**3GPP TSG RAN WG1 #107-e R1-2112525**

**e-Meeting, November 11 –19, 2021**

**Source: Moderator (OPPO)**

**Title: FL summary for AI 8.11.1.1 – resource allocation for power saving (before 2nd GTW)**

**Agenda item: 8.11.1.1**

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

Introduction

In the latest version of Rel-17 [WID](http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_90e/Docs/RP-202846.zip) for NR sidelink enhancement, the objective for enhancing resource allocation (RA) to reduce UE power consumption in mode 2 is captured as followed.

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| 2. Resource allocation enhancement:   * Specify resource allocation to reduce power consumption of the UEs [RAN1, RAN2]   + Baseline is to introduce the principle of Rel-14 LTE sidelink random resource selection and partial sensing to Rel-16 NR sidelink resource allocation mode 2.   + Note: Taking Rel-14 as the baseline does not preclude introducing a new solution to reduce power consumption for the cases where the baseline cannot work properly.   + This work should consider the impact of sidelink DRX, if any. |

This contribution provides a summary of the submitted contributions, email discussion topics and outcomes during RAN1#106bis-e meeting. Note that, all past outcomes including agreements, conclusions and working assumptions reached during this WI are captured in Section 5 (5 Appendix) of this document.

Collection of agreements / conclusion in RAN1#107-e

Agreements reached during November 11th GTW session for R17 NR eSL

**Agreement**

When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*, the general design framework in Approach 1 from RAN1#106bis-e in below is adopted. Note that, the details can still be updated.

* Approach 1: (*SA*is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of *M* slots for CPS)
  + The UE selects a set of *Y’* candidate slots with corresponding PBPS and/or CPS results (if available) within the RSW.
    - FFS how to handle the case if the total number of *Y’* candidate slots is less than a (pre-)configured threshold *Y’min* without dropping the aperiodic transmission
    - FFS whether the Y’ candidate slots for aperiodic transmission is the same as the Y candidate slots in PBPS for periodic transmission of another TB(s)
    - FFS whether/how to prioritize/select resources based on partial sensing results.
    - FFS: How to select Y’ in case of CPS only
  + Candidate resource set (*SA*) is initialized to the set of all single-slot candidate resources in the selected *Y’* candidate slots.
  + For the CPS monitoring window [*n*+*T*A, *n*+*T*B]:
    - *TA* and *TB* are both selected such that UE has sensing results for a minimum of *M* consecutive logical slots before *ty0*, where *ty0* is the first slot of the selected *Y’* candidate slots.
      * FFS: By default, *M* is 31 unless (pre-)configured with another value, or M is (pre-)configured based on transmission priority
      * FFS the range of (pre-)configured *M* from a TBD lowest value up to 30
      * FFS: how to handle the case when the minimum *M* slots for CPS cannot be guaranteed
  + FFS: RSW in case of CPS only

**Agreement**

When SL DRX active time of Rx-UE is provided by the higher layer for candidate resource selection (including resource (re)selection and re-evaluation/pre-emption checking), the following working assumption is confirmed with option 2 as agreement (with modification in RED)

**Working Assumption (RAN1#106bis-e)**

When PHY layer is indicated with an active time of RX UE from MAC layer for candidate resource selection, a restriction is applied in PHY layer so that at least a subset of candidate resources reported to MAC layer is located within the indicated active time of the RX UE. The following options will be further discussed in RAN1 to restrict resources for candidate resource selection taking into account the indicated active time from MAC layer:

* ~~Option 1: PHY layer selects and reports candidate resources only within the indicated active time of the RX UE~~
* Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE
  + FFS: Details on when the number of subsets of candidate resource is less than the threshold
  + FFS: The subset of candidate resource outside of the active time should consider each inactive time period
  + FFS: UE selection of resource selection window to overlap with indicated RX UE active time
  + FFS: Whether it is up to UE implementation to report candidate resources only within the indicated active time of the RX UE
* ~~Option 3: PHY layer selects and reports an additional candidate resource set of candidate resources within the indicated active time of the RX UE~~

Topics for email discussion

[107-e-NR-R17-Sidelink-01] Email discussion on resource allocation for power saving– Kevin (OPPO)

* 1st check point: November 15
* Final check point: November 19

## Topic #1: Impact of sidelink DRX on sensing and candidate resource reporting

**Background**: For the first issue on UE performing PSCCH decoding and RSRP measurement during SL DRX inactive time, based on the agreement from RAN1#106-e, RAN1 already had several rounds of discussion of trying different solution approaches in the last meeting. From reading contributions submitted to this meeting, it is observed company opinions and preferences are still widespread between the 3 choices of UE is required to perform sensing regardless of DRX active and inactive time, UE perform sensing according to certain rules/conditions, and up to UE implementation.

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| ***Agreement (RAN1#106-e)***  A UE can perform SL reception of PSCCH and RSRP measurement for sensing during its SL DRX inactive time.   * FFS: When such reception and measurement is performed, whether it is subject to specification, or is up to UE implementation * FFS: Other details |

For the option of UE perform sensing according to certain rules/conditions, there is also widespread of schemes among the proposals. It is in FL’s opinion, some of the schemes are too complicated or optimized (e.g., if this happens then do this, else if that happens then do something else, or (pre-)configure a different set of parameter settings for DRX inactive time), and some of them might have the “chicken and egg” problem to determine CBR before sensing or total sensing slots when aperiodic trigger is unpredictable. On the other hand, some proposed simple rules could be considered, such as only one periodic sensing occasion is monitored in PBPS and only the (pre-)configured minimum *M* slots are monitored in CPS. So, the FL would like to propose these simple rules as the compromise to resolve this issue in Proposal 1-1 (I) in Section 3.1.1.

For the second issue on how PHY layer should report candidate resources to higher layer when the DRX active time of Rx-UE is provided, RAN1 reached the following working assumption and informed RAN2 in the last meeting.

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| ***Working Assumption (RAN1#106bis-e)***  *When PHY layer is indicated with an active time of RX UE from MAC layer for candidate resource selection, a restriction is applied in PHY layer so that at least a subset of candidate resources reported to MAC layer is located within the indicated active time of the RX UE. The following options will be further discussed in RAN1 to restrict resources for candidate resource selection taking into account the indicated active time from MAC layer:*   * *Option 1: PHY layer selects and reports candidate resources only within the indicated active time of the RX UE* * *Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE* * *Option 3: PHY layer selects and reports an additional candidate resource set of candidate resources within the indicated active time of the RX UE* |

Based on the above WA in RAN1’s reply LS, it is FL’s understanding that RAN2 have reached the following agreement during the current on-going RAN2#116-e meeting. It seems like the choice of which option to take is completely up to RAN1. To save time or gain more time for discussion in RAN1, let’s start our discussion now without waiting for RAN2’s LS. Then based on reviewing the contributions submitted to this meeting (refer to Section 4.4), it is clear Option 3 should be eliminated firstly, due to unnecessary complexity to report an additional candidate resource set as commented by most companies and no company expressed interest.

For the remaining Option 1 and 2, there is no clear majority of preference. In light of the RAN2 agreement below, let’s gather further views and reasons on which option to take by answer the question in Question 1-2 (I) in Section 3.1.1.

Note that, this SL DRX topic is chosen to be discussed firstly due to its impact on selection/initialization of candidate resource set (*SA*) when SL DRX active time of Rx-UE is provided by higher layer.

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| * TX UE shall selects initial transmission resource only in the RX UE’s active time where SL DRX timers are running now or will be running in future (at least on-duration timer). Further details of active time can be considered later. FFS on spec impact. * MAC indicates the active time information to PHY. * It is up to RAN1 to select an option. * We will send LS to inform RAN1 of the related agreements from this offline discussion [706]. |

### Proposals before 1st GTW

**Proposal 1-1 (I):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window when SL DRX is (pre-)configured.

* When UE performs periodic-based partial sensing, UE monitors the default periodic sensing occasion or one periodic sensing occasion per *Preserve* when *k* value is (pre-)configured.
* UE monitors a minimum of *M* slots for CPS.

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| **Company** | **Comments** |
| LGE | Support with the following modification.   * When UE performs periodic-based partial sensing, UE monitors the periodic sensing occasions based on the same rule as used in no SL DRX operation.   Proposal 1-1 is related to the issue of partial sensing operation outside the active time. We support that the required partial sensing based on a single rule should be performed regardless of SL DRX operation. Therefore UE should perform the same PBPS as in no SL DRX operation is performed. CPS already follows the same rule in the second bullet. |
| vivo | For the PBPS case, we are fine with the spirit of proposal in general. But the wording may need some refinement. In our understanding, only when at least part of PSO is located within the non-active time, will UE drop monitoring of some PSO for power saving, otherwise there is no need to dropping the monitoring of PSO.  **Proposal 1-1 (I):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window when SL DRX is (pre-)configured.   * When UE performs periodic-based partial sensing, for a given *Preserve*,   + Regardless if k value is (pre-)configured or not, if all of the corresponding PSO to be monitored are outside the active time, UE monitors the ~~default~~ most recent periodic sensing occasion   + when *k* value is (pre-)configured, and one of PSO is outside the active time, UE monitors the one periodic sensing occasion that is located in the active time * When UE performs CPS, UE monitors a minimum of *M* slots for CPS. |
| Fujitsu | We agree this proposal with some comments.  For the 1st sub-bullet, we agree vivo’s comments, that is, if only one periodic sensing occasion overlaps with SL DRX active time, we prefer UE to only monitor this occasion instead of monitoring both two occasions; otherwise, if neither of the two periodic sensing occasion overlaps with SL DRX active time, we prefer UE to only monitor the most recent one.  For the 2nd sub-bullet, we are fine. |
| NTT DOCOMO | Agree with this direction and we support update by LGE. |
| Huawei, HiSilicon | We disagree the proposal.  The proposal seems to allow a UE to always performs PBPS and/or CPS during SL-DRX inactive time, which is not beneficial for power saving. Because a UE does not need to perform sensing on all partial sensing slots for all the time. A more reasonable approach would be to define conditions, to allow UE to wake up for sensing during SL-DRX inactive, e.g. considering how the SL-DRX inactive affect the sensing (e.g. a ratio of the number of partial sensing slots overlapped SL-DRX inactive time over the number of total partial sensing slots), CBR, priority.  For making progress, we suggest a way forward based on conditions and the conditions also allow UE to always perform partial sensing, which is listed as below:  **Proposal 1-1 (I):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window when SL DRX is (pre-)configured.   * When UE performs periodic-based partial sensing, UE monitors the default periodic sensing occasion or one periodic sensing occasion per *Preserve* when *k* value is (pre-)configured during SL-DRX active, and during SL-DRX inactive when conditions are met. * UE monitors a minimum of *M* slots for CPS during SL-DRX active, and during SL-DRX inactive when conditions are met. * Conditions includes a ratio of the number of partial sensing slots overlapped SL-DRX inactive time over the number of total partial sensing slots is above a threshold, CBR is above a threshold or priority value is lower than threshold.   + A condition allows UE to always perform partial sensing is included as well. |
| Xiaomi | We support to keep the same sensing requirements for partial sensing regardless of DRX on or idle duration.  Therefore, we are fine with the second sub-bullet. For the 1st sub-bullet, we support LGE’s revision. |
| Ericsson | Support the proposal.  We propose the following modification to avoid any misunderstanding with the nomenclature:  **Proposal 1-1 (I’):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window when SL DRX is (pre-)configured.   * When UE performs periodic-based partial sensing, UE monitors the default periodic sensing occasion or one periodic sensing occasion per *Preserve* when *k* value is (pre-)configured. * UE monitors a minimum sensing window CPSmin. |
| Samsung | The intention of P1-1 is not clear for us. For periodic transmissions, the UE behaviour seems the same as for resource (re-)selection. If that is the intention then we are OK. For aperiodic transmissions, we are unclear whether/how PBPS-based monitoring can always be supported by the UE.  As a summary of our position, we prefer same sensing behaviour regardless of DRX active/inactive time. Here sensing behaviour includes both partial sensing and full sensing. |
| Futurewei | We are supportive with this direction. For the first subbullet, since we have discussed that the default periodic sensing occasion, i.e., most recent sensing occasion, is more efficient, for the SL DRX, it is better to consider most recent sensing occasion regardless preconfigured K values. Also, we think this shall be imposed only on the sidelink DRX inactive time. For active time, it is better to follow the configurations. Therefore, we propose the following updates on the proposal.  **Proposal 1-1 (I):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window in SL DRX inactive time when SL DRX is (pre-)configured.   * When UE performs periodic-based partial sensing, UE monitors the default periodic sensing occasion ~~or one periodic sensing occasion per~~ *~~P~~~~reserve~~* ~~when~~ *~~k~~* ~~value is (pre-)configured.~~ * UE monitors a minimum of *M* slots for CPS. |
| CATT | Disagree.  one periodic sensing occasion per *Preserve* when *k* value is (pre-)configured : what is the intention for this ? this should be removed  UE monitors a minimum of *M* slots for CPS: Is this M the same that we discussed several times before (minimal CPS window size)? If yes why do we still need this here? |
| MediaTek | Agree with the approach fundamentally, but some modifications needed.  UE sensing behaviour should depend on whether SL-DRX inactive time overlaps with sensing occasions or not; not based on whether SL-DRX is (pre-)configured.  We suggest following modification:  **Proposal 1-1 (I):** UE performs SL reception of PSCCH and RSRP measurement for sensing in the following periodic sensing occasion and monitoring window when SL DRX is (pre-)configured.   * When UE monitors default periodic-based sensing occasions (without pre-configured k), UE follows PBPS rules irrespectively of SL-DRX configuration. * When k is (pre-)configured for PBPS:   + If both of the sensing occasions per Preserve are outside of SL-DRX inactive time, UE follows PBPS rules (i.e., UE takes sensing measurement on both occasions per Preserve)   + If SL-DRX inactive time overlaps with either one of the sensing occasions per Preserve, UE only takes sensing measurement on the other sensing occasion (Preserve) that doesn’t overlap with SL-DRX inactive time.   + If SL-DRX inactive time overlaps with both sensing occasions per Preserve, UE takes sensing measurement on either one of the sensing occasions. Whichever sensing occasions is selected is up to UE implementation. * UE monitors a minimum of *M* slots for CPS. Default value for M is 31 unless another value is (pre-)configured. |
| Apple | Disagree.  The proposal aims to let UE perform partial sensing, regardless the sidelink DRX configuration. This largely reduces the power saving benefit of sidelink DRX, although it leaves the possibility of reducing the corresponding sensing occasions of PBPS and monitoring window of CPS. We prefer to define some additional condition (e.g., existing a resource selection trigger) to further restrict UE’s partial sensing in sidelink DRX inactive time. |
| Qualcomm | We disagree with the proposal.  As pointed out by Huawei and others, the proposal significantly negates the power saving gains from DRX.  Our preference is to leave sensing during inactive time up to UE implementation. In our view, the UE does not need to monitor PBPS occasions during inactive time, DRX active and periodic transmissions should be aligned to obtain power savings from DRX. If RAN1 is to set a condition on performing CPS, we’d be ok with performing CPS if the UE has data to transmit. |
| OPPO | We are fine of the principle of the proposal. We think LGE’s version is better. |
| Lenovo&MotM | We agree with LGE’s version |
| Spreadtrum | We prefer LGE’s version that a same rule should be performed regardless of SL DRX operation. |
| Panasonic | We disagree with the proposal.  Similar as HW, Apple, QC, we think the current proposal defeats the purpose of power saving by DRX. |
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**Question 1-2 (I):** When SL DRX inactive time of Rx-UE is provided by the higher layer for candidate resource selection (including resource (re)selection and re-evaluation/pre-emption checking), which one of the following options should be taken to restrict resources for candidate resource selection, and why?

* Option 1: PHY layer selects and reports candidate resources only within the indicated active time of the RX UE
* Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE

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| **Company** | **Option 1 or 2** | **Reason(s)** |
| LGE | Option 2 | As many companies commented, restricting the candidate resources only within the active time causes high congestion level in the active time. It results in additional retransmissions, which should also be selected within the active time. This repeated operations never solve the problem. Compared to this, Option 2 is more reasonable in that it provides a balanced use of resources between the active and the inactive time. |
| vivo | Option2 | According to RAN2 agreement above, only current active time and semi-static on duration in future will be indicated to PHY layer. In this case, UE cannot select resource located in the extended active time if option1 is used, which leads to worse PRR performance due to limited candidate resources. In our simulation, option2 outperforms option1 by around 3-10% gain. |
| NEC | Option 1 | We don’t think resources in the inactive duration of RX UE will be helpful.  Seems a type in main bullet: When SL DRX ~~in~~active time of Rx-UE is provided by the higher layer |
| Fujitsu | Option 2 | Option 1 is too restrictive if all the selected resources are located within “active time” of Rx UE.  Further, if the active time is confirmed as “current” active time, it will make the DRX active time extension mechanism designed in RAN2 (e.g., Inactivity timer and Retransmission timer) become meaningless since no resources will be located within the extended active time. |
| NTT DOCOMO | Question | Option 1 means that S\_A is initialized with slots only within DRX active time? If correct, then it would lead to more collisions as mentioned by companies.  Or Option 1 means that S\_A is determined as Rel-16, and after that, PHY reports resources only within DRX active time? If this understanding is correct, then we do not see any issue on the Option 1.  With the second interpretation above, we prefer Option 1 since resources within the DRX inactive time is meaningless.  FL: It is also my understanding that Option 1 means S\_A is initialized with slots only within DRX active time, because the WA says “…*selects and reports candidate resources only within the indicated active time* …” |
| Huawei, HiSilicon | Option 2 | We support Option 2.  Option 1 is too constraint that cannot work for every case. For example, when SL-DRX active time and RSW only overlaps with a small number of slots. As a consequence, the number of resource in reported S\_A for initial and retransmissions could be very limited and span on the small number of slots in time domain. In this case MAC cannot select sufficient number of resources for retransmissions.  We also note that RAN2 agreed that a RX UE can determine time resources of retransmissions based on SCI indication and thus to wake up from SL-DRX inactive to receive retransmissions. With this, it does not needs to restrict all the retransmissions taken place within SL-DRX active time. |
| Xiaomi | Option 2 | UE may select more than 1 resources for repetitions. From receiving UE perspective, it can predict the future repetition transmission and in turn prolong the DRx one duration based on the SCI reservation information and HARQ-ACK states. Therefore, no all the resources for repletion transmissions should be in the original MAC informed DRx on duration. If option 1 is used, the initial candidate resource set will be more limited, and resources with more interference would be selected. |
| Ericsson | Option 1 | Option 1 optimizes the resource selection for the targeted RX UE(s), i.e., only resources within the active time selected by MAC are considered by PHY layer.  Regarding Option 2 the possibility of selection resources outside the indicated active time that could account for, e.g., future active time of Rx UE(s) should be handled by MAC layer during the active time selection step because all DRX timers are maintained at MAC layer, not in PHY layer. |
| Samsung | Option 1 | An appropriate DRX configuration should allow UE to select sufficient number of resources for (re)transmissions of a TB, so we don't see the need of selecting candidate resources in DRX inactive time, and the motivation and gain of Option 2 is unclear for us.  In addition, even if UE select candidate resources in DRX inactive time only for retransmissions, and reserve the resources in DRX inactive time in SCI, RX UE still may not be aware of it e.g. due to miss detection of SCI, therefore option 2 impacts system performance compared with option 1. |
| Futurewei | Option 2 | The criterion of step 7 may be difficult to be satisfied if only considering the resources in active time of RX UE. Since active time of Rx UE is informed by high layer, high layer can prioritize the resource in active time of the RX UE |
| CATT | See comments | In principle option2. But the wording of option 2 has problem, pefer the following;  PHY layer can select and reports candidate resources that include a subset of the candidate resources is within the indicated active time of the RX UE |
| MediaTek | Option 2 | As mentioned by companies, option 1 appears to be too restrictive. |
| Apple | Option 1 | Option 1 is the simple solution which works.  Option 2 is aimed for optimization which is based on the active time extension at the Rx UE for retransmissions. However, the benefit and performance gain of this optimization is unclear to us. Also, more specification efforts are needed for Option 2, e.g., what is the percentage of resources in S\_A need to be in RX UE DRX active time.  At the last stage of Rel-17, we prefer the simple solution. |
| Qualcomm | Option 1 | In Option 2, the size of the subset isn’t defined, which means that PHY could report only one resource within active time, which might not be enough. Option 1 ensures that the receiver is in active and is able to receive the selected resources.  We also share Samsung’s view about the receiver missing SCIs and not extending its active time. |
| OPPO | Option 2 | For option 1, it is possible that the duration corresponding to the indicated active time from MAC layer is less than T2min, which is the minimal size of resource selection window. In that case, option 1 is hardly to be applied since it cannot promise that ONLY the resource within the indicated active time will be reported. |

### Proposals for 1st GTW

FL observations and comments based on inputs received in Sec. 3.1.1:

* On Proposal 1-2 (I):
  + Based on the responses, it is observed that the majority prefers Option 2 for the following reasons.
    - Option 1 is too restrictive in selecting candidate resources 🡺
      * possibly lead to too few resources to make the final selection
      * high congestion level will lead to more retransmissions
      * high collision probability / interference due to RSRP increment to reach X%
    - Option 2 outperforms Option 1 by around 3-10% gain.
  + FL: Based on RAN2’s agreement where it says “*TX UE shall selects initial transmission resource only in the RX UE’s active time …*”, this implies at least to me that retransmissions can occur during RX UE’s inactive time. So there is no strong reason why the PHY layer should select and report candidate resources only within the indicated DRX active time of the RX UE.

**Question 1-2 (II):** When SL DRX ~~in~~active time of Rx-UE is provided by the higher layer for candidate resource selection (including resource (re)selection and re-evaluation/pre-emption checking), Option 2 from RAN1#106bis-e in below is to be taken in the partial sensing design.

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| ***Working Assumption (RAN1#106bis-e)***  *When PHY layer is indicated with an active time of RX UE from MAC layer for candidate resource selection, a restriction is applied in PHY layer so that at least a subset of candidate resources reported to MAC layer is located within the indicated active time of the RX UE. The following options will be further discussed in RAN1 to restrict resources for candidate resource selection taking into account the indicated active time from MAC layer:*   * *Option 1: PHY layer selects and reports candidate resources only within the indicated active time of the RX UE* * *Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE* * *Option 3: PHY layer selects and reports an additional candidate resource set of candidate resources within the indicated active time of the RX UE* |

### Proposal until 2nd GTW

FL observations and comments based on inputs received in Sec. 3.1.1:

* On Proposal 1-1 (I): TBD

## Topic #2: Partial sensing for aperiodic transmission

**Background**: From past RAN1 meetings (up to RAN1#106bis-e), details of partial sensing (including PBPS + CPS) for resource (re)selection for periodic transmission () are considered to have been mostly finalized with the following main points:

* A single set of candidate resources (*SA*) is initialized for a set of *Y* candidate slots selected within a resource selection window [*n*+*T*1,*n*+*T*2], where *T1* and *T2* are defined as per R16.
* UE performs PBPS by monitoring periodic sensing occasions (PSOs), where a PSO is a set of slots according to if is included in the set of *Y* candidate slots.
  + By default, UE monitors the most recent PSO before the first slot of *Y* candidate slots () subject to processing time constrains ( and ) for a given reservation periodicity.
  + If (pre-)configured, UE additionally monitors the most recent PSO and/or the last PSO prior to the most recent one according to the configured value(s).
* UE performs sensing within a CPS monitoring window [*n*+*T*A,*n*+*T*B], where *n*+*T*A is *M* logical slots earlier than slot and *n*+*T*B is slots earlier than .
  + By default, *M* is 31 unless (pre-)configured with another value.

On details of partial sensing (including PBPS+CPS and CPS-only) for resource (re)selection for aperiodic transmission (), it was commonly preferred to have a unified solution design for cases when UE performs PBPS+CPS or CPS-only in the resource pool. As the result, an agreement was reached in RAN1#106bis-e meeting where 3 possible approaches can be used as a starting point. Based on Tdocs submitted to this meeting (refer to Section 4.1 for summary of reasons, details and supports), and the dependency of this design discussion/decision is also related to partial sensing for re-evaluation / pre-emption checking and SL DRX active time of Rx-UE (please keep these aspects in mind when selecting the design approach), the FL suggest to do in the following steps in this final meeting to complete the partial sensing design.

* Step 1: *By the second GTW session for NR sidelink (Monday 15th of November)*
  + Make selection which partial sensing design approach to take for aperiodic transmission
    - Only the general design approach / framework is necessary, details to be finalized in Step 2
  + Partial sensing details for re-evaluation and pre-emption checking begins based on the selected general design approach / framework
* Step 2: *By the third GTW session (Wednesday 17th of November)*
  + Decide and finalize details for initializing the candidate resource set (*SA*), and details for *TA* and *TB* in CPS monitoring window [*n+TA*, *n+TB*]
  + Decide and finalize how to handle the case when *Y’min* or *T2min* and the minimum *M* slots for CPS cannot be guaranteed
  + Decide (if possible) partial sensing details for re-evaluation and pre-emption checking
  + Decide which option of candidate resources reporting when SL DRX active time of Rx-UE is provided
* Step 3: *By the fourth GTW session (Friday 19th of November)*
  + Finalize remaining partial sensing details for re-evaluation and pre-emption checking
  + Finalize details for candidate resources reporting when SL DRX active time of Rx-UE is provided

According to the above planning for Step 1, in order to make a selection of the general design approach / framework of partial sensing for aperiodic transmission, FL proposes to selection between Approach 1 and Approach 2 only, as it has been raised that Approach 3 is optimized according to types of partial sensing are being performed by the UE, a unified design solution for partial sensing is not achieved, and also it is the least supported approach of only 3 companies.

Additionally, it will be helpful to close early the FFS item on the definition of *T1* for resource selection window when UE performs CPS-only in resource pool without periodic reservation for another TB (*sl-MultiReserveResource*) enabled. Based on contributions submitted to this meeting and those provided their views on this issue, the majority has the view that the *T1* definition should follow / same as Rel-16 for consistency.

### Proposals before 1st GTW

**Question 2-1 (I):** When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*, which one of the following general partial sensing design frameworks agreed in RAN1#106bis-e should be adopted and why? Note that, the details can still be updated.

* Approach 1: *SA* is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of *M* slots for CPS.
* Approach 2: *SA* is initialized based on all candidate single-slot resources after CPS and guarantee a minimum of *M* slots for CPS

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| **Company** | **Approach 1 or 2** | **Reason(s)** |
| LGE | Approach 1 | We prefer a unified approach for all types of RA. Approach 1 is aligned with that used for periodic transmission, and it reduces power consumption compared to Approach 2. |
| vivo | Approach1 | We prefer a unified design for all cases so approach1 is supported. Moreover, in approach2, candidate single-slot resources after CPS includes slots without any corresponding sensing results, these slots have a higher possibility to be reported and to be selected than slots with corresponding sensing result, which can be problematic as these slots may have been reserved by other UE. Similar issue exists in R16 but MAC can trigger re-evaluation to avoid potential collision. However, for a power-saving UE, relying on frequently triggered re-evaluation not only defeat purpose of power saving but also cannot ensure PRR performance. |
| NEC | Approach 1 | Y candidate slots will be determined which is aligned with legacy partial sensing procedure and also the PBPS results could be took into account which is benefit for CPS sensing |
| Fujitsu | Approach 1 | 1. Approach 1 provides a more generic framework for PBPS+CPS and CPS only case; 2. Approach 1 can prioritized include the slots with PBPS sensing results, which is beneficial for reliability. 3. Approach 2 can be seen as a special case of approach 1. |
| NTT DOCOMO | Approach 1 | When PBPS results are available for some slots, the slots should be preferentially included in Y’ slots. Better collision avoidance is assumed than Approach 2. We are not sure what is the benefit of Approach 2. |
| Huawei, HiSilicon | Approach 1 | We support Approach 1 in first priority.  Approach 1 allows a unified work to cover all cases (periodic or aperiodic traffic, CPS with or without combing PBPS). Given RAN1 has already agreed the design on PBPS + CPS for periodic transmission, similar design framework, i.e. based on selected Y’, to cover other cases, which introduce less spec efforts and UE implementation complexity.  For the case PBPS + CPS are performed, resource selection on a set of Y’ is more reliable since both PBPS and CPS result can be applied to. For the CPS only case, a set of Y’ can still be selected based on UE implementation, which can contain any available slots (including all slots, i.e. approach 2) within RSW, to provide more randomization between UEs.  We can also consider a compromise approach to make progress. For example, the two approaches can be configured by gNB or decided by conditions. Specifically, gNB can configure which approach is used by signalling in a resource pool, or UE can select which approach based on conditions, such as whether periodic reservation is enabled on the resource pool or whether Ymin’ candidate slots can be satisfied. |
| Xiaomi | Approach 2 | The initial candidate set SA from approach 2 is a superset of that from approach 1. In approach 2, the sensing results from PBPS (if available) are also counted and resource exclusions are performed based on all the existing sensing results. There is no reason why approach 2 will have performance worse than that of approach 1. Compared with approach 2, the candidate set of approach 1 could be too limited so UE has to select resource with high interference level. |
| Ericsson | Approach 2 | For aperiodic transmissions the set SA shall be initialized based on the triggering of the aperiodic transmissions which in our view is aligned with Approach 2. |
| Samsung | Approach 3, see comment | We support approach 3 as agreed candidate approach in last meeting:   * Approach 3: (independent approach for different case)   + When UE additionally performs periodic-based partial sensing in the resource pool, the above Approach 1 applies.   + When UE does not perform periodic-based partial sensing in a resource pool that does not allow resource reservation for another TB, the above Approach 2 applies.   For UEs additionally performing PBPS in the pool, the candidate slots with existing PBPS/CPS results have better reliability compared with other slots in RSW, therefore Approach 1 is beneficial to enhance performance. Therefore, when there are sufficient candidate slots with existing PBPS/CPS result in RSW, approach 1 is adopted; otherwise approach 2 can be adopted.  For UEs not performing PBPS, there is no need to select candidate single slots, since the slots in RSW have no existing sensing result thus have equal reliability, and Approach 2 is better to be used. |
| Futurewei | Approach 2 with comments | Approach 2 is general which can cover approach 1 by UE implementation |
| CATT | See comments | In principle approach 1 but both approach need to refine the wording   * Approach 1:  *need to clarify the meaning of ‘slots with PBPS etc’ clearly, need to clarify and/or , does ‘or’ here mean for ue implementation?* * Approach 2:  *need to clarify ‘* after CPS’ , we cannot put crypto in specification |
| MediaTek | Approach 1 | When available, both PBPS + CPS results should be taken into account before initializing candidate set. |
| Apple |  | When UE performs both PBPS and CPS, then the UE can determine the set of candidate slots based on PBPS results. If the candidate slots resulting from PBPS are contained in the resource selection window of the aperiodic traffic, then it is preferred for this UE to select resources from these candidate slots.  When UE performs CPS only, then the UE does not have candidate slots from PBPS to start with. Hence, the candidate resource slots could be any from the resource selection window excluding the CPS monitoring slots.  Overall, we still prefer Approach 3 which is the combination of Approach 1 and Approach 2 for different scenarios. |
| Qualcomm | Please comments | In generate we support using resources with PBPS results when possible. However, this should not come at the expense of have too few resources for the aperiodic transmission. Hence, our view is that the selection window should be chosen without regards for slots with PBPS results. Then, slots within the selection window that have PBPS results could be used to initialize S\_A if there is a sufficient number of them. |
| OPPO | Approach 1 | For Approach 2, and with CPS only, if S\_A is initialized to all single-slot resources after CPS, it is likely that candidate resource sets includes the resource which is 31 slots after CPS since these resource has no CPS sensing results and will not be excluded. In that case, it will result in large delay for resource selection/transmission.  For Approach 1, it is reasonable to set S\_A to the single-slot resource which has sensing results. It can be left to UE implementation whether additional more slots can be included. Approach 2 can be seen as a special case of Approach 1. |

**Question 2-2 (I):** When UE performs only contiguous partial sensing in a mode 2 Tx pool without periodic reservation for another TB (***sl-MultiReserveResource***) enabled, can we define *T1* of the resource selection window based on step 1) of Rel-16 TS 38.214 Sec. 8.1.4? If not, what is the concern(s)?

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| **Company** | **Comment / concern(s)** |
| vivo | Yes. Prefer to have a unified design of T1 for PBPS+CPS and CPS only case. |
| NTT DOCOMO | Rel-16 T1 should be OK. |
| Ericsson | T1 should be selected in order to guarantee a minimum resource selection window size. We have to include a restriction on the selection of the value T1 to fulfil this constraint.  Therefore, we propose the following:  Proposal: The value T1 of the resource selection window is selected such that a minimum resource selection window is guaranteed. |
| Samsung | We think it is unnecessary to define T1 in this case. We should just define the time interval over which S\_A is being initialized, which is already reflected in approach 2.  “Candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in [*n+TB+Tproc,0+Tproc,1*, *n+T2*], …”  Therefore, when we go with approach 2, it’s not needed to spend time on discussing this issue. |
| Futurewei | We may not need T1 as the RSW can be defined with TB, T2 and processing time. |
| MediaTek | Yes, Rel-16 T1 definition is fine. |
| Apple | Yes, we can still define T1 as in Rel-16. But the definition of T1 may not be necessary in Approach 2. |
| Qualcomm | Even if T1 is selected based on Rel-16 procedure, not all resources within [T1, T2] could be used to initialize S\_A if T\_B is after T1. Therefore, we prefer to redefine T1 using T\_B while also accounting for T\_2,min. |
| OPPO | Yes. Reuse R16 mechanism is fine. The minimal window size of RSW is also considered in R16 mechanism. |
| Futurewei2 | Based on agreed approach 1, Y’ slots are select within RSW. Therefore, T1 and T2 are needed for defining RSW first. We then prefer to reuse T1 and T2 from Rel-16 specification. T2 will be used to handle remaining PDB issue. |
| Lenovo&MotM | Yes, we are fine with R16 T1 defination |
| Spreadtrum | Yes. Rel-16 T1 is fine. |

### Proposals for 1st GTW

FL observations and comments based on inputs received in Sec. 3.2.1:

* On Proposal 2-1 (I):
  + Overall, similar comments and preferences from the Tdoc review are also observed here during the email discussion. The preference of the majority is Approach 1, for the following reasons:
    - A unified partial sensing design for all types of RA
    - Better reliability from having corresponding PBPS sensing results
    - Y’ candidate slots can include all slots in RSW as a special case (Approach 2)
  + FL:
    - Technically, Approach 1 and Approach 2 can have similar/same reliability performance if slots with corresponding PBPS results are prioritized during resource (re)selection. Similarly, if number of slots with corresponding PBPS results are less than *Y’min* in Approach 1, other slots (without PBPS results) will need to be selected as well. So, for any given scenario, both Approach 1 and 2 will end up with very similar situation.
    - For Approach 3, although technically optimized and feasible, but we will end up with 3 different solution designs in the spec. The specification and implementation impact is significant, hence it is not preferred by the most.
    - Since the performance is expected to be similar between the two approaches, but Approach 1 offers a unified sensing design for all types of RA, FL recommends to go with the solution framework described in Approach 1 from RAN1#106bis-e.

**Proposal 2-1 (II):** When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*, the general design framework in Approach 1 from RAN1#106bis-e in below is adopted. Note that, the details can still be updated.

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| ***Agreement (from RAN1#106bis-e)***  *When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (Prsvp\_TX=0) in slot n, TA and TB for CPS monitoring window and a candidate resource set (SA) is initialized according to potentially one of the following approaches (final decision in RAN1#107-e). Other approaches are not precluded and the details in each approach can still be updated.*   * *Approach 1: (SAis initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of M slots for CPS)*   + *The UE selects a set of Y’ candidate slots with corresponding PBPS and/or CPS results (if available) within the RSW.*     - *FFS how to handle the case if the total number of Y’ candidate slots is less than a (pre-)configured threshold Y’min without dropping the aperiodic transmission*     - *FFS whether the Y’ candidate slots for aperiodic transmission is the same as the Y candidate slots in PBPS for periodic transmission of another TB(s)*     - *FFS whether/how to prioritize/select resources based on partial sensing results.*     - *FFS: How to select Y’ in case of CPS only*   + *Candidate resource set (SA) is initialized to the set of all single-slot candidate resources in the selected Y’ candidate slots.*   + *For the CPS monitoring window [n+TA, n+TB]:*     - *TA and TB are both selected such that UE has sensing results for a minimum of M consecutive logical slots before ty0, where ty0 is the first slot of the selected Y’ candidate slots.*       * *FFS: By default, M is 31 unless (pre-)configured with another value, or M is (pre-)configured based on transmission priority*       * *FFS the range of (pre-)configured M from a TBD lowest value up to 30*       * *FFS: how to handle the case when the minimum M slots for CPS cannot be guaranteed*   + *FFS: RSW in case of CPS only* * *…* |

### Proposals until 2nd GTW

Since we have down-selected to go ahead with Approach 1, let’s continue our discussion until the next GTW session on finalizing the remaining details for selecting the *Y’* candidate slots and the CPS monitoring window when UE is triggered to perform resource (re)selection for aperiodic transmission.

First of all, the original intention for selecting a set of *Y’* candidate slots, besides having a unified design to the periodic transmission case, is to match to a selected set of *Y* candidate slots for PBPS (if available) as much as possible with a minimum length of *Y’min* slots within the RSW in a resource pool (pre-)configured WITH periodic reservation for another TB (*sl-MultiReserveResource*) enabled. If the matching of Y’ and Y candidate resource sets can be found, a minimum of *M* sensing slots before the first slot of the *Y* () can be also reused for the aperiodic transmission. As such, we only have to deal with the case when the total number of *Y’* candidate slots is less than a (pre-)configured threshold *Y’min* without dropping the aperiodic transmission. Based on the contributions submitted to this meeting, in general, there can be two options. In Option 1, UE finds other candidate slots within the RSW until *Y’* = *Y’min*. In Option 2, UE performs random resource selection in an exceptional pool.

In addition, if UE selects other candidate slots without corresponding PBPS results to fulfil the minimum *Y’min* number of slots requirement, there is a proposal that the candidate slots with corresponding PBPS results should be given higher priority for selection.

In the case when UE performs CPS-only in a resource pool WITHOUT periodic reservation for another TB (*sl-MultiReserveResource*) enabled, the main motivation is purely to have a unified design framework for partial sensing, hence, less specification effort. For this case, since the UE only needs to perform CPS for detecting aperiodic reservations, the selection of Y’ candidate slots only need to take into consideration of whether any CPS slots has been monitored prior to the resource (re)selection trigger in slot *n*. For example, if the UE has already monitored *X* number of slots just prior to slot *n*, then the UE only need to continue the CPS monitoring for another (*M – X*) slots before UE selecting and reporting a set of candidate resources to the higher layer. Another words, the selection of *TA* and *TB* for the CPS monitoring window needs ensure the UE monitor at least *M* minimum number slots earlier than the first slot of the *Y’* candidate slots (). And it is up to UE implementation to select the set of *Y’* candidate slots with a minimum length of *Y’min* slots within a RSW. Hence the existing description for UE selection of a set of *Y’* candidate slots and the CPS monitoring window are also applicable for the case of UE performing CPS-only.

Furthermore, when minimum *M* slots for CPS cannot be guaranteed, e.g., for the case when *M*+*Y’min* > *remaining PDB*, based on the contributions submitted to this meeting, in general, there can be also two options. In Option A, the UE ensures the *Y’min* criterion is fulfilled, meaning the UE performs resource selection based on however many sensing results it is able to obtain. In Option B, UE performs random resource selection in an exceptional pool.

Considering the above, details of Approach 1 are updated in the following Proposal 2-1 (III). If there is a concern or propose of improvement, please suggest revised wordings.

**Proposal 2-1 (III):** When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*,

* ~~Approach 1: (~~*~~S~~~~A~~*~~is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of~~*~~M~~*~~slots for CPS)~~
* The UE selects a set of *Y’* candidate slots with corresponding PBPS and/or CPS results (if available) within the RSW.
  + ~~FFS how to handle the case i~~If the total number of *Y’* candidate slots is less than a (pre-)configured threshold *Y’min*, ~~without dropping the aperiodic transmission~~
    - Option 1: UE selects other candidate slots within the RSW until *Y’* = *Y’min*.
    - Option 2: UE performs random resource selection in an exceptional pool.
  + ~~FFS whether the Y’ candidate slots for aperiodic transmission is the same as the Y candidate slots in PBPS for periodic transmission of another TB(s)~~
  + ~~FFS whether/how to prioritize/select resources based on partial sensing results.~~
  + ~~FFS: How to select Y’ in case of CPS only~~
* Candidate resource set (*SA*) is initialized to the set of all single-slot candidate resources in the selected *Y’* candidate slots.
* For the CPS monitoring window [*n*+*T*A, *n*+*T*B]:
  + *TA* and *TB* are both selected such that UE has sensing results for a minimum of *M* consecutive logical slots before *ty0*, where *ty0* is the first slot of the selected *Y’* candidate slots.
    - ~~FFS:~~ By default, *M* is 31 unless (pre-)configured with another value, ~~or~~ where *M* is (pre-)configured based on transmission priority
    - FFS the range of (pre-)configured *M* from a TBD lowest value up to 30
    - ~~FFS: how to handle the case w~~When the minimum *M* slots for CPS cannot be guaranteed,
      * Option A, the UE ensures the *Y’min* criterion is fulfilled.
      * Option B: UE performs random resource selection in an exceptional pool.
* If some of candidate resources in set *SA* reported to the higher layer have corresponding PBPS results, index of those slots in the set *SA* that have corresponding PBPS results are also reported to the higher layer.
* FFS: RSW in case of CPS only

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| **Company** | **Comment / concern(s)** |
| Futurewei | First, we would like to have a clarification on the FL’s summary. As in the GTW, we commented that we would like UE to have a flexibility not to use existing PBPS, as the the slots with PBPS results may come much later from n. As the responses in GTW from companies support that Approach 1 cover this case as the main bullet says “corresponding PBPS and/or CPS results (if available) within the RSW”. The summary seems assuming that that UE has to match the Y’ slots with existing PBPS results, which is not what we agreed in Approach.  When Y’ candidate slots are selected with corresponding PBPS and/or CPS results, since the UE does not need to specify another PBPS, therefore Y’min is not an appropriate threshold to determine whether UE needs to expand the slots. T2min in Rel-16 can be used. Also it is not necessary to restrict the slots with minimum number of slots. Therefore, instead of “=” in option 1, it should be “>=”.  Since the definition of M is for CPS sensing slot (as stated in “UE has sensing results for a minimum of *M* consecutive logical slots”) and there is a processing time Tproc,0+Tproc,1, the default value of M should be smaller than 31.  When the minimum M slots for CPS cannot be guaranting, UE ensures Y’min (T2min) criterion to be fulfilled. And UE performs sensing on what left in CPS as they may be used for re-evaluation/pre-emption later.  Last, we do not think there is a need that UE reports indexes of the slots with PBPS results to the high layer.  Based on above discussions, we propose the following updates on the proposals. Again, we prefer Option 1 and Option A in the updated proposal.  **Proposal 2-1 (III):** When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*,   * ~~Approach 1: (~~*~~S~~~~A~~*~~is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of~~*~~M~~*~~slots for CPS)~~ * The UE selects a set of *Y’* candidate slots with corresponding PBPS and/or CPS results (if available) within the RSW.   + ~~FFS how to handle the case i~~If the total number of *Y’* candidate slots is less than a (pre-)configured threshold *~~Y’~~~~min~~* *T2min*, ~~without dropping the aperiodic transmission~~     - Option 1: UE selects other candidate slots within the RSW ~~until~~ *~~Y’~~* ~~=~~ *~~Y’~~~~min~~* to ensure Y’≥ *T2min* .     - Option 2: UE performs random resource selection in an exceptional pool.   + ~~FFS whether the Y’ candidate slots for aperiodic transmission is the same as the Y candidate slots in PBPS for periodic transmission of another TB(s)~~   + ~~FFS whether/how to prioritize/select resources based on partial sensing results.~~   + ~~FFS: How to select Y’ in case of CPS only~~ * Candidate resource set (*SA*) is initialized to the set of all single-slot candidate resources in the selected *Y’* candidate slots. * For the CPS monitoring window [*n*+*T*A, *n*+*T*B]:   + *TA* and *TB* are both selected such that UE has sensing results for a minimum of *M* consecutive logical slots before *ty0*, where *ty0* is the first slot of the selected *Y’* candidate slots.     - ~~FFS:~~ By default, *M* is 31-M*,Tproc* unless (pre-)configured with another value, ~~or~~ where *M* is (pre-)configured based on transmission priority       * ~~Where~~ M*,Tproc* is number of logical slots within Tproc,0+Tproc,1     - FFS the range of (pre-)configured *M* from a TBD lowest value up to 30-M*,Tproc*     - ~~FFS: how to handle the case w~~When the minimum *M* slots for CPS cannot be guaranteed,       * Option A, the UE ensures the *~~Y’~~~~min~~**T2min* criterion is fulfilled.       * Option B: UE performs random resource selection in an exceptional pool. * ~~If some of candidate resources in set~~ *~~S~~~~A~~* ~~reported to the higher layer have corresponding PBPS results, index of those slots in the set~~ *~~S~~~~A~~* ~~that have corresponding PBPS results are also reported to the higher layer.~~ * FFS: RSW in case of CPS only |
| Xiaomi | We are generally fine with the FL proposal. Pls find the following comments:  The exact meaning of “a set of *Y’* candidate slots with corresponding PBPS and/or CPS results” should be clarified. First, all the slots after slot n has not been sensed. Should we assume that all the future slots can be sensed for both PBPS and CPS, and decide which candidate slots is with PBPS and CPS results based on this assumption? Secondly, the set of slots with PBPS and CPS is different from the set with PBPS or CPS. Which condition should be used in which case should be clarified. |
| Qualcomm | In our view, having fewer than Y’min slots with periodic sensing results is part of regular operation and not an exceptional case. Hence, resources for those transmissions would still be in the regular resource pool.  Given that prior agreements stated that he UE need to sense for M slots, and this proposal also applies the same restriction, it is not clear when the UE will not have sufficient CPS sensing results.  Based on the above, we support Option 1 (based on the prior agreement to sense for M slots) and Option A. |
| vivo | We are generally fine with the proposal, and prefer Option2+optionB  We prefer to have a unified design for PBPS and CPS. In LTE, for PBPS, if a Y set satisfying Ymin limit cannot be found, UE should perform random selection. Similarly, for CPS involved case, if Ymin’ cannot be met, UE should perform random selection.  Regarding whether UE should select a set of Y’ candidate slots to match to a selected set of Y candidate slots for PBPS (if available) as much as possible discussed in the summary, we don’t think it is needed. For the transmissions requiring high reliability, a smart UE can by its implementation to determine a Y’-slot set aligned with existing Y-slot. For an aperiodic transmission with small PDB, UE should do sensing and select a Y’-slot set that is as earlier as possible. So there is no need to always mandate UE to select a Y’-slot set matching existing Y-slot, there is also no need to prioritize candidate slots with corresponding PBPS results, so the 4th bullet can be removed.   * ~~If some of candidate resources in set SA reported to the higher layer have corresponding PBPS results, index of those slots in the set SA that have corresponding PBPS results are also reported to the higher layer.~~ |
| Apple | In our view, if the number of candidate slots resulting from PBPS is less than Y’min, then the candidate slots from PBPS should not be used at all. Instead, the CPS operations could be applied with CPW window [n+1, n+TB], where TB is selected to be larger than M and there are enough slots in the remaining resource selection window. Hence, we propose to add an option: “Option 3: UE selects candidate slots belonging to [n+TB+Tproc,0+Tproc,1, n+T2]”.  When the minimum M slots for CPS cannot be guaranteed, we support Option B.  We also agree with vivo that the 4th bullet can be removed. |
| Lenovo&MotM | On the sub-bullet “If some of candidate resources in set *SA* reported to the higher layer have corresponding PBPS results, index of those slots in the set *SA* that have corresponding PBPS results are also reported to the higher layer.” , we think it will introduce new behaviour to high layer on resource selection, e.g., firstly random select resource among the resources with PBPS results, which may be not beneficial for interference/collision randomize among multiple UEs. So we support Option 2 and Option B without this sub-bullet |
| Spreadtrum | We are generally fine with FL’s proposal. And we prefer option 1+ option A.  For the report of slots index, we think that the final candidate resources should be treated equally, and there is no need to give higher priority to the slots that have corresponding PBPS results. So, the 4th bullet should be removed. |
| Panasonic | We are fine with the proposal. |

## Topic #3: Partial sensing for re-evaluation and pre-emption checking

**Background**: Beside partial sensing details for re-evaluation and pre-emption checking, which are dependent on the partial sensing design for resource (re)selection, there are also some other remaining details (FFS items / open issues) that should be finalized for this topic. One of such issues is on support of re-evaluation and pre-emption checks for UE performing random resource selection but capable of performing sensing operation. This issue has been left open since RAN1#103-e in the following. Based on reviewing contributions submitted in this and past meetings, the main reason to support is for better reliability performance. Sometimes a sensing capable UE performs random resource selection due to lack of sensing results from short / tight PDB latency requirement or SL DRX inactive time. If the UE is capable of sensing, it will be better for the UE to perform sensing after random selection to support re-evaluation and pre-emption checking.

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| *Agreements (in RAN1#103-e):*   * *Re-evaluation and pre-emption checking are not supported by UEs that do not perform any sensing (i.e. PSCCH reception)* * *Re-evaluation and pre-emption checking are supported by UEs that perform sensing*   + *FFS details and any conditions(s) in which re-evaluation and pre-emption can be performed* * *FFS whether/how re-evaluation and pre-emption can be supported by UEs performing random resource selection that do perform sensing* * *Note: details about sensing in this context, including when it is performed, are not decided yet.* |

Another open issue is about introducing triggering enhancement for re-evaluation and pre-emption checking. Based on contributions submitted to this meeting, there has not been many (if any) proposals to enhance / introduce additional triggering enhancement, especially for re-evaluation. In the past, the main reason for enhancement is to introduce (pre-)configuration for enabling/disabling re-evaluation for partial sensing UEs to further reduce power consumption (on top of partial sensing). However, this is harder to justify having this (pre-)configuration after an WA is made in the last meeting that up to UE implementation to perform re-evaluation in non-initial reservation period. That is, the UE only needs to perform resource re-evaluation only in the first / initial reservation period. If this re-evaluation is further disabled, the performance lost is shown in [28].

One new issue on triggering re-evaluation and pre-emption checking is identified in [9]. In Rel-16, full sensing is always assumed for UEs that perform re-evaluation and pre-emption checking. As such, at the time of re-evaluation and pre-emption triggering in slot *n* (e.g., earlier than, at or after *m-T3*), the UE has all required sensing results in the past for the resource exclusion step. However, for partial sensing UEs, they monitor PSOs/CPS window based on *Y* candidate slots in the future or perform sensing after the triggering slot. For a UE triggered to perform re-evaluation and pre-emption checking, the triggering timing is unpredictable to L1 if triggered by the MAC layer earlier than or after slot (*m-T3*), as such it cannot perform partial sensing beforehand (31 slots earlier). Except that the PHY layer only knows the slots in which the resources are selected for (*r0*, *r1*, *r2*, …) and (*r0’*, *r1’*, *r2’*, …). Due to this problem, it is proposed that re-evaluation and pre-emption checking is triggered only in slot (*m-T3*) when UE performs partial sensing or random resource selection and capable of sensing.

In RAN1#106bis-e, details of partial sensing for resource (re)selection when a periodic transmission is triggered in a mode 2 Tx pool are agreed as followed. Based on this agreement, the concept of CPS is to monitor *M* logical slots before the first candidate resource which is initialized based on selected *Y* candidate slots for PBPS. On top of that, based on past agreement on PBPS, the UE also monitor corresponding PSOs based on (pre-)configured *Preserve* values. After PBPS and CPS sensing, overlapped resources in the initialized candidate resource set (*SA*) are excluded based on these sensing results. Then the remaining candidate resource set is reported to the higher layer for the final selection. For resource re-evaluation and pre-emption checking, it is obvious and straight forward that these already obtained PBPS and CPS results can be and should be reused as long as the same or remaining set of *Y* candidate slots (starting from the first provided resource from the higher layer) are also used for re-evaluation and pre-emption checking. Therefore, one sensing scheme suggested among the contributions submitted to this meeting for re-evaluation and pre-emption checking is to perform PBPS for the remaining *Y* candidate slots according to , where is a slot belong to the remaining *Y* candidate slots, and *k* and *Preserve* are the same as resource (re)selection. CPS monitoring window is *M* logical slots earlier than , which is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (*r0*, *r1*, *r2*, …) and pre-emption checking (*r0’*, *r1’*, *r2’*, …). Let’s call this Scheme 1.

Other than Scheme 1, a partial sensing scheme where UE performs contiguous sensing immediately after the resource (re)selection until the last retransmission of the transport block is also proposed. That is, the CPS monitoring window always starts from *n+TA* = and ends at *n*+*T*B is slots earlier than , which is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (*r0*, *r1*, *r2*, …) and pre-emption checking (*r0’*, *r1’*, *r2’*, …). Let’s call this Scheme 2.

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| **Agreement**  When UE performs periodic-based and contiguous partial sensing schemes in a mode 2 Tx pool with periodic reservation for another TB (*sl-MultiReserveResource*) enabled,   * For a resource (re)selection procedure triggered by periodic transmission () in slot *n*, *TA* and *TB* for the CPS monitoring window is defined according to one of the followings:   + *n*+*T*A is M logical slots earlier than slot , and *n*+*T*B is slots earlier than , where is the first slot of the selected *Y* candidate slots of PBPS, and , are in units of physical time/slots.     - By default, M is 31 unless (pre-)configured with another value. |

### Proposals before 1st GTW

**Proposal 3-1 (I):** It is supported for a UE capable of sensing to perform re-evaluation and pre-emption checking (if enabled) after random resource selection.

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| --- | --- |
| **Company** | **Comments** |
| vivo | support |
| NTT DOCOMO | Support |
| Ericsson | We would like clarification regarding the wording “(if enabled)”. Is the right understanding that this only includes the pre-emption checking?  In affirmative case, we are supportive of the proposal. |
| Samsung | Support |
| Futurewei | We do not support this proposal. If UE performs random resource selection for power saving, UE should not perform re-evaluation and pre-emption.  Note that if due to insufficient CPS sensing time and if re-evaluation and pre-emption is enabled, UE should perform sensing on the limited CPS sensing slots as they are still useful for re-evaluation and pre-emption. Then for this scenario, it is not viewed as random resource selection. Therefore, the proposal is not applicable. |
| CATT,GOHIGH | Oppose. Similar view with futurewei here. |
| Apple | Support |
| Qualcomm | Support. Our results show that such a procedure brings performance very close to full-sensing UEs. It is also suitable when the PDB is small, where waiting for CPS to finish could cause the transmission to be dropped or the RSW size to be too small causing collisions due to the larger RSRP threshold used. |
| OPPO | Support |
| Lenovo&MotM | Support |
| Spreadtrum | Support. |
| Panasonic | Support |
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**Proposal 3-2 (I):** No additional triggering enhancement in re-evaluation and pre-emption checking for partial sensing UEs in Rel-17.

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| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | Triggering mechanism is 3-3, right? With the understanding, we are OK with this proposal. |
| Ericsson | We would like to add clarification that this proposal does not restrict the triggering of re-evaluation and pre-emption checking due to inter-UE coordination message in scheme 2. |
| Samsung | No. Re-evaluation/pre-emption is useful when the UE is capable of doing sensing. We can reuse current triggering mechanisms. |
| Futurewei | We are ok with the proposal |
| CATT,GOHIGH | No. reuse current. |
| Apple | We are fine with the proposal. |
| Qualcomm | Disagree, we propose to reuse Rel-16 behaviour where the UE is required to trigger the check (if enabled) at m – T3 but could do it more frequently. |
| OPPO | Support the proposal. It is better to clarify in the proposal that R16 mechanism is reused. |
| Vivo | support |
| Lenovo&MotM | We support this proposal |
| Spreadtrum | We support the proposal. |
| Panasonic | Support |
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**Proposal 3-3 (I):** When UE performs partial sensing or random resource selection and capable of sensing, re-evaluation and pre-emption checking (if enabled) is triggered only in slot (*m-T3*).

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| **Company** | **Comments** |
| NTT DOCOMO | Support for random selection.  For partial sensing, we had agreements at the last meeting, didn’t we? |
| Samsung | Agree. This is the same as Rel-16 behaviour |
| Futurewei | It would be very restrictive for UE’s resource reselection if re-evaluation and pre-emption checking (if enabled) is triggered only in slot (*m-T3*). Following the same design spirit in rel-16, re-evaluation and pre-emption checking (if enabled) should be triggered at n+TB.  Again, if UE performs random resource selection, re-evaluation and pre-emption check is not supported. Therefore, we propose the following update  **Proposal 3-3 (I):** When UE performs partial sensing ~~or random resource selection and capable of sensing~~, re-evaluation and pre-emption checking (if enabled) is triggered ~~only~~ in slot ~~(~~*~~m-T~~~~3~~*~~).~~ n+TB. |
| Apple | We are fine with the proposal. |
| OPPO | Not support. We prefer to reuse R16 mechanism. In R16, the re-evaluation/pre-emption checking is performed at least in slot (*m-T3*). Whether to perform the checking before slot (*m-T3*) is left to UE implementation. We don’t think R16 mechanism has power saving issue. If to save power, UE can perform the checking ONLY in slot (*m-T3*) by implementation. |
| vivo | Not support. We prefer to reuse R16 mechanism that UE can trigger re-evaluation/pre-emption checking before or after (*m-T3*) |
| Lenovo&MotM | We are fine with the proposal |
| Panasonic | Support |
|  |  |

**Proposal 3-4 (I):** When UE is triggered to perform re-evaluation and pre-emption checking for periodic transmission () in slot n,

* Candidate resource set (*SA*) is initialized to the remaining *Y* candidate slots, where the remaining *Y* candidate slots starts from slot and ends at the last slot of the Y candidate slots used in the initial resource (re)selection.
  + is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (*r0*, *r1*, *r2*, …) and pre-emption checking (*r0’*, *r1’*, *r2’*, …).
  + FFS how to handle the case when number of the remaining *Y* candidate slots is less than *Ymin*.
* Scheme 1:
  + UE performs PBPS for the remaining *Y* candidate slots from the initial resource (re)selection according to , where is a slot belong to the remaining *Y* candidate slots, and *k* and *Preserve* are the same as resource (re)selection.
  + UE performs CPS *M* logical slots earlier than .
    - By default, *M* is 31 unless (pre-)configured with another value.
* Scheme 2:
  + UE performs CPS starts from *n+TA* = and ends at *n*+*T*B is slots earlier than .
    - By default, *M* is 31 unless (pre-)configured with another value.

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| **Company** | **Comments** |
| LGE | Support scheme 1. It is aligned with the partial sensing operations for the initial resource (re)selection, which is preferred as a unified approach. Some exceptional case can be discussed as FFS points, but as a general direction, scheme 1 is more reasonable.  Scheme 2 requires more power consumption than scheme 1, especially when the resources are apart from the slot n, which is controversial to the power saving purpose. |
| vivo | We suggest to discuss re-evaluation and pre-emption checking separately. For re-evaluation, we support scheme1. Since re-evaluation check is only applied for the initial period, both the CPS and PBPS can be performed for re-evaluation to decrease the possibility of collision without significant power consumption. |
| NEC | Scheme 1. |
| Fujitsu | We prefer Scheme 1 with comments. Because Scheme 1 does not need to perform a long-term contiguous sensing as Scheme 2, which is more beneficial for power saving.  For PBPS, we think if the remaining Y candidate slots are less than Ymin or Y’min, additional slots should be included in the candidate resource set; otherwise, the candidate resources will be not sufficient if the resource re-selection is triggered. PBPS can also be triggered for these additional slots, or only CPS is done for these slots.  For CPS, we think it is also needed subject to the processing time. |
| NTT DOCOMO | Our preference is Option 1 in the FL summary at the last meeting.  (Option 1: UE performs partial sensing only for the pre-selected resources and/or reserved resources)  But we can be flexible with this direction. Then in this case, we agree with vivo’s suggestion. This direction is OK for re-evaluation, while for pre-emption check, there is no remaining Y slots normally. This proposal does not work for pre-emption check.  In this proposal, we would like to ask how to determine RSRP threshold. If Step4/5/6/7 are performed as normal procedure with less remaining Y candidate slots, RSRP threshold might become much higher. We suggest discussing this aspect. For this proposal, one FFS can be added as “FFS: how to determine RSRP threshold”. |
| Huawei, HiSilicon | On the sub-bullet that “ t\_r^SL is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (r0, r1, r2, …) and pre-emption checking (r0’, r1’, r2’, …).” The case that r0 is ty0 should be excluded. A UE does not need to be triggered to re-evaluate it, because ty0 already has latest PBSP and CPS result in the process of candidate resource set determination, given that PBPS and CPS is defined as a reference to ty0.  The FFS “how to handle the case when number of the remaining Y candidate slots is less than Ymin.”is not needed. It is not necessary to have remaining Y candidate slots must be larger than Ymin during the whole re-evaluation/pre-emption checking processing for every (r0, r1, r2, …) and (r0’, r1’, r2’, …), the minimum number of resources set is ensured by step 7, where resource shall be no less than , rather than Ymin.  It is not clear about the relationship between two schemes, they will be down selected to one or both of them are proposed? We can support scheme 1 in principle, if above comments are addressed.  Similarly to Rel-16, re-evaluation and pre-emption checking should be triggered at m-T3, thus for every (r0, r1, r2, …) and (r0’, r1’, r2’, …) except that r0 = ty0, both PBPS and CPS needs be performed for checking. Therefore, we suggest to have following changes on the proposal.  **Proposal 3-4 (I):** When UE is triggered to perform re-evaluation and pre-emption checking for periodic transmission () in slot n,   * Candidate resource set (*SA*) is initialized to the remaining *Y* candidate slots, where the remaining *Y* candidate slots starts from slot and ends at the last slot of the Y candidate slots used in the initial resource (re)selection.   + is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (*r0*, *r1*, *r2*, …) and pre-emption checking (*r0’*, *r1’*, *r2’*, …) and is not ty0 if included in the sets.   + ~~FFS how to handle the case when number of the remaining~~ *~~Y~~* ~~candidate slots is less than~~ *~~Y~~~~min~~*~~.~~ * Scheme 1:   + UE performs PBPS for the remaining *Y* candidate slots from the initial resource (re)selection according to , where is a slot belong to the remaining *Y* candidate slots except ty0, and *k* and *Preserve* are the same as resource (re)selection.   + UE performs CPS *M* logical slots earlier than .     - By default, *M* is 31 unless (pre-)configured with another value   … |
| Xiaomi | Scheme 1. We have agreed sensing requirements for resource (re)selection of periodic transmission. The similar behaviour can be applied for pre-emption and re-evaluation.  The 2nd sub-sub-bullet of the 1st sub-bullet is suggested to be revise as: “FFS whether/how to handle the case when number of the remaining Y candidate slots is not enough ~~less than Ymin~~.” |
| Ericsson | We are supportive of the proposal. We can use it as starting point for the discussion and down-select one of the schemes based on it. |
| Samsung | We don’t think it beneficial to trigger new/additional PBPS for re-evaluation/pre-emption checking. Considering power consumption, our preference is that UE only does CPS for revaluation starting at M slots before and ending at slots earlier than.  Reusing of existing PBPS result, if candidate slots for re-evaluation/pre-emption overlapped with or is a subset of candidate slots in resource (re)selection, is acceptable for us.  Therefore we propose the modified Scheme 1 as follows, to clarify that no new/additional PBPS will be triggered:   * Scheme 1:   + UE performs PBPS for the remaining *Y* candidate slots, which is a subset of the Y candidate slots in the initial resource (re)selection, that from the initial resource (re)selection according to , where is a slot belong to the remaining *Y* candidate slots, and *k* and *Preserve* are the same as resource (re)selection.   + UE performs CPS starting *M* logical slots earlier than , to slots earlier than .     - By default, *M* is 31 unless (pre-)configured with another value.   Or directly use scheme 3:   * Scheme 3:   + UE performs CPS starting *M* logical slots earlier than , to slots earlier than     - By default, *M* is 31 unless (pre-)configured with another value. |
| Futurewei | We prefer scheme 2 with modification. It is unnecessary to specify TA, TB, or M for re-evaluation and pre-emption. We do not need a restriction of M as UE may reselect a resource earlier than   * Scheme 2:   + UE ~~performs~~ continues CPS ~~starts from~~ *~~n+T~~~~A~~* ~~= and ends at~~ *~~n~~*~~+~~*~~T~~*~~B~~ ~~is~~ till slots earlier than .     - ~~By default,~~ *~~M~~* ~~is 31 unless (pre-)configured with another value.~~ |
| CATT/GOHIGH | In principle scheme 1 but we think further retuning is needed.  For the purpose of pre-emption, whether periodic-based partial sensing should be performed or not depends on pre-emption enable or disable |
| Apple | We support scheme 1 with modifications.  To avoid contiguous/periodic collision, we think in resource re-evaluation and pre-emption checking, Prsvp\_Tx should be included in the Preserve set which is used for resource (re)selection. Hence, we have the following modification:   * Scheme 1:   + UE performs PBPS for the remaining *Y* candidate slots from the initial resource (re)selection according to , where is a slot belong to the remaining *Y* candidate slots, and *k* and *Preserve* are the same as resource (re)selection plus Prsvp\_Tx.   + UE performs CPS *M* logical slots earlier than .   By default, *M* is 31 unless (pre-)configured with another value. |
| Qualcomm | We’re ok with the proposal as a starting point. |
| OPPO | We prefer to discuss it after the schemes for initial transmission is ready.  This proposal is about re-evaluation/pre-emption checking for the case of PBPS+CPS for periodic traffic, do we need to pursue a unified solution for all cases, includes another two cases: PBPS+CPS for aperiodic traffic, and CPS only for aperiodic traffic? I think that depends on whether a unified solution can be achieved for initial transmission. |
| [vivo-2] | For re-evaluation, we support scheme1. Since re-evaluation check is only applied for the initial period, both the CPS and PBPS can be performed for re-evaluation to decrease the possibility of collision without significant power consumption. While for pre-emption checking, as it has to be performed in every period, CPS only is sufficient and thus scheme2 is supported. as the M limit should be ensured, the start of CPS window *n+TA* should be max( ,). Thus  **Proposal 3-4 (I):** When UE is triggered to perform re-evaluation and pre-emption checking for periodic transmission () in slot n,   * Candidate resource set (*SA*) is initialized to the remaining *Y* candidate slots, where the remaining *Y* candidate slots starts from slot and ends at the last slot of the Y candidate slots used in the initial resource (re)selection.   + is the smallest slot index among the sets of resources provided by higher layer for re-evaluation (*r0*, *r1*, *r2*, …) and pre-emption checking (*r0’*, *r1’*, *r2’*, …).   + FFS how to handle the case when number of the remaining *Y* candidate slots is less than *Ymin*. * When UE is triggered to perform re-evaluation checking for periodic transmission () in slot n, support Scheme 1:   + UE performs PBPS for the remaining *Y* candidate slots from the initial resource (re)selection according to , where is a slot belong to the remaining *Y* candidate slots, and *k* and *Preserve* are the same as resource (re)selection.   + UE performs CPS *M* logical slots earlier than .     - By default, *M* is 31 unless (pre-)configured with another value. * When UE is triggered to perform pre-emption checking for periodic transmission () in slot n, support Scheme 2   + UE performs CPS starts from *n+TA* =max( ,) and ends at *n*+*T*B is slots earlier than .     - By default, *M* is 31 unless (pre-)configured with another value. |
| Lenovo&MotM | We support scheme 1. We think both PBPS and CPS are needed for re-evaluation and pre-emption checking, if the time gap between and first slot of Y is larger than M slots, only CPS(scheme 2) cannot exclude the transmission with resource reservation happened during this time gap, so we think PBPS is also needed as in Scheme 1. |
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### Proposals for 1st GTW

FL observations and comments based on inputs received in Sec. 3.3.1:

* TBD

## Topic #4: Congestion control for partial sensing and random resource selection

**Background**:

In LTE-V2X, when UE is configured to perform partial sensing and random selection, CBR and CR values for determining transmission related parameters are fixed/(pre-)configured due to lack of sensing results.

In Rel-16 NR-V2X, SL CBR is measured in slot *n* based on SL RSSI measurement within a CBR window [*n-a*, *n-1*], where *a* is equal to 100 or 100·2µ slots, according to higher layer parameter *sl-TimeWindowSizeCBR*. SL CR is evaluated in slot n for number of sub-channel used and granted between slots [n-a, n+b], where *a+b+1 =* 1000 or 1000·2*µ* slots, according to higher layer parameter *sl-TimeWindowSizeCR*, *b < (a+b+1)/2*.

Based on contributions submitted to this meeting, there is wide variant of proposals on how to enhance/modify the existing Rel-16 CBR and CR definition for UE performing partial sensing when a smaller number of slots are monitored. On the other hand, there are also proposals to adopt the LTE-V mechanism of (pre-)configuring CBR and CR values, since it is described in the WID objective to take Rel-14 LTE-V design as the baseline and introduce a new solution when the baseline cannot work properly.

### Proposals before 1st GTW

**Question 4-1 (I): For UE perform partial sensing or random resource selection, which one of the following options should be adopted for SL CBR in Rel-17 and why?**

* Option 1: SL CBR values are (pre-)configured as in Rel-14 LTE-V
* Option 2: Rel-16 SL CBR measurement should be updated to suit Rel-17 partial sensing, and how?
* Option 3: A new SL CBR measurement should be defined for Rel-17 partial sensing, and how?

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| **Company** | **Option 1, 2 or 3** | **Comments** |
| Futurewei | Option 1,2, Comments | If UE performs random resource selection or total number of sensing slots is smaller than a threshold, option 1 (pre-) configured values are used.  Otherwise, option 2, i.e., CBR is defined as ratio of occupied subchannels over the ones in all the sensing slots within 100 or 100\*2 slots.  Note that the rules are applied to both partial sensing and SL DRX. |
| Xiaomi | Option 2 | In our understanding, in Rel-14 V2x, defaultTxConfigIndex is (pre-)configured by upper layers if CBR measurement results are not available. UE should use this configuration instead if CBR measurement results are not available. And CBR measurement shall be performed if the UE is capable of CBR measurement and configured to transmit non-P2X related V2X sidelink communication. Therefore, whether CBR measurement is performed for partial sensing and random selection is by UE implementation in Rel-14 V2x. Therefore, option 1 should be revised as:  Option 1: whether to perform CBR measurement is by UE implementation, and default Tx (pre-)configuration is used if the CBR measurement results are not available as in Rel-14 LTE-V  We think CBR measurement enhancement is critical for NR V2x due to the following reasons:  1. Different from Rel-14 V2x, in Rel-17 NR sidelink we are considering all use cases including V2x, public safety and commercial. It is a reasonable assumption that P2X communication load is relatively low for V2x use cases, however, it is not true for public safety and commercial cases. Most of UEs performing PS or commercial sidelink communication have the demand of power saving. A working well congestion control mechanism would be necessary.  2. Only simple enhancement on CBR measurement would be workable. For example, a minimum number of slots within a CBR window which have S-RSSI measurement results can be(pre-)configured. How to select the slots to perform S-RSSI measurement can be up to UE implementation. The specification impact would be rather small, but the benefit of enabling suitable congestion control is signification for sidelink use cases especially including PS and commercial. |
| Qualcomm | Option 2 | The UE calculates CBR based on partial sensing results in partial sensing occasions, including during re-evaluation or pre-emption checking. Separately, the UE shouldn’t be required to perform CBR measurements outside of DRX active time. |
| vivo | Modified option2 with comments | According to discussion in Proposal 1-1, DRX also has impact on determining the slots for sensing and measurement, so suggest refining the wording of option2 as：Option 2’: Rel-16 SL CBR measurement should be updated to suit Rel-17 partial sensing and DRX  The following way can be considered.  the CBR window includes slots on which measurement are actually performed as specified by the agreement of the partial sensing and DRX, additional CBR calculated based on the window is multiplied with a (pre)configured factor |
| Apple | Option 2 | The sensing slots for re-evaluation and pre-emption checking should be counted in CBR calculation. Also, the non-sensing slots due to DRX inactive time should be excluded in CBR calculation. |
| Lenovo&MotM | Option 1 |  |
| Spreadtrum | Option 2 | At this stage, we think that the simple solution should be adopted. A minimum number of slots or the ratio of slots need to be measured within a CBR window can be defined. And how to select the slots to perform S-RSSI measurement can be up to UE implementation. |

**Question 4-2 (I): For UE perform partial sensing or random resource selection, which one of the following options should be adopted for SL CR in Rel-17 and why?**

* Option 1: SL CR values are (pre-)configured as in Rel-14 LTE-V
* Option 2: Rel-16 SL CR evaluation is directly reused for Rel-17 partial sensing
* Option 3: Rel-16 SL CR evaluation should be updated to suit Rel-17 partial sensing, and how?
* Option 4: A new SL CR evaluation should be defined for Rel-17 partial sensing, and how?

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| **Company** | **Option 1, 2, 3 or 4** | **Comments** |
| Futurewei | Option 2, 3 with comments | With the updates on CBR measurement, same CR evaluation and CRlimits in Rel-16 for congestion control can be used.  We are also open to option 3, i.e., a scaling on either the CR value or the Crlimit value can be applied, where the scaling is determined based on the RSW in the active time used over all possible candidate slots within the slots [n-a, n+b]. This is to avoid potentially a large channel occupancy for a UE within a short period, i.e., a very bursty channel occupancy. |
| Xiaomi | Option 2 | SL CR measurement is calculated based on the total number of sub-channels used for UE’s own transmission. It does not require UE receiving capability. Only CR\_limit is (pre)-configured by the higher layer which is used for congestion control. From our understanding, even in Rel-14 power saving resource selection, the CR is still measured by UE to meet the (pre-)configured CR\_limit. Therefore, we think the description of option 1 is not correct.  We do not see the motivation to enhance measurement of CR. |
| Qualcomm | Option 2 | CR is related to the UE’s own transmissions and could be kept independent of the partial sensing occasions. |
| Vivo | Modified option2 with comments | CR is also related to DRX active time. Specifically if the RX UE of a TX UE has DRX, then the TX UE must ensure that the transmission to the RX UE is located within the active time of the DRX pattern. In this case, if R16 CR window is reused, part of the resources (i.e., the non-active slots) in the CR window can never be used by the TX UE, thus it is less likely to meet the CR limit than a TX UE without considering DRX.  Similar to 4-1(I), suggest refining the wording of option3 as： Option 3’: Rel-16 SL CR evaluation should be updated to suit Rel-17 partial sensing and DRX,  For a TX UE, if DRX is determined for the corresponding RX UE, the following way can be considered.  1.CR past/future window are defined as the number of slots in the active time during [n-a, n-1] and [n-a, n+b]. additionally, the calculated CR value based on the active slots is multiplied with a (pre)configured factor |
| Apple | Option 2 | Since CR is not directly related to sensing operation, Rel-16 SL CR definition could be directly applied to the UE with power saving resource allocation schemes. |
| Lenovo&MotM | Option 1 |  |
| Spreadtrum | Option 2 |  |

### Proposals for 1st GTW

FL observations and comments based on inputs received in Sec. 3.4.1:

* TBD

Contribution summary for power saving RA

## Partial sensing for aperiodic transmission (PBPS+CPS and CPS-only)

* **Definition of T1 and RSW when UE performs CPS-only**
  + *T1* and RSW are defined as per R16
    - [1/HW, HiSi], [9/OPPO], [19/LGE]
    - [9/OPPO]: The remaining RSW should overlap with at least *N* slots of SL-DRX active time of Rx-UE.
* **Approach 1: *SA* is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of *M* slots for CPS**
  + Reasons:
    - A unified partial sensing framework for all Tx scenarios;
      * *SA* is initialized to the set of *Y* candidate slots in PBPS for periodic Tx.
      * *SA* is initialized to the set of *Y’* candidate slots based on PBPS and/or CPS sensing results for aperiodic Tx.
        + *Y’* candidate slot set may or may not be the same as *Y* candidate slots from PBPS
    - The *Y'* candidate slots for aperiodic transmission are taken from the *Y* candidate slots from PBPS (if located within RSW), thus the same PBPS and CPS results can be reused.
      * In Approach 2, for slots that do not belong to *Y* candidate slots for PBPS (and thus without corresponding PBPS result), it is unreliable to include them in the candidate resource set.
    - Existing PBPS results are used as much as possible while ensuring the minimum CPS window size.
  + Details:
    - When UE performs PBPS + CPS:
      * Selection of candidate slots:
        + According to existing PBPS and/or CPS results within the RSW (if available) based on UE implementation.

[18/Samsung] If the total *Y'* candidate slots is less than a (pre-)configured threshold *Y'min*, then Approach 2 is applied.

* + - * + [1/HW, HiSi], [7/Fujitsu], [17/NEC], [20/IDC] The candidate slots are the same as *Y* candidate slots in PBPS for periodic transmission, except for slots that are located within slot *n* and slot *n+M* and slots that are after PDB.

When , UE performs random resource selection in the exceptional pool. [1/HW, HiSi], [7/Fujitsu], [17/NEC]

* + - * + [4/vivo] If PBPS is also performed for the same resource (re)selection procedure, set *Ymin'=Ymin*, and the set of *Y'* candidate slots within the RSW determined for the CPS is the same as the set of *Y* candidate slots for the PBPS. If PBPS is not performed for the same resource (re)selection procedure, it is up to UE to determine whether the set of *Y'* candidate slots for CPS should be overlapped with the set of *Y* candidate slots for existing PBPS.
        + [8/CATT, GOHIGH] Modified Approach 1:

The UE selects RSW *[n+TB+Tproc,0+Tproc,1, n+T2] ≥ T2min.*

Candidate resource set (*SA*) is initialized to a selected *Y’*candidate slots with corresponding PBPS result (if available) within the selected RSW.

* + - * + [17/NEC] Support multiple range sets of *Y* values in high layer. E.g., each set per priority/SCS and a minimum value for *Y* is (pre-) configured from a proper set.
        + [28/QC]: *Y’* candidate slots for aperiodic transmission do not need the same as the Y candidate slots in PBPS for periodic transmission.

If total *Y’* candidate slots with PBPS results is less than a (pre-)configured threshold *Y’min*, the UE initializes *SA* with resources from the RSW. [13/CMCC], [20/IDC]

* + - * CPS monitoring window [*n+TA*, *n+TB*]:
        + [1/HW, HiSi], [11/Intel]: is *M* logical slots earlier than slotand
        + [4/vivo] It is up to UE to determine a CPS window with no less than *M* slots, and existing slots before *n* having sensing results can be considered as a part of the CPS window.
        + [7/Fujitsu] *n+TA*=*ty0-31* and ty0 is the first slot of the selected Y’.
        + [17/NEC] *M* could be applied as 0 by UE when the minimum *M* slots for CPS cannot be guaranteed. Re-evaluation should be performed to check the randomly selected resources.
        + [18/Samsung]: No negative value for *TA*
        + [19/LGE]: and , where is the timing of the first candidate slot, *WCPS* is not smaller than a (pre-)configured *WCPSmin*.
        + [23/Sharp] Remove the (pre-)configuration of *M* consecutive logical slots, and *TA =1* and *n+ TB* isslots earlier than.
      * When the minimum *M* slots for CPS cannot be guaranteed
        + [1/HW, HiSi], [13/CMCC], [19/LGE] Random resource selection in the exceptional pool.
        + [18/Samsung], [4/vivo] UE still monitors the CPS window [n+*TA*, n+*TB*], and perform resource exclusion and reporting according to the limited sensing results.
        + [20/IDC] UE performs random resource allocation in the resource pool (pre-)configured with random resource allocation (e.g., exceptional resource pool).
    - When UE performs CPS-only:
      * Selection of candidate slots:
        + [1/HW, HiSi]: Up to UE implementation to select candidate slots ( is no less than (pre-)configured *Ymin'*) from slots [*n+T1+M*, *n+T2*], where *M* is the minimum of number of slots for CPS. The value of *Ymin'* is same as *Ymin* defined for PBPS.
        + [7/Fujitsu] RSW starts after the CPS monitoring window and Y’ candidate slots is selected by UE implementation within the RSW.
      * CPS monitoring window [*n+TA*, *n+TB*]:
        + [1/HW, HiSi]: is and *.*
        + [20/IDC] *TA* = 1, where *TA* is the first slot of the CPS window.
  + Support (16):
    - [1/HW, HiSi], [2/Nokia, NSB], [4/vivo], [7/Fujitsu], [8/CATT, GOHIGH], [13/CMCC], [14/ZTE, Sanechips], [17/NEC], [19/LGE], [23/Sharp], [26/DCM], [30/ITL]
* **Approach 2: *SA* is initialized based on all candidate single-slot resources after (*n+TB+Tproc,0+Tproc,1*) and guarantee a minimum of *M* slots for CPS**
  + Reasons:
    - Since a minimum of M consecutive logical slots needs to be satisfied in both Approach 1 and Approach 2, the [remaining] RSW in Approach 2 will cover at least the same set of Y candidate slots in PBPS for periodic transmission of another TB(s).
    - Since the [remaining] RSW [*n+TB+Tproc,0+Tproc,1, n+T2*] is not restricted by the Y candidate slots in PBPS for periodic transmission of another TB(s), it will have a larger set of resources for selection;
    - Special utilization of slots with PBPS is an optimization;
    - Less / simpler specification impact without describing a set of Y’ candidate slots relating to a set of Y candidate slots in PBPS for periodic transmission of another TB(s), and defining the associated Y’min.
    - If a full or partial set of Y candidate slots (PBPS) is located within [*n, remaining PDB*] 🡺 adjust *TB* for the CPS monitoring window so that the same/existing PBPS and CPS results can be reused;
    - Aligned with R16 design, where the entire RSW up to the remaining PDB is initialized for the set *SA* for resource selection;
    - The partial sensing design approach can be easily reused/extended for re-evaluation/pre-emption checking.
  + Details:
    - Initialization of candidate resource set *SA*:
      * [RAN1#106b-e]: The set of all candidate single-slot resources in [*n+TB+Tproc,0+Tproc,1*, *n+T2*], where TB is selected by the UE such that length of [*n+TB+Tproc,0+Tproc,1*, *n+T2*] ≥ *T2min*.
      * [11/Intel]: The set *SA* is initialized to all remaining resources inside the RSW starting from t*y0* (FL: hybrid between Approach 1 and 2)
    - CPS monitoring window [*n+TA*, *n+TB*]:
      * *TA* and *TB* are both selected such that UE has sensing results for a minimum of *M* consecutive logical slots before the starting of the remaining RSW (*n+TB+Tproc,0+Tproc,1*).
      * *TB* is selected to ensure (remaining) RSW [*n+TB+Tproc,0+Tproc,1*, *n+T2*] covers a minimum of *N* slots of SL-DRX active time.
      * [3/Futurewei] By default, *M* should be a SCS dependent value smaller than 31, and can be (pre-)configured with another value.
        + If (pre-)configured, *M* is in a range of [*Mmin*, *Mmax*], where *Mmax* can be the 1 slot less than the default value, *Mmin* can be a fixed value or a SCS dependent value.
        + *TA* can be up to UE implementation with minimum value of 1 as long as the constraints of remaining PDB, minimum RSW size, and minimum CPS window size are satisfied.
        + *TB* is upper bounded by *PDB-T2min - (Tproc,0 +Tproc,1).*
      * [12/Xiaomi]: *MIN\_RSW* is the minimum RSW window size of CPS

1) If *T2- MIN\_RSW – 31≥ 0*,

- *TA* is determined by UE implementation within *[0, T2- MIN\_RSW – 31]*;

- *TB = TA + 31 – Tproc0 – Tproc1*;

2) else if *T2- MIN\_RSW– 31<0*, and *T2- MIN\_RSW – Tproc1 – Tproc0 > 0*，

- *TA* is determined by UE implementation with *TA ≤0*;

- *TB = T2- MIN\_RSW – Tproc1 – Tproc0*;

3) else

- *TA = TB = 0;*

* + - * [28/QC] *X* is determined such that that UE has sensing results for a minimum of *M* consecutive logical slots before the start of (*n+TB+Tproc,0+Tproc,1*). An upper bound on X in CPS can be defined.
      * [31/E///] M is determined based on the measured CBR.
    - When the minimum *M* slots for CPS cannot be guaranteed
      * [18/Samsung], [3/Futurewei] UE still monitors the CPS window [n+*TA*, n+*TB*], and perform resource exclusion and reporting according to the limited sensing results.
        + Set *TB* to its upper bound and perform sensing on [*n+1*, *n+TB,max*]
      * [31/E///] If *M* + *T2min* > PDB, UE performs random resource selection. If *M* + *T2min* ≤ PDB, *TB* is upper bounded with respect to *T2min*.
      * [20/IDC] UE performs random resource allocation in the resource pool (pre-)configured with random resource allocation (e.g., exceptional pool).
    - Resource selection based on slots with PBPS results
      * UE reports the index of slots for which L1 has corresponding PBPS results
      * UE first selects resources from slots with corresponding PBPS results, then slots with no PBPS results
      * If any remaining candidate resource in *SA* is located on the *Y'* candidate slots, the candidate resource is prioritized for resource selection.
      * [27/Lenovo, MotM] Up to UE implementation to prioritize resource slots with PBPS results.
  + Support (9):
    - [3/Futurewei], [5/Spreadtrum], [9/OPPO], [11/Intel], [12/Xiaomi], [16/CAICT], [27/Lenovo, MotM], [31/E///]
* **Approach 3: Independent approach for different case (i.e., Approach 1 for PBPS+CPS; Approach 2 for CPS-only)**
  + Reasons:
    - When UE performs PBPS (in a resource pool with periodic reservation enabled), existing PBPS/CPS sensing results (for another TB) should be reused to improve reliability. 🡺 Initialize set *SA* based on *Y’* candidate slots.
    - When UE performs CPS-only, there is no need to further select *Y’* candidate slots and simply initialize set *SA* as all resources within RSW after sensing window.
  + Details:
    - When UE performs PBPS + CPS (refer to Approach 1):
      * Selection of candidate slots:
        + According to existing PBPS and/or CPS results (up to UE implementation).
        + [18/Samsung]: If the total number of *Y'* candidate slots is less than a (pre-)configured threshold *Y'min*, then Approach 2 is applied.
      * CPS monitoring window [*n+TA*, *n+TB*]:
        + No negative value for *TA*
        + The minimum CPS window of M consecutive slots is (pre-)configured based on transmission priority and/or PDB
    - When UE performs CPS-only (Approach 2):
      * CPS monitoring window [*n+TA*, *n+TB*]:
        + No negative value for *TA*
        + The minimum CPS window of M consecutive slots is (pre-)configured based on transmission priority and/or PDB
  + Support (3):
    - [18/Samsung], [20/IDC], [21/Apple]
* **Prioritization of candidate slots in Approach 1 and 2:**
  + Reasons:
    - Candidate slot with more sensing results (PBPS and/or CPS) should have higher priority to be selected.
    - The more sensing result includes: larger number of monitored PBPS occasions, larger number of monitored CPS slots, more type of sensing results e.g., candidate slots with PBPS+CPS results is prioritized over candidate slots with only CPS results.
  + Support:
    - YES: [9/OPPO] (only for slots with PBPS results), [18/Samsung]
    - NO: [1/HW, HiSi],

## Re-evaluation and pre-emption checking

* **Re-evaluation and pre-emption checks for UE performing random resource selection**
  + Yes (for Type D UEs): [4/vivo], [9/OPPO], [28/QC] (sim), [21/Apple], [26/DCM], [19/LGE], [24/Convida], [31/E///]
  + No: [1/HW, HiSi]
* **Sensing mechanisms:**
  + CPS sensing only in every slot after UE reporting a subset of resources for resource (re)selection until at least the last pre-selected/reserved resource of the TB. [9/OPPO], [22/ETRI]
  + At least for periodic transmission, re-evaluation and pre-emption checking procedures for partial sensing RA should reuse that defined in Rel-16 full sensing RA as much as possible with following changes: [1/HW, HiSi], [9/OPPO]
    - After,
      * Sensing occasions corresponding to are monitored for re-evaluation and pre-emption checking to detect periodic reservations
        + For PBPS, the same process should be followed as per resource (re)selection (including *Preserve* and k values) as   
          , where is the timing of the *i*-th selected resource and *m* is an integer greater than zero within PDB. [9/OPPO], [26/DCM], [19/LGE], [16/CAICT]
      * *M* slots prior to are monitored for re-evaluation and pre-emption checking to detect aperiodic reservations, where *M* = 31 by default unless (pre-)configured [1/HW, HiSi], [9/OPPO]
      * The *Y* slots in non-initial period are equal to the *Y* slots in initial period plus integer multiple times of the resource reservation period indicated in SCI format 1-A [9/OPPO]
      * If the remaining *Y* candidate slots is less than *Ymin*, the set *SA* can be initialized / extended up to the remaining PDB [9/OPPO]
      * CPS resource selection window starts immediately after *SA* is reported to MAC and ends at the end of the initial RSW. The sensing time ends at (*m-T3*) – same as R16. [8/CATT, GH]
        + The end of checking window should be fixed to end of initial RSW
      * CPS starts from slot *m-32* [16/CAICT]
      * Sensing slots for CPS includes additionally slots within, where *m* is a slot index that re-evaluation/pre-emption check is triggered. [26/DCM]
      * UE performs contiguous partial sensing over the window [*,* ], whereis the timing of the *i*-th selected resource, and [19/LGE]
        + for periodic transmission, for aperiodic transmission, and .
  + [4/vivo]
    - Only the CPS can be triggered for pre-emption check.
    - The selection window for re-evaluation and pre-emption should be restricted in *Y* defined in the resource (re-)selection.
    - Resource re-selection for re-evaluation and/or pre-emption can base on all the available sensing results regardless of the SL processes.
  + CPS should extend to Mmax-T3-Tproc,0 to increase the candidate resource set for resource re-selection. [10/Sony]
  + At least for resource(s) selected by PBPS, when performing re-evaluation or pre-emption, [12/Xiaomi]
    - Option 1: reuse the set of candidate slots in resource (re)selection
    - Option 2: the set of candidate slots only includes the slots of transmission resource for re-evaluation or pre-emption
  + For a pre-selected/reserved resource in slot m, UE monitors slots [m-31, m-*T*3-*T*proc,0), where *T*3 and *T*proc,0 are defined as the same value in Rel-16 NR V2X. [18/Samsung]
    - PBPS-based sensing for pre-emption check and re-evaluation check can be supported by reusing existing PBPS results, if any
  + For re-evaluation and pre-emption purpose, *Y ca*ndidate resource slots should at least contain and/orrespectively. [17/NEC]
  + Support different configurations for CPS and PBPS (e.g., smaller number of required sensing slots) for resource re-evaluation and pre-emption. [20/IDC]
  + The CPS for resource re-evaluation or pre-emption checking occurs at where *n* is the slot of resource selection and *m* is the slot of a selected or reserved resource. [21/Apple]
  + [23/Sharp]
    - The sensing occasions of PBPS and CPS defined for resource selection apply for re-evaluation and pre-emption in partial sensing.
    - For PBPS, the selected *Y* candidate slots include at least the slots corresponding to the resources subject to pre-emption check / re-evaluation.
    - Ifis included in the set of *Y* candidate slots and at least a resource subject to pre-emption check is in slot , the UE monitors slots of periodic sensing occasions except for the slot of a prior SCI which indicates the resource.
* **Others**
* When HARQ-feedback is enabled, detection of a number of NACKs on PSFCH occasions corresponding to a UE’s own PSSCH transmissions can be used to trigger re-evaluation and pre-emption for partial sensing RA. [1/HW, HiSi]
* UE performs re-evaluation and/or pre-emption only in slot (not before or after), so that the UE performs sensing results for the right *M* slots. [9/OPPO]
* When determining the sensing occasions for re-evaluation/pre-emption, different conditions may need to be considered separately, e.g., [7/Fujitsu]
  + if pre-emption is disabled in the resource pool, only sensing occasions for re-evaluation need to be determined based on both PBPS and CPS;
  + if HARQ-ACK is enabled and an “ACK” is received from Rx UE, the subsequent sensing for re-evaluation/pre-emption can be skipped.
* Periodic-based partial sensing is not used for re-evaluation/pre-emption checking. [22/ETRI]
* Resource re-evaluation or pre-emption checking after resource (re)selection can be performed in the following cases: [19/LGE]
  + When the number of the periodic-based partial sensing slots for resource (re)selection is below a threshold
  + When only the contiguous partial sensing is performed for resource (re)selection in a resource pool where the periodic transmission is enabled
  + When the priority value of a packet is above a threshold (e.g. pre-emption priority value)
  + When the congestion/interference level in a resource pool is above a threshold
  + When the required reliability level is above a threshold
  + When the number of retransmissions is below a threshold
  + For the selected resources whose collision with other UE’s transmission resources cannot be detected by contiguous partial sensing (e.g., the resources selected in the latter part of a selection window)
* In determining the candidate resource set (SA), the candidate resources having partial sensing results are prioritized to the candidate resources having no partial sensing results. [19/LGE]
* The pre-emption priority for power saving UE is separately (pre-)configured from that for a vehicle UE. [19/LGE]
* The candidate resource set for resource re-evaluation and/or pre-emption checking is based on the candidate resource set from the resource selection. [21/Apple]

## Congestion control for power saving RA

* **CBR related**
  + CBR measurement for partial sensing is performed at least on every Kth slot of the Rel-16 CBR measurement window, where K is (pre-)configured per resource pool. [1/HW, HiSi]
  + UE is not mandated to perform measurement for CBR/CR outside the DRX active time. [4/vivo]
  + Enhancements for CBR: [4/vivo]
    - Alt.1 CBR measurement window is defined only based on the number of active slots in the resource pool during [n-a, n-1].
    - Alt.2 CBR measurement window is defined in the same way as R16, CBR measurement performed in the active time and inactive time are scaled by the corresponding factor(s) to derive the CBR measurement results.
  + CBR is calculated based on *N* measurable slots, where N is (pre-)configured. [9/OPPO]
  + [11/Intel]
    - Define a new minimum number of slots for CBR measurements when UE performs partial sensing
  + Support enhancements to reduce the number of slots to be sensed for CBR measurements. [12/Xiaomi]
  + RSSI measurement should be adjusted based on PSCCH/PSSCH reception types. CBR measure occasion should be adjusted based on monitoring occasions. CBR/CR window should be adjusted considering DRX configuration. [17/NEC]
  + If P-UE has no PSCCH/PSSCH reception capability, a (pre-)configured CBR value is used for PHY parameter selection, as in LTE-V2X operation. [19/LGE]
  + If P-UE has PSCCH/PSSCH reception capability, the following CBR value is used for PHY parameter selection: [19/LGE]
    - CBR measured in the partial sensing slots if the number of decoded PSCCH/PSSCH slots is above a threshold
    - a (pre-)configured CBR value, otherwise
  + Measured CBR in slot n is the ratio of sub-channels whose SL RSSI exceed a (pre-)configured threshold to all the sub-channels in the partial sensing slots within a window [n-a, n-1], where a is (pre-)configured. [19/LGE]
  + The congestion control metrics are calculated in relation to the active time of the UE as follows: [31/E///]
    - The subset of the total number of configured sub-channels corresponds to the number of sub-channels in which the UE has been actively receiving or is configured to receive.
      * Modify the value a = 100 or 100·2µ slots in R16 CBR measurement to aPS = active/sensing time.
    - RAN1 introduces separate congestion control configurations for UEs performing intermittent reception (e.g., using partial sensing and/or SL DRX).
* **CR related**
  + Enhancements for CR: [4/vivo]
    - Alt.1 CR past/future window are defined as the number of active slots in the resource pool during [n-a, n-1] and [n-a, n+b]
    - Alt.2 Reuse the CR window definition in R16, portions of used/granted subchannels in the active time and inactive time are scaled by the corresponding factor(s) to derive the CR measurement results.
  + [11/Intel]
    - When UE cannot perform CBR measurement for a (pre-)configured minimum number of slots, pre-configured CR threshold values are used
    - If minimum number of slots is not available, fall back to (pre)-configured table of CR thresholds per priority
  + CBR/CR window should be adjusted considering DRX configuration. [17/NEC]
  + The evaluation of CR and the definition of for power saving resource allocation schemes reuse the design for full sensing resource allocation schemes. [21/Apple]

## Sidelink DRX

* **Sensing related**
  + UE performing partial sensing in SL-DRX inactive time according to
    - Specification:
      * One or more of the following conditions [1/HW, HiSi]:
        + Condition 1: A ratio of the number of partial sensing slots overlapped with SL-DRX inactive time over the number of total partial sensing slots, is above a (pre-)configured T% threshold
        + Condition 2: Measured CBR is above a (pre-)configured CBR threshold
        + Condition 3: The priority value of to-be-transmitted PSSCH is below a (pre-)configured priority threshold
      * One of the following alternatives [3/Futurewei]:
        + Alt.1 Different settings can be configured for partial sensing in DRX active and inactive durations
        + Alt.2 In DRX inactive time, the UE performs sensing only in the most recent sensing occasion for a given periodicity [4/vivo]
        + Specify the minimum sensing requirement for UE performing sensing during DRX inactive time. UE is required to perform sensing during DRX inactive time on the slots belonging to the minimum sensing requirement.
      * The inactive sensing occasions is defined. A SL UE is only required to perform sensing in the inactive sensing occasions in DRX inactive time. [6/Pana]
        + An inactive sensing occasion should be defined as backward extended from a DRX active time when a SL transmission triggering slot is near to the beginning of active time. The period of inactive sensing occasions can be FFS among same size as the sensing window, truncated size of the sensing window or the sensing window extended by a fixed value (e.g., 32 slots).
      * UE performs sensing during DRX inactive time only after its sidelink data arrival. [21/Apple]
      * UE performs sensing during DRX inactive time only up to the minimum CPS monitoring window size *M*. [31/E///]
      * At least for aperiodic resources reservation, only contiguous partial sensing can to be allowed outside the DRX active time. [32/Bosch]
      * At least for periodic resources reservation, the DRX active-time may be extended to another configured value if, e.g., sensing results are insufficient or resources are triggered before the initial configured DRX active-time. [32/Bosch]
      * The same set of sensing occasions / window specified for the case when SL-DRX is not (pre-)configured [7/Fujitsu] (for CPS), [8/CATT, GH], [9/OPPO], [14/ZTE, Sanechips], [18/Samsung], [19/LGE], [26/DCM]
    - Up to UE implementation: [5/Spreadtrum], [29/MTK]
    - (Pre-)configurability between mandating or up to UE implementation during SL DRX inactive time: [26/DCM]
    - Different settings can be configured for periodic partial sensing in DRX active and inactive periods, e.g., maximum number of sensing occasions, different k value. [7/Fujitsu]
    - Support different configurations for CPS and PBPS for the UE configured with SL DRX. [20/IDC]
* **Transmission related**
  + Option 1: PHY layer selects and reports candidate resources only within the indicated active time of the RX UE
    - (11+2 if the indicated active time includes future active time): [2/Nokia, NSB], [11/Intel], [14/ZTE, Sanechips], [17/NEC] (if future active time), [18/Samsung], [25/ASUSTek], [26/DCM], [27/Lenovo, MotM], [28/QC], [31/E/// (future active time can be included as part of the indicated active time)],
  + Option 2: PHY layer selects and reports candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE
    - (8+1 if current active time only): [1/HW, HiSi], [4/vivo], [9/OPPO], [12/Xiaomi], [17/NEC] (if current active time), [19/LGE], [20/IDC], [33/ITL]
  + Option 3: PHY layer selects and reports an additional candidate resource set of candidate resources within the indicated active time of the RX UE
    - 0
  + If the remaining resources within DRX active time of the RX UE is smaller than a threshold: [1/HW, HiSi]
    - Restore those excluded resources within the DRX active time of the RX UE after step 5;
    - Restore those excluded resources within the indicated active time of the RX UE via RSRP thresholds adjustment in step 7.
  + [7/Fujitsu]
    - If the “active time” is confirmed as “current active time” by RAN2
      * At least for unicast/groupcast, Option 1 should be removed and RAN1 should make down-selection only b/w Option 2 and Option 3.
    - If SL DRX is configured for the Rx UE, the starting time of the RSW should be aligned with the starting time of SL DRX active time of Rx UE.
    - A standalone resource exclusion procedure can be done on a subset of the candidate resource (i.e., in option 2) or a separate candidate resource set (i.e., in option 3) within the SL DRX active time of Rx UE
      * Remaining resources after the exclusion procedure can be reported to MAC layer separately for at least initial transmission resource selection
  + For the overlapping portion between DRX active time of RX UE and resource selection window, if the number of resources is less than X% of total resources of the overlapped part, increase 3dB of RSRP threshold and repeat resource exclusion procedure [9/OPPO]
  + The resource selection parameters such as RSRP threshold, RSRP threshold increment, and target resource ratio are separately (pre-)configured between the active and the inactive time of RX UE. [19/LGE]
  + [8/CATT, GH]
    - In case of Tx UE performing partial sensing based resource selection, the transmission resources selected by Tx UE need to be within the DRX active time of Rx UE.
    - For cases where there is some uncertainty in the timing of a retransmission for a HARQ process (e.g. due to no retransmission resource indicated in the SCI, or possible reselection by the Tx UE), the Rx UE uses a configured SL HARQ RTT timer.
    - The Tx UE can take the predictable drx-RetransmissionTimer running duration of the Rx UE into consideration for determining the allowable transmission time, in order to ensure that the transmission resources selected by the Tx UE can be within Rx UE’s DRX active time.
    - RAN1 should send an LS to RAN2 to inform the following consideration.
      * For cases where there is some uncertainty in the timing of a retransmission for a HARQ process (e.g. due to no retransmission resource indicated in the SCI, or possible reselection by the Tx UE), the Rx UE uses a configured SL HARQ RTT timer.
      * The Tx UE can take the predictable drx-RetransmissionTimer running duration of the Rx UE into consideration for determining the allowable transmission time, in order to ensure that the transmission resources selected by the Tx UE can be within Rx UE’s DRX active time.
    - Before implementing the restriction that at least a subset of candidate resources reported to MAC layer is located within the indicated active time of the RX UE, the PHY layer of the TX UE adjusts the resource selection window to be at least partially overlap with the indicated active time of the Rx UE.
    - Down-selection should be done between the following candidate resource selection methods:
      * PHY layer selects and reports an additional candidate resource set of candidate resources within the indicated active time of the RX UE.
      * PHY layer selects candidate resources in which at least a subset of the candidate resources is within the indicated active time of the RX UE and reports the candidate resource set as well as the adjusted start time of the resource selection window to MAC.
    - When the Rx UE is DRX enabled, Tx UE only restricts that at least the initial transmission should be performed during the DRX on-duration of the Rx UE to achieve a trade-off between Packet Reception Ratio (PRR) and power consumption.
  + High layer provides a restricted set of slots based on Rx-UE’s sidelink DRX inactive time. This restricted set of slots is not to be included in the resource selection window determined at the physical layer. [21/Apple]
  + Consider DRX-On duration period and slot offset as input to the candidate resource selection procedure where candidate resources can be reported from more than one on-duration period until PDB. [27/Lenovo, MotM]
* **Others**
  + Dropping or re-selection of resource(s) at the TX UE is triggered if dropping or re-selection of a resource results in that another resource is not within the active time of the RX UE anymore. [7/Fujitsu]
  + Candidate resources are aligned with the SL DRX active period in order to maximize the power saving gains. [15/Fraunhofer]
    - 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.
  + [6/Panasonic]:
    - The SL DRX active time is consisting of the semi-static active time and extended active time similar to Uu active time.
    - A SL DRX semi-static active time could be extended for a SL UE to complete its transmission, reception, decoding, etc.
    - he inactive sensing occasion and extension of SL DRX semi-static active time could be triggered by previous SL or DL signalling.
    - 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”.
  + For partial sensing UE, the sensing results obtained by SL DRX operation in active time are used for resource (re)selection and resource re-evaluation/pre-emption checking, in addition to the partial sensing results. [19/LGE]
  + 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. [19/LGE]
  + The Rx UE in its SL DRX active time shall decode both the first and second SCI. [20/IDC]
  + Consider congestion control enhancement for DRX operation. [20/IDC]
  + 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. [28/QC]
    - For unicast and groupcast, the Tx UE retransmits on the resources outside of the Rx UE's ON duration only if it receives a NACK in response to the (re)transmission inside the ON duration indicating reservations.
  + To align DRX cycles between Rel-17 UEs and to be compatible with Rel-16 UEs, configure DRX resource pools over-lapping with full/partial sensing resource pool. [32/Bosch]

References

1. [R1-2110844](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110844.zip) Sidelink resource allocation to reduce power consumption Huawei, HiSilicon
2. [R1-2110861](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110861.zip) Resource allocation for power saving Nokia, Nokia Shanghai Bell
3. [R1-2110886](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110886.zip) Power consumption reduction for sidelink resource allocation FUTUREWEI
4. [R1-2111036](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111036.zip) Remaining issues on resource allocation for sidelink power saving vivo
5. [R1-2111111](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111111.zip) Discussion on sidelink resource allocation for power saving Spreadtrum Communications
6. [R1-2111121](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111121.zip) Discussion on Sidelink Resource Allocation for Power Saving Panasonic Corporation
7. [R1-2111150](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111150.zip) Considerations on partial sensing and DRX in NR Sidelink Fujitsu
8. [R1-2111228](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111228.zip) Remaining issues on sidelink resource allocation enhancements for power saving CATT, GOHIGH
9. [R1-2111300](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111300.zip) Discussion on power saving in NR sidelink communication OPPO
10. [R1-2111406](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111406.zip) Discussion on sidelink resource allocation for power saving Sony
11. [R1-2111514](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111514.zip) Remaining Details of Sidelink Resource Allocation Schemes for UE Power Saving Intel Corporation
12. [R1-2111546](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111546.zip) Discussion on sidelink resource allocation enhancement for power saving Xiaomi
13. [R1-2111625](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111625.zip) Discussion on resource allocation for power saving CMCC
14. [R1-2111637](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111637.zip) Discussion on resource allocation for power saving ZTE, Sanechips
15. [R1-2111649](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111649.zip) NR Sidelink Resource Allocation for UE Power Saving Fraunhofer HHI, Fraunhofer IIS
16. [R1-2111656](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111656.zip) Considerations on partial sensing mechanism of NR V2X CAICT
17. [R1-2111699](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111699.zip) Discussion on resource allocation for power saving NEC
18. [R1-2111758](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111758.zip) On Resource Allocation for Power Saving Samsung
19. [R1-2111815](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111815.zip) Discussion on resource allocation for power saving LG Electronics
20. [R1-2111824](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111824.zip) Sidelink resource allocation for power saving InterDigital, Inc.
21. [R1-2111894](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111894.zip) Sidelink Resource Allocation for Power Saving Apple
22. [R1-2111997](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2111997.zip) Discussion on resource allocation for power saving ETRI
23. [R1-2112024](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112024.zip) Discussion on resource allocation for power saving Sharp
24. [R1-2112033](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112033.zip) On NR Resource Allocation for Power Saving Convida Wireless
25. [R1-2112042](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112042.zip) Discussion on partial sensing and SL DRX impact ASUSTeK
26. [R1-2112126](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112126.zip) Discussion on sidelink resource allocation for power saving NTT DOCOMO, INC.
27. [R1-2112164](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112164.zip) Sidelink resource allocation for power saving Lenovo, Motorola Mobility
28. [R1-2112237](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112237.zip) Power Savings for Sidelink Qualcomm Incorporated
29. [R1-2112305](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112305.zip) Remaining details on sidelink power saving MediaTek Inc.
30. [R1-2112336](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112336.zip) Resource allocation for power saving in NR sidelink enhancement ITL
31. [R1-2112351](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112351.zip) Resource allocation procedures for power saving Ericsson
32. [R1-2112394](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112394.zip) Discussion on sidelink enhancements for power saving ROBERT BOSCH GmbH
33. [R1-2112167](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2112167.zip) Candidate resource selection for SL DRX ITL

Appendix (outcomes of past meetings)

## RAN1#103-e (26/Oct – 13/Nov 2020)

**Conclusion**

* SL reception Type A and Type D should be used as the reference for evaluation and designing of SL power saving features in R17.
  + Type A: UE is not capable of performing reception of any SL signals and channels, FFS with exception of performing PSFCH and S-SSB reception (aim to conclude in RAN1#104-e)
  + Type D: UE is capable of performing reception of all SL signals and channels defined in R16. It does not preclude UE to perform reception of a subset of SL signals/channels
  + If there are evaluations with assumptions other than the above reference, the detailed assumptions need to be reported
  + Note: the types and the associated capability defined here are not intended to be defined as Rel-17 UE features as is.

Agreements:

* Partial sensing based RA is supported as a power saving RA scheme
  + FFS details
* Random resource selection is supported as a power saving RA scheme
  + FFS any changes or enhancement
  + FFS on conditions to apply random resource selection

Agreements:

* In R17, a SL Mode 2 Tx resource pool can be (pre-)configured to enable full sensing only, partial sensing only, random resource selection only, or any combination(s) thereof
  + FFS details, including usage, potential restrictions, whether/how any enhancement or condition is needed for the coexistence of full sensing and power saving RA scheme(s) in a same resource pool, etc.

Agreements:

* Re-evaluation and pre-emption checking are not supported by UEs that do not perform any sensing (i.e. PSCCH reception)
* Re-evaluation and pre-emption checking are supported by UEs that perform sensing
  + FFS details and any conditions(s) in which re-evaluation and pre-emption can be performed
* FFS whether/how re-evaluation and pre-emption can be supported by UEs performing random resource selection that do perform sensing
* Note: details about sensing in this context, including when it is performed, are not decided yet.

Agreements:

* Further study congestion control based on CBR and CR for power saving RA schemes
  + Identify necessary changes from R16 CBR/CR (if any), including transmission resource selection and transmission parameters that can be adjusted and applicable to power savings RA schemes
  + Note: this is not intended to require all UEs to perform sensing for the purpose of CBR measurement

## RAN1#104-e (25/Jan – 05/Feb 2021)

Agreements**:**

* Random resource selection is applicable to both periodic and aperiodic transmissions
  + FFS conditions for random resource selection

**Conclusion:**

* PSFCH reception is not included for Type A UE
* S-SSB reception is not included for Type A UE
* SL reception Type B is additionally added
  + Type B: Same as Type A with an exception of performing PSFCH and S-SSB reception
* Note: the same conditions as in RAN1#103-e regarding the context of the discussion of Type A and Type D still apply (also applicable to type B)

Agreements**:** In a resource pool (pre-)configured with at least partial sensing, if UE performs periodic-based partial sensing, at least when the reservation for another TB (when carried in SCI) is enabled for the resource pool and resource selection/reselection is triggered at slot n, it is up to UE implementation to determine a set of Y candidate slots within a resource selection window, where

* FFS condition(s) and timing(s) for which periodic-based partial sensing is performed by UE
* The resource selection window is [n+T1, n+T2]
  + As a baseline, T1 and T2 are defined in the same way as in R16 NR-V2X according to step 1 [TS 38.214 Sec. 8.1.4]
  + Further discuss whether or not to introduce a threshold to re-define T1 and T2 such that
    - T1≥ 0 (subject to processing time constraint Tproc, 1), and T2 ≤ remaining PDB
    - T2-T1 *≤* (pre-)configured threshold
* A minimum value for Y is (pre-)configured from a range of values, FFS details
* FFS any restriction to determine Y candidate slots (including its relationship with SL-DRX)
* FFS whether the resource selection window [n+T1, n+T2] should be confined within a set of periodic set of resources and its relationship with SL-DRX
* Note: The terminology “periodic-based partial sensing” is based on the “partial sensing” used in LTE-V and it is intended to be used for the design and discussion of partial sensing in Rel-17.

Agreements**:** In a resource pool (pre-)configured with at least partial sensing, if UE performs periodic-based partial sensing, at least when the reservation for another TB (when carried in SCI) is enabled for the resource pool and resource selection/reselection is triggered at slot n, the UE monitors slots of at least one ~~a set of~~ periodic sensing occasion~~s~~, where a periodic sensing occasion is a set of slots according to 

if tvSL is included in the set of Y candidate slots.

* *P*reserve is a periodicity value from the configured set of possible resource reservation periods allowed in the resource pool (*sl-ResourceReservePeriodList*). Down select to one:
  + Option 1: *P*reserve corresponds to all values from the configured set *sl-ResourceReservePeriodList*
  + Option 2:  *P*reserve corresponds to a subset of values from the configured set *sl-ResourceReservePeriodList*
    - FFS how to determine the subset (e.g., by (pre-)configuration, UE determination)
  + Option 3:  *P*reserve is a common divisor among values in the configured set *sl-ResourceReservePeriodList*
  + Option 4: FFS others
* k ~~equals to~~is selected according to (down select to one)
  + Option 1: Only the most recent sensing occasion ~~within sensing window~~ for a given reservation periodicity before the resource (re)selection trigger or the set of Y candidate slots subject to processing time restriction
  + Option 2: The two most recent sensing occasions ~~within sensing window~~ for a given reservation periodicity before the resource (re)selection trigger or the set of Y candidate slots subject to processing time restriction
  + Option 3: All possible sensing occasions after
  + Option 4: Only one periodic sensing occasion for one reservation period. The k value is up to UE implementation. Max value for k is (pre-)configured.
  + Option 5: k is (pre-)configured, including multiple values
  + Option 6: (pre-)configuration of a bitmap, same as in LTE-V
  + Option 7: FFS others
* FFS relationship between periodic sensing occasions and SL-DRX
* FFS condition(s) and timing(s) for which periodic-based partial sensing is performed by UE
* Note: companies are encouraged to show performance data for the down selections

Agreements:

* In a resource pool (pre-)configured with at least partial sensing, if UE performs contiguous partial sensing and resource (re-)selection is triggered in slot n, support the following option:
  + Option 1: For the purpose of resource (re-)selection, the UE monitors slots between [*n*+*T*A, *n*+*T*B] and performs identification of candidate resources, in or after slot *n*+*T*B, based on all available sensing results, including periodic-based partial sensing results (if applicable).
    - FFS *T*A, *T*B (including the possibility of equal to zero, positive or negative) and remaining details (in particular, whether there should be exclusion of slots, changes in TA/TB values for different purposes, etc.)
    - FFS whether n can be replaced by e.g., index of some of Y candidate slots
  + FFS condition(s) in which contiguous partial sensing is performed by UE
  + FFS interaction with SL-DRX, if any
  + FFS interaction with periodic-based partial sensing, if any
  + Other options are not precluded
  + Note: This option is not to replace random resource selection only without sensing or re-evaluation and pre-emption checking

## RAN1#104b-e (12 – 20 April 2021)

**Conclusion:**

* In periodic-based partial sensing,
  + It is not necessary to further discuss whether or not to introduce a threshold to re-define T1 and T2.

**Agreements:**

* In periodic-based partial sensing,
* For the set of *P*reserve values, down-select to one of the following in RAN1#105-e
  + - Alt.1: *P*reserve corresponds to all values from the configured set *sl-ResourceReservePeriodList*
    - Alt.2: A set of *P*reserve values is (pre-)configured and includes up to the full set of values from the configured set *sl-ResourceReservePeriodList*
      * FFS if support multiple sets of *P*reserve values based on one or more metrics
      * FFS whether/how to restrict the set of values
* For the k value, down-selection to one of the following in RAN1#105-e (further refinement of each of the alternatives is possible)
  + - * + Alt 1: Option 1 as in RAN1#104-e
        + Alt 2: A modified Option 5 as in RAN1#104-e, where the modification is such that it also includes option 1

FFS how to (pre-)configure (e.g. including bitmap), whether a maximum number of k values is needed, and whether it can be up to UE implementation to select a k value based on the (pre-)configuration

* + - * + FFS details, e.g., sensing before the resource (re)selection trigger or the first slot of the set of Y candidate slots subject to processing time restriction, etc.
      * Note: companies are encouraged to provide more evaluations

**Agreement:**

* When periodic-based partial sensing is potentially performed by UE in a mode 2 Tx resource pool provided by higher layer, at least all of the followings are met:
  + Periodic reservation for another TB (sl-MultiReserveResource) is enabled for the resource pool
  + The resource pool is (pre-)configured to enable partial sensing
  + Partial sensing configured by higher layer in the UE

## RAN1#105-e (10 – 27 May 2021)

Agreement:

* For the set of *P*reserve values in periodic-based partial sensing,
  + If no (pre-)configuration (i.e., by default), *P*reserve corresponds to all values from the (pre-)configured set *sl-ResourceReservePeriodList*.
  + Otherwise, a single set of *P*reserve values can be (pre-)configured, where the set of P*reserve* values are restricted to a subset of the (pre-)configured set *sl-ResourceReservePeriodList*
    - This is per mode 2 Tx resource pool (pre-)configuration
    - A UE by implementation may also monitor other *sl-ResourceReservePeriodList* values not part of the restricted subset
      * In particular, the UE may additionally monitor occasions corresponding to P\_RSVP\_Tx
        + FFS whether the monitoring can be mandatory

Agreement:

* In periodic-based partial sensing for resource (re)selection, the UE at least monitors in periodic sensing occasion(s) for a given reservation periodicity before the first slot of the selected Y candidate slots subject to processing time restriction for the identification of candidate resources.

  o   The processing time restriction includes *Tproc,0SL*  and *Tproc,1SL*.

  o   Aspects relating to sensing during SL DRX are to be discussed separately

* Relationship to re-evaluation and pre-emption operation for periodic-based partial sensing to be discussed separately
  + FFS details including whether monitoring of periodic sensing occasions between triggering slot n and the first slot of the selected Y candidate slots subject to processing time restriction is performed as part of resource (re)selection or re-evaluation and pre-emption checking

Agreement:

* For the k value in periodic-based partial sensing for resource (re)selection,
  + By default, the UE monitors the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger slot n or the first slot of the set of Y candidate slots subject to processing time restriction.
  + If (pre-)configured, UE additionally monitors periodic sensing occasions that correspond to a set of values which can be (pre-)configured with at least one value
    - (Working assumption) Possible values correspond to the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger slot n or the first slot of the set of Y candidate slots, and the last periodic sensing occasion prior to the most recent one for the given reservation periodicity are included.
    - FFS: whether/which other values and details of the (pre-)configuration (e.g. max number of values or sensing occasions)
    - FFS: whether a value denotes a specific occasion to monitor or the earliest occasion to start the monitoring.
  + FFS relationship between periodic-based partial sensing occasions and SL-DRX
  + Note:
    - This is for the case when the resource (re)selection triggering slot n is expected by UE

Agreement:

* For random resource selection,
  + Reuse the maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI for the same TB, which was defined in R16 for full sensing operation.
  + SL HARQ feedback enabled transmission is supported (FFS applicable conditions if any)
    - The minimum HARQ feedback time gap (Z) shall be respected between any two selected resources of a TB where a HARQ feedback for the first of these resources is expected.
* FFS the impact of resource collision when random resource selection is performed by a UE which does not perform sensing / re-evaluation and pre-emption checking in a resource pool with mixed RA schemes (e.g. for low priority or any priority transmissions).
  + Including study potential solution(s) if the impact is not negligible (e.g. threshold based, raising priority, minimum time gap, pattern based, a priori SCI reserving initial transmissions, resource pool partitioning, and etc.).

Agreement**:** In contiguous partial sensing for resource (re)selection, *TA* and *TB* values can be zero, positive or negative

* *TA* and *TB* values or range depend on different operating scenarios or conditions (e.g., periodic/aperiodic traffic, predictability of triggering slot n, remaining PDB, re-evaluation/pre-emption checking, HARQ feedback, CBR/CR parameter, power saving, etc)
  + FFS details
* FFS: details of how periodic-based partial sensing and contiguous partial sensing are used for re-evaluation and pre-emption checking. Including how to reduce UE’s power consumption (caused by additional sensing operation of re-evaluation/pre-emption) after its resource selection, with the considerations of different operating scenarios or conditions (e.g., pre-emption enabled/disabled, HARQ-ACK enabled/disabled, etc).

## RAN1#106-e (16 – 27 August 2021)

**Agreement**

In periodic-based partial sensing, UE monitoring of periodic sensing occasions between triggering slot n and the first slot of the selected Y candidate slots subject to processing time restriction is performed as part of resource (re)selection.

**Agreement**

Conditions in which contiguous partial sensing is performed by UE, when at least all of the followings are met:

* L1 [is expected to be or] is triggered by higher layer to report resources for resource (re-)selection in a mode 2 Tx pool
  + FFS: When the trigger will be received by L1
* The resource pool is (pre-)configured to enable partial sensing
* Partial sensing is configured by higher layer in the UE

**Agreement**

For a resource pool (pre-)configured with at least partial sensing and UE is configured by its higher layer for partial sensing,

* Periodic-based partial sensing and contiguous partial sensing schemes are supported for resource re-evaluation and pre-emption checking
  + FFS details of partial sensing for re-evaluation and pre-emption checking, including any restrictions / conditions on performing PBPS and CPS, subset of resources, timing, candidate resource set (*SA*) and etc
* Same as in Rel-16, the higher layer indicates a set of resources and/or a set of resources for re-evaluation and/or pre-emption checking, respectively
  + Pre-emption checking is enabled according to the Release-16 interpretation of *sl-PreemptionEnable.*
    - FFS: If additional enhancements are needed for enabling/disabling
* The triggering of re-evaluation and pre-emption checking is as in R16.

**Agreement**

**When UE performs only contiguous partial sensing (CPS) in a mode 2 Tx pool with periodic reservation for another TB (*sl-MultiReserveResource*) disabled, and a resource (re)selection is triggered in slot n,**

* **The resource selection window (RSW) is [**n+T1**,** n+T2**] where** T2 **is defined based on step 1) of Rel-16 TS 38.214 Sec. 8.1.4**
  + FFS whether the resource selection window **[**n+T1**,** n+T2**]** should be confined within a set of periodic set of resources and its relationship with SL-DRX
* **On the sensing window [**n+TA**,** n+TB**] for CPS,**
  + Details of TA and TB values based on the agreements from previous RAN1 meetings
  + FFS whether and how to define a minimum CPS window size, including (pre-)configurability and the case when TB **-** TA **is smaller than the minimum CPS window size**
  + FFS whether and how to define a maximum value / upper bound for TB with respect at least to the minimum RSW size and the remaining PDB, including (pre-)configurability
* **FFS how a set of candidate resource (**SA**) is initialized** considering candidate single-slot resources, including
  + Whether and how to define a minimum size for the RSW (e.g., Rel-16 T2min), including (pre-)configurability
  + Whether the set SA is confined within a set of Y candidate slots within the RSW
* **UE performs resource exclusion from the set** SA **based on at least all available sensing results and based on step 6) and 7) of Rel-16 TS 38.214 Sec. 8.1.4**
* **Note, re-evaluation and pre-emption checking in a resource pool with periodic reservation for another TB (*sl-MultiReserveResource*) disabled is considered separately.**
* **FFS: Details on** T1

**Agreement**

For random resource selection in a resource pool (pre-)configured with full/partial sensing and random resource selection, down-select to one of the followings in RAN1#106bis-e

* Option 1: A priority threshold value or a range of priority levels is (pre-)configured for the resource pool, below or within which random resource selection is allowed
  + Note, lower value means higher priority
  + FFS whether resource pool partitioning can be additionally applied
* Option 2: Increase the priority for the transmission based on random selection and indicate the new priority value in the priority field in the 1st-stage SCI
  + FFS: An extra field is added in SCI for indicating the original priority value associated with QoS requirement,
  + FFS: A 1-bit field in the SCI indicates that the UE is performing random resource selection, or
  + FFS: An extra field is added in SCI for indicating the mapping to the original priority value associated with QoS requirement.
* Option 7: Exclude resources reserved by UE performing random selection without re-evaluation / pre-emption checking, regardless of their priorities. E.g. a 1-bit field in the SCI indicates that the UE is performing random resource selection and not performing re-evaluation and pre-emption checking
* Option 12: No special consideration

**Agreement**

When UE performs periodic-based and contiguous partial sensing schemes in a mode 2 Tx pool with periodic reservation for another TB (sl-MultiReserveResource) enabled,

* For a resource (re)selection procedure triggered by aperiodic transmission (Prsvp\_TX=0) in slot n,
  + The resource selection window (RSW) is [n+T1, n+T2], and T1 and T2 are defined in the same way according to step 1) of Rel-16 TS 38.214 Sec. 8.1.4
    - FFS whether UE determines a new set of Y candidate slots within the RSW and monitors corresponding periodic sensing occasions between slot n and the first slot of the new Y candidate slots subject to processing constraints
    - FFS how to initialize a set of candidate resource (SA) for the triggered resource (re)selection procedure and which partial sensing scheme(s) and results can be used for resource exclusion in the resource (re)selection procedure
    - FFS whether the resource selection window [n+T1, n+T2] should be confined within a set of periodic set of resources and its relationship with SL-DRX
* Note, re-evaluation and pre-emption checking based on periodic-based and contiguous partial sensing schemes is considered separately

**Agreement**

When UE performs periodic-based and contiguous partial sensing schemes in a mode 2 Tx pool with periodic reservation for another TB (sl-MultiReserveResource) enabled,

* For a resource (re)selection procedure triggered by periodic transmission (Prsvp\_TX≠0) in slot n
  + A set of candidate resource (SA) is initialized to the set of selected Y candidate slots of PBPS
    - UE performs contiguous partial sensing in [n+TA, n+TB] for resource exclusion from the initialized candidate resource set (SA)
      * FFS details of TA and TB based on the agreement(s) from previous RAN1 meetings
* Note, re-evaluation and pre-emption checking based on periodic-based and contiguous partial sensing schemes is considered separately

FFS: The condition under which UE performs periodic-based and contiguous partial sensing schemes in a mode 2 Tx pool with periodic reservation for another TB (sl-MultiReserveResource) enabled

## RAN1#106bis-e (11 – 19 October 2021)

**Working Assumption**

When PHY layer is indicated with an active time of RX UE from MAC layer for candidate resource selection, a restriction is applied in PHY layer so that at least a subset of candidate resources reported to MAC layer is located within the indicated active time of the RX UE. The following options will be further discussed in RAN1 to restrict resources for candidate resource selection taking into account the indicated active time from MAC layer:

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

**Agreement**

In the agreement from RAN1#105-e, the working assumption is confirmed and the FFS bullet (in RED) is closed without any agreement.

|  |
| --- |
| Agreement from RAN1#105-e:   * For the k value in periodic-based partial sensing for resource (re)selection,   + By default, the UE monitors the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger slot n or the first slot of the set of Y candidate slots subject to processing time restriction.   + If (pre-)configured, UE additionally monitors periodic sensing occasions that correspond to a set of values which can be (pre-)configured with at least one value     - (Working assumption) Possible values correspond to the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger slot n or the first slot of the set of Y candidate slots, and the last periodic sensing occasion prior to the most recent one for the given reservation periodicity are included.     - FFS: whether/which other values and details of the (pre-)configuration (e.g. max number of values or sensing occasions)     - FFS: whether a value denotes a specific occasion to monitor or the earliest occasion to start the monitoring.   + FFS relationship between periodic-based partial sensing occasions and SL-DRX   + Note:     - This is for the case when the resource (re)selection triggering slot n is expected by UE |

**Agreement**

When UE performs periodic-based and contiguous partial sensing schemes in a mode 2 Tx pool with periodic reservation for another TB (*sl-MultiReserveResource*) enabled,

* For a resource (re)selection procedure triggered by periodic transmission () in slot *n*, *TA* and *TB* for the CPS monitoring window is defined according to one of the followings:
  + *n*+*T*A is *M* logical slots earlier than slot , and *n*+*T*B is slots earlier than , where is the first slot of the selected *Y* candidate slots of PBPS, and , are in units of physical time/slots.
    - By default, *M* is 31 unless (pre-)configured with another value.

**Agreement**

For the periodic sensing occasion(s) (PSO(s)) that a UE needs to additionally monitored in PBPS, it shall be (pre-)configured jointly for all *Preserve* values.

* The UE is not required to monitor PSOs earlier than *n–T0* if the UE is triggered to do resource (re)selection in slot n, where *T0* is (pre-)configured

**Agreement**

When UE performs at least contiguous partial sensing in a mode 2 Tx pool for a resource (re)selection procedure triggered by aperiodic transmission (*P*rsvp\_TX*=0*) in slot *n*, *TA* and *TB* for CPS monitoring window and a candidate resource set (*SA*) is initialized according to potentially one of the following approaches (final decision in RAN1#107-e). Other approaches are not precluded and the details in each approach can still be updated.

* Approach 1: (*SA*is initialized based on at least slots with PBPS and/or CPS results and guarantee a minimum of *M* slots for CPS)
  + The UE selects a set of *Y’* candidate slots with corresponding PBPS and/or CPS results (if available) within the RSW.
    - FFS how to handle the case if the total number of *Y’* candidate slots is less than a (pre-)configured threshold *Y’min* without dropping the aperiodic transmission
    - FFS whether the Y’ candidate slots for aperiodic transmission is the same as the Y candidate slots in PBPS for periodic transmission of another TB(s)
    - FFS whether/how to prioritize/select resources based on partial sensing results.
    - FFS: How to select Y’ in case of CPS only
  + Candidate resource set (*SA*) is initialized to the set of all single-slot candidate resources in the selected *Y’* candidate slots.
  + For the CPS monitoring window [*n*+*T*A, *n*+*T*B]:
    - *TA* and *TB* are both selected such that UE has sensing results for a minimum of *M* consecutive logical slots before *ty0*, where *ty0* is the first slot of the selected *Y’* candidate slots.
      * FFS: By default, *M* is 31 unless (pre-)configured with another value, or M is (pre-)configured based on transmission priority
      * FFS the range of (pre-)configured *M* from a TBD lowest value up to 30
      * FFS: how to handle the case when the minimum *M* slots for CPS cannot be guaranteed
  + FFS: RSW in case of CPS only
* Approach 2: (*SA* is initialized based on all candidate single-slot resources and guarantee a minimum of *M* slots for CPS)
  + Candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in [*n+TB+Tproc,0+Tproc,1*, *n+T2*], where *TB* is selected by the UE such that length of [*n+TB+Tproc,0+Tproc,1*, *n+T2*] ≥ *T2min*.
    - *Tproc,0*, *Tproc,1* are in units of physical time/slots
    - FFS whether/how to prioritize/select resources based on partial sensing results (if PBPS is performed).
  + For the CPS monitoring window [*n*+*T*A, *n*+*T*B]:
    - *T*A = X
      * FFS value X for *TA* including X=1 and negative value
    - *TB* is selected such that UE has sensing results for a minimum of *M* consecutive logical slots before the start of (*n+TB+Tproc,0+Tproc,1*).
      * FFS: By default, *M* is 31 unless (pre-)configured with another value, or M is (pre-)configured based on transmission priority
      * FFS the range of (pre-) configured *M* from a TBD lowest value up to 30
      * FFS: how to handle the case when the minimum *M* slots for CPS cannot be guaranteed
* Approach 3: (independent approach for different case)
  + When UE additionally performs periodic-based partial sensing in the resource pool, the above Approach 1 applies.
  + When UE does not perform periodic-based partial sensing in a resource pool that does not allow resource reservation for another TB, the above Approach 2 applies.

**Working Assumption**

In a resource pool (pre-)configured to enable partial sensing, when UE is configured with partial sensing by its higher layer, the resources for which the UE performs re-evaluation and/or pre-emption checking are for the initial transmission and retransmissions of every TB according to Rel-16 specification based on partial sensing results.

* Same as in Rel-16, for periodic transmission, re-evaluation check is not applied to the resources that have been signalled in current period or previous periods, except that it is up to UE implementation whether to apply re-evaluation check to the resources in non-initial reservation period that have been signalled neither in the immediate last nor in the current period.
* The resource in the main bullet is the set of resources (*r*0, *r*1, *r*2, …) and/or the set of resources (*r*0', *r*1', *r*2', …)  for re-evaluation and/or pre-emption checking, respectively, which has been agreed in RAN1 #106-e.