**3GPP TSG RAN WG1 #106bis-e R1-2110477**

**e-Meeting, October 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.

|  |
| --- |
| 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#106bis-e

To be collected once agreement is reached.

Topics for email discussion

[106bis-e-NR-R17-Sidelink-01] Email discussion on resource allocation for power saving– Kevin (OPPO)

* 1st check point: October 14
* Final check point: October 19

## Topic #1: Remaining issues in PBPS (resolving FFS items)

**Background**: The working assumption (WA) from RAN1#105-e on the (pre-)configuration of periodic sensing occasions for k and the subsequent FFS items should be finalized in this meeting for the RRC parameter list. From reviewing contributions submitted to this meeting (in Section 4), the majority of companies (11) see no technical issue or enhancement needed to include more *k* values on top of the most recent two periodic sensing occasions per *Preserve* in the existing WA. On the other hand, 5 companies propose to include more k values / PSOs to provide more flexibility. However, it was argued that such flexibility is not needed as the most recent two PSOs will provide the most updated/relevant reservation information, more power consumption will be needed to monitor more PSOs, and it is not in line with R14 partial sensing where only the most recent PSO is monitored per reservation period.

Moreover, it is brough up that the product of the resource reservation periodicity *Preserve* and its corresponding *k* value is upper bounded by a (pre)configured threshold.

For the set of (pre-)configured *P*reserve values, there is still an open FFS on whether UE is mandated to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set. Based on reviewing the contributions, 8 companies think it is unnecessary while 4 think it should be mandated.

### Questions before 1st GTW session

**Question: For UE monitoring periodic sensing occasions (PSOs) In periodic-based partial sensing (PBPS),**

* **Question 1-1:** Is it agreeable that when (pre-)configured, only the two most recent PSOs (before the first slot of *Y* candidate slots subject to processing time restriction) per reservation periodicity can be monitored by the UE according to the WA made for *k* value in RAN1#105-e?
  + If yes, the following two FFS items can be closed, besides the details of the (pre-)configuration can be handled as part of RRC parameter list discussion.
    - 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.
  + If no, which other values / PSOs should be included for the flexibility enhancement and whether a value denotes a specific occasion to monitor or the earliest occasion to start the monitoring.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Xiaomi | Yes | From our point of view, the current working assumption can work and there is no need to further optimize on this case. |
| Ericsson | Yes | We propose to confirm the WA from RAN1#105-e where the two most recent sensing occasions are monitored if they are (pre-)configured. |
| Fraunhofer | No | We prefer to maintain flexibility with regards to the UE monitoring the number of PSOs depending on the priority of the transmission. For example, k could indicate the last 4 PSOs and UEs could use the two most recent PSOs for low priority transmissions, three for medium and 4 for high priority transmissions. This can be a trade-off between reduced power consumption and enhanced performance. |
| Qualcomm | Please see comment | The proposal needs to be clarified as whether the additional monitoring is enabled for all periodicities jointly or independently. We support jointly enabling/disabling of the additional monitoring for all periodicities. |
| Futurewei | No | We propose to have more sensing occasions and only specify a maximum number of sensing occasions for every periodicity and leave the (pre-)configurations for each periodicity to the implementation. Since there are many overlaps on the sensing slots between the third most recent sensing occasion and the two most recent sensing occasions for different periodicities and different slots in the Y candidate slots, the additional slots for UE to monitor are not many, compared with the slots in two most recent sensing occasions. Moreover, by specify a maximum number of sensing occasions. We do not need to specify additional restriction as in Question 1-2.  We are ok to have maximum number of sensing occasion being 3.  The value in the (pre)configuration denotes a specific occasion to monitor. |
| Apple | No | We think the largest k value for each periodicity P\_reserve could be configured. Probably, the configuration of largest k value is related to T\_0 in Question 1-2. |
| LGE | Yes | We prefer (pre-)configuration for full flexibility of the network. But for making progress, if majority prefer most two recent PSOs, we’re ok for it with one clarification. The PSO is (pre-)configured per periodicity, which includes possibility of (pre-)configuring PSO separately for each periodicity. |
| Convida Wireless | Yes | We are ok to confirm the WA when (pre-)configured only the two most recent PSOs (before the first slot of *Y* candidate slots subject to processing time restriction) per reservation periodicity can be monitored by the UE according to the WA made for *k* value in RAN1#105-e. |
| OPPO | Yes | This is a trade-off between power saving and reliability. Current WA can work and there is no necessary to perform additional optimization at current stage. |
| Samsung | Yes with comments | We’re fine two remove the two FFS bullets, but have concern on confirming the WA as the wording is ambiguous with the phrase “Possible values”.  One point from the RRC parameter discussion is whether to configure the monitoring of using a single value for all monitored periodicities or to have a value configured for each periodicity. This point should be discussed in this meeting and we prefer the latter solution. |
| NTT DOCOMO | Yes | We do not see benefit from high flexible configurations of k value. Two most recent sensing occasions are sufficient. |
| Spreadtrum | Yes | We support to confirm the WA in RAN1#105-e that the two most recent PSOs per reservation periodicity are monitored when (pre-)configured. |
| Huawei, HiSilicon | Yes | The point in the question is already settled by the working assumption, unless and until the working assumption is cancelled. It does not need to be re-addressed here, if at all time-consuming. We are fine to confirm the working assumption, but otherwise suggest not spending time trying to do so.  Agree that the two FFS can be closed. |
| Fujitsu | No | We agree FutureWei and Apple to have more sensing occasions and only specify a maximum number of sensing occasions to bring more flexibilities. |
| vivo | No | The values that can be included can be any value that does not exceed a certain limit. For example, it can be specified that the earliest occasion that the UE can monitor for a TB is the 10th most recent occasion before the resource set, then any value corresponding to an occasion that is not earlier than that occasion can be configured, e.g., if 10 corresponds to the 10th most recent occasion, then a value <=10 can be configured. |
| CATT | Yes | We are ok to close the FFS |
| Lenovo&MotM | Yes | To consider the progress, we share the same view with Xiaomi, further optimization is not needed. |
| Panasonic | Yes | We agree to confirm the WA. |
| ZTE, Sanechips | No | Similar view as vivo |
| Nokia, NSB | Yes | This WA was agreed two meetings ago. We shall close this by confirming the WA. |

* **Question 1-2:** Is it agreeable to restrict UE monitoring of PSOs not earlier than *T0*, the (pre-)configured sensing window for the Tx resource pool (*sl-SensingWindow*)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Xiaomi | Yes | First of all, it should be PSOs not earlier than n-T0, where T0 is defined the same as in sensing window of Rel-16 V2x.  We support the proposal. Even for full sensing based resource selection, the sensing results before n-T0 is not considered in resource (re)selection. The sensing results before n-T0 could be too early so it may provide inaccurate or even wrong information, e.g. a set of periodic reservations have already stopped. Therefore, we do not see the need to consider sensing results before n-T0 in partial sensing. |
| Ericsson | See comment | In our view, the specification mandates that a UE using PBPS must have monitored all PSOs in [n-T0, n-Tproc,0] and uses the corresponding sensing results to determine the status of the resources in the RSW. There is no need to specify or even discuss what happens earlier than T0. |
| Fraunhofer | Yes | We do not see the need for UEs to consider the monitoring of PSOs earlier than *T0*. |
| Qualcomm | Please see comment | Is the proposal that the UE doesn’t monitor PSOs prior to T0? If yes, we support the proposal but would like the wording to be clarified  The UE does not monitor PSOs earlier than n – T0, where T0 is the (pre-)configured sensing window parameter for the Tx resource pool (*sl-SensingWindow*) |
| Futurewei | Comments | We do think that a restriction on UE monitoring of PSOs is necessary. However, we think that defining a maximum number of sensing occasions for all periodicities should be sufficient. |
| Apple | Yes | In Rel-16 V2X with full sensing, the sensing window is limited. This is because the earlier sensing results may not be valid. We should have the similar constraints for partial sensing UEs. Considering the power saving requirements, we think T\_0 could be smaller for partial sensing UEs than that for full sensing UEs. This T\_0 could also restrict the largest value of k in Question 1-1. |
| LGE | Yes | All SOs need to be limited within a (pre-)configured range to avoid unnecessary outdated monitoring for a long periodicity. |
| Convida Wireless | Yes | We are ok with the proposal. |
| OPPO | Yes | The motivation of T0 is to determine the starting position of sensing window. We don’t think it is reasonable to perform sensing before n-T0. |
| Samsung | Please see comment | At first we think “not earlier than *T0*” should be modified as “not earlier than n-*T0*”. In addition, we would like to clarify whether question 1-1 and 1-2 works together, e.g. even if UE is (pre-)configured to monitor two most recent PSOs, UE still may monitor single most recent PSO if the second most recent PSO is before n-*T0*. |
| NTT DOCOMO | Yes | Monitoring slots earlier than slot n-T0 is unnecessary as Rel-16. |
| Spreadtrum | Yes | We support the proposal. |
| Huawei, HiSilicon | No | In LTE-V, there is no sensing window defined for partial sensing procedure, and so far, the agreements are for partial sensing occasions are only based on PBPS occasions and CPS window. There is no need to define sensing window (which is used for full-sensing) to restrict partial sensing occasions for partial sensing. |
| Fujitsu | See comment | We agree with Ericsson’s view that we only need to specify how to define the PSOs, and there is no need to discuss what happens earlier than T0. |
| vivo | Comments | This proposal seems to be aimed at invalidating several configured sensing occasions. If T0 is =1100ms, with the proposal, then UE is not allowed to monitor the second most recent sensing occasion for Preserve=1000ms as that occasion is earlier than 1100ms. However, this case is due to a misconfiguration and can be avoided by proper configuration. |
| CATT | Yes | We are ok with the proposal |
| Lenovo&MotM | Yes |  |
| Panasonic | Yes | We support the proposal. |
| ZTE, Sanechips | Comment | Similar view as Ericsson. No need to discuss this. |
| Nokia, NSB | Yes | Not sure why we need to discuss about this. |

* **Question 1-3:** Is it agreeable not mandating UE to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set of *Preserve* values? That is, the UE may additionally monitor occasions corresponding to *PRSVP\_Tx* based on its implementation.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Xiaomi | No | It is important for a UE to sense the sensing occasions corresponding to the same periodicity of its data for transmission, otherwise consistent collision may happen which can severely degrade the performance. Note that other UEs which does not transmit data of this periodicity does not need to sense sensing occasions corresponding to the periodicity if this periodicity is not included in the (pre)configured set of Preserve values. |
| Ericsson | See comment | We do not think that we should be discussing whether to not mandate a behaviour or not.  Given the discussions in earlier meetings, we think the existing agreement from RAN1#105-e stating that “the UE may additionally monitor occasions corresponding to P\_RSVP\_Tx” is all we need at this point. |
| Qualcomm | No | Our evaluations in Rel-16 showed that PRSVP\_Tx is the most important period value to monitor. |
| Futurewei | Yes | It is NOT necessary to mandate UE to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set of *Preserve* values. |
| Apple | No | To avoid contiguous (periodic) resource collision, we prefer that Tx UE mandatory monitors *PRSVP\_Tx*, **at least for resource re-evaluation and pre-emption (if configured)**. |
| LGE | Yes | If the network does not force it by no configuration, it should be totally up to UE implementation. |
| Convida Wireless | See comment | We don’t think it is necessary to mandate UE to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set of *Preserve* values. The UE may additionally monitor occasions corresponding to *PRSVP\_Tx* based on its implementation and this may be sufficient. |
| OPPO | No | Sensing based on *PRSVP\_Tx* is very important to avoid consistent transmission collision. That is one of the motivation/benefit for inter-UE coordination topic. It is not a good way to drop a simple method (perform sensing based on *PRSVP\_Tx* ) while to pursue a complex method (inter-UE coordination, which has more open issues till now) |
| Samsung | Yes | We think it’s unnecessary to mandate monitoring of PRSVP\_Tx, since it was already supported by UE implementation as agreed in previous meetings, and we would like not to spend time discussing it. |
| NTT DOCOMO | Yes | We think the existing agreement is sufficient. Also if regulator prefers to mandate UE to monitor it, possible P\_RSVP\_TX can be pre-configured in P\_reserve. |
| Spreadtrum | Yes | We prefer to leave implementation. It is not necessary to mandate UE to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set of *Preserve* values. |
| Huawei, HiSilicon | Yes | Unless mandated behaviour is agreed, there is no such behaviour defined and hence none specified. RAN1 may not need to spend much time on such issues. In this case, it results in a workable solution, because if the configuration does not provide particular periodicity values, it means network assumes the resulting performance is acceptable. Network can always configure all (or any) values if there is reliability concern. |
| Fujitsu | Yes | UE can monitor the PSOs corresponding to *PRSVP\_Tx* by its implementation. |
| vivo | Yes | It can be up to UE implementation. |
| CATT | Yes | We prefer to leave implementation |
| Lenovo&MotM | No | Mandate UE to monitor PSOs corresponding to *PRSVP\_Tx* is necessary. It can help to avoid potential collision. |
| Panasonic | Yes | We prefer not to mandate it and UE implementation should be sufficient. |
| ZTE, Sanechips | Yes | Up to implementation |
| Nokia, NSB | Yes | Not to mandate in the specs when the PSO is not part of the (pre-)configured set of *Preserve* values. But UE can still monitor based on its implementation. |

### Proposals before 2nd GTW session

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

* On Question 1-1 (number of PSOs that can be (pre-)configured), 17 companies think the most recent two PSOs are sufficient for PBPS and would like to confirm the WA, while 7 companies prefer to have more (e.g., 3, 4 or 10) for the flexibility in (pre-)configuration signalling. It should be noted that the reason why only the two most recent PSOs are chosen in the WA was due to its performance can achieve almost the same as R16 full sensing. Given the current situation and there is an urgent need to finalize its corresponding RRC parameter in this meeting for RAN2, it is recommended to confirm the WA and close the subsequent two FFS items.

Regarding the question brought up by Qualcomm and Samsung on “whether the additional monitoring is enabled for all periodicities jointly or independently”, let’s further discuss this in this meeting.

* On Question 1-2 (restricting UE monitoring of PSOs not earlier than *n-T0*), this was treated during the first online GTW session on Tuesday (1st week). This is generally seen as an optimization and not entirely essential. Therefore, this issue will not be pursued any further.
* On Question 1-3, 17 companies think it is not necessary to mandate the UE to monitor PSOs corresponding to *PRSVP\_Tx* when it is not part of the (pre-)configured set of *Preserve* values, while 6 companies preferred it is mandated. Since it is already agreed that the UE may additionally monitor occasions corresponding to *PRSVP\_Tx*, it is recommended to close this FFS item from RAN1#105-e without any agreement.

**Proposal 1-1 (I):** The following working assumption from RAN1#105-e is confirmed and the two subsequent related FFS bullets are closed without any agreement.

|  |
| --- |
| *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* |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | Support. |
|  |  |
|  |  |
|  |  |
|  |  |

**Question 1-1 (II):** When the k value in periodic-based partial sensing for resource (re)selection is (pre-)configured, whether the additional monitoring is enabled for all reservation periodicities jointly or independently?

|  |  |  |
| --- | --- | --- |
| **Company** | **Jointly/Independently** | **Comments** |
| NTT DOCOMO | Independently | k value for two most recent sensing occasions is different among periodicity value. In addition, same configuration between large periodicity and short periodicity would not be good. Therefore Independent (pre-)configuration is preferred. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Topic #2: Partial sensing details (defining TA, TB and candidate resource set SA)

**Background for Topic 2-1:**

|  |
| --- |
| **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. |

For the above agreement reached in RAN1#106-e, the slots for which the candidate resource set (*SA*) is initialized are according to the selected *Y* candidate slots of PBPS in the case of periodic transmission. And since the resource (re)selection triggering slot *n* for periodic transmissions is can assume to be predictable (known in advanced), and *TA* and *TB* can be negative values, based on reviewing the submitted contributions to this meeting, most company (if not all) think CPS monitoring can start from 31 slots before the first slot of *Y* candidate slots (which is also *SA*).

According to some companies, due to discussion of aperiodic transmission cases, there may be a need to introduce a minimum number of CPS monitoring window (e.g., *M* slots) to ensure there is a minimum / sufficient amount of CPS results for resource selection, the same minimum number of *M* slots can also be adopted for periodic transmission as well.

Furthermore, considering the amount of specification effort and the complication to describe partial sensing behaviour for different cases (i.e., PBPS+CPS for periodic Tx, PBPS+CPS for aperiodic Tx, CPS-only for aperiodic Tx), it may be desirable to have a unified spec description approach in a manner such that it can be applied to all of these 3 cases. One way of describing this is to simply say it is up to UE implementation to select a set of *Y* candidate slots within the RSW such that the UE is able to obtain sufficient partial sensing results from PBPS and CPS for any in the set of *Y* candidate slots. That is, the UE needs to have monitored all slots that could have a SCI pointing to a slot in the set of *Y* candidate slots before the resource (re)selection / reporting of a subset of resources to the higher layer. And this can include slots that have already monitored/to be monitored by the UE for another resource (re)selection and re-evaluation/pre-emption checking process. As such, all available and applicable sensing results for the same resource pool can be utilized.

**Background for Topic 2-2:**

|  |
| --- |
| **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 |

For the above agreement reached in RAN1#106-e, there seems to be split of opinion of whether or not a new set of *Y* candidate slots should be selected by the UE. One reason is to obtain additional PBPS results when there are PSOs between the triggering slot *n* and first slot of *Y*. Another reason is to ensure there are also Y candidate slots for the resource (re)selection, to be the same as the case for periodic transmission, even without any potential PSOs between slot *n* and first slot of *Y*. And there is also an opinion that the UE should reuse whatever Y candidate slots from a PBPS that fall / are located within the RSW of the triggered resource (re)selection procedure. In Proposal 2-2, different approaches are listed with their corresponding potential CPS monitoring window definition. In general, the FL lists solutions/schemes that are simple and most straight forward.

If a different approach, alternative or enhancement should be included to overcome shortcoming of the listed ones from the FL, please indicate and describe them in the response.

**Background for Topic 2-3:**

|  |
| --- |
| **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 |

For the above CPS-only agreement reached in RAN1#106-e, based on contributions submitted to this meeting, there are wide range of opinions on how to define *T1* and the RSW. Again, the FL tried to capture the simplest one and the most straight forward approaches and alternatives for defining *TA*, *TB* and initializing the set of candidate resources (*SA*).

If a different approach, alternative or enhancement should be included to overcome shortcoming of the listed ones from the FL, please indicate and describe them in the response.

### Proposals before 2nd GTW session

**Proposal 2-1 (I):** 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:
  + Alt.1: *n*+*T*A = and *n*+*T*B = , where is the first slot of the selected *Y* candidate slots of PBPS.
  + Alt.2: *n*+*T*A ≥ and *n*+*T*B = , where *T*B should be selected by the UE such that *T*B *– T*A *≥ M* and *M* is a (pre-)configured minimum number of slots for CPS monitoring window based on priority, latency or measured CBR.
  + Alt.3: *T*A and *T*B are determined by the UE to monitor all or at least *M* slots (before the reporting of a subset of resources to higher layer) that could have a SCI indicating a reserved resource in any of the selected set of *Y* candidate slots.

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt.1, 2 or 3** | **Comments** |
| NTT DOCOMO | Alt 1 | For periodic transmission, UE can monitor slots prior to slot n. In this case, there is no reason to skip monitoring some slots corresponding to other UE’s aperiodic reservation. Alt 2 will obtain quite small power saving gain, while lead to significant reliability degradation.  It is unclear for us what is difference between Alt 3 and Alt 1+2. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Proposal 2-2 (I):** 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 () in slot *n*, *TA* and *TB* for CPS monitoring window and a candidate resource set (*SA*) is initialized according to one of the following approaches.
  + Approach 1: Based on a minimum number of Y candidate slots (*Ymin*)
    - No new set of *Y* candidate slots is selected by the UE
    - When there are at least *Ymin* slots of a set of *Y* candidate slots from a PBPS located within the RSW
      * Candidate resource set (*SA*) is initialized to all the slots of the set of Y candidate slots that are located within the RSW
      * CPS monitoring window:
        + *n*+*T*A =
        + *n*+*T*B =
    - When there are less than *Ymin* slots in the RSW
      * Candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in the remaining RSW [, ], where *TB* is selected by the UE such that length of remaining RSW ≥ *T2min*.
      * For the CPS monitoring window [*n*+*T*A, *n*+*T*B], *T*A = 1 and *T*B is selected by the UE such that *TB* – *TA* ≥ *M*, or *TA* and *TB* are both selected such that UE has sensing results for at least *M* slots before the start of the remaining RSW () including sensing results already obtained by the UE before slot *n* for another resource (re)selection or re-evaluation/pre-emption process.
        + *M* is a (pre-)configured minimum number of slots for CPS monitoring window based on based on priority, latency or measured CBR.
      * *SA* slots with corresponding PBPS results are prioritized in resource selection.
  + Approach 2: Based on a set of Y candidate slots
    - Candidate resource set (*SA*) is initialized to a set of Y candidate slots within the RSW, where all or some of Y candidate slots may be newly selected or from an existing PBPS
    - CPS monitoring window:
      * Alt.1: *n*+*T*A = and *n*+*T*B = , where is the first slot of the *Y* candidate slots.
      * Alt.2: *n*+*T*A ≥ and *n*+*T*B = , where *T*B should be selected by the UE such that *T*B *– T*A *≥ M* and *M* is a (pre-)configured minimum number of slots for CPS monitoring window based on priority, latency or measured CBR.
      * Alt.3: *T*A and *T*B are determined by the UE to monitor all or at least *M* slots (before the reporting of a subset of resources to higher layer) that could have a SCI indicating a reserved resource in any of the selected set of *Y* candidate slots.

|  |  |  |
| --- | --- | --- |
| **Company** | **Approach 1 or 2 (Alt.1, 2 or 3)** | **Comments** |
| NTT DOCOMO | Approach 2 with Alt 2 | We do not understand the meaning of “No new set of Y candidate slots is selected by the UE” in approach 1. The behaviour is only when the UE has another periodic transmissions and the Y candidate slots are available for the aperiodic TX? Or Y slots concept is not applied?  Approach 2 is simple enough, and Alt 2 is better than Alt 1 to ensure sufficient monitoring. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Proposal 2-3 (I):** 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*,

* *T1* and RSW are defined according to one of the followings:
  + Definition 1: *T1* and RSW are defined according to step 1) of Rel-16 TS 38.214 Sec. 8.1.4.
  + Definition 2: *T1 = TB + +*  and the RSW is .
    - Candidate resource set (*SA*) is initialized to the set of all the candidate single-slot resources within the RSW.
* *TA* and *TB* for CPS monitoring window and a candidate resource set (*SA*) for the above Approach 1 is initialized according to one of the following approaches.
  + Approach 1: Based on a remaining RSW after CPS monitoring
    - If *T1* and RSW are defined as per Rel-16, the candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in the remaining RSW [, ], where *TB* is selected by the UE such that length of remaining RSW ≥ a minimum selection window size (*T2min, Ymin*, etc).
    - For the CPS monitoring window [*n*+*T*A, *n*+*T*B], *T*A = 1 and *T*B is selected by the UE such that *TB* – *TA* ≥ *M*, or *TA* and *TB* are both selected such that UE has sensing results for at least *M* slots before the start of the remaining RSW () including sensing results already obtained by the UE before slot *n* for another resource (re)selection or re-evaluation/pre-emption process.
      * *M* is a (pre-)configured minimum number of slots for CPS monitoring window based on priority, latency or measured CBR.
  + Approach 2: Based on a set of Y candidate slots
    - If *T1* and RSW are defined as per Rel-16, the candidate resource set (*SA*) is initialized to a set of *Y* candidate slots which is to be selected by the UE within the RSW.
    - CPS monitoring window:
      * Alt.1: *n*+*T*A = and *n*+*T*B = , where is the first slot of the *Y* candidate slots.
      * Alt.2: *n*+*T*A ≥ and *n*+*T*B = , where *T*B should be selected by the UE such that *T*B *– T*A *≥ M* and *M* is a (pre-)configured minimum number of slots for CPS monitoring window based on priority, latency or measured CBR.
      * Alt.3: *T*A and *T*B are determined by the UE to monitor all or at least *M* slots (before the reporting of a subset of resources to higher layer) that could have a SCI indicating a reserved resource in any of the selected set of *Y* candidate slots.

|  |  |  |
| --- | --- | --- |
| **Company** | **Definition 1 or 2,**  **Approach 1 or 2 (Alt.1, 2 or 3)** | **Comments** |
| NTT DOCOMO | Definition 1 + Approach 2 with Alt 2 | Important thing is to ensure monitoring sufficient slots. We think the following directions can achieve this.   * Definition 2 + Approach 1 * Definition 1 + Approach 2 with Alt 2 * Definition 1 + Approach 1   Either is OK for us, but slight preference is Definition 1 + Approach 2 with Alt 2 for commonality with the case when periodic reservation is enabled. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Proposals for 2nd GTW session

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

* TBD

## Topic #3: Random resource selection (resolving remaining issues / FFS items)

**Background**: In RAN1#106-e, we agreed on the following possible options to resolve the issue of non-sensing capable UEs performing random resource selection for low priority transmission in a resource pool with mixed RA schemes (e.g., random selection with full/partial sensing). Based on reviewing contributions submitted to this meeting, please refer to Section 4 for identified issues and amount of support in each option, it is clear that we should try to agree on Option 1 for simplicity and backward compatibility.

|  |
| --- |
| **Agreement** (RAN1#106-e):  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 |

Additionally, there is still an FFS item on “whether/how re-evaluation and pre-emption can be supported by UEs performing random resource selection that do perform sensing” from RAN1#104-e meeting. Based on reviewing the contributions in this meeting, there is a majority to support this for Type D UEs (7 vs. 2).

### Proposals before 1st GTW session

**Proposal 3-1 (I):** For random resource selection in a resource pool (pre-)configured with full/partial sensing and random resource selection, 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
* FFS remaining details for the RRC parameter (e.g., possible priority threshold values or the range of priority values)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Xiaomi | Support.  We also think the priority threshold value /range of priority level can be CBR based (pre)configured. We hope this can be reflected in the proposal. |
| Ericsson | We are not supportive of this proposal and we have the following comments on the background information about Option 1 from FL:   * We do not think that Option 1 is simpler that Option 2 or Option 7. We have the field for reserved bits in SCI 1st stage which can be used to accommodate the information that the UE is performing random resource selection so other UEs can know this information. * Moreover, the addition of this information in SCI 1st stage does not make the procedure non-backward compatible.   + Rel-16 UEs will simply ignore this new information. Rel-16 UEs will be able to receive the SCI 1st stage from Rel-17 UEs performing random resource selection in a shared resource pool.   Therefore, we propose to modify Option 2 as follows in order to have a simpler implementation:  **Proposal 3-1 (II):**  Option 2’: Include a 1-bit field in the 1st stage SCI that indicates that the UE is performing random resource selection. |
| Fraunhofer | We are supportive of the FL’s proposal.  Regarding the first FFS, if only high priority transmissions can be transmitted in a mixed pool, we need to discuss where UEs that carry out random resource selection for low priority transmissions can transmit - whether it be in a separate resource pool configured for only random resource selection or any other solution. |
| Qualcomm | We don’t support the proposal.  We prefer to not introduce any special handling for this case based on our evaluation results that showed no impact on full-sensing UEs’ performance when random selection UEs are introduced to the pool. |
| Futurewei | We prefer option 2 as it will also benefit to legacy Rel-16 UE. It will not impact the re-evaluation/pre-emption process for legacy UE as the increased priority level (lower value) is sent on the priority field in 1st stage SCI. So backward compatibility won’t be an issue for option 2. Therefore, we suggest keep option 2 for initial online discussion. Since the third FFS covers the first two FFS’s, we can rephrase the 3rd FFS to simplify the proposal.  We do not think option 1 is a simple solution. There are some issues if the resource partitioning is not introduced. First, the low-priority random selection may not get its data transmitted in time if its priority is lower (larger value) than the configured priority threshold. Second, there may be some overlap between the resource pool from rel 16 and resource pool from Rel 17, or between two Rel-17 resource pools with different thresholds. Some specification or rules need to be specified for the resource pool overlap. Therefore, for option 1, resource partitioning is necessary and different priority thresholds can be applied for resource partitions. Therefore, we propose  **Proposal 3-1 (I):** 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 r~~Resource pool partitioning can be ~~additionally~~ applied   + FFS remaining details for the RRC parameter (e.g., possible priority threshold values or the range of priority values) * 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 mapping to the original priority value associated with QoS requirement or that the UE performs random resource selection. |
| Apple | Not support.  This is not efficient in resource usage. If there is no resource pool (pre)configured to dedicatedly support random resource selection, then a UE with random resource selection is unable to transmit any sidelink data with low priority. |
| LGE | We prefer option 12 that no consideration is needed. But as a compromise for progress, we’re ok with option 1 as proposed. But we have objection on any further optimization by leaving FFS.  Support with removing FFS. |
| Convida Wireless | We are ok with the proposal.  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. |
| OPPO | Not support  If a UE (e.g. UE1) with priority P1 which is higher than the priority threshold can use random resource selection in a RP, that will affect the performance of other UEs which has higher priority than P1 since other UE cannot perform resource reselection based on re-evaluation/pre-emption checking to avoid collision with UE1. Only UEs with lower priority than P1 can avoid collision with UE1. That means UE1 (with priority P1) will only collides with other UEs who have higher priority than UE1. That is not reasonable. In our view, the UE with higher priority, its performance should be protected.  For option 2, we also don’t think it should be supported. Increasing the priority in SCI of random resource selection is not acceptable. The priority in SCI not only reflects the priority of corresponding data packet, some other physical procedure are also based on priority, such as TX/TX or TX/RX collision handling. Increasing the priority in SCI will affect other procedures.  For option 7, that is not backward compatibility.  In our view, some simple solution can be used, such as the resource pool partitioning (the first FFS in the proposal). On the other hand, option 12 is acceptable to us. |
| Samsung | Support.  For the 1st FFS bullet, we prefer that the priority value is provided for a subset of resources of the resource pool, rather than the entire resource pool, otherwise for some random resource selection transmissions, the UE will not be able to transmit anything. |
| NTT DOCOMO | Support. Option 1 is simple one and gets benefit since UEs performing sensing can avoid collisions by re-evaluation/pre-emption check. Option 1 does not need any further agreements other than RRC parameter discussion. We do not think discussions pointed out by FW are unnecessary since current option 1 without any additional enhancement can work. Option 2 needs much more discussions as we see “FFS”s, so not preferable. |
| Spreadtrum | We support the proposal and the first FFS that resource pool partitioning should be removed. |
| Huawei, HiSilicon | Agree.  This issue has been identified by many companies, in their simulation results. The issue is due to that Rel-17 support mixed types of RA in the same resource pool, which is not the case in LTE-V.  Option 1 controls the population of random selection UE in a mixed RA resource pool via priority threshold which is similar to pre-emption threshold in Rel-16 to control the pre-emption operation. It will only allow the random selection UE with enough high priority operation in the mixture resource pool to have less impact on full sensing UE. Furthermore, option 1 has no additional design on SCI field and is backward compatible for Rel-16 UE. |
| Fujitsu | We don’t support this proposal as option 1 is not an efficient way of resource usage.  We prefer option 2 considering backward compatibility and suggest keeping it for initial discussion. |
| vivo | We prefer Option 2 because it also benefits the R16 UE, while in Option 1, the R16 UE still has a higher risk of collision with the random-selection UE than the R17 sensing UE. |
| CATT | We support the proposal |
| Lenovo&MotM | Not support. |
| Panasonic | We support the proposal |
| ZTE, Sanechips | Support |
| Nokia, NSB | Do not support this proposal.  We’d prefer Option 2 because it can provide backward compatibility for Rel-16 UE.  The resource reservation by a UE with random resource selection can be pre-empted by a UE with sensing. But this UE can’t identify the situation leading to collision. We may consider increasing the priority at PHY for a UE with random selection or adding SCI bits to indicate sensing capability (resource selection scheme).  The above issue also exists in the case that the shared resource pool is also used by Rel-16 sensing UEs. Adding SCI bits to indicate sensing capability doesn’t work since Rel-16 UEs can’t identify newly added SCI bits. On the contrary, increasing PHY priority for a UE with random selection is a feasible choice for backward compatibility with Rel-16 sensing UEs. We may use the increased priority value in the priority field in the 1st-stage SCI. This can increase the capability of a Rel-17 UE with random resource selection to protect itself from being pre-empted by Rel-16 UEs. Accordingly, to retain proper operations between Rel-17 UEs with different resource selection schemes, an extra priority field containing the original priority value associated with QoS requirements can be added to the SCI. |

**Proposal 3-2 (I):** Re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) are applicable for sensing capable (Type-D) UEs performing random resource selection.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Xiaomi | From our understanding UE applies random resource selection to minimize the power consumption by cancelling the sensing behaviour. If re-evaluation and pre-emption are still performed, UE is actually preforming sensing; and this should be discussed as special case for partial sensing based RA, for example, some special case in CPS. In addition, if re-evaluation/pre-emption is supported for random RA, and if the reselection is triggered, whether the sensing results in re-evaluation/pre-emption should be used in the re-selection? If so, this is in CPS scope. Therefore, we suggest to discuss this issue after the relationship between random RA and CPS based RA is clarified. |
| Ericsson | We are supportive of the direction of this proposal. Nevertheless, in order to make the proposal clearer, we propose the following rewording:  **Proposal 3-2 (II):**  Re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) are applied by sensing capable (Type-D) UEs performing random resource selection |
| Qualcomm | We support with a minor text change.  Re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) are applicable for sensing capable ~~(Type-D)~~ UEs performing random resource selection.  We showed that random selection + re-evaluation brings the performance close to full-sensing performance. This approach is also more suitable for small PDB packets because CPS after selection trigger would reduce the selection window size, which would impact the performance of those small PDB packets. |
| Futurewei | We do not support this proposal. Type D UE chooses performing random resource selection to save power. Re-evaluation and pre-emption require sensing, which is against the original intention for type-D UE performing random resource selection. For periodic transmission, the periodic partial sensing occasions before the Y candidate slots, if initiated, mostly passed when performing re-evaluation and pre-emption. |
| Apple | Support.  In our view, Type-D UE could perform random resource selection for the purpose of power saving. A Type-D UE with sensing capability can perform sensing between the resource selection time and the resource re-evaluation/pre-emption checking time. These sensing results can be used in resource re-evaluation and pre-emption checking to reduce the resource collision chance of a randomly selected resource. Hence, resource re-evaluation and pre-emption checking should be supported for a UE performing random resource selection while having sensing capability. |
| LGE | By some reason such as insufficient sensing, UE can select random resource selection. But after that, if possible, UE should be able to perform re-evaluation and pre-emption checking to avoid resource collision as much as possible. |
| Convida Wireless | We are ok with the proposal.  Re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) are applicable for sensing capable (Type-D) UEs performing random resource selection. |
| OPPO | Support.  There maybe several reasons for type-D UE to perform random resource selection. For example, the PDB is very small and there is no time to perform CPS for resource selection. In this case, UE can perform random resource selection and based on re-evaluation/pre-emption to avoid potential collision. Our simulation result also shows the performance of this case. |
| Samsung | We’re OK with the proposal |
| NTT DOCOMO | Support. Even if UE performs random selection, collision can be avoided by re-evaluation/pre-emption check. This means, power saving gain can be obtained at resource selection procedure while reliability is ensured by the re-evaluation/pre-emption check. One good balance becomes possible. |
| Huawei, HiSilicon | No  Whenever a packet arrives, the UE can always do some CPS before ty0. This questions the relationship between “random + re-evaluation/pre-emption” and “CPS”.  Random resource selection is used to minimize the power consumption, with revaluation/pre-emption checking for random resource selection, it will significantly increase the power consumption. If reliability is concerned, for type-D UE, it can also use partial sensing, either PBPS + CPS, or CPS only, with revaluation/pre-emption checking. Thus we don't see the necessity to have this.  In summary, we suggest to discuss CPS first, which may already cover “random + re-evaluation/pre-emption”, so that RAN1 can avoid specifying duplicate functions for the same purpose. |
| Fujitsu | We do not support this proposal.  If random selection is selected, the purpose is obviously to save power as much as possible, so do re-evaluation/pre-emption will contradict with this original purpose of random selection. |
| vivo | We are ok with the proposal. UE could decide to perform random selection to save power, but it should be allowed to re-evaluate and perform pre-emption checks to improve reliability, and we see no strong motivation to prohibit such behaviour. |
| CATT | No.  We think these UE should not perform re-evaluation and pre-emption. For random selection ,there is no benefit of further re-evaluation and pre-emption, while the ue power consumption will go up. |
| Lenovo&MotM | Support. |
| Panasonic | We don’t support the proposal. Performing re-evaluation/pre-emption for random selection defeats the purpose of power saving. |
| ZTE, Sanechips | Support |
| Nokia, NSB | The question is whether a type-D UE (w/ sensing capability) is allowed to perform re-evaluation/pre-emption while random selection is used for resource allocation. There is no clear advantage for a type-D UE because the UE has its sensing capability anyway. Not support this. |

### Proposals before 2nd GTW session

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

* On Proposal 3-1 (random resource selection in a resource pool with mixed RA schemes),
  + Supportive of the proposal (based on Option 1 in RAN1#106-e): Xiaomi, Fraunhofer, LGE (remove FFS), Convida, Samsung, DCM (remove FFS), Spreadtrum (remove FFS), Huawei, HiSilicon, CATT, Panasonic, ZTE, Sanechips
  + Not support of the proposal (without mentioning other preference): Apple, Lenovo&MotM
  + Preferred Option 2 or a modified version: Ericsson (option 2’), Futurewei, Fujitsu, vivo, Nokia, NSB
  + Preferred Option 12: Qualcomm, LGE, OPPO

It is observed the original Option 1 has the majority support of 13 companies, while Option 2 has 5 supporting companies and Option 12 has 3. It is recommended that we try to move forward with Option 1 without the FFS bullet to keep the solution as simple as possible. For low priority transmissions, they can always be transmitted using the exceptional pools.

* On Question 3-2 (re-evaluation and pre-emption checking for random selection),
  + Support (13): Ericsson, Qualcomm, Apple, LGE, Convida, OPPO, Samsung, DCM, vivo, Lenovo&MotM, ZTE, Sanechips
  + Questions: Xiaomi,
  + Not support (8): Futurewei, HW, HiSi, Fujitsu, CATT, Panasonic, Nokia, NSB

It was clarified by some companies that some of the motivations / reasons why a sensing capable UE would perform random resource selection could be due to insufficient sensing, short PDB, and power saving for the resource selection but improving reliability from re-evaluation and pre-emption checking. At the same time, there was also a suggestion that we can revisit this proposal after the discussion for CPS. Since this issue does not have impact to other designs, let’s revisit at a later stage.

**Proposal 3-1 (II):** For random resource selection in a resource pool (pre-)configured with full/partial sensing and random resource selection,

* 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 remaining details for the RRC parameter (e.g., possible priority threshold values or the range of priority values)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | Support. |
|  |  |
|  |  |
|  |  |
|  |  |

## Topic #4: Re-evaluation and pre-emption checking (next level details)

**Background**: In R16 NR sidelink, UE performs re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) for every pre-selected / reserved resource and all TBs in every period (for periodic transmissions). For R17 power saving UEs, we should aim adopt a mechanism to achieve a good balance between PRR / reliability performance and power saving gain. This includes the actual sensing mechanism and how often the re-evaluation and pre-emption checking should be performed by the UE.

From reviewing the contributions submitted to this meeting, there are two issues we can try to have some initial discussions.

First issue: Transmission period / TB for re-evaluation and pre-emption checking

* Option 1: UE performs re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) ONLY during the initial resource (re)selection period for both periodic and aperiodic transmission cases.
* Option 2: UE performs re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) for every TB / transmission period, in case of periodic transmission.
* Option 3: (Pre-)configurable between Option 1 and Option 2 for the case of periodic transmission.
* Option 4: (Pre-)configured to perform re-evaluation based on the priority of the TB; Skip pre-emption for certain reservation periods and the number of skip periods is (pre-)configured per priority.

Second issue: Candidate resources for partial sensing in re-evaluation and pre-emption checking

* Option 1: UE performs partial sensing only for the pre-selected resources and/or reserved resources .
* Option 2: UE performs partial sensing according to the remaining candidate resources set (*SA*) from the initial resource (re)selection procedure.
* Option 3: UE performs partial sensing beyond the remaining candidate resources set (*SA*) from the initial resource (re)selection procedure (e.g., covering also some or all of the remaining RSW)

### Proposals before 1st GTW session

**Question 4-1:** Should the UE perform re-evaluation and pre-emption checking only in the initial resource (re)selection period or in every transmission period / TB?

* Option 1: ONLY during the initial resource (re)selection period for both periodic and aperiodic transmission cases.
* Option 2: For every TB / transmission period, in case of periodic transmission.
* Option 3: (Pre-)configurable between Option 1 and Option 2 for the case of periodic transmission.
* Option 4: (Pre-)configured to perform re-evaluation based on the priority of the TB; Skip pre-emption for certain reservation periods and the number of skip periods is (pre-)configured per priority.
* Option 5: other, please elaborate

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| Xiaomi | Option 2 | All other options may have issue that the pre-emption from higher priority transmission would be ignored, this would degrade the reliability of high priority data transmission. Therefore, option 2 should be supported. |
| Ericsson | Option 5 | For every TB / transmission period, for both periodic and aperiodic transmission cases. |
| Qualcomm | Option 2 | Checking every TB transmission period increases the probability of detecting other UEs’ reservations and reduces collision likelihood by providing the UE with more opportunities to change its selected or reserved resources. |
| Futurewei | Option 2 | Same rule in Rel-16 V2X on re-evaluation and pre-emption checking can be applied. Power consumption is already reduced a lot by periodic based partial sensing. Addition power saving over partial sensing by skipping re-evaluation and pre-emption is very limited. For additional power saving, UE can consider the random resource selection. |
| Apple | Option 2 | To achieve the reliable resource selection, we prefer Option 2 to ensure the resource re-evaluation or pre-emption checking is performed at each period. |
| LGE | 2 | We support option 2 for resource collision avoidance. The sensing results for initial resource selection cannot guarantee no collision on the TBs of the following periodic transmissions. |
| Convida Wireless | Option 2 | The UE should perform re-evaluation and pre-emption checking in every transmission period or TB. |
| OPPO | Option 2 with comment | Support the proposal in general. Perform re-evaluation and pre-emption checking for each TB can achieve higher reliability. Our simulation compares the PRR performance between option 1 and option 2, and the results show that option 2 has better performance.  We agree with Ericsson’s comment. This should apply to both periodic and aperiodic transmission. |
| Samsung | Option 2 | Neighbour UEs may enter the communication range recently e.g. after TX UE’s transmission in last period, thus resource reservation in last period may not work, especially in high mobility scenarios. Therefore Pre-emption/re-evaluation for every TB/transmission period is needed. |
| NTT DOCOMO | Option 5 | Same view as Ericsson. |
| Spreadtrum | Option2 | Considering the reliability of resource selection, we prefer option 2. |
| Huawei, HiSilicon | With comments | We prefer to reuse the re-evaluation and pre-emption checking procedure in Rel-16 as much as possible. For both initial transmission and retransmission in each period, at least slot m-T3 is checked, where slot m refers to any resources selected by MAC layer, i.e. a resource belongs to  **or .**  The current question 4-1 is not clear whether the retransmission is included or not and whether option 2 is same as Rel-16 or not.  On top of the re-evaluation and pre-emption checking issues, we think the “sensing mechanism” summarized in section 4.5 is essential and can be prioritized to discuss as well. So we suggest to have one (or more) question(s)/proposal(s) on the sensing mechanism design, such as which slots are monitored for re-evaluation and pre-emption checking, etc. |
| Fujitsu | Option 1 or Option 4 | We think such methods can be considered to obtain more power saving gain, which is aligned with the objective of this topic. For instance, different from resource selection, additional sensing for re-evaluation and pre-emption may be useless if the collision is not detected. So, we think we can consider some trade-off methods like Option 1 and 4. |
| vivo | Option 2 | We share similar view with LGE. If only the initial period is checked, there is no guarantee that collisions in subsequent periods can be avoided. |
| CATT | Option 5 | Re-evaluation checking should be performed during the initial resource (re)selection period for both periodic and aperiodic transmission cases.  Note: In Release 16, for resource(s) pre-selected and to be first time signaled, re-evaluation checking is mandatory. But for the non-resource selection TB/transmission period(s), resource(s) has been already signaled, and there is no need to perform re-evaluation checking. Same rule in Rel-16 V2X on re-evaluation checking should be applied.  Pre-emption checking should be performed for every TB / transmission period, in case of periodic transmission, when *sl-PreemptionEnable* is (pre-)configured |
| Lenovo&MotM | Option 2 |  |
| Panasonic | Option 5 | We agree with Ericsson’s comments to apply for both periodic and aperiodic TBs. |
| ZTE, Sanechips | Comments | The triggering of re-evaluation/pre-emption is up to MAC. It’s better to use ‘can’ instead of ‘should’. Moreover, both initial and retransmissions for every aperiodic/periodic TB can be subject to reevaluation/pre-emption. |
| LGE(2) | Comments on FL proposal | We need clarification on Proposal 4-1 by FL. We understand Option 2 as a same rule as in Rel.16 NR V2X. There are some notes in Section 5.22.1.2a in 38.321 regarding the case of periodic transmission.  NOTE 6: For the selected sidelink grant corresponds to transmissions of multiple MAC PDU, 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.  Further clarification needs to be added as below to follow the Rel.16 rule.  **Proposal 4-1 (I):** It is supported that UE performs re-evaluation and pre-emption checking for the initial transmission and retransmissions of a TB in each transmission period based on Rel.16 rule, for both periodic and aperiodic transmission case. |
| Nokia, NSB | Option 2 |  |

**Question 4-2:** How to determine candidate resources for partial sensing in re-evaluation and pre-emption checking?

* Option 1: UE performs partial sensing only for the pre-selected resources and/or reserved resources .
* Option 2: UE performs partial sensing according to the remaining candidate resources set (*SA*) from the initial resource (re)selection procedure.
* Option 3: UE performs partial sensing beyond the remaining candidate resources set (*SA*) from the initial resource (re)selection procedure (e.g., covering also some or all of the remaining RSW)

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| Xiaomi | Option1 or option 2 | We think UE should reuse the existing sensing results as much as possible, and thus option 1 or option 2 is preferred. |
| Ericsson |  | For this question, we would like to get clarification on it. In our view, the options in the questions are either the legacy behaviour of a UE performing re-evaluation and pre-emption checking or the procedure has been already agreed in previous meetings.  What is the intention of this proposal and which parts of the procedure would be changed? |
| Qualcomm | Option 1 | We don’t see the need to depart from Rel-16 procedure for this case. |
| Futurewei | Comments | Since the initial set SA for aperiodic transmission with CPS or PBPS+CPS is not yet specified yet, we suggest considering this after discussions of initial set, sensing windows, resource selection window for aperiodic traffic with CPS and PBPS+CPS.  In general, for re-evaluation and pre-emption, we propose to follow the procedures in Rel-16 as much as possible, i.e., UE continues the sensing and performs resource exclusions before m-T3. Therefore, for partial sensing, we can follow the same procedure. Since periodic partial sensing slots are specified based on most recent sensing occasion before the first slot of Y candidate slot, no additional sensing is performed within Y slots. Contiguous sensing can be specified within Y candidate slots (for periodic traffic) and within RSW (for aperiodic), UE shall perform CPS beyond remaining candidate resources set (*SA*). One other issue is that remaining candidate resource set is formed based on a procedure with RSRP threshold change. With new sensing results, some resource that was excluded may appear in the remaining set. Therefore, generally, option 3 is preferable. But we are open to option 2 depending on outcome from other discussions as aforementioned. |
| Apple | Option 1 or Option 2 with comments | We may need to discuss periodic based partial sensing and contiguous partial sensing separately.  For periodic based partial sensing, we support Option 2. In case a selected/reserved resource is unavailable, then UE could select a replacement resource from candidate resource set.  For contiguous partial sensing, we support Option 1 since there is no clear candidate resource set defined. |
| LGE | 2 | We support option 2 as it preserves the resources for reselection if collision is detected based on re-evaluation and pre-emption checking. |
| Convida Wireless | Option 1 or Option 2 | We prefer the option 1 and option 2 for UE performs partial sensing only for the pre-selected resources and/or reserved resources or UE performs partial sensing according to the remaining candidate resources set (*SA*) from the initial resource (re)selection procedure |
| Samsung | Option 1 with comments | We prefer option 1 to reuse existing sensing result and follow legacy structure as much as possible. In addition, we suggestion the following modification:  Option 1: UE performs partial sensing only for the ~~pre-selected~~ higher-layer selected resources subject to re-evaluation and/or ~~reserved~~ higher-layer selected resources subject to pre-emption . |
| NTT DOCOMO | Option 1 or Option 2 | Additional monitoring slots of PBPS for re-evaluation/pre-emption check should be avoided. Option 1/2 can achieve this, but Option 3 cannot. |
| Huawei, HiSilicon | Discuss sensing mechanism first. | We prefer to reuse Rel-16 mode 2 procedure as much as possible, for those resources selected by higher layer resource (i.e.  **or**), a UE performs re-evaluation and pre-emption checking. On the other hand, we want some clarifications from FL that whether option 1 is same as Rel-16 re-evaluation and pre-emption checking or not?  Similar to Question 4-1, we suggest to discuss the sensing mechanism first. |
| Fujitsu | Comments | We think this issue including two aspects, maybe we can discuss them separately:   1. Defining PSOs for re-evaluation/pre-emption checking for the pre-selected resources and/or reserved resources . 2. Defining PSOs for resource reselection candidate resource set triggered by re-evaluation/pre-emption checking   For 1), we think specify the PSOs for option 1 is enough; For 2), we prefer option 3 because the remaining candidate resources set (SA) may be not enough (i.e., less than Ymin), so additional resources beyond the remaining candidate resources set can be selected during the resource reselection. |
| vivo | Option1 | According to the agreement highlighted below, our understanding is that option1 is the only way to go. We also see no motivation to depart from the R16 procedure to introduce more candidate resources in addition to the indicated set.  **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. |
| CATT | Option 2 | UE should reuse the existing sensing results as much as possible. |
| Panasonic | Option 1 or 2 | We prefer to reuse existing resources. |
| ZTE, Sanechips | Comments | Similar view as Fijitsu. |
| Nokia, NSB | Comments | We’d like to defer this discussion after the resource selection of partial sensing for both CPS and CPS+PBPS. Besides, we shall reuse Rel-16 as much as possible. |

### Proposals before 2nd GTW session

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

* On Proposal 4-1 (re-evaluation and pre-emption checking in every transmission period), this was briefing discussed during the first GTW session for sidelink on Tuesday (1st week). Based on the comments received and raised during the first round of discussion, the proposal is updated below.
* On Question 4-2 (candidate resources for partial sensing in re-evaluation and pre-emption checking),
  + Option 1: Xiaomi, QC, Apple, Convida, Samsung, DCM, vivo, Panasonic
  + Option 2: Xiaomi, Apple, LGE, Convida, DCM, CATT, Panasonic
  + Comments:
    - Ericsson: In our view, the options in the questions are either the legacy behaviour of a UE performing re-evaluation and pre-emption checking or the procedure has been already agreed in previous meetings.
    - Futurewei/HW/HiSi/Nokia/NSB: defer this discussion after the resource selection of partial sensing for both CPS and CPS+PBPS
    - Fujitsu/ZTE/Sanechips:
      * Defining PSOs for re-evaluation/pre-emption checking for the pre-selected resources (r\_0,r\_1,r\_2,…) and/or reserved resources (r\_0^',r\_1^',r\_2^',…).
      * Defining PSOs for resource reselection candidate resource set triggered by re-evaluation/pre-emption checking

Since there is a somewhat strong desire to finalize the sensing mechanism for both CPS and PBPS+CPS, we can revisit this later (maybe in the next meeting).

**Proposal 4-1 (II):**

When UE is configured with partial sensing by its higher layer, the UE performs re-evaluation and pre-emption checking (when *sl-PreemptionEnable* is (pre-)configured) for the initial transmission and retransmissions of a TB in each transmission period as per Rel-16 behaviour, for both periodic and aperiodic transmission cases.

* Note, in Rel-16, it is up to UE implementation to perform re-evaluation after the initial resource (re)selection period.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | Supportive but clarification.  Now we are talking about “when” UE performs re-evaluation and pre-emption checking, right? “How” UE performs is separate issue (Question 4-2).  The reason of this clarification is that “as per Rel-16 behaviour” can be understood “How” is also included. This point should be clearly mentioned in this proposal. |
|  |  |
|  |  |
|  |  |
|  |  |

## Topic #5: Sidelink DRX

**Background**: For the issue (LS from RAN2) on UE performing sensing operation and its relationship with SL DRX (when configured), RAN1 reached the following agreement during the last RAN1#106-e meeting.

|  |
| --- |
| **Agreement**  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 |

From reviewing the contributions submitted to this meeting, for the first FFT item, it is observed that different proposals can be categorised in into the following 3 options.

* Option 1: UE performing PSCCH reception and RSRP measurement for sensing based on defined rules / processes in the specification regardless of SL DRX active and inactive time of the UE.
* Option 2: UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time according to one or more specified rules / conditions (e.g., total number of sensing slots in DRX inactive time is greater than a threshold, using different set of (pre-)configured settings for sensing during SL DRX inactive time, only the most recent PSO is monitored, only after resource (re)selection trigger, etc.)
* Option 3: Up to UE implementation

### Proposals before 1st GTW session

**Question 5-1:** Which one of the following options is preferred for UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time? Please elaborate the reason(s) why for the preference and/or why others are not preferred.

* Option 1: UE performing PSCCH reception and RSRP measurement for sensing based on defined rules / processes in the specification regardless of SL DRX active and inactive time of the UE.
* Option 2: UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time according to one or more specified rules / conditions (e.g., total number of sensing slots in DRX inactive time is greater than a threshold, using different set of (pre-)configured settings for sensing during SL DRX inactive time, only the most recent PSO is monitored, only after resource (re)selection trigger, etc.)
* Option 3: Up to UE implementation

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| Xiaomi | Option 1 | For a given UE the data transmitting and reception can be two independent processes. To reduce the standardization effort, the same rules can be applied regardless of SL DRX status. |
| Ericsson |  | We propose to have as general behaviour that it is up to UE implementation to perform PSCCH reception and RSRP measurement for sensing outside the Active Time. If a UE gets a packet for transmission during its inactive time, it has two options:   * Wait until active time, and then sense and select resources as soon as it has enough sensing results according to the rules for the sensing procedure it is using. * Start sensing during inactive time, until it has enough sensing results according to the rules for the sensing procedure it is using.   That is:   * The sensing procedure used by the UE determines how much sensing it must perform (number of slots, etc.) * The UE decides whether it wants to start sensing immediately or wait.   Option 1: UE performing PSCCH reception and RSRP measurement for sensing based on defined rules / processes in the specification, e.g., the minimum contiguous sensing window is not fulfilled, regardless of SL DRX active and inactive time of the UE. |
| Fraunhofer | Option 2 | Since the UE can already perform PSCCH reception and RSRP measurement within the SL DRX active time, we need to define only the time period when the UE carries out sensing within the inactive time. |
| Qualcomm | Option 3 | If Option 1 is introduced, it will largely negate the power saving benefits of DRX since the UE would be prevented from going to sleep in many cases. The simplest option in our view is to leaving sensing outside of active time up to UE implementation rather than try to define a rule for every case and scenario. |
| Apple | Option 2 | We think UE does not have to perform PSCCH reception and RSRP measurement during its SL DRX inactive time, except it has data to transmit. Hence, it could perform sensing in SL DRX inactive time only after resource (re)selection trigger. |
| Futurewei | Option 2 | One or more specified rules/conditions, e.g., minimum sensing requirements, need to be specified for sensing during SL DRX inactive time. |
| LGE | 1 | We support option 1 as it guarantees reliable sensing results in SL DRX as same as in no SL DRX operation. |
| Convida Wireless |  | We are open for the options 1 and 2. UE performing PSCCH reception and RSRP measurement for sensing based on defined rules in the specification regardless of SL DRX active and inactive time of the UE. UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time may be according to one or more specified rules or conditions. |
| OPPO | Option 1 | Considering time limit (only 2 meeting left for R17), there is many other important issue to be discussed. For this topic/issue, there is no necessary to pursue additional optimization for the sensing behaviour. |
| Samsung | Option 1 | For Option 2, since Rel-17 UE sensing behaviour was not completed yet, it is difficult to justify the benefit of Option 2 compared with Option 1. We think that Option2 is for optimization.  Option 3 will cause system performance degradation since some UE may not perform sensing within DRX inactive time by UE implementation and that can cause interference to other UEs. |
| NTT DOCOMO | Option 1 (or 2) | Firstly Option 3 is not OK for us. Completely up to UE implementation means that many reservations would be missed and so many collisions are assumed. Option 1 (or Option 2 as compromise) should be agreed. Note that even in option 1 or option 2, if the UE does not have any transmit data, then the UE can sleep and achieve power saving gain. The UE needs to do sensing ONLY when the UE has transmit data.  One possible compromise would be configurability of which option 1/2 or option 3 is applied for a resource pool. |
| Spreadtrum | Option 3 | Whether supporting sensing during SL DRX inactive time is a tradeoff between power saving and resource selection reliability. From the perspective of power saving, we don’t support option 1. And considering the progress, we prefer some simply solution. So, we support option 3 that SL reception of PSCCH and RSRP measurement for sensing during SL DRX inactive time is up to UE implementation. |
| Huawei, HiSilicon | Option 2 | Option 2 is preferred to balance the power saving gain and performance. So conditions should be defined and UE performs sensing during SL-DRX inactive only when conditions are met.  Option 3 leaves uncontrolled the impacts on system performance where up to UE implementation to decide whether or not performing sensing during inactive time.  Option 1 undermines the power saving gain of SL-DRX. |
| Fujitsu | Option 2 | We think different set of (pre-)configured settings for sensing during SL DRX inactive time can be considered, for example, for PBPS, if all the corresponding PSOs are overlapped with SL DRX inactive time, only the most recent PSO is monitored. |
| CATT | Option 2 | Option 2 is more flexible to achieve power saving gain and avoid collision. |
| Lenovo&MotM | Option 2 |  |
| Panasonic | Option 2 | If option 1 applies, it will lose the power saving benefit of DRX.  We prefer option 2 to have (configurable) trade-offs between performance and power saving with rules. |
| ZTE, Sanechips | Option 1 |  |
| Nokia, NSB | Option 3 | If Option 2 is applied, the open issues would be the specification and/or signalling of these “rules” and “conditions”. Better leave this for UE implementation. |
| vivo | Option2 | Option 2 is preferred as it can balance reliability and power saving gain. Some more conditions can be further included. For example, when the number of sensing slots in the inactive time is small and requires no significant power consumption, or when the CBR/CR is high or the priority of the TB to be transmitted is high, UE can perform sensing in the inactive time.   * Option 2: UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time according to one or more specified rules / conditions (e.g., total number of sensing slots in DRX inactive time is greater than a threshold, using different set of (pre-)configured settings for sensing during SL DRX inactive time, only the most recent PSO is monitored, only after resource (re)selection trigger, total number of sensing slots in DRX inactive time is smaller than a threshold, CBR/CR is higher than a threshold, priority of the TB to be transmitted is higher than a threshold, etc.)   In addition, some restrictions on the inactive slots which are/are not used for sensing can be considered as well   * + The slots during its SL DRX inactive time on which PSCCH reception and RSRP measurement for sensing is performed should be no larger than a (pre-)configured value   The slots during its SL DRX inactive time on which PSCCH reception and RSRP measurement for sensing is not performed should be no smaller than a (pre-)configured value |

### Proposals before 2nd GTW session

FL observations and comments based on inputs received in Sec. 3.5.1:

* On Proposal 5-1 (UE sensing during SL DRX inactive time),
  + Option 1 (8): Xiaomi, LGE, Convida, OPPO, Samsung, DCM, ZTE, Sanechips
  + Option 2 (13): Fraunhofer, Apple, Futurewei, Convida, DCM, HW, HiSi, Fujitsu, CATT, Lenovo&MotM, Panasonic, vivo
  + Option 3 (5): Ericsson, QC, Spreadtrum, Nokia, NSB

**Proposal 5-1 (I):** It is (pre-)configurable between the following options:

* Option 1: UE performing PSCCH reception and RSRP measurement for sensing based on defined rules / processes in the specification regardless of SL DRX active and inactive time of the UE.
* Option 2: UE performing PSCCH reception and RSRP measurement for sensing during its SL DRX inactive time according to one or more specified rules / conditions.
  + FFS the rules / conditions (e.g., total number of sensing slots in DRX inactive time is greater than a threshold, using different set of (pre-)configured settings for sensing during SL DRX inactive time, only the most recent PSO is monitored, only after resource (re)selection trigger, etc.)
* Option 3: Up to UE implementation

|  |  |
| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | Not best way, but we are fine with (pre-)configurability for compromise.  Regulator can select what is more important, reliability performance in the resource pool or power saving performance for each power saving UE. |
|  |  |
|  |  |
|  |  |
|  |  |

Contribution summary for power saving RA

## Periodic-based partial sensing (remaining issues)

* Value for k
  + Confirm the working assumption made in #105-e (i.e., k = the most recent two occasions)
    - Yes: [1/HW, HiSi], [3/Nokia, NSB], [7/OPPO], [12/Xiaomi], [16/MTK], [32/E///]
    - Modify/clarify the working assumption to include only the last periodic sensing occasion prior to the most recent one: [1/HW, HiSi], [10/CMCC], [18/DCM], [25/Sharp]
    - Simulation results:
      * [1/HW, HiSi]: We observed k = most recent two outperforms k = most recent one with an increase of 20m in communication range at PRR = 99%
  + Maximum or additional values for k
    - More than 2 (pre-configured): [2/Futurewei] – the last 3 occasions, [5/vivo], [13/ Fraunhofer], [17/Intel] – 4 values, [22/ETRI]
  + RRC (pre-)configuration signalling:
    - The RRC parameter set *additionalPeriodicSensingOccasion* lists the additional sensing occasions for each periodicity in *sl-ResourceReservePeriodList* or its subset if configured. [2/Futurewei]
    - Whether the k value is (pre-)configured per P\_reserve depends on the format of the k, and details can be up to RAN2 [10/CMCC]
    - The additional sensing IE additionalPeriodicSensingOccasion, if configured, applies to all the periodicity. [20/ZTE, SC]
    - Adopt a bitmap for (pre-)configuration of k and (pre-)configuration of k values in PBPS applies for all the reservation periodicities. [25/Sharp], [30/ITL]
  + Others
    - [26/Apple]: when more than the most recent sensing occasion for a given resource reservation periodicity *Preserve* needs to be monitored, the product of the resource reservation periodicity *Preserve* and its corresponding *k* value is upper bounded by a (pre)configured threshold.
* Identification of Y candidate slots (within resource selection window)
  + Minimum number of candidate slots Y (*Ymin*) is determined based on
    - Transmission packet priority, [21/Sony], [6/Fujitsu], [8/NEC], [7/OPPO], [17/Intel] (1..32), [24/IDC]
    - congestion/interference level, [21/Sony], [6/Fujitsu], [9/CATT, GH]
    - number of PSCCH/PSSCH resources to be selected [26/Apple]
  + When PSFCH is configured, HARQ RTT related timing restriction should be considered when UE determines the “Y” candidate slots. [6/Fujitsu]
* Others (e.g., how to handle insufficient sensing results / Y candidate slots within RSW, resource exclusion process, and partial sensing for set of periodically occurring/partitioning resources, etc)
  + Insufficient PBPS results may be due to
    - number of candidate slots for which periodic-based partial sensing is performed is less than the (pre-)configured minimum number of *Y* candidate slots (*Ymin*)
    - *N*⸱*PTX* > *Preserve\_threshold* where
      * *N* is number of TBs transmitted without semi-persistent reservation configured for given PTX
      * *PTX* is the reservation period for transmission
      * *Preserve\_threshold* is a pre-configured threshold from one of the *Preserve* values
  + When PBPS result is insufficient, possible solutions are:
    - Random resource selection in a normal resource pool configured with random resource selection (if priority is higher than a configured threshold) or in an exceptional pool [1/HW, HiSi], [7/OPPO], [23/LGE]
    - Resource selection only based on contiguous partial sensing [7/OPPO], [14/Samsung], [17/Intel], [23/LGE]
      * Plus, all applicable periodic-based partial sensing results (e.g. there may still be some Y candidate slots within the RSW) [7/OPPO], [14/Samsung]
      * UE is not allowed to use semi-persistent reservation [17/Intel]
    - PBPS candidate slots should be prioritized in resource selection [3/Nokia, NSB]
    - UE uses assistance information messages in order to obtain the required sensing information for carrying out reliable resource selection. [13/Fraunhofer]
  + For periodic-based partial sensing, with semi-persistent transmissions enabled per resource pool and multiple sensing occasions configured for *Preserve* [17/Intel]
    - A slot is excluded if all of the *k* sensing occasions for each *Preserve* were not monitored for this slot
    - Each sensing occasions is treated independently for the SL-RSRP based candidate resource exclusion – following the step 6) and 7) of Rel-16 TS 38.214 Sec. 8.1.4 [23/LGE]
  + When determining the sensing occasions for resource re-selection, RAN1 may need to further discuss whether the definition rule of partial sensing occasions for initial resource selection should be completely reused. [6/Fujitsu]
  + For sidelink partial sensing, make sure that the slots hypothetically reserved by non-monitored slots due to SL transmissions are excluded from Y candidate slots. [8/NEC]
  + It is suggested to clarify whether the resource pool is shared between Mode1 and Mode2, and whether periodic resource reservation is supported for Mode1 in the shared resource pool, when to configure k. [11/CAICT]
  + The determination of the Y slots should be pre-defined patterns instead of up to UE implementation. The pattern timing could be with reference to t=n or absolute slot number. [19/Panasonic]
  + Periodic sensing occasions that a UE monitors should be within a sensing gap [20/ZTE, SC]
  + [28/ASUSTeK]:
    - UE shall handle not-monitored slot case, at least for periodic sensing occasions between triggering slot n and the first slot of the selected Y candidate slots subject to processing time restriction.
    - UE shall handle not-monitored slot case for sensing slots within contiguous partial sensing region.
  + [29/QC]:



* + - For supporting mode 2 resource allocation with partial sensing, define a set of periodic partial sensing resource sets partitioning a resource pool.
    - A UE can perform partial sensing over a single or multiple resource sets.
    - The reservation of a resource in a given set can only be signalled from another slot associated with the same resource set.
    - For a UE performing partial sensing, if the resource selection procedure is triggered in slot , the resource selection window consists of the slots associated with a given partial sensing window that lie within .
    - For identifying the availability of resources in a selection window associated with a given partial sensing set in a resource pool with periodic reservation disabled, the sensing information from the past 32 slots that are within the intersection of the sensing window and the same partial sensing set is sufficient.
    - For identifying the availability of a slot associated with a given partial sensing set in a resource pool with periodic reservation enabled, in addition to the sensing information for aperiodic reservations as proposed in Proposal 6, the sensing information from , , is required if belongs to the same partial sensing set.
    - A partial sensing UE performs reception over the set of periodic resources assigned for sensing/transmission.
    - Other UEs should know when a partial sensing UE can receive in order to communicate with it.
  + Mandating UE monitoring of occasions corresponding to *PRSVP\_Tx*
    - If a single set of *Preserve* values can be (pre-)configured, monitoring corresponding to *PRSVP\_Tx* not part of the set is NOT mandated. [5/vivo], [9/CATT, GH], [10/CMCC], [16/MTK], [18/DCM], [22/ETRI], [32/E///]
    - It should be mandated: [12/Xiaomi], [21/Sony], [26/Apple], [29/QC]
  + Enhancements on periodic reservations [9/CATT, GH]
    - In PBPS, when (pre-)configuring additional *k* value(s), for a decoded SCI in slot *m* indicating , UE can assume the associated resources in slot , … , are reserved.

## PBPS + CPS (RP with periodic reservation enabled)

* Condition(s) to perform periodic-based partial sensing + contiguous partial sensing
  + When a resource pool is enabled with periodic reservation and UE is triggered to perform resource (re)selection based on partial sensing,
    - PBPS+CPS shall be always performed [1/HW, HiSi], [5/vivo], [7/OPPO], [10/CMCC], [16/MTK], [17/Intel], [18/DCM], [21/Sony], [23/LGE], [24/IDC]
  + Send an LS to RAN2 to check whether to report periodic-based partial sensing results only is allowed [20/ZTE, SC]
* Determination of CPS monitoring window [n+*TA*, n+*TB*]
  + For periodic transmissions,
    - [1/HW, HiSi], [8/NEC]: *n*+*T*A = and *n*+*T*B =  (regardless of periodic or aperiodic transmission)
    - [2/Futurewei]: CPS starting slot is ty0-31 or later based on a pre-defined range or list. The ending slot is between [TB,min and TB,max]
    - [4/Spreadtrum]: CPS can be performed before slot n, and *TB* - *TA* should be 31 slots.
    - [5/vivo]: *n*+*T*A = and *n*+*T*B =
    - [7/OPPO]: *n*+*T*A ≥ and *n*+*T*B = , where *T*B *– T*A *> M*.
    - [10/CMCC]: [n + TA, n + TB] should be [ty0 - 31, ty0 – Tproc,0 – Tproc,1]
    - [12/Xiaomi]:
      * If *y0 – 31 ≥ 0*; then *TA = y0- 31*, and *TB = y0– Tproc1 – Tproc0*
      * Elseif *y0 – Tproc1 – Tproc0 ≥ 0*; then *TA* is determined by UE implementation with *TA ≤0; TB = y0 - Tproc1 - Tproc0*
      * Else, *TA= TB = 0*
    - [16/MTK]: *n*+*T*A ≥ and *n*+*T*B ≥ , where is the last Y candidate slot
    - [6/Fujitsu]:
    - [17/Intel]:
      * Two alternatives for TA:
        + TA within a range: –max(*tn-M*, resource selection window size) ≤ TA ≤ 1 slot, where tn-N is the distance in physical slots to the slot that is *M* logical slots before the slot with physical index n
        + TA within a range: –max((∆A + tn-*M*), resource selection window size) ≤ TA ≤ 1 slot, where tn-N is the distance in physical slots to the slot that is *M* logical slots before the slot with physical index n, the value of ∆A depends on the maximum time required for switching from sleep state to the monitoring/sensing state
      * TB = ∆B – T3 ≤ PDB, where the value ∆B is determined by slot corresponding to the last retransmission of a given TB or HARQ feedback, T3 is processing delay in slots
    - [26/Apple]: and, where is the time gap between the resource selection trigger and the first candidate resource slot based on periodic-based partial sensing.
    - [14/Samsung]: and
    - [23/LGE]: and *,* where *WCPS* isnot smaller than a (pre-)configured *WCPSmin*
    - [18/DCM], [24/IDC]: and *n+TB = − −*
    - [20/ZTE, SC]: *n*+*T*A should be later than and *n*+*T*B is the slot y1 - .
  + For aperiodic transmissions,
    - [1/HW, HiSi]: *n*+*T*A = and *n*+*T*B = (regardless of periodic or aperiodic transmission)
    - [2/Futurewei]: TB is upper bounded by PDB-WRSW,min - (Tproc,0 +Tproc,1 ) and a minimum CPS monitoring window is smaller than 32- (*Tproc,0* +*Tproc,1*).
    - [4/Spreadtrum]: CPS should perform after resource (re-)selection trigger slot n.
    - [5/vivo]: CPS window corresponding to the Y slots
    - [14/Samsung]: and , where is the slot index of earliest candidate resource. *T*B or its lower/upper bound can be configured according to priority and remaining PDB. If there exists no sufficient resource satisfying any of conditions above, consider further reducing *T*B value or not perform partial sensing.
    - [16/MTK]: *n*+*T*A ≥ and *n*+*T*B ≥ , where is the last Y candidate slot
    - [6/Fujitsu]: andare positive integers and
    - [7/OPPO]: *T*A = 0 or 1, M ≤ TB-TA ≤ 31, T2-TB ≥ Ymin, where M is min CPS window
    - [12/Xiaomi]: TA and TB are determined using the same method as that for CPS only.
    - [26/Apple]: and, where is the time gap between the resource selection trigger and the first candidate resource slot based on periodic-based partial sensing.
    - [23/LGE]: , , where  is the timing of the first candidate slot, *WCPS* is not smaller than a (pre-)configured *WCPSmin*
    - [17/Intel]:
      * TA = 1 slot or TA ≤ ∆A, where ∆A is the max time for UE to switch from a sleeping state to monitoring state needs to be considered. ∆A = 1 meaning that the monitoring window starts at slot ‘n+1’
      * TB = ∆B – T3 ≤ PDB, where the value ∆B is determined by slot corresponding to the last retransmission of a given TB or HARQ feedback, T3 is processing delay in slots
    - [18/DCM]: and *n+TB = − −*
    - [24/IDC]:
      * If there are Y ≥ Ymin candidate slots within the RSW:
        + UE determines the CPS window according to the first slot of *Y* candidate slots and resource (re)selection trigger slot *n*.
      * If there are no Y ≥ Ymin candidate slots within the RSW:
        + *TA = 1*, minimum value of *TB* is (pre-)configured per priority. The set of candidate resources (Set A) is initialized in the window [*n+ TB + Tproc, n+**T2*]
* Whether a new set of Y candidate slots is selected within the RSW for aperiodic transmission
  + Yes
    - If there are corresponding periodic sensing occasions between slot n and first slot of Y. [3/Nokia, NSB], [5/vivo] (up to UE implementation)
    - Y candidate slots for CPS can be separately configured from existing candidate slot for PBPS [9/CATT, GH]
    - When the set of Y candidate slots within the RSW is smaller than a configured parameter *Ymin,p*, a new set of *Y* candidate slots can be determined by the UE to monitor corresponding periodic sensing occasions. [10/CMCC], [24/IDC]
  + No
    - No new set of Y candidate slots, reuse existing Y candidate slots only [1/HW, HiSi], [2/Futurewei], [7/OPPO], [14/Samsung], [17/Intel], [18/DCM], [23/LGE], [25/Sharp]
* Initialization of candidate resource set (SA)
  + For aperiodic transmission,
    - One candidate resource set (*SA*) per resource (re)selection trigger is initialized to the set of all candidate single-slot resources within a selected Y candidate slots in PBPS.
      * It is up to UE implementation to select the set of Y candidate slots within the RSW (e.g. reusing an existing set of Y slots and/or select a new set of Y slots when existing Y candidate slots does not match with RSW)
      * [1/HW, HiSi], [5/vivo], [18/DCM], [23/LGE], [26/Apple]
    - When there is an existing set of Y candidate slots and at least *Ymin* slots of them are located within the RSW, [7/OPPO]
      * a candidate resource set (*SA*) per resource (re)selection trigger is initialized to the set of all candidate single-slot resources from those slots that are located within the RSW. [24/IDC]
      * Otherwise, a candidate resource set (*SA*) per resource (re)selection trigger is initialized to the set of all candidate single-slot resources within the remaining RSW after a CPS monitoring window.
    - PBPS candidate slots should be prioritized in resource selection [3/Nokia, NSB], [7/OPPO]
    - Results from the k PBPS sensing occasions and the CPS are combined to define the candidate set of resources [32/E///]
  + When a resource (re)selection procedure is in a mode 2 Tx pool with reservation for another TB enabled, if UE is configured with both periodic-based and contiguous partial sensing for the resource (re)selection procedure, the sensing results of the two schemes corresponding to different traffic should be applied to the different resource selection windows. [9/CATT, GH]

## CPS only (RP with periodic reservation disabled)

* Definition of *T1* and resource selection window (RSW)
  + *T1* and RSW are defined as per R16
    - [1/HW, HiSi], [7/OPPO], [23/LGE], [24/IDC], [25/Sharp]
    - [7/OPPO]: After CPS, the remaining RSW should overlap with at least *N* slots of SL-DRX ON duration of Rx-UE.
  + New definition of *T1*:
    - [9/CATT, GH]: 
      * No. of candidate slots in RSW should not exceed 32 logical slots to avoid selecting resource with no corresponding sensing results
    - [14/Samsung]: Selection of *T*1 is up to UE implementation under
    - [12/Xiaomi] (minimum RSW is prioritized / guaranteed over CPS window):
      * If T2 – MIN\_RSW – 31 ≥ 0
        + *T1 = n +TA + 31*
      * *Elseif T2- MIN\_RSW– 31<0*, and *T2- MIN\_RSW – Tproc1 – Tproc0 > 0*
        + *T1 =T2- MIN\_RSW*
      * *Else: T1 = Tproc1*
    - [18/DCM]: *n+T1 = n+TB + +*
  + [14/Samsung]:
    - Reuse the definition of *T*2 in legacy full sensing procedure, except that *T*2min is determined according to a minimum threshold of *T*2 – *T*1, and the minimum threshold of *T*2 – *T*1 is configured per priority.
    - The resource selection window of TX UE can be confined within slots corresponding to current or future DRX active time of RX UE(s).
  + A minimum RSW or remaining RSW is defined by
    - Ymin': [5/vivo] (Ymin'= Ymin if PBPS is also performed)
    - *T2min*: [7/OPPO], [32/E///]
    - **Ymin,c: [10/CMCC]**
    - **MIN\_RSW: [12/Xiaomi]**
    - 31- (*Tproc,0 +Tproc,1*) or smaller: [2/Futurewei]
* Determination of CPS monitoring window [n+*TA*, n+*TB*]
  + A minimum CPS monitoring window (*TB – TA*) size *M* is (pre-)configured.
    - Support:
      * [5/vivo], [18/DCM]
      * [2/Futurewei] (smaller than 32- (*Tproc,0* +*Tproc,1*))
      * [7/OPPO], [24/IDC] (according to L1 priority)
      * [9/CATT, GH], [13/ Fraunhofer] (priority and latency)
      * [32/E///] (according to measured CBR)
    - Not required: [20/ZTE, SC]
  + *TA* and *TB* values are dependent on:
    - TB is upper bounded by the remaining PDB minus the minimum RSW size and the processing time from sensing to transmission [2/Futurewei], [3/Nokia, NSB]
      * PDB-WRSW,min - (Tproc,0 +Tproc,1 )
    - TB -TA, depends on the remaining value of the PDB, the minimum RSW for a specific transmission, and CBR/CR metrics [32/E///]
    - The upper bound of the sensing window i.e., *TB*, is defined with respect to the minimum RSW (*T2min*). [32/E///]
      * If PDB < *M + T2min*,
        + The min sensing window size constraint can be neglected [2/Futurewei]
        + UE performs random resource selection [32/E///]
      * If PDB > *M + T2min*, UE performs sensing up to *n+TB*
  + [1/HW, HiSi]: *n*+*T*A = and *n*+*T*B =
  + [5/vivo]: CPS monitoring window takes into consideration of existing sensing slots from other procedure(s).
    - If min number of candidate slots (*Ymin*) and min *M* CPS slots criteria cannot be both met, the *Ymin* candidate slots should be fulfilled over the *M* CPS slots.
  + [7/OPPO]:
    - A minimum time criteria-based approach (min *M* CPS slots, and min *N* slots for DRX), or
    - and , where is selected by UE implementation and *M* is the minimum number of consecutive logical slots for the CPS monitoring window.
  + [8/NEC]: The end time of CPS windowcould be min [y0 – T1 – Tproc,0, y0 – Prev]. The start time of CPS window could be as early as possible, e.g., slot n.
  + [10/CMCC]: [n + TA, n + TB] should be [n+1, min{31, T2 - Ymin,c-Tproc,0 -Tproc,1 }]
  + [12/Xiaomi]:

1) If *T2- MIN\_RSW – 31≥ 0*,

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

- *TB = TA + 31 – Tproc0 – Tproc1*;

- *T1 = n +TA + 31*;

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*;

- *T1 =T2- MIN\_RSW;*

3) else

- *TA = TB = 0;*

- *T1 = Tproc1*;

* + [14/Samsung]: [*n*+*T*A, *n*+*T*B), where *T*A=1, and *T*B is up to 32
    - The value of *T*B or a lower/upper bound of *T*B is configured per priority or according to remaining PDB
  + [26/Apple]:
    - and , if the triggering slot *n* is not predictable
    - and if the triggering slot n is predictable
* Initialization of candidate resource set (*SA*)
  + *Y* candidate slots are selected within a RSW and *SA* is initialised for the selected *Y*.
    - [1/HW, HiSi], [8/NEC], [20/ZTE, SC]
  + Candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in the remaining RSW (after CPS) as [*n+TB+Tproc,0+Tproc,1*, *n+T2*]
    - [7/OPPO], [24/IDC], [25/Sharp],
  + Candidate resource set (*SA*) is initialized to the set of all candidate single-slot resources in the RSW as [*n+T1*, *n+T2*]
    - [14/Samsung], [18/DCM]
* Resource selection (RAN2)
  + UE prioritizes selection of the resources within Y = 31 slots from the CPS window. [24/IDC]

## Random resource selection (including mixed full/partial sensing with random selection in a same pool)

* Conditions in which random resource selection is applied
  + [9/CATT, GH]
    - UE capability, requirement on power saving, resource pool configuration, congestion condition (as indicated by CBR etc.) and (pre-)configured minimum contiguous partial sensing duration can be the criteria for random resource selection.
  + [12/Xiaomi]
    - A CR limit can be (pre)configured for resource usage of random resource selection for a UE, below which the UE can perform random resource selection. The CR limitation can be CBR dependent as in Rel-16.
  + [17/Intel]
    - UE does not decode PSCCH and measure RSRP (i.e., Type A and Type B UE)
    - UE is configured to operate in power saving resource allocation mode
* Identified issue 1: Randomly selected transmission by UE with no sensing capability and no re-evaluation and pre-emption checking in a resource pool configured with mixed RA schemes.
  + Observations from simulations
    - [1/HW, HiSi]: 1~4% PRR degradation to full sensing UEs
  + Solutions
    - 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.
      * Identified issues: how to handle packets with lower priority than the threshold,
        + UEs carrying out random resource selection and transmitting low priority transmissions should use a resource pool that is configured with random resource selection only. [13/Fraunhofer]
      * Option 1 with resource partitioning: [1/HW, HiSi], [14/Samsung]
        + Identified issues: non-backward compatible, reduced resource efficiency
        + Not support: [30/ITL]
      * Support (20): [1/HW, HiSi], [4/Spreadtrum], [7/OPPO], [8/NEC], [9/CATT, GH], [10/CMCC], [11/CAICT], [12/Xiaomi], [13/Fraunhofer], [14/Samsung], [17/Intel], [18/DCM], [19/Panasonic], [21/Sony], [24/IDC], [27/Convida], [30/ITL], [31/Bosch]
    - 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.
      * Identified issues: questionable performance gain and impact to full sensing UEs, misleading priority value for R16 UEs for QoS management (non-backward compatible), unfair penalty to sensing-based traffic
      * Possible enhancements:
        + An extra 2-bit field is added in SCI for indicating the original priority value associated with QoS requirement based on a mapping function/table.
        + Partition the resource pool into several resource sub-pools. UE selects a sub-pool based on a (pre-)configured priority threshold value or a range of priority levels.
      * Support (7): [2/Futurewei], [3/Nokia, NSB], [5/vivo], [8/NEC], [16/MTK], [19/Panasonic]
    - 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.
      * Identified issues: non-backward compatible, unfair penalty to sensing-based traffic
      * Support (3): [18/DCM], [22/ETRI], [26/Apple]
    - Option 12: No special consideration
      * Support (5): [7/OPPO], [10/CMCC], [12/Xiaomi], [21/Sony], [29/QC]
      * Not support: [2/Futurewei]
    - Other options:
      * Random selection UE with high priority can reserve the resource by sending reservation indication before its data transmission. [20/ZTE, SC]
      * UE shall select/reserve resources for consecutive transmissions with a separation/gap large enough so that the sensing UE can react accordingly if a collision happens. [32/E///]
* Identified issue 2: Persistent collision between a random resource selecting UE with other UEs due to same reservation period [1/HW, HiSi], [3/Nokia, NSB]
  + Due to contiguous NACK for multiple TBs across consecutive periods, when using random selection, reception of NACK across multiple periods of a periodic reservation is a condition for (re-)selecting resources by using exclusion (to turn on sensing). FFS how many periods are required to trigger (re-)selection. [1/HW, HiSi], [3/Nokia, NSB]
  + UE with reception capability of PSFCH can reselect the resource according to the HARQ feedback information to reduce periodically collision occasions. [9/CATT, GH]
  + UEs with different reception capabilities, they are configured with different priorities for the reserved resources by random selection. [9/CATT, GH]
* Others
  + UE should reserve resources for multiple TBs if partial sensing is allowed in the pool and *sl-MultiReserveResource* is configured with {enable}. [8/NEC]
  + Resource pools with random resource selection enabled are configured with PSFCH disabled. [13/Fraunhofer]
  + For UEs carrying out random resource selection and are not capable of PSFCH reception, we propose to restrict the maximum number of blind retransmissions to be carried out based on the priority of the transmission. [13/Fraunhofer]
  + Should a random resource selection procedure be described in PHY spec?
    - Support priority-based resource set report and resource selection. [8/NEC]
    - The resource selection window [*T1*, *T2*] is determined in the same way as in R16 NR-V2X according to step 1 [TS 38.214 Sec. 8.1.4]. [23/LGE]
    - When UE randomly selected a resource for periodic transmission, the resource is reselected based on the NR-V2X SPS resource reservation procedure for the following periodic transmissions, similar to LTE-V2X operation, within the number of periods (*Cresel*). [23/LGE]
  + For random resource selection, the starting subchannel indices for the reserved resources are pseudo-randomly changed based on Source ID. [22/ETRI]

## Re-evaluation and pre-emption checking

* Re-evaluation and pre-emption checking for periodic transmission
  + Option 1: For pre-selected and reserved resources ONLY during initial resource (re)selection period
  + Option 2: For pre-selected and reserved resources in every TB / transmission period
    - [7/OPPO] – sim results, [9/CATT, GH], [31/Bosch]
  + Option 3: (Pre-)configurable between Option 1 and Option 2.
    - [17/Intel]
  + Option 4: (Pre-)configured to perform re-evaluation based on the priority of the TB; Skip pre-emption for certain reservation periods and the number of skip periods is (pre-)configured per priority.
    - [24/IDC]
* Re-evaluation and pre-emption checks for UE performing random resource selection
  + Yes (for Type D UEs): [5/vivo], [7/OPPO], [29/QC], [26/Apple], [18/DCM], [27/Convida], [32/E///]
  + No: [1/HW, HiSi], [9/CATT, GH]
* Sensing mechanisms:
  + Scheme 0: No new PBPS or CPS only for re-evaluation and pre-emption checking [2/Futurewei]
  + Scheme 1: 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 for the TB. [32/E///], [22/ETRI]
  + Scheme 2 (e.g. for periodic transmission only): 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], [7/OPPO], [29/QC]
    - 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) [7/OPPO], [18/DCM], [29/QC]
        + UE performs periodic-based partial sensing before each selected resources by monitoring the most recent sensing occasion (k=1) as   
          , where is the timing of the *i*-th selected resource. [23/LGE], [11/CAICT]
      * A maximum 31 slots prior to are monitored for re-evaluation and pre-emption checking to detect aperiodic reservations [1/HW, HiSi], [7/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. [9/CATT, GH]
      * CPS starts from slot m-32 [11/CAICT]
      * Sensing slots for CPS includes additionally slots within, where *m* is a slot index that re-evaluation/pre-emption check is triggered. [18/DCM]
      * UE performs contiguous partial sensing over the window [*,* ], whereis the timing of the *i*-th selected resource, and [23/LGE]
        + for periodic transmission, for aperiodic transmission, and .
      * CPS is performed over [], where *n* is the slot of resource selection and *m* is the slot of a selected resource.
      * 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 occasionsexcept for the slot of a prior SCI which indicates the resource. [25/Sharp]
        + Replace *n* with index of the *Y candidate slots, set TA* assubject to the processing time and *TB* as 31 resource pool slots later than *TA*, where is the minimum of values*.*
      * UE monitors slots in for a transmission in slot . [29/QC]
  + Scheme 3: 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. [14/Samsung]
    - FFS PBPS-based sensing
  + Scheme 4: CPS should extend to Mmax-T3-Tproc,0 to increase the candidate resource set for resource re-selection. [21/Sony]
* 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]
* Partial sensing should be enhanced by either priority adjustment or signalling, to support re-evaluation / pre-emption checking while maintaining the power saving performance [6/Fujitsu]
* Y candidate resource slots should at least contain and/or a set of resources for re-evaluation and/or pre-emption checking, respectively. [8/NEC]
* In order to achieve power saving gain, when performing re-evaluation/pre-emption after contiguous partial sensing resource selection, the end of RSW for re-evaluation/pre-emption checking should not exceed the ending time of the initial RSW. [9/CATT, GH]
* At least for resource(s) selected by period-based partial sensing, 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
* Re-evaluation with power saving mode(s) can be enabled/disabled by resource pool (pre-) configuration. [14/Samsung]
* UE pre-emption behaviour in terms of resource yielding and re-selection is reused from NR-V2X R16 for each partial sensing time interval, determined from partial sensing windows [17/Intel]
* Maximum distance shorter than 32 slots between any two resources indicated by a single SCI is supported for power reduction in resource re-evaluation or pre-emption checking. Details of parameters are FFS. [23/LGE]
* Agreements/conclusions reached for resource selection in partial sensing apply for re-evaluation/pre-emption check. [25/Sharp]
* The candidate resource set for resource re-evaluation and/or pre-emption checking is based on the candidate resource set from the resource selection. [26/Apple]

## Congestion control for power saving RA

* Decisions related to congestion control for partial sensing UEs are discussed when design of partial sensing mechanism is completed (at least enough details are defined) [17/Intel]
  + FFS how to support congestion control in case of random resource selection if no SL reception is supported by UE
* 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]
  + CBR is calculated based on *N* measurable slots, where N is (pre-)configured. [7/OPPO]
  + UE is not mandated to perform measurement for CBR/CR outside the DRX active time. [5/vivo]
  + Enhancements for CBR: [5/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.
  + RSSI measurement should be adjusted based on PSCCH/PSSCH reception types. [8/NEC]
  + CBR measure occasion should be adjusted based on monitoring occasions. [8/NEC]
  + If UE performs periodic-based partial sensing, CBR in slot n can be measured by UE in *M* periodic partial sensing occasions before slot *n*, *M* periodic partial sensing occasions could be a subset of the configured partial sensing occasions. [9/CATT, GH]
  + Support enhancements to reduce the number of slots to be sensed for CBR measurements. [12/Xiaomi]
  + Relation between CBR measurement window and active period of a DRX cycle should be discussed and detection of congestion for each active period shall be defined. [15/Lenovo, MotM]
  + Restriction of transmission parameter based on the CBR measurement is performed per active period of a DRX cycle. [15/Lenovo, MM]
    - Restriction of transmission parameter based on the CBR measurement is performed per active period of a DRX cycle
  + 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. [23/LGE]
  + If P-UE has PSCCH/PSSCH reception capability, the following CBR value is used for PHY parameter selection: [23/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. [23/LGE]
* CR related
  + Enhancements for CR: [5/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.
  + CBR/CR window should be adjusted considering DRX configuration. [8/NEC]
  + The evaluation of CR and the definition of for power saving resource allocation schemes reuse the design for full sensing resource allocation schemes. [26/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 [2/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 [5/vivo]
      * The inactive sensing occasions is defined. A SL UE is only required to perform sensing in the inactive sensing occasions in DRX inactive time. [19/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. [26/Apple]
      * The same set of sensing occasions / window specified for the case when SL-DRX is not (pre-)configured [6/Fujitsu] (for CPS), [7/OPPO], [9/CATT, GH], [14/Samsung], [17/Intel], [23/LGE], [24/IDC], [31/Bosch]
    - Up to UE implementation: [4/Spreadtrum], [17/Intel], [29/QC], [32/E/// (min CPS window size *M* is mandatory)]
    - (Pre-)configurability between mandating / not mandating sensing during SL DRX inactive time: [18/DCM]
    - Introduce a UE capability of whether sensing during its SL DRX inactive time can be performed as mandatory or not. [18/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. [2/Futurewei], [6/Fujitsu]
* Transmission related
  + For periodic traffic, the transmitting UE can signal the time when the receiving UE expects the next transmission so that the receiving UE can align the DRX with the data reception for better power saving. [2/Futurewei]
  + RSW, set of Y slots, or candidate resource set (*SA*) should overlap with SL-DRX ON duration or active time of Rx-UE as much as possible or at least *N* slots. [5/vivo], [6/Fujitsu], [7/OPPO], [9/CATT, GH]
  + RAN1 can be responsible for determining the candidate resources corresponding to the DRX active time of the RX UE(s) by reporting two candidate resource sets, which correspond to the candidate resources within the DRX active time of the Rx UE(s) and all candidate resources (i.e. *SA*) within the resource selection window respectively. Or RAN2 can be responsible for determining the candidate resources corresponding to the DRX active time of the RX UE(s) based on the candidate resource set (i.e. *SA*) and the adjusted start time of the resource selection window reported by PHY. [9/CATT, GH]
  + When the Rx UE is DRX enabled, Tx UE should ensure that at least the initial transmission can be made during DRX on-duration of the Rx UE to achieve a trade-off between Packet Reception Ratio (PRR) and power consumption. [9/CATT, GH], [6/Fujitsu]
  + Tx UE excludes resources that are not within the time slots of Rx UE DRX on duration. [12/Xiaomi]
  + Resource selection with DRX should be done by RAN2 instead of RAN1. [20/ZTE, SC]
  + In partial sensing based or random selection under SL-DRX operation, the resource selection window [*T1, T2*] is determined in the same way as in R16 NR-V2X according to step 1 [TS 38.214 Sec. 8.1.4]. [23/LGE]
    - UE can select the candidate slots within ON duration or the active time of the SL-DRX cycle, depending on the RAN2 decision.
    - TX UE selects at least resources for the initial transmission and a (pre-)configured number of retransmissions in RX UE’s SL DRX ON duration or active time.
  + 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. [26/Apple]
  + SL DRX active time of intended RX UE is considered for candidate resources identification of mode 2 resource selection. [28/ASUSTek]
  + 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. [29/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 NAK in response to the (re)transmission inside the ON duration indicating reservations. [29/QC]
  + Selection of resources at the TX UE is restricted to fall within the Active Time of the RX UE(s) and implemented in RAN1. [32/E///]
* 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. [6/Fujitsu]
  + 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. [9/CATT, GH]
  + 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. [9/CATT, GH]
  + Partial sensing occasions are aligned with the SL DRX active period in order to maximize the power saving gains. [13/Fraunhofer], [15/Lenovo, MotM]
    - 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.
  + Additional DRX configuration can be configured for Tx UE performing periodic partial sensing considering multiple resource reservation periods. [15/Lenovo, MotM]
  + RAN1 study on the transmission of assistance indication like go-to-sleep to aid Rx UE(s) enter early DRX sleep state. [15/Lenovo, MotM]
  + The design of SL DRX cycle needs to ensure that UE partial sensing behaviour is respected (i.e., UE wake up time intervals for the purpose of partial sensing need to be aligned with ON duration intervals, as well as traffic characteristics) [17/Intel]
  + [19/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”.
  + UE in SL DRX can perform either sensing-based resource selection or random resource selection. [24/IDC]
  + The Rx UE in its SL DRX active time shall decode both the first and second SCI. [24/IDC]
  + Consider congestion control enhancement for DRX operation. [24/IDC]

## Others

* Switching between RA schemes (full sensing, partial sensing, random selection)
  + In a resource pool configured with more than one resource allocation scheme, possible conditions / criteria should be studied for switching between RA schemes (full/partial sensing, random selection) [5/vivo], [8/NEC], [12/Xiaomi], [16/MTK], [19/Panasonic], [23/LGE], [27/Convida]
    - E.g., UE battery/power status, available resource ratio, CR, a timer or counter, higher layer configuration, priority, remaining PDB, based on UE implementation, CBR, sensing results, DRX configuration, HARQ error rate, etc
* During a coordination window for inter-UE coordination operation, a UE does not sense for resources selection to reduce power consumption whilst uses resources indicated from its coordinating UEs for transmission to improve reliability. [1/HW, HiSi]
* Specify a new list of X for partial sensing or set new rules for partial sensing on X with the existing list sl-TxPercentageList for termination criterion in the resource exclusion procedure. [2/Futurewei]
* For public safety use case, to reduce UE power consumption, consider a receiving UE monitor a partial region of a period (similar as control region specified for Rel-12 sidelink) to determine whether to turn on in the rest of the period. [3/Nokia, NSB]
  + To inherit Rel-16 PSCCH/PSSCH channel structure, consider limiting the first transmission of a TB (transport block) in this partial region.
* Assistant information can be provided via sidelink signalling to the UEs performing random selection. [4/Spreadtrum]
* Longer PSFCH period or enhancement of conducting resource selection should be studied. [8/NEC]
* [13/Fraunhofer]:
  + Tx-UE utilizes assistance information from assistance entities, providing a set of resources that power saving UEs can use for increased reliability in their resource selection procedure. [27/Convida]
  + Since power saving UEs are required to be active based on their location, we propose to enable these UEs to wake up and carry out transmissions only when they are in a pre-configured region.
  + Power saving UEs should support bandwidth adaptation by operating over shortened frequency regions or by carrying out partial sensing over a smaller bandwidth. [27/Convida]
* [15/Lenovo, MotM]:
  + RAN1 study the cross-slot scheduling enhancement with a time gap specified between data (+2nd SCI) and 1st SCI, 1st SCI contains information whether the intended recipient is a pedestrian or Vehicular UEs for power saving purposes.
  + Design additional resource reservation indication/signalling for collision avoidance.
  + Support SL Tx/Rx performed in a power saving manner by configuring a resource pool partition for resource alignment among multiple UEs.
    - A resource pool partition is configured by a set of disjoint resource patterns.
    - Each resource pattern can be configured with features about controlling selection opportunities for different type of services and thus facilitating resource avoidance.
    - For a resource pool selected for use, a UE can further (re-)select resource pattern(s) based on sensing results.
    - Resource alignment can be performed by indicating identity of resource pattern among UEs.
  + Mechanism of sensing result sharing by RSU or other UE can be considered for VRU to achieve power saving.
* Study wake-up signal in sidelink to enhance power saving from Rx-UE’s perspective. [16/MTK]
* [17/Intel]:
  + To reduce time for transmission of a TB and improve power saving, randomly pick one out of N first in time candidate resources, where the value of N is pre-configured.
  + Partial sensing can be enabled / disabled per transmission priority level and QoS requirements.
  + For power saving, UE can skip PSSCH demodulation depending on transmission priority level.
  + For UE sidelink power saving, NR supports adaptation of sidelink power saving resource allocation schemes (i.e. b/w random, partial, or full sensing-based resource selection).
  + UEs using partial sensing or random resource selection for transmissions with enabled HARQ feedback are required to monitor the associated PSFCH resources.
* In resource selection after resource identification, UE selects preferentially resource at earlier time in the identified resource set. [18/DCM]
* [19/Panasonic]:
  + The sidelink UE can take sidelink information (including the sensing/resource allocation timing) into account for the UE assistance information for network to inform the gNB for a better coordination with Uu at the network.
  + The decision that SL reception type B or D capable UE is operated as SL reception type A should be by the network when UE is under network coverage. The SL reception type B or D capable UE could either: 1) inform the network its recommended reception type and ask for confirmation, or 2) inform its SL requirements and power reduction capability to the network and let the network to determine the suitable reception type.
  + The reception type D can have a sub reception type that a UE Support SL signals only for PSCCH sensing and not receive PSSCH.
  + No SL transmission is allowed if a UE is in Type A and without a valid synchronization.
  + A dedicated resource pool should be allowed for partial sensing UEs that the Tx pool not overlap with full sensing UEs’ Tx pool and within full sensing UEs’ Rx pool; while the Rx pool is known to full-sensing UEs for partial-sensing UE targeted SL messages.
* Additional enhancements besides random resource selection and partial sensing for power saving should be also discussed. [22/ETRI]
* Prioritization is applied for selection of resource allocation schemes in case the UE is capable of multiple resource allocation schemes configured to enable in a resource pool. And full sensing is always allowed in a resource pool. [25/Sharp]

References

1. [R1-2108763](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2108763.zip) Sidelink resource allocation to reduce power consumption Huawei, HiSilicon
2. [R1-2108800](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2108800.zip) Power consumption reduction for sidelink resource allocation FUTUREWEI
3. [R1-2108818](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2108818.zip) Resource allocation for power saving Nokia, Nokia Shanghai Bell
4. [R1-2108924](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2108924.zip) Discussion on sidelink resource allocation for power saving Spreadtrum Communications
5. [R1-2108998](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2108998.zip) Resource allocation for sidelink power saving vivo
6. [R1-2109036](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109036.zip) Considerations on partial sensing and DRX in NR Sidelink Fujitsu
7. [R1-2109059](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109059.zip) Discussion on power saving in NR sidelink communication OPPO
8. [R1-2109129](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109129.zip) Discussion on resource allocation for power saving NEC
9. [R1-2109191](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109191.zip) Further discussion on sidelink resource allocation enhancements for power saving CATT, GOHIGH
10. [R1-2109300](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109300.zip) Discussion on resource allocation for power saving CMCC
11. [R1-2109348](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109348.zip) Considerations on partial sensing mechanism of NR V2X CAICT
12. [R1-2109384](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109384.zip) Discussion on sidelink resource allocation enhancement for power saving Xiaomi
13. [R1-2109430](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109430.zip) NR Sidelink Resource Allocation for UE Power Saving Fraunhofer HHI, Fraunhofer IIS
14. [R1-2109512](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109512.zip) On Resource Allocation for Power Saving Samsung
15. [R1-2109541](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109541.zip) Sidelink resource allocation for power saving Lenovo, Motorola Mobility
16. [R1-2109564](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109564.zip) Remaining issues on sidelink power saving MediaTek Inc.
17. [R1-2109631](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109631.zip) Sidelink Resource Allocation Schemes for UE Power Saving Intel Corporation
18. [R1-2109699](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109699.zip) Discussion on sidelink resource allocation for power saving NTT DOCOMO, INC.
19. [R1-2109731](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109731.zip) Discussion on Sidelink Resource Allocation for Power Saving Panasonic Corporation
20. [R1-2109732](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109732.zip) Discussion on resource allocation for power saving ZTE, Sanechips
21. [R1-2109800](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109800.zip) Discussion on sidelink resource allocation for power saving Sony
22. [R1-2109818](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109818.zip) Discussion on resource allocation for power saving ETRI
23. [R1-2109860](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109860.zip) Discussion on resource allocation for power saving LG Electronics
24. [R1-2109883](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2109883.zip) Sidelink resource allocation for power saving InterDigital, Inc.
25. [R1-2110005](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110005.zip) Discussion on resource allocation for power saving Sharp
26. [R1-2110053](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110053.zip) On Sidelink Resource Allocation for Power Saving Apple
27. [R1-2110116](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110116.zip) Discussion on NR SL Resource Allocation for Power Saving Convida Wireless
28. [R1-2110131](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110131.zip) Discussion on partial sensing and SL DRX impact ASUSTeK
29. [R1-2110208](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110208.zip) Power Savings for Sidelink Qualcomm Incorporated
30. [R1-2110305](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110305.zip) Resource allocation for power saving in NR sidelink enhancement ITL
31. [R1-2110307](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110307.zip) Further discussion on power saving for sidelink resource allocation ROBERT BOSCH GmbH
32. [R1-2110339](file:///C:\3GPP\RAN1_Meetings\Tdocs\2021\R1-2110339.zip) Resource allocation procedures for power saving Ericsson

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

**Agreement**

Regarding RAN2’s question in R1-2106413, in RAN1’s opinion it is feasible, other than in the following exceptional cases:

* SL transmission dropping due to prioritization or congestion control
* Due to re-evaluation, a re-selected resource is earlier than a reserved resource by UE implementation in Mode 2
* If (pre-)configured with many-to-one mapping between Tx and Rx resource pools in some cases *(e.g., when PSFCH is not configured)*

**Agreement**

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