**3GPP TSG RAN WG1 #106-e R1-210xxxx**

**e-Meeting, August 16 – 27, 2021**

**Agenda Item: 8.11**

**Source: Moderator (ZTE)**

**Title: Moderator Summary of Email Discussion [106-e-NR-R17-Sidelink-03] Reply LS to R1-2100021**

**Document for: Discussion and Decision**

# Introduction

The reply LS to R1-2100021 was discussed during three previous RAN1 meetings. The reply is closely related to whether UE is allowed to perform sensing operations including PSCCH monitoring and RSRP measurement during its SL DRX inactive time. During RAN1#105-e, extensive debate was done in the email discussion with respect to the two alternatives below where Alt 1 was majority view. The opponents to Alt 1 emphasized the simulation results from some source can demonstrate the performance degradation is limited restricting UE sensing related operation to DRX active time under a given setting. This document synthesizes the related contribution under AI 5 as well as those under 8.11.1.1 aiming to make a convergence on this topic, based on which the reply LS can finally be done.

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| 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 |

# Discussions

## Round 1 discussion

Proposed possible agreement

A UE shall perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX active time, for UE behavior during its SL DRX inactive time, down-select in RAN1#106-e from the following two alternatives:

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

The above possible proposed agreement is consolidated based on the discussion so far, with the intention to facilitate further convergence. Please companies share your views on whether you support the proposed possible agreement or not. If not, please indicate the change you would like to make and the underlying reason in a constructive manner.

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| **Company** | **View** |
| OPPO | Support. |
| Xiaomi | We are generally supportive to FL proposal.  However, if a UE does not perform any data transmission, it does not need to do sensing. Therefore, we suggest to clarify by revising the 1st sentence as :  “For partial sensing based resource (re)selection, a UE shall perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX active time.” |
| Lenovo/Motorola | Support. |
| Ericsson | We can be supportive for the sake of progress, but the situation is quite clear in our opinion. Besides this, we have not read any argument as to why the specification should prohibit some UE behavior in this case. In our opinion, there is no reason for that. |

The initial assessment on companies' preferences are made below,

Preference covered by Alt 1(13 companies): Huawei, HiSilicon[R1-2106477, R1-2108186], Nokia[R1-2106531, R1-2108178,R1-2108179],CATT[R1-2106942],Fujitsu[R1-2107037],FUTUREWEI[R1-2107091], Qualcomm[R1-2107367],CMCC[R1-2107422],LG[R1-2107528],Intel[R1-2107609],APPLE[R1-2107760, R1-2107705], DOCOMO[R1-2107879], ZTE[R1-2108085, R1-2108078, R1-2108079], Ericsson[R1-2108136, R1-2108128,R1-2108133]

Preference covered by Alt 2(4 companies): vivo[R1-2106620, R1-2107958], Spreadtrum[R1-2106714], Panasonic[R1-2107021], Samsung(R1-2106909)

The moderator would like to further check companies' views to Alt 1& Alt 2 in the possible agreement. Respecting both the instructions below from RAN1 chair as well as the past discussion history of this topic, it's encouraged that companies could be more constructive so that collective RAN1 consensus could be established.

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| Couple of things that I would like to request/announce as we start the meeting:  3.To everyone: RAN1#106-e will be a critical meeting in completing Rel-17. I hope we can work together constructively towards completing what we had set out to do 18 months ago. |

Please indicate whether you support Alt 1 or Alt 2 in the possible proposed agreement and necessary justification.

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| **Company** | **View** |
| OPPO | Alt.1 is preferred.  From our simulation results (R1-2107223), it shows PRR performance gain in both periodic-based partial sensing and contiguous partial sensing if sensing is performed within DRX inactive time with marginal power consumption increasing compared to no sensing within DRX inactive time. Therefore, we think it is reasonable to perform sensing within DRX inactive time. |
| Xiaomi | Alt 1 is preferred.  We agree that the data transmission and reception of a UE may be decoupled. For alt 2, the partial sensing requirement may not be always satisfied, and thus the system performance would be degraded due to lack of sensing results. |
| Lenovo/Motorola | Alt 1 is preferred.  The impact of SL DRX setting on PSCCH/PSSCH reception should be avoided as much as possible by using elaborate selection of DRX on-duration period with respect to resource reservation periods/partial sensing config. Hence from power saving perspectives, we propose that partial sensing configuration and DRX on-duration for UE must be as much aligned as possible so that the UE maximizes the capturing as much reservation periods configured in a resource pool. |
| Ericsson | Alt.1  Besides the comments made in the reply above, note the following:  In our view, the main aim/target of having SL-DRX and partial sensing operation is to save power during the resource allocation procedure, i.e., trying to reduce as much as possible the sensing time. However, the shorter the sensing time the higher likelihood of collision by the UEs due to a lower resource pool knowledge.  Following the Active Time in the SL DRX is essential to ensure correct TX/RX communication. Sensing outside the Active Time, while not being required, may be helpful in reducing the collision probability. Thus, our proposal is to leave that possibility up to UE implementation: |

# References

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2. R1-2107705 Discussion on RAN2 LS on Sidelink DRX Apple
3. R1-2107958 Draft Reply LS on SL DRX design vivo
4. R1-2108078 Further consideration of SL DRX ZTE, Sanechips
5. R1-2108079 [draft]Reply LS on sidelink DRX ZTE, Sanechips
6. R1-2108128 [Draft] Reply LS on SL DRX design Ericsson
7. R1-2108133 Discussion on RAN2 LS on SL DRX design Ericsson
8. R1-2108178 [Draft] Reply LS on SL DRX design Nokia, Nokia Shanghai Bell
9. R1-2108179 Discussion on RAN2 LS on DRX impact Nokia, Nokia Shanghai Bell
10. R1-2108186 Discussion on RAN2 LS on DRX impact Huawei, HiSilicon
11. [R1-2106477](file:///C:\Users\10217598\Desktop\Docs\R1-2106477.zip) Sidelink resource allocation to reduce power consumption Huawei, HiSilicon
12. [R1-2106531](file:///C:\Users\10217598\Desktop\Docs\R1-2106531.zip) Resource allocation for power saving Nokia, Nokia Shanghai Bell
13. [R1-2106620](file:///C:\Users\10217598\Desktop\Docs\R1-2106620.zip) Resource allocation for sidelink power saving vivo
14. [R1-2106714](file:///C:\Users\10217598\Desktop\Docs\R1-2106714.zip) Discussion on sidelink resource allocation for power saving Spreadtrum Communications
15. [R1-2106724](file:///C:\Users\10217598\Desktop\Docs\R1-2106724.zip) Discussion on resource allocation for power saving Zhejiang Lab
16. [R1-2106818](file:///C:\Users\10217598\Desktop\Docs\R1-2106818.zip) Discussion on sidelink resource allocation for power saving Sony
17. [R1-2106909](file:///C:\Users\10217598\Desktop\Docs\R1-2106909.zip) On Resource Allocation for Power Saving Samsung
18. [R1-2106942](file:///C:\Users\10217598\Desktop\Docs\R1-2106942.zip) Discussion on sidelink resource allocation enhancements for power saving CATT, GOHIGH
19. [R1-2107021](file:///C:\Users\10217598\Desktop\Docs\R1-2107021.zip) Discussion on Sidelink Resource Allocation for Power Saving Panasonic Corporation
20. [R1-2107022](file:///C:\Users\10217598\Desktop\Docs\R1-2107022.zip) NR Sidelink Resource Allocation for UE Power Saving Fraunhofer HHI, Fraunhofer IIS
21. [R1-2107037](file:///C:\Users\10217598\Desktop\Docs\R1-2107037.zip) Considerations on partial sensing and DRX in NR Sidelink Fujitsu
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25. [R1-2107171](file:///C:\Users\10217598\Desktop\Docs\R1-2107171.zip) Considerations on partial sensing mechanism of NR V2X CAICT
26. [R1-2107195](file:///C:\Users\10217598\Desktop\Docs\R1-2107195.zip) Discussion on resource allocation for power saving Hyundai Motors
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33. [R1-2107609](file:///C:\Users\10217598\Desktop\Docs\R1-2107609.zip) Sidelink Resource Allocation Schemes for UE Power Saving Intel Corporation
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38. [R1-2108023](file:///C:\Users\10217598\Desktop\Docs\R1-2108023.zip) Resource Allocation for Power Saving in NR SL Convida Wireless
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41. [R1-2108096](file:///C:\Users\10217598\Desktop\Docs\R1-2108096.zip) Discussion on partial sensing and SL DRX impact ASUSTeK
42. [R1-2108121](file:///C:\Users\10217598\Desktop\Docs\R1-2108121.zip) Resource allocation for power saving in NR sidelink enhancement ITL
43. [R1-2108136](file:///C:\Users\10217598\Desktop\Docs\R1-2108136.zip) Resource allocation procedures for power saving Ericsson

# Appendix

*R1-2106922*

***Proposal 1: It is not preferred that sensing operation is only allowed in its own SL DRX active duration.***

***Proposal 2: Sensing operation is allowed in SL DRX inactive duration without the restriction of its own SL DRX configuration***

***Proposal 3: Reply LS to RAN2,***

* ***From RAN1’s perspective, sensing operation is allowed in SL DRX inaction duration without the restriction of its own SL DRX configuration. And RAN1 respectfully asks RAN2 to take the information into account.***

*R1-2107705*

***Observation 1:*** *Sensing during sidelink DRX off duration significantly reduces the power-saving benefits of sidelink DRX.*

***Observation 2:*** *No sensing during sidelink DRX off duration leads to a higher resource selection collision possibility.*

***Proposal 1:*** *When a UE is configured with sidelink DRX,*

* *the UE performs sensing after its sidelink data arrival, even if the sensing occasion is in its sidelink DRX off duration.*
* *the UE does not perform sensing before its sidelink data arrival, if the sensing occasion is in its sidelink DRX off duration.*

*R1-2107958*

RAN1 thanks RAN2 for the LS informing the working assumption and agreements on sidelink DRX design. RAN1 would like to confirm RAN2’s understanding, i.e., if SL DRX is used, the impact of DRX on sensing (as well as resource allocation) should be considered in addition to data reception. More specifically, a UE is not required to perform sensing out of the DRX active time. RAN1 will consider the DRX impact in RAN1’s design, and respectfully asks RAN2 to provide any updates of DRX design that may have potential impacts on sensing and resource allocation.

*R1-2108078, R1-2108079*

[Observation 1: The granularity of SL DRX operation could be per a pair of source/destination, or per cast type, or per L2 destination ID.](#_Toc79167941)

[Observation 2: The SL DRX configurations can be obtained from pre-configuration,SIB ,dedicated-RRC or PC5-RRC.](#_Toc79167942)

[Observation 3: For one UE, more than one SL DRX configurations would be configured.](#_Toc79167943)

[Observation 4: For unicast, the SL DRX for both Tx UE and RX UE can be acquired by one UE.](#_Toc79167944)

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

Proposal 2: For data reception, all configured SL DRX should be applied .

Proposal 3: The reception that can be known in advance needs to be monitored even if in off-duration, e.g. SPS transmissions.

RAN1 would like to thank RAN2 on the announcement of their agreement and working assumption on sidelink DRX.

Regarding the below working assumption

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| Working assumption:  SL DRX should take PSCCH monitoring also for sensing (in addition to data reception) into account if SL DRX is used. |

It's RAN1's understanding that UE can perform PSCCH monitoring for sensing during SL DRX inactive time. Thus RAN1 has concern on the WA which may imply that the PSCCH monitoring for sensing should take SL DRX into account and is not allowed during DRX inactive time.

*R1-2108128,R1-2108133*

**Reply to RAN2 LS:** From RAN1 perspective, there are no objections to the working assumptions and agreements reached by RAN2. Nevertheless, it is important to clarify whether a UE is allowed to perform sensing operations including PSCCH monitoring and RSRP measurement during SL-DRX *Inactive Time*.

From RAN1 perspective, a UE shall perform sensing during its SL-DRX *Active Time.* It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL-DRX *Inactive Time*.

Observation 1 The main objective of SL-DRX and partial sensing operation is to reduce the power consumption during the resource allocation procedure.

[Proposal 1 A UE shall perform sensing during its SL-DRX Active Time. It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.](#_Toc79153246)

*R1-2108178,R1-2108179*

RAN1 would like to confirm RAN2’s working assumption: SL DRX should take PSCCH monitoring also for sensing into account if SL DRX is used.

Through RAN1 discussion, RAN1 reached this agreement:

[It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.]

**Proposal 1: It is up to UE implementation to perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.**

*R1-2108186*

***Proposal 1: Reply to RAN2 as follows:***

* + - ***When a sensing UE has a SL DRX configuration, a UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time, at least according to specified conditions.***

*R1-2106714*

***Proposal 8: SL reception of PSCCH and RSRP measurement for sensing should not be supported during SL DRX inactive time.***

*R1-2106724*

***Proposal 5: The Y candidate slots and the associated periodic sensing occasions should be within the SL-DRX ON duration.***

*R1-2106818*

Proposal 11: For resource selection, UE should exclude resources which it has not monitored during the OFF state of sidelink DRX operation in a resource sensing window.

Proposal 12: A UE based on partial sensing RA scheme should determine a partial sensing window considering an ON state of DRX operation.

*R1-2106909*

**Proposal 12: For UE with enabled SL DRX, sensing window is adjusted into DRX active time with configured sensing window.**

* **Sensing is not performed (e.g. using random selection instead) if no sensing slot is within active time.**

**Proposal 13: The same principle can be applied both for partial sensing and full sensing when SL DRX is performed.**

**Proposal 14: When TX UE performs resource selection for RX UE with SL DRX enabled, the resource selection window is adjusted (within remaining PDB) according to SL-DRX active time of RX UE.**

* **Exceptional resource pool is used if there is no available slot for resource selection**

**Proposal 15: SCI is used to align SL DRX wake-up time between TX UE and RX UE(s).**

*R1-2107021*

*Proposal 1: The SL DRX active time is consisting of the semi-static active time and extended active time similar to Uu active time.*

*Proposal 2: No SL operation should be mandated outside the DRX active time for power saving consideration*

*Proposal 3: For SL operation allocated within DRX semi-static inactive time, a SL UE is mandated to extend its DRX active time or up to UE implementation*

*Proposal 4: A SL DRX semi-static active time could be backward extended for sensing purpose when a SL transmission triggering slot is near to the beginning of semi-static active time. The extension could be same size as the sensing window, truncated or extended by a fixed value*

*Proposal 5: A SL DRX semi-static active time could be forward extended for a SL UE to complete its transmission, reception, decoding, etc*

*Proposal 6: The extension of SL DRX semi-static active time could be triggered by previous SL or DL signalling*

*Proposal 7: Uu DRX function is independent indication from sidelink sensing/resource allocation timing. On the other hand, a sidelink UE's actual "off" is when both Uu and sidelink operation (sensing/resource allocation timing and SL transmission) are “off”*

*Proposal 8: The sidelink UE can take sidelink information (including the sensing/resource allocation timing) into account for the UE assistance information for network to inform the gNB for a better coordination with Uu at the network.*

*R1-2107022*

**Proposal 4: We propose that the partial sensing occasions are aligned with the SL DRX active period in order to maximize the power saving gains.**

**Proposal 5: In the case of Mode 2, we propose that the RX UE aligns its partial sensing occasions according to the received SL DRX configurations, either from the TX UE in the case of unicast, or from pre-configuration in the case of groupcast or broadcast transmissions.**

**Proposal 6: In the case of inadequate sensing results, we propose that the UE uses assistance information messages in order to obtain the required sensing information for carrying out reliable resource selection.**

*R1-2107037*

Sensing can be performed during SL DRX inactive time as well as active time.

For periodic-based partial sensing, it may be beneficial to refine the determination rule of “k” for a given periodicity when SL DRX is configured, from power saving perspective.

For contiguous partial sensing, when SL DRX is configured, the corresponding slots can be monitored regardless of whether they overlap with SL DRX active time or not.

*R1-2107091*

***Proposal 14:*** ***Allow UE to perform sensing during the DRX inactive period.***

***Proposal 15:*** ***Different settings can be configured for periodic partial sensing in DRX active and inactive periods, e.g., maximum number of sensing occasions.***

***Proposal 16:*** ***For periodic traffic, the transmitting UE can signal the time when the receiving UE expects the next transmission so that the receiving UE can align the DRX with the data reception for better power saving.***

*R1-2107151*

Proposal 8: Study the above potential solutions to reduce impact of sidelink DRX.

*R1-2107163*

**Proposal 4: Consider the potential impacts on RAN1 when DRX is introduced. For example, scheduling time gap and resource selection/re-evaluation.**

**Proposal 5: RAN1 further discuss the issue of DRX on-duration alignment problem arising due to contiguous partial sensing with negative TA negative value.**

**Proposal 6: Additional DRX configuration can be configured for Tx UE performing periodic partial sensing considering multiple resource reservation periods.**

**Proposal 7: RAN1 study on the transmission of assistance indication like go-to-sleep to aid Rx UE(s) enter early DRX sleep state.**

*R1-2107223*

**Observation 3: If sensing is performed within DRX active time only, that will affect sensing accuracy and re-evaluation/pre-emption are not applicable in some cases.**

**Observation 4: If sensing is performed within both DRX active time and DRX inactive time, more accurate sensing results can be obtained and re-evaluation/pre-emption are applicable.**

**Proposal 14: Performing partial sensing within both DRX active time and DRX inactive time is supported.**

**Proposal 15: If SL DRX is configured, the selected resource for initial transmission should be within DRX ON duration of RX UE.**

**Proposal 16: If SL DRX is configured, some enhancements of mode 2 resource selection procedure should be further studied.**

**Observation 5: If RX UE miss transmission from TX UE, it will not start related SL DRX timer, that will cause error in following transmissions.**

*R1-2107367*

Observation 5: Partially overlapping DRX configurations increase collisions among power saving UEs' transmissions.

Proposal 12: In order to keep the collision probability manageable, RAN1 should discuss the conditions for scheduling a (re-)transmission outside of the DRX ON duration of the RX UE.

**Proposal 13: For unicast and groupcast, the Tx UE retransmits on the resources outside of the Rx UE's ON duration only if it receives a NAK in response to the (re)transmission inside the ON duration indicating reservations.**

Proposal 14: It should be left to the UE’s implementation to decide whether sensing is limited to its DRX ON duration or not.

*R1-2107422*

***Observation 1: If partial sensing is only performed within SL DRX active time, the available sensing occasions may not enough to acquire accurate sensing results***

***Proposal 3: A UE performs SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.***

[*R1-2107481*](file:///C:\Users\10217598\Desktop\Docs\R1-2107481.zip)

***Proposal 9: Study potential impacts of SL DRX on sensing operation.***

[*R1-2107528*](file:///C:\Users\10217598\Desktop\Docs\R1-2107528.zip)

***Observation 4: Resource selection procedure based on partial sensing uses a separate procedure from that for SL DRX operation. As a result, partial sensing and SL DRX operation are specified separately in Rel.17.***

***Proposal 33:*** *For partial sensing UE, sensing results obtained by SL DRX operation in active time are used for resource (re)selection, resource re-evaluation/pre-emption checking, in addition to the partial sensing results.*

***Proposal 34:*** *If RX UE performs SL DRX operation, TX UE selects at least the resources for the initial transmission and a (pre-)configured number of retransmissions in RX UE’s SL DRX ON duration or active time. The remaining retransmission resources can be selected in OFF duration, which is expected to be an active time extended based on the reception during active time.*

***Proposal 35:*** *When RX UE performs SL DRX operation, if TX UE detects DTX of a certain transmission and the next retransmission is expected outside the RX UE’s SL DRX active time, TX UE triggers resource reselection for the next transmission resource so that the reselected resource is within the active time.*

***Proposal 36:*** *TX UE performs random resource selection when resource (re)selection is triggered within a range of a threshold from the start of RX UE’s SL DRX ON duration.*

***Proposal 37:*** *If RX UE performs SL DRX operation, the target resource ratios are separately configured for RX UE SL DRX ON and OFF duration in TX UE’s resource allocation for periodic transmission.*

***Proposal 38:*** *If RX UE performs SL DRX operation, the RSRP threshold is separately adjusted until each target resource ratio is achieved in RX UE SL DRX ON and OFF duration in TX UE’s resource allocation for periodic transmission.*

***Proposal 39:*** *Two options can be considered for channel sensing duration in SL DRX mode-2 resource allocation.*

*Opt 1. Sensing is allowed only during the active time.*

*Opt 2. Sensing is allowed during the inactive time as well as the active time.*

***Proposal 40:*** *If RX UE performs SL DRX operation, in resource allocation procedure, TX UE deprioritizes or excludes resources that are affected by the interference caused by RF On and Off operations due to Uu link DRX operation. Details are FFS.*

[*R1-2107609*](file:///C:\Users\10217598\Desktop\Docs\R1-2107609.zip)

***The design of SL DRX cycle needs to ensure that UE partial sensing behavior is respected (i.e. UE wake up time intervals for the purpose of partial sensing need to be aligned with On duration intervals, as well as traffic characteristics)***

***Defined partial sensing procedure (periodic and contiguous) need to be fulfilled irrespective of the SL DRX status***

***Sensing in the SL DRX inactive time is up to UE implementation***

***If information about the SL DRX active time of one or more of the recipients of a transmission is known, this should be considered when selecting the candidate resources***

[*R1-2107879*](file:///C:\Users\10217598\Desktop\Docs\R1-2107879.zip)

**Observation 9:**

* *For a resource pool (pre-)configured with full/partial sensing, it would be a valid situation that at least full sensing UE can transmit on any time resource in the resource pool. If power saving UE does not perform sensing during its SL DRX inactive time, many resource collisions would happen.*

**Proposal 14:**

* *Support Alt 1, i.e.*
  + *A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.*

**Proposal 15:**

* *For sensing during its SL DRX inactive time, either option is supported.*
  + *Option 1: UE shall perform sensing during its SL DRX inactive time.*
  + *Option 2: UE performs sensing during its SL DRX inactive time, based on specified rule(s). FFS the rule(s)*

[*R1-2107899*](file:///C:\Users\10217598\Desktop\Docs\R1-2107899.zip)

**Proposal 12: Support the Tx UE to preclude resources that are not within the time slots of Rx UE DRX on duration.**

**Proposal 13: When SL DRX is configured and partial sensing RA scheme is performed, UE should keep sensing during SL active duration.**

[*R1-2108035*](file:///C:\Users\10217598\Desktop\Docs\R1-2108035.zip)

**Proposal 21: The UE in SL DRX can perform either sensing-based resource selection or random resource selection.**

**Proposal 22: The Rx UE in its SL DRX active time shall decode both the first and second SCI.**

**Proposal 23: For partial sensing purposes, monitoring PSCCH is not affected by SL DRX configuration.**

**Proposal 24: In the slots outside of DRX active time where the UE performs sensing, the UE decodes the first SCI only.**

**Proposal 25: Consider congestion control enhancement for DRX operation.**