**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

|  |  |
| --- | --- |
| 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, Nokia, the following categorization received support from 4 companies(HW/HiSilicon, DoCoMo, Futurewei, Nokia)

   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

|  |  |
| --- | --- |
| 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.  Moderator: Thanks. I further refined Alt 2 to reflect the situation where SL DRX active time is fully/partially overlapped with sensing window. Depending on your reply, I speculate random selection instead of sensing during SL DRX inactive time is preferred. Thus I wonder whether one of the refined alt 2 can reflect your position better. |
| 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.  Moderator: Thanks, please check whether alt 2-1 reflected your position better |
| 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.  Moderator: I totally appreciate your simulation and get your point. From moderator perspective, we need to move on for this meeting. I refined Alt 2 a bit, please let me know your views on this or any further compromise you could offer and convince the group in addition to the proposed agreement. |
| 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.  Moderator: From my perspective, even if RAN2 can try to configure the DRX setting such that the sensing window can be aligned to the best effort with the DRX setting. It’s still hard to ensure that always holds if we consider the transmission is unpredictable/unknown or re-evaluation/pre-emption mechanism. But I refined Alt 2 a bit into 2 alts to address this point. Please check whether your concern is reflected. As CATT/GOHIGH mentioned, the DRX time in RAN2 spec. is designed from Rx perspective and the sensing from Tx perspective, thus I think RAN2 may provide more input in this regard. |
| 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.  Moderator: In the first round, the proposal was without explicitly mentioning the first FFS, yet there could be some confusion over the ‘wording ‘ can according to companies’ feedback. If the FFS parts are correct, then I think we can keep them at least for direction of further discussion. |
| 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. |
| Futurewei | We support Alt 1.  If SL DRX is not aligned well with partial sensing, not performing partial sensing during the DRX off period will impact the resource selection performance significantly due to insufficient sensing results.  SL DRX is a power saving sensing scheme. Since partial sensing already a power saving scheme, additional power saving gain by not performing sensing in DRX off period is small but at a cost of a large performance degradation. |
| Fraunhofer | We are supportive of Alt. 1. We tend to agree with the reasons already mentioned by LG. |
| MediaTek | We support Alt-1.  UE should be able to perform sensing; otherwise not allowing any sensing would be too restrictive to performance. |
| Qualcomm | We prefer to use the 4 options being discussed in the email thread.  The option we support would map to Alt 1 where sensing is left up to UE implementation. We don’t support requiring the UE to perform sensing during its inactive time as that negates the power savings of DRX.  Moderator : I understand your preference. But it seems quite challenging that companies converge on one option given it’s some companies’ preference to specify some additional mechanism to trigger the sensing during SL DRX inactive time. In the meantime, we really need to move on. Given your preferred option 3 is captured under Alt 1, maybe we could have further discussion on this once Alt 1 is stable. |

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.

|  |  |
| --- | --- |
| Company | View |
| Samsung | For Option 4, we need to discuss about detailed UE behavior. Please see our comment in Q1 above.  Moderator: Thanks. I further refined Alt 2 to reflect the situation where SL DRX active time is fully/partially overlapped with sensing window. Depending on your reply, I speculate random selection instead of sensing during SL DRX inactive time is preferred. Thus I wonder whether one of the refined alt 2 can reflect your position better. |
| 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.  Moderator: Thanks, please check whether alt 2-1 reflected your position better |
| 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.  Moderator: Thanks for letting me know your views. It seems companies have different understanding of the wording of the options listed. Thus I also agree that we can further discuss the options if the alt 1 is stable. |
| 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. |
| Futurewei | As in our comments in the email discussions, we support the option 2 in the original proposal by DCM with some changes.   * Option 2: UE can perform sensing during its SL DRX inactive time, based on specified rules and configurations. FFS the rules and configurations   We do not support the change of "can" to "should" as the change could eliminate certain conditions or configurations that UE do not perform sensing during the DRX inactive time. We are also fine using the wording “UE performs sensing ….” that Huawei proposed in the email discussions.  If “rules” include the (pre-)configurations, we are ok to remove “configuration” in our proposed changes for simplicity.  We also agree with OPPO, the discussion and decision on the Question 1 are sufficient to answer the RAN2 for the LS. Discussions on the three options may not be necessary and may be continued under AI 8.11.1.1. |
| Fraunhofer | We are supportive of Option 2, with the change of the word from “should” to “can”, as mentioned by Huawei. |
| MediaTek | We support Option-2, and also Option-3.  In some cases (limited sensing measurements, high priority traffic, etc.), UE should be expected to perform sensing by specifications. In other cases, UE should be allowed to perform sensing up to its implementation. |
| Qualcomm | We support leaving the decision on whether to sense during inactive time to UE implementation (Option 3). |

## Round 3 discussion

Moderator Observation for Round 2

Among the replies from 20 companies, the following preference is shown

|  |
| --- |
| 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 |

Supported by: OPPO, CATT/GOHIGH, Sharp, Fujitsu, NTT DOCOMO, LG Electronics, Intel, HW/HiSilicon, ZTE/Sanechips, Ericsson, Nokia(removing the FFS), Futurewei, Fraunhofer, MediaTek, Qualcomm(Prefer to leave to UE implementation)

15 in total

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

Supported by: Samsung, Panasonic, Xiaomi, vivo, Apple(prefer the option based approach and option 4)

5 in total

First of all, it’s moderator’s understanding that the 4 options should be the next step progress if companies could have consensus as to which alternative to go with. Moreover, the scope of this email discussion should be strictly limited to whether UE is allowed to performing sensing in SL DRX inactive time according to previous communication with Mr.Chair, Rapporteur and FL of 8.11.1.1.

The technical concern with Alt 2 is the performance degradation due to insufficient sensing results. Moreover, companies mentioned that even for Uu, there is no prohibition of implementing a UE performing PDCCH monitoring during Uu DRX. Thus following Uu logic, at least it’s safe to assume it’s up to UE implementation which is captured in Alt 1.

The technical concern with Alt 1 is the degradation of power saving gain of DRX techniques. But from moderator perspective, perhaps there could be other approaches to compensate the power saving gain mitigation, e.g. by some adjustment of the sensing parameters if needed. Compared with power saving benefits, transmission reliability seems more important.

Given it's strongly expected that RAN1 can make a conclusion on this topic to facilitate LS reply. Moderator would like to make the following proposed agreement based on the above observations, companies can further input, if not addressed in the moderator reply for the previous round:

Possible Agreement 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

|  |  |
| --- | --- |
| Company | View |
| Samsung | We do not support the current proposal.  The purpose of SL DRX is for power saving. Therefore, we think that power saving is more important criteria than performance. According to vivo’s observation, performance degradation is minor with Alt 2. As a reasoning for Alt 1, it does not make sense to follow Uu DRX principle since in Uu there is no UE determined resource allocation based on sensing. Furthermore, if the performance is important, SL DRX may not configured to UE. The final decision on SL DRX configuration and operation is up to RAN2. Therefore, considering current RAN1 discussion, we suggest to capture the two alternatives in the reply LS and add RAN1 observation for each alternatives as  *Alt 1. A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.*   * + - * + *FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation*         + *FFS: Other details*   *Alt 2. A UE cannot perform sensing out of the DRX active time*   * + - * + *FFS: Other details*   *RAN1 has discussed above two alternatives but could not reach a consensus since the power consumption due to sensing over SL DRX is expected in Alt 1 while the performance degradation due to insufficient sensing is expected in Alt 2.*  We can discuss further how to reply.  Moderator: Thank you for the reply. I get your point. Please check my reply to vivo on the simulation part. Though I do sympathize with you that NW can avoid the configuration of SL DRX at the first place from performance perspective, yet this RAN2 LS is about the situation when such configuration is there. Thus perhaps we need to have a conclusion for the case when SL DRX interacts with sensing. Moreover, if your interpretation is Alt 2-1, could you please kindly check the modified moderator proposal intended to address Xiaomi’s concern? Whether SL DRX active time is extended to cover the sensing operation is up to RAN2.  A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time (the duration when a UE is not expected to perform PSCCH monitoring for data reception).  1. FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation  2. FFS: Other details |
| vivo | We are not supportive to this proposal.  Firstly, the “technical concern with Alt 2” in the summary has not been proven – there is no simulation result to demonstrate any significant performance degradation due to insufficient sensing results, while, on the other hand, in our simulation results such performance degradation is quite limited. Thus, the observations and technical arguments for Alt 1 and 2 in the summary is not correct, and should be fixed. Consequently, the Moderator’s proposal is not technically driven, but simply by counting of hands raised.  Secondly, it is correct that in Uu the spec does not forbid the UE to monitor the PDCCH in DRX inactivity time. Actually, In Uu the spec only defines the UE behavior in DRX active time, and does not require the UE to monitor PDCCH in inactivity time. In this sense, we can accept the similar approach for SL, but still the current wording is not acceptable, as it seems to be a stronger requirement than that in Uu for inactivity time.  In order to make progress, we provide the following compromise:  A UE is not required to ~~can~~ perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. FFS: Whether there is any condition UE performs ~~when~~ such reception ~~is performed is subject to specification, or is up to UE implementation~~FFS: Other details Moderator: Thank you for the reply. The following texts are copied from vivo’s contribution R1-2104385.  It is noted that there exists obvious PRR performance gap between case 1 and case 2 when the load is medium as presented in Figure 30, the reason is that, the sensing mechanism plays a more important role in the case with higer load. Therefore, further optimizations can be considered for case 1, without significant increase of power consumption. For example, UE can confine the sensing/partial sensing/contiguous sensing window within the DRX active time. Besides, to extend the DRX active time in some special conditions also works.  My understanding from the above text is the following:  In case loading is significantly increased, resource collision caused by insufficient sensing results under case 1 will lead to more severe performance degradation, at least more ‘obvious’ PRR performance gap between case 1(UE performs sensing during the part of sensing window *within the DRX active time only*.) and case 2(*regardless of whether its sensing window* is fully overlapped/partially overlapped/non overlapped with its DRX active time.). Thus I think it’s not fair to say that ‘Consequently, the Moderator’s proposal is not technically driven, but simply by counting of hands raised.’ based on vivo’s contribution.  I think we need to consider the power saving gain over performance mitigation case by case, it’s hard to justify the necessity to mandate UE to follow a DRX setting which is non-overlapped at all with its sensing window. For example, when a UE is configured with a completely non-overlapped DRX pattern from its destination UE. For the purpose of data reception, its own DRX pattern needs to be followed, while for Tx to the destination UE and the prerequisite sensing, the DRX pattern of the destination UE should be considered. This case is likely to take place in particular when a UE is either the Tx or Rx for multiple communication links. For this case, I would say the performance loss of case 1 compared to case 2 is similar to the performance loss between random selection and partial sensing.  Regarding the wording change, the ‘is not required to’ wording was proposed by moderator as the Alt 3 on the table in the previous round. But from companies’ reply, some confusion is mentioned in terms of whether to interpret it as either   * a UE is not required to perform sensing out of the DRX active time but can do it if it wants (and later make use of the gathered information) * a UE is not allowed to perform sensing out of the DRX active time.   The ambiguity is there even with the FFS part as in case there is no RAN1 consensus to specify the conditions in the FFS, likely to be discussed during later meetings, the above ambiguity would exist. This seems not a good way forward and perhaps not even progress compared with the compromise proposed by Samsung to leave the two alternatives as they are. |
| Xiaomi | From our understanding, RAN2 has not made a complete decision on how to define DRX active time or DRX inactive time. The only related agreement in RAN2 LS R1-210021 is:  “*If a UE is in SL active time, UE should monitor PSCCH. FFS on PSSCH. FFS for sensing impacts*.”  It is still not clear whether a duration that UE only performs sensing can be set as SL active time or not.  Therefore, the following revision is suggested to better reflect the understanding in RAN1:   * A UE can perform SL reception of PSCCH and RSRP measurement for sensing ~~during its SL DRX inactive time~~ in slots that UE does not need to monitor PSCCH for data reception.   + - * + FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation         + FFS: Other details   Moderator: Thank you for the reply. I get your point. I am wondering whether the following clarification in Alt 1 is fine to you and the group as well. Whether SL DRX active time is extended to cover the sensing operation is up to RAN2.  A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time(the duration when a UE is not expected to perform PSCCH monitoring for data reception).  1. FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation  2. FFS: Other details  *“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.”*  The above RAN2 agreement defines the SL DRX active time as the duration when SCI reception is performed for data reception.  Xiaomi2: Thank you for the explanation and clarification. From the cited agreement of RAN2 it has been clearly stated that sensing aspect is not considered in this agreement. From my understanding, here “not considered” does not mean sensing aspect is precluded, but rather means that sensing aspect is still FFS. This is aligned with the agreement cited in the LS R1-210021.  In addition, in LS R1-210021 RAN2’s request is to ask RAN1 to provide feedback if there is any concern on the working assumption: “SL DRX should **take PSCCH monitoring also for sensing (in addition to data reception) into account** if SL DRX is used”. If RAN2 has already agreed that SL DRX active time as the duration when SCI reception is only performed for data reception, it seems to be contradictory to the wording assumption. I think RAN1 do not need to discuss the definition of SL DRX (in)active duration, which is a complete RAN2 topic. What we suggest to do is just to precisely describe RAN1 understanding and leave the definition of “inactive time” to RAN2. Even if it is true that RAN2 has agreed SL DRX active time is the duration when SCI reception is performed for data reception, I did not see any problem to replace “SL DRX inactive time” by the red color wording. If I have mis-understood anything, pls feel free to correct me. |
| Huawei, HiSilicon | We support the proposal. DRX configuration is used to ensure that a UE within DRX active time should perform data reception. Sensing of a UE would be impacted by DRX configuration, but cannot be limited only within SL DRX active time.  We do not see any point in sending both the two alternatives both to RAN2, since doing so would not answer their question. The wording change proposed by vivo would only reduce the clarity of the response, and alter its meaning from Alt. 1 to Alt. 2 so do not agree to that.  The words proposed to be added by Xiaomi, and similar by FL in email, amount to RAN1 imposing a definition of SL DRX inactive which is in detail a little different than RAN2 have stated. Therefore, we don’t consider it necessary/appropriate to include those words. If RAN2 need to seek clarification from RAN1, as they progress with defining SL DRX (in)active more precisely, they will do so.  Moderator: Thank you for the response. I agree with you that having two alts is not helpful for the response, in particular if we consider this reply has been discussed for two meetings. Yet from companies’ response, I wonder whether we can find a compromise that includes in the current Alt 1 some compromise, which is the intention of question 3. |
| Ericsson | We are supportive of the current Agreement 1:  Possible Agreement 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  We do not think that any extra clarification regarding the definition of SL-DRX inactive time since this was also the terminology used in the LS from RAN2.  Moreover, the first FFS indicates clearly that there are two options: a UE based on specification UE shall perform during active Time or based on UE implementation, so no extra clarification is needed in our view.  Even if the first FFS is problematic for the group, we can modify the proposal to have a general, i.e., FFS: details.  Moderator: Thank you for the response. In case the first FFS is removed, this is reverted to the previous Alt 1 in round 1 which was not preferred due to the ‘up to UE implementation’ implication of the wording ‘can’. I think if Ericsson is OK to alt 1 and not to have down selection among one of a particular option, it may be compromise to have the  1. FFS: Whether when such reception is performed is subject to specification (including e.g.UE shall perform sensing during its SL DRX inactivity time.), or is up to UE implementation |
| Futurewei | We support this agreement.  As commented before, we are already working on the partial sensing for the power saving. The additional power saving over partial sensing by not performing sensing in DRX inactive time is limited but at a cost of a large performance degradation. If SL DRX is not aligned well with partial sensing, not performing partial sensing during the DRX off period will impact the resource selection performance significantly due to insufficient sensing results.  Although we think it is not necessary to define the term of DRX inactive time, we are ok with the change by the moderator in the response to Xiaomi’s comments to explain to RAN2 the meaning of the term from RAN1.  We do not support to remove the two FFS’s. These are to clear the concerns or possible confusions on the agreement that sensing during the DRX inactive time is only up-to UE implementation. They will help to make progress and reach an agreement. |
| Qualcomm | We don’t support the proposal.  We’d like to emphasize that our position isn’t “Alt 1 with a preference to leave up to UE implementation.” We are only ok with Alt 1 if the sensing during inactive time is left up to UE implementation. As mentioned in our Round 2 reply, we don’t support any alternative where the UE is required to perform sensing during inactive time.  In the general case, we don’t see the need to perform sensing during DRX inactive time. There are some cases where the UE itself could benefit from doing sensing during inactive time but those are the exception and should be left up to UE implementation. The purpose of DRX is to enable the UE to stop reception during certain periods to save power. Forcing the UE to perform reception (for the purpose of sensing or otherwise) runs counter to that purpose.  To move forward, we can support the version proposed by vivo:  A UE is not required to ~~can~~ perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. FFS: Whether there is any condition UE performs ~~when~~ such reception ~~is performed is subject to specification, or is up to UE implementation~~FFS: Other details |
| Apple | We do not support the proposal.  As we mentioned earlier, the main design purpose of SL DRX will be largely sacrificed if sensing is done in SL DRX inactive time.  If RAN1 has not reached consensus on this topic, we agree with Samsung’s proposal to capture both alternatives in the reply LS and mentions that no consensus has been achieved in RAN1. |
| Nokia, NSB | We okay with FL’s proposal. The proposal “A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time” with the wording “***can***” does not mandate that the SL UE performs sensing during inactive time.  To consider companies’ concern, there is a proposal from last meeting that may provide some compromise. This proposal is agreeable for us:  It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time. |

In addition, from the replies of the advocates of Alt 2, it seems companies have some confusion as to the relationship between the SL DRX time and sensing. Thus Alt 2 is further divided into two sub alts to capture companies’ views and find a potential compromise for the advocates of alt 2.

Question 3 Do you agree that Alt 2 can be further divided into two cases depending on whether the sensing window is fully overlapped with the DRX active time. If yes, please provide your thoughts on your preferred alts and try to convince the group in addition to the proposed agreement.

Alt 2-1 A UE cannot perform sensing out of the DRX active time always assuming the sensing window is fully overlapped with configured DRX active time conditioned on no concern raised from RAN2

Alt 2-2 A UE cannot perform sensing out of DRX active time even if the sensing window is partially/non overlapped with configured DRX active time.

|  |  |
| --- | --- |
| Company | View |
| Samsung | Our preference is Alt 2-1 since this provide more opportunities for UE to perform sensing. As we commented in the second round discussion, if Alt 2 is considered, we need to discuss how to manage Alt 2 as the next step. So we suggested to add FFS: other details in Alt 2-1 also.  However, as FL commented, let’s focus on the two alternatives (Alt 1 vs Alt 2) in this meeting. |
| vivo | We don’t see the rational to discuss this question, and either alternative seems not clear to us. Anyway, we don’t see the relation of this question with the LS reply. |
| Xiaomi | Our understanding is actually Alt 2-1.  As we have commented in the last question, we think it is still not clear whether a duration that UE only performs sensing would be considered as SL inactive time or not. Since RAN2’s question is on their working assumption “*SL DRX should take PSCCH monitoring also for sensing (in addition to data reception) into account if SL DRX is used*”, it is possible that duration of UE sensing is also considered as SL DRX active time. RAN1 should be careful to use undefined wording such as “SL DRX inactive time” to avoid possible confusion. Therefore, we suggest to revise the wording of alt 1 to be :   * A UE can perform SL reception of PSCCH and RSRP measurement for sensing ~~during its SL DRX inactive time~~ in slots that UE does not need to monitor PSCCH for data reception.   + - * + FFS: Whether when such reception is performed is subject to specification, or is up to UE implementation         + FFS: Other details   We can accept alt 1 if the above wording is acceptable to proponents of alt 1. |
| Huawei, HiSilicon | After Alt. 1 is agreed, there is no need for this new question. We do not think dividing Alt.2 into two separate alternatives would help to make progress, and it is not the purpose of the email discussion either. It only confuses the discussion. |
| Ericsson | We do not need to include/have any discussion regarding this issue. |
| Futurewei | We do not think it is necessary to discuss this as the discussions for the Agreement 1 is sufficient to address the LS. We do not think that the discussion of this question will help to make progress. |
| Qualcomm | We don’t see the need to discuss this question as part of the reply LS. |
| Apple | We do not see the need to discuss this question. |
| Convida Wireless | We don’t see the need to discuss this question for the LS reply. |
| Nokia, NSB | No need for discussion once the previous proposal is agreed. |

## Round 4 Discussion

According to the discussion in the email thread and the feedback captured in the document for round 3. Companies’ positions are mostly unchanged.

***Statistics by 5/26***

Support: OPPO, CATT/GOHIGH, Sharp, Fujitsu, NTT DOCOMO, LG Electronics, Intel, HW/HiSilicon, ZTE/Sanechips, Nokia, Futurewei, Fraunhofer, MediaTek, Xiaomi (would the last subbellet address the concern?),

Note: the supported companies except Qualcomm are copied from the previous round given there is no objection received so far, in case of change of position, please kindly indicate your new position for this round.

Object: Samsung, Qualcomm, vivo, Apple

Additional Wording change ：Ericsson/Intel

Thus it’s moderator’s understanding that if an agreement is targeted for this meeting, the possible agreement that follows is the only way worth trying considering:

* The possible agreement can still harness the possible benefits from power saving perspective because ‘up to UE implementation’ direction is not precluded. UE can implement in a manner that sensing is not performed out of active time for better power saving benefits. Moreover, by allowing sensing to be performed under some well-designed rues, better trade off between power saving gain and performance loss can be achieved. In this sense, the possible agreement is capable of bringing additional benefit.
* With the wording ‘is not required to’ or ‘may’, even if the condition is specified, the UE behavior will still be ‘is not required to’ or ‘may’ and thus precludes the two directions preferred by companies:

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

2. UE performs sensing during its SL DRX inactivity time, based on specified rule(s). FFS the rule(s).

* The loading and the degree of overlapping between the sensing duration and the DRX active time can have impact on performance degradation or alternatively lead to reTx and prolonging of DRX active time of Rx end that could mitigate the power saving gain if sensing beyond SL DRX active time is not allowed.
* SL DRX is configured to reduce power consumption for data reception (including 1st and 2nd SCI decoding). If it is not configured, UE should monitor every slot for potential data reception that will cause great power consumption especially in case of unicast. Even if sensing is allowed during SL DRX inactive time for the purpose of re-assuring performance, the power saving contribution of SL DRX is still preserved.
* If the wording ‘is not required to’ or ‘may’ be interpreted as ‘a UE is allowed to perform sensing out of the DRX active time (and later make use of the gathered information)’. The wording of the proposed agreement which is preferred by more companies is in essence the same and will eliminate the confusion of precluding the preferences of companies.

A summary of the companies’ concerns and corresponding feedback is summarized as below.

|  |  |
| --- | --- |
| Concern | Feedback |
| [vivo][Qualcomm]   From power saving perspective, please note that the most significant part of power saving gain comes from deep sleep. If the UE wakes up frequently for sensing, it may only be able to have light or micro sleep – this is also proven in our simulation. | [Moderator to vivo/Qualcomm]  The possible agreement can still harness the possible benefits from power saving perspective because ‘up to UE implementation’ direction is not precluded. UE can implement in a manner that sensing is not performed out of active time for better power saving benefits. Moreover, by allowing sensing to be performed under some well-designed rues, better trade off between power saving gain and performance loss can be achieved. In this sense, the possible agreement is capable of bringing additional benefit.  The following texts are copied from vivo’s contribution R1-2104385.  It is noted that there exists obvious PRR performance gap between case 1 and case 2 when the load is medium as presented in Figure 30, the reason is that, the sensing mechanism plays a more important role in the case with higer load. Therefore, further optimizations can be considered for case 1, without significant increase of power consumption. For example, UE can confine the sensing/partial sensing/contiguous sensing window within the DRX active time. Besides, to extend the DRX active time in some special conditions also works.  My understanding from the above text is the following:  In case loading is significantly increased, resource collision caused by insufficient sensing results under case 1 will lead to more severe performance degradation, at least more ‘obvious’ PRR performance gap between case 1(UE performs sensing during the part of sensing window within the DRX active time only.) and case 2(regardless of whether its sensing window is fully overlapped/partially overlapped/non overlapped with its DRX active time.). Thus I think it’s not fair to say that ‘Consequently, the Moderator’s proposal is not technically driven, but simply by counting of hands raised.’ based on vivo’s contribution.  I think we need to consider the power saving gain over performance mitigation case by case, it’s hard to justify the necessity to mandate UE to follow a DRX setting which is non-overlapped at all with its sensing window. For example, when a UE is configured with a completely non-overlapped DRX pattern from its destination UE. For the purpose of data reception, its own DRX pattern needs to be followed, while for Tx to the destination UE and the prerequisite sensing, the DRX pattern of the destination UE should be considered. This case is likely to take place in particular when a UE is either the Tx or Rx for multiple communication links. For this case, I would say the performance loss of case 1 compared to case 2 is similar to the performance loss between random selection and partial sensing. |
| [vivo] The potential collision due to less sensing can be avoided by VUE performing full sensing, that is how preemption/reselection works. | [Moderator to vivo] This is conditional on the priority of the VUE. Moreover this will not work for under e.g. P to P transmission. |
| [Samsung]  DRX is for UE to stop reception to save power | [OPPO to Samsung]  SL DRX is configured to reduce power consumption for data reception (including 1st and 2nd SCI decoding). If it is not configured, UE should monitor every slot for potential data reception, that will cause great power consumption especially in case of unicast. While sensing (including 1st SCI decoding only, and RSRP measurement) is used for data transmission, if there is no data to transmit, UE does not need to perform sensing at all. While if there is data to transmit, UE can perform sensing within inactive time. Even in this case, SL DRX is also beneficial for power saving since UE does not need to decode 2nd SCI within inactive time.  If sensing is not allowed to be performed within inactive time, that will cause PRR degradation since it cannot obtain accurate sensing results. Furthermore, UE cannot perform re-evaluation/pre-emption checking if the resource selection window is within inactive time. That is even worse in the mix RA resource pool which can allow random resource selection. If SL DRX will affect some legacy behavior, such as re-evaluation/pre-emption, which is important feature introduced in R16 and will also be used in R17 to avoid transmission collision to improve PRR performance, we don’t think SL DRX is a good mechanism to be introduced.  [DOCOMO to Samsung]  Regarding power saving perspective,  -        From TX side, ‘more transmissions’ and ‘additional power consumption’ are the issue.  -        From RX side, more transmissions mean DRX inactivity timer/retransmission timer (agreed in RAN2) is running longer time. Then RX UE needs to be awake longer time. Is it incorrect? I may misunderstand, if so please let me know kindly... |
| [Ericsson] Prefer to drop the last FFS | [Moderator to Ericsson] I am OK with or without the FFS. The intention of the FFS is to include the case that SL DRX time and sensing duration is always ensured depending on future RAN2 discussion. I think if it’s not incorrect maybe we should anyway discuss this during the LS reply phase |
| [Intel] | [Moderator to Intel] I would suggest not to do wording change until we have finalized the concern. The current wording seems acceptable to quite a lot of companies and is a direct answer to the question from RAN2 LS. |

*Possible Agreement*

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

* FFS whether such reception is performed is subject to specification(including e.g. UE shall perform sensing during its SL DRX inactivity time), or is up to UE implementation
* FFS: Other details
* Further discuss during the LS preparation phase how to clarify RAN1 understanding on SL DRX ~~in~~active time, i.e. whether it's the duration when a UE is expected to perform PSCCH monitoring for data reception only

Question 4 Please opponents use this table to indicate your concerns and the proponents provide feedback in time. Please feel free to indicate the change of position if applicable.

|  |  |
| --- | --- |
| Concern | Feedback |
| [Company A] | [Company B to A] |
| [Company C] | [Company D to C] |
| [Company A] | [Company B to A] |

# 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)