by vivo is adopted as the additional question asked to collect companies’ views after they provided answer to the preference of the alternatives proposed by HW/HiSilicon because:

The modification has better distinction between UE implementation and specification work by replacing the wording ‘can’.

Companies’ are kindly invited to provide answers to the following questions, we will see whether we can agree to any alternative, or future progress on given option under an alternative with companies’ feedback.

## Round 2 discussion

Question 1: Out of the two alternatives, which one do you prefer as the direction for agreement to the topic.

   Alt 1 A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.

1. FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation

2. FFS: Other details

 Alt 2 A UE cannot perform sensing out of the DRX active time

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| Company | View |
| Samsung | We support Alt 2 in order to achieve the power saving by prohibiting sensing (SL reception of PSCCH and RSRP measurement) during the SL DRX inactive time. Like Alt 1, additional UE behavior should be discussed for Alt 2. For example, for UE with SL DRX, sensing window can be adjusted into DRX active time within configured sensing window and if the sensing window is not available, UE can perform random selection without sensing. So, we suggest to add “FFS other details” also for Alt 2. |
| OPPO | Support Alt 1.  In our view, if sensing cannot performed out of DRX active time, there will be the following issues:   * + Issue 1: The sensing results is not accurate since in some cases the most recent sensing occasion is within inactive time   The most recent sensing occasion carries the more accurate sensing results. That is why when we discussing partial sensing, at least k=1 should be monitored. If the period corresponding to k=1 is not monitored, that will degrade PRR performance.   * + Issue 2: Re-evaluation/pre-emption is not applicable in case the resource selection window (which is determined by the packet arriving time of TX UE) is within TX UE’s inactive time.   Re-evaluation and pre-emption is important feature introduced in R16 to avoid collision with aperiodic traffic. It is more important in R17 considering mix RA including random resource selection. If sensing cannot be performed out of active time which result in re-evaluation/pre-emption cannot be performed either, the collision with aperiodic traffic, especially the UE with RS, is hardly to be avoided which will degrade the PRR performance greatly. |
| CATT, GOHIGH | We support Alt 1.  In RAN2 #113-e meeting, the following agreement was achieved on SL DRX:  *“4: For data reception, RAN2 defines the behaviour for monitoring the SCI reception (i.e., PSCCH and 2nd SCI on PSSCH) during the SL active time for SL DRX. For data reception, the UE may skip monitoring of PSCCH and 2nd SCI on PSSCH during inactive time for SL DRX. Sensing aspect is not considered in this agreement.”*  It is clear that RAN2 defines SL DRX active time as the duration during which the UE performs SCI reception (i.e., PSCCH and 2nd SCI on PSSCH) for the purpose of data reception. Since DRX is entirely a receive behavior, it should not be confused with sensing (PSCCH reception and SL-RSRP measurement) which is a transmission behavior.  From RAN1’s perspective, if Tx UE is restricted to performing sensing only during its DRX active time, sensing performance cannot be guaranteed. Tx UE should either give up the sensing occasions which fall into the DRX inactive time or configure the DRX active time to include all the sensing occasions. However, the former may cause a loss of resource selection performance due to insufficient sensing results, while the latter is difficult to implement and may prolong the DRX active time, leading to increased power consumption.  Thus, in order to achieve a trade-off between PRR performance and power consumption, sensing operation should be allowed in SL DRX inactive time without the restriction of UE’s own SL DRX configuration, i.e. Alt 1 is a more reasonable alternative. |
| Sharp | We support Alt 1.  In addition to reasons from other companies, Alt 1 actually covers Alt 2, so we think the concern from proponents of Alt 2 could be eased by conditions/rules to be further discussed for Alt. 1. |
| Panasonic | We support Alt 2.  Our understanding of Uu DRX is that "UE shall monitor PDCCHs in active time and UE may monitor PDCCHs in inactive time". Therefore, from receiver perspective, mandatory behaviors are specified in DRX active time, while "up to implementation” behaviors are specified DRX inactive time.  Following the same principle and certain sensing is mandatory, our thinking is such sensing should be defined as "active time". |
| Xiaomi | Support Alt 2.  The working assumption of RAN2 is “SL DRX should take PSCCH monitoring also for sensing (in addition to data reception) into account if SL DRX is used.” From our understanding, the work assumption guarantees that a slot is within DRX active time if a UE is required to sense in the slot for resource selection purpose (e.g. based on partial sensing procedures). In other words, if partial sensing is enabled, DRX configuration should be set such that the requirement of partial sensing is satisfied and all the sensing are performed in DRX active time. |
| Fujitsu | We support Alt 1.  In our opinion, limiting sensing within the SL DRX active time may degrade the sensing accuracy and system performance, because in this case, it is more likely to choose a resource that collides with other UEs based on the insufficient sensing results.  In fact, due to more collisions, Alt.2 may not actually achieve the power saving effect, because more retransmissions may be needed in this case, then the power consumption of Tx UE for transmission/re-evaluation/pre-emption and Rx UE for reception power will increase accordingly. |
| vivo | Support Alt 2 (although we think the word of ‘cannot’ is confusing)  The gain of Alt 2 seems to be clear for everyone, i.e., lower power consumption.  The concern of Alt 2 is on the PRR performance degradation due to less sensing results. However, as shown in our simulation results (in R1-2106067), even without performing sensing in the inactivity time, the PRR performance degradation is minor, while around 7%-11% power consumption can be saved. |
| NTT DOCOMO | Support Alt 1.  We would like to clarify what is the meaning of ‘DRX active/inactive time’. Is it common understanding that DRX active time is time duration in which UE can perform data reception? That is, the definition is independent to sensing. |
| LG Electronics | We are supportive of Alt 1.  The followings are the reasons why we prefer Alt 1.   * According to the current specification, it specifies only the UE behavior during the active time of Uu DRX. In other words, there is no restriction on the UE behavior during the inactive time of Uu DRX. In this sense, there is no motivation to prohibit Rel-17 Power Saving UE from performing the sensing operation during the inactive time of SL DRX by its implementation. * It would be difficult for Rel-17 Power Saving UE to dynamically adjust the pattern of SL DRX so that its active time always includes the sensing occasions required for the packet transmission. Furthermore, for this problematic case, performing the random resource selection (i.e., without using the sensing result) does not guarantee the satisfaction of QoS requirement. Considering these aspects, we think that at least from the perspective of UE’s implementation, allowing the sensing operation within the inactive time of SL DRX is supported. |
| Intel | Support Alt 1:  In our opinion it is possible to configure the SL DRX independently of partial sensing. Thus, we think partial sensing inside the inactive time should be allowed. At the same time partial sensing requirements for communication should be respected. |
| Huawei/HiSilicon | We support Alt1.  In order to make sure the transmission reliability, a UE can perform sensing during SL DRX inactive time when the sensing results within SL DRX active time is insufficient.  If a UE cannot perform sensing outside the DRX active time, there would be two possible operations due to insufficient sensing results.   * A UE would drop the packet transmission due to insufficient sensing results. This would be the worst choice, which would increase the PIR. * A UE would perform SL transmission without considering the insufficient sensing results, particularly for the case that there is only a little overlap between SL DRX active time and sensing window/occasions. How this would be done without degrading performance of the UEs which did perform sensing is not clear (and might amount to random selection even where the RP does not allow it), which would lead to an unpredictable system-level performance..   In order to avoid resource collision as far as possible, the UE should be allowed to perform sensing during DRX inactive time for sensing based RA. |
| ZTE, Sanechips | Alt 1. Due to the concerns mentioned in our previous round, we are fine to have alt 1 as conclusion for this meeting.  Regarding Alt 2, we think there may be some confusion points based on our reading of companies' feedback including whether the DRX active time is overlapped with sensing window or not. To eliminate the confusion from companies and reflect some companies' concerns on performance aspects, we suggest adding some further clarification to that as below.  Alt 2 A UE cannot perform sensing out of the DRX active time assuming the sensing window is fully overlapped with configured DRX active time |
| Ericsson | We are supportive of Alt.1.  The UE shall perform sensing during its Active Time and up to UE implementation to perform sensing during its Inactive Time. |
| Nokia, NSB | Support Alt 1.  These two FFS can be also removed. |
| Apple | Alt 2  If a UE still needs to perform sensing during sidelink DRX off duration, then the only operational difference from sidelink DRX on duration is the omission of 2nd SCI and data decoding. The corresponding power saving benefit from sidelink DRX is very limited.  In order to monitor PSCCH for sensing, a UE needs to switch on sidelink radio for the first several symbols of a sidelink slot. This prevents UE from entering the deep sleep state because the UE needs to receive PSCCH at every sensing slot. We think the power consumption level of “PSCCH-only Rx” state may be comparable with that of “PDCCH-only for cross-slot scheduling” state, which is 50 for FR1. This power consumption level is much higher than that of deep sleep state, which is 1.  Furthermore, in order to measure sidelink RSRP for sensing, UE needs to switch on sidelink radio for the entire PSSCH duration in case sidelink RSRP measurement is configured to be based on PSSCH DMRS. This prevents UE from even entering the micro sleep state.  On the other hand, a UE in Uu DRX off duration does not monitor PDCCH at all. We think the similar principle could be extended to sidelink DRX. |

Question 2: If your answer to the first question is alternative 1, please indicate which option from option 1 – 3 is your preference, please indicate any other detail you would like to share. If your preference to the first question is alternative 2, please indicate whether option 4 is your preference and any other detail you would like to share.

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| Company | View |
| Samsung | For Option 4, we need to discuss about detailed UE behavior. Please see our comment in Q1 above. |
| OPPO | The LS from RAN2 just ask whether RAN1 has concern on the following WA. The selection between Alt1 or Alt 2 in Q1 is enough to answer to the LS from RAN2. The details for the sensing, corresponding to option 1-3, is not related to the LS and can be discussed later in RAN1.  Working assumption:  SL DRX should take PSCCH monitoring also for sensing (in addition to data reception) into account if SL DRX is used. |
| CATT, GOHIGH | We support option 1 with following modification:  Option 1: UE shall perform sensing in every sensing occasion during its SL DRX inactivity time.  As our comments in Q1, DRX is entirely a receive behavior and should not have direct impact on sensing. That is to say, once the sensing occasion is determined by the sensing and resource selection procedure, UE shall perform sensing in every sensing occasion, whether during its DRX active time or inactive time.  The above-mentioned behavior should not be up to UE implementation and no more specified rule(s) is(are) needed. Thus, we do not support option 2 and option 3. |
| Sharp | Agree with OPPO that for the purpose of replying to RAN2 LS, it is sufficient to make a decision between Alt 1 and Alt 2 in this email discussion. |
| Panasonic | Our position for Q1 is alt2, and we support option 4 with following comments.  For mandatory sensing behaviors, we think they should be defined as "active time". Additionally, if certain sensing is optional (up to implementation), such sensing could be defined in inactive time. |
| Xiaomi | We may need to inform RAN2 on the understanding of RAN1, that the DRX should be set such that the requirement of partial sensing can be satisfied. The detailed design on DRX can be up to RAN2. |
| Fujitsu | We support option 2.  Regarding option 1, it seems to imply that no coordination is needed b/w partial sensing and SL DRX, but this may cause the UE to perform too much sensing during its SL DRX inactive time and/or switch between active and non-active states too frequently, which is obviously not beneficial from power saving perspective.  Regarding option 3, we think if sensing occasions can be determined fully up to UE implementation, the sensing accuracy and system performance may still be degraded since UE may choose not to perform sensing during some slots which overlap with SL DRX inactive time. In our view, at least for some sensing slots which are specified in section 8.11.1.1, sensing should always be done regardless of whether they overlap with SL DRX active time. For example, the most recent sensing occasion for a give periodicity, should always be monitored to obtain the most reliable sensing result.  So, we prefer option 2 which can be a trad-off b/w system performance and power efficiency, that is, some alignment mechanism b/w partial sensing and SL DRX can be considered and specified in RAN1 or RAN2.  We can also accept the proposal from OPPO that to postpone this detailed discussion in RAN1. |
| vivo | As stated before, we support option 4. |
| NTT DOCOMO | Support Option 1; otherwise, so many resource collisions occur. Why can we go with this direction (Option 2/3/4) considering resource pool with mixed RA mechanisms?  BTW, Panasonic’s position seems not current Alt 2/Option 4 since they assume different definition of ‘DRX active time’. To avoid misalignment among companies, to clarify definition of ‘DRX active time’ is better before concluding our discussion.  In our understanding, chairman’s guidance is that this email thread should be beyond LS reply. This is why Kevin dropped DRX perspective from his summary. Limiting this thread as only LS reply is not helpful to move forward. |
| LG Electronics | We share the same view with OPPO. In other words, the necessary discussion of down-selection of possible options can be taken under AI 8.11.1.1 in the future meeting. |
| Intel | We prefer Option 2 to specify only partial sensing. Partial sensing requirement could than mandate sensing inside the inactive time. |
| Huawei/HiSilicon | The wording of option 2 is problematic because “should” cannot be meaningfully specified. We understand the intention of option 2 is that there are certain conditions on whether or not sensing may/may not (i.e. UE does or does not have specification permission to) or shall/shall not (i.e. has a specification requirement to or not) be performed during a given SL DRX inactive time. In that sense, the word “can” would be correct, and the word “should” is not correct.  We support Option 2, but only in case of without the change from “can” to “should” as described above. It is also possible to support option 1 by adjusting it to say “FFS details”.  DRX configuration is used for power saving. If a UE is configured with DRX, the UE would like to decrease the power consumption as far as possible. When the sensing result during SL DRX active time is sufficient, it is unnecessary that a UE shall be required to perform sensing during its SL DRX inactive time.  In option 3, up to UE implementation means that a UE is allowed to transmit PSSCH in any case. It would lead to an unpredictable baseline system-level performance.  However, we also agree with others that to reply to RAN2, it is enough for RAN1 to answer only Question 1 of this FL summary. |
| ZTE, Sanechips | We prefer focusing on the first question in this meeting. Downselection among option 1- 3 seem infeasible for this meeting especially considering the wording for the options is not stable from companies' comment. |
| Ericsson | We are supportive of Option 3 with a slight wording modification for clarification.  -       Option 3: Whether perform sensing during its SL DRX inactivity time is up to UE implementation. ~~It is up to UE whether to perform sensing during its SL DRX inactivity time.~~ |
| Nokia, NSB | If Alt 1 is agreed, Option 4 is out of the question.  Not sure which version of these options are open now. Option 1 and Option 2 are similar. We’d prefer the proposal in the last meeting:  It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. |

# Conclusion

TBD

# References

1. Chair's Notes RAN1#104b-e v012
2. R1-2104093, FL summary for AI 8.11.1.1 – resource allocation for power saving (final), Moderator(OPPO)