**3GPP TSG RAN WG1 #105-e R1-2106031**

**e-Meeting, May 10 –27, 2021**

**Source: Moderator (OPPO)**

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

**Agenda item: 8.11.1.1**

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

Introduction

In the latest version of Rel-17 WID for NR sidelink enhancement [1], the objective for enhancing RA to reduce UE power consumption in mode 2 is captured as followed.

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| 2. Resource allocation enhancement:* Specify resource allocation to reduce power consumption of the UEs [RAN1, RAN2]
	+ Baseline is to introduce the principle of Rel-14 LTE sidelink random resource selection and partial sensing to Rel-16 NR sidelink resource allocation mode 2.
	+ Note: Taking Rel-14 as the baseline does not preclude introducing a new solution to reduce power consumption for the cases where the baseline cannot work properly.
	+ This work should consider the impact of sidelink DRX, if any.
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This contribution provides a summary of the submitted contributions, email discussion topics and outcomes during RAN1#105-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 summary document.

Collection of agreements / conclusion in RAN1#105-e

To be collected once agreement is reached.

Topics for email discussion

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

* 1st check point: 5/21
* 2nd check point: 5/25
* Final check: 5/27

## Topic #1: Periodic-based partial sensing – Preserve, k value and sensing occasions to be monitored

**Background**: In RAN1#104b-e, it was agreed to do down-selection of alternatives during this meeting to decide the set of *P*reserve values and the k value for the periodic-based partial sensing according to the following.

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| **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
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Based on reviewing of Tdocs submitted in this meeting:

* + For the set of *P*reserve values, the main reason for Alt. 1 (full set of *sl-ResourceReservePeriodList*) is to ensure high reliability is maintained by avoiding Tx collision in reserved resources with periodicities that were not monitored by the Tx UE. On the other hand, the main reason for Alt. 2 (a subset of *sl-ResourceReservePeriodList* or multiple sets of *P*reserve values) is to achieve better power saving and provide flexibility at the same time. Some expressed usage of Alt. 2 include:
		- Alt. 2.1: A full set of *sl-ResourceReservePeriodList* is used for high priority transmissions or RP with high measured CBR; A subset/smaller set is used for others;
		- Alt. 2.2: A subset or a common divisor (e.g., 100ms) is used for configured reservation periodicities [100…1000], and combined with a bitmap for k values. Another subset for configured periodicities within [1…99];
		- Alt. 2.3: Only one subset is configured with reservation periodicities that is larger than a threshold (e.g., FFS the threshold periodicity value). For sensing occasions that are smaller than the threshold can be monitored/covered by using contiguous partial sensing.
		- Alt. 2.4: Only one subset is configured containing the mostly used/expected to use reservation periodicities.

Based on submitted simulation results in this meeting, it was shown that additional power saving from monitoring a subset of periodicities is about 10%. The communication range improvement from monitoring the full set is about 16 meters at PRR = 99%. It was also shown that when multiple subsets are configured, the power consumption is comparable to the single/full set case. On the other hand, one company showed that the power saving even with additional power consumption of HARQ re-Tx from monitoring only a subset due to collisions, is 28% less than monitoring the full set.

FL comments:

* + - There is no clear majority of company preference between Alt. 1 and Alt. 2 (16 vs. 20).
		- For schemes such as Alt. 2.2 and 2.3, the power saving UE eventually monitors all reservation periodicities configured in *sl-ResourceReservePeriodList*. Effectively, there is no power saving gain. For Alt. 2.1, when the Tx priority or the CBR is low, there always exists some cases of Tx collision due to non-monitored periodicities, e.g., for UEs with priority less than a threshold and monitor only a subset of periodicities and causing collision/interference to high priority transmissions. For Alt. 2.4, it is unclear how to determine the most commonly used / expected periodicities to be used. If a periodicity is not expected to be used, then likely it won’t be configured in *sl-ResourceReservePeriodList*.
		- Overall, based on submitted simulation results, it is clear some performance degradation can be expected when a subset of periodicities is monitored by the UE, while the power saving gain depends on the amount of periodicity reduction in the subset.
		- **Therefore, Alt. 1 is recommended for the down-selection in Proposal 1-1 below.**
	+ For the k value, the main reasons for supporting Alt. 1 (only the most recent sensing occasion for a given reservation periodicity) are due to it offers most power saving gain, missed detection of SCI is low and almost no PRR difference to the full sensing. On the other hand, the main reasons for supporting Alt. 2 (k is (pre-)configured with multiple values including the most recent sensing occasion as in option 1 from RAN1#104-e) are due to network flexibility of configuring the UE to monitor additional sensing occasions other than the most recent one and better reliability from additional sensing in case of SCI missed detection.

Based on submitted simulation results, better PRR performance is observed from using multiple k values per reservation periodicity by two companies, while one company showed no performance gain from doing so, and one company showed PRR is very close to the full sensing result from monitoring just the most recent sensing occasion per periodicity. In terms of power saving, one company showed it costs 10% more power from sensing one additional k value and another company showed 50% more. The difference in these power saving results may came from how much overlapping between the sensing occasions and the size of the selected Y candidate slots.

FL comments:

* + - There is no clear majority of company preference between Alt. 1 and Alt. 2 for the k value (17 vs. 16).
		- Although it is claimed that Alt.2 offers flexibility of configuring the exact sensing occasions to be monitored by the UE, it is still unclear why such flexibility is needed since the older the sensing occasions are the less relevant the information they contain.
		- According to simulation results, monitoring more sensing occasions will generally offer better PRR performance, but at a cost of higher power consumption for the UE.
		- **Since Alt. 2 is a superset of Alt. 1, it is recommended to down-select to Alt. 2 with up to UE implementation to decide how many k values per reservation periodicity to monitor.**
	+ For the sensing occasions to be monitored by the UE before the resource (re)selection triggering slot n or before the first slot of the set of Y candidate slots subject to processing time restriction for the identification of candidate resource set, it was left to be further studied from the last meeting. From the reviewing the Tdocs submitted to this meeting, the only reason to monitor sensing occasions only before the resource (re)selection trigger slot n was to match with R14 and R16 behaviour, where resource is selected at triggering slot n. This view was supported by two companies. On the other hand, majority of companies (13) expressed that the UE should monitor sensing occasions all the way just before the first slot of the set of Y candidate slots to obtain the latest resource reservation information from the most recent sensing occasions and that all corresponding periodic sensing occasions are taken into account for the initial resource selection to minimize collision probability.

FL comments: In LTE-V2X, the smallest reservation periodicity and PDB were always to be 100ms for P2X traffic. In this case, no matter where the Y candidate subframes are selected within the PDB, the most recent sensing occasions are always before the resource (re)selection trigger slot n. In NR sidelink, however, the most recent sensing occasions could very well fall between the triggering slot n and the set of Y candidate slots since much smaller reservation periodicities are supported. This is particularly true when the SL-DRX ON duration of the receiver UE starts far away from the triggering slot n of the Tx UE such that there is a large gap between the triggering slot and the set of Y slots. In addition, if this gap is larger than 31 slots, which should be the duration for the contiguous partial sensing, then there could be sensing occasions between the triggering slot and the Y slots are not monitored by the contiguous partial sensing. Therefore, it is recommended to go with majority that the UE is to monitor sensing occasions before the first slot of the set of Y candidate slots in periodic-based partial sensing for the identification and reporting of candidate resources to the MAC layer.

### Proposals before 1st check point

**Proposal 1-1:**

* For the set of *P*reserve values in periodic-based partial sensing,
	+ Alt. 1 from RAN1#104b-e is selected, where *P*reserve corresponds to all values from the configured set *sl-ResourceReservePeriodList*.

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| **Company** | **Comments** |
| NTT DOCOMO | Support.Alt 2 leads to performance degradation, which is against to direction of NR-SL where high reliability is supported. At least one occasion per periodicity should be monitored. |
| Panasonic | We support FL’s proposal.  |
| Intel | In our view, Alt. 2 should be supported as it covers Alt. 1 and does not bring additional complexity to the UE. At the same time, it provides additional power saving benefits w/o noticeable impact on reliability especially for the cases when transmissions with certain periodicity are dominant in the system. Therefore, we think the configured subset of Preserve values should be supported per sidelink resource pool and can be properly configured during system profiling stage. |
| OPPO | Support. |
| Sharp | Support. |
| CMCC | We think that Alt. 2 provides configuration flexibility, which takes both power saving and sensing performance into consideration. Note that Alt. 2 includes Alt. 1which supports up to the full set of values from the configured reservation periods, therefore, we prefer Alt. 2.  |
| Ericsson | Supportive of this proposal |
| Huawei, HiSilicon | Agree. Just as the comment we gave during the GTW, the purpose of partial sensing is to target to balance the PRR performance and power consumption reduction, rather than to totally minimize power consumption (for which purpose Rel-17 will support random resource selection). For PBPS, even with *P*reserve = full set, it still achieves significant power reduction ratio gain compared to the baseline full-sensing and guarantee the PRR performance. But with *P*reserve = subset, collisions are caused due to unmonitored occasions and degrade PRR performance, simulation results are shown in our tdoc R1-2104236: Figure 1 Average power reduction ratio (baseline: Rel-16 mode 2) for full set case and subset case for *Preserve* value (stacked histogram)Pvlaue_0508Figure 2 Average PRR for full set case and subset case for P value. |
| Fraunhofer | We support Alt 2, since it includes Alt 1 as well as provides UEs with the flexibility to balance power saving and PRR performance. |
| Futurewei | We support this proposal. |
| Apple | We support Alt 2 due to the following reasons:1. It has a slightly more supports. 2. It has power saving benefits over Alt 1 (up to 28% gain by simulations).3. It is a superset over Alt 1. Alt 2 could cover Alt 1 if the set of Preserve is configured as full set. If two sets of Preserve are supported, then it can provide more flexibility to balance power saving and reliability.  |
| InterDigital | We support Alt. 2. We share the similar view with Intel and CMCC. Moreover, it might not be feasible to perform periodic-based partial sensing with the full set for aperiodic traffic if periodic based partial sensing is supported for aperiodic traffic. |
| Nokia, NSB | We support FL’s proposal. |
| MediaTek | We prefer Alt.2, which can offer more power saving gain without increasing reliability with correct network configuration. |
| Bosch | We support Alt 2 as it has more supporters and also Alt 2 possibly covers Alt 1 if configured to have the full set sl-ResourceReservePeriodList. We also believe that Alt 2 can compromise between power saving and performance.  |
| Qualcomm | We support the proposal |
| CATT | We oppose alt1 and support Alt 2, since alt2 includes Alt 1 and it also provides UEs with the flexibility to balance power saving and PRR performance. ALT2 is the compromise to go. |
| Fujitsu | Do not support. We still prefer Alt.2 because it does not only cover Alt.1 but also provide the same flexibility as in LTE-V. For instance, in Alt.2, the subset of the periodicities can be simply (pre-)configured as a trade-off between the sensing accuracy and UE power consumption. |
| NEC | Support. We think the reason to support were clearly captured in background session. |
| Convida Wireless | We are fine with the proposal. |
| ZTE,Sanechips | Support. |
| vivo | Disagree.On one hand, forcing UE to always monitor all values from the configured set *sl-ResourceReservePeriodList* means that the UE may get a lot of redundant or unnecessary reservation information, which does not improve reliability but increase unnecessary power consumption compared with alt2. On the other hand, Alt.2 is a superset of alt.1, which provides configuration flexibility to trade-off between the power consumption and the sensing robustness. The argument of performance degradation is not relevant – by alt.2 it is anyway possible to use all the values.Regarding FL’s comment: Based on submitted simulation results in this meeting, it was shown that additional power saving from monitoring a subset of periodicities is about 10%.We have provided some further evaluation in our revised paper[R1-2106067], it is observed that the power saving benefit from monitoring a subset is about 20% with respect to the total power consumption, and about 30% in terms of power consumption for sensing, while it shows almost the same reliability performance as alt.1, the PRR loss is less than 1%.  |
| Spreadtrum | We support Alt.2. Alt.2 is more flexible, including Alt.1. We think power saving gain and reliability can be balanced through reasonable (pre-)configuration. |
| Sony | We support Alt 2 since Alt 2 is super set of Alt 1 and Alt 2 can have power saving benefit.  |
| xiaomi | We support Alt2 as it is more flexible and is a superset over Alt 1. Considering that arbitrary period values can be set in NR V2x, flexibility and forward compatibility is very important in the design. |
| ETRI | We support Alt. 2. As commented by other companies, Alt. 2 can cover Alt. 1. |
| Samsung | We prefer Alt.2 since it provides higher flexibility and allows further power saving gain. As commented by other companies, when certain periodicity are dominant in the system, power consumption can be significantly reduced with acceptable PRR performance loss. Furthermore, Alt.1-like configuration can also be covered by Alt. 2, thus for traffic with very high requirement of reliability, Alt.2 still work with no performance degradation by configuring the full set of periodicities. |
| LGE | Support with modification.We need to separate discussion on sensing for resource (re)selection from that for resource re-evaluation and pre-emption checking. As we don’t have any agreement on whether periodic-based partial sensing is used for resource re-evaluation or pre-emption checking, FL proposal is applied only to the case of resource (re)selection at this stage of discussion.As a conclusion, we suggest the following modification.**Proposal 1-1:*** For the set of *P*reserve values in periodic-based partial sensing for resource (re)selection,
	+ Alt. 1 from RAN1#104b-e is selected, where *P*reserve corresponds to all values from the configured set *sl-ResourceReservePeriodList*.
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| Lenovo | Support. |

**Proposal 1-2:**

* For the k value in periodic-based partial sensing,
	+ Alt. 2 from RAN1#104b-e is selected, where k is (pre-)configured, including multiple values and the most recent sensing occasion for a given reservation periodicity
		- It is up to UE implementation to decide one or multiple k values per reservation periodicity and at least the most recent sensing occasion for a given reservation periodicity shall be monitored.
		- Note that 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 may correspond to a k value other than k=1.
		- When the k value corresponds to the most recent sensing occasion for a given reservation periodicity is not k=1, the UE does not monitor a (pre-)configured k value that is smaller than it for that given reservation periodicity.

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| **Company** | **Comments** |
| NTT DOCOMO | ‘Up to UE implementation’ is not OK.Just configurability (+ most recent occasion) should be fine and UEs shall follow the K value, where regulator can decide which should be prioritized between very high reliability performance and good power saving performance.If the configurability is unacceptable by companies, we are OK with Alt 1 as well.Our preference is:- 1st: Alt 2 (not up to UE implementation)- 2nd: Alt 1 |
| Panasonic | We are ok with alt 2. Further, we wish FL could clarify the “given reservation periodicity” is one period or entire period series, and whether a UE could implement different k values for different periods within a series of periods. For the 1st sub-bullet, we share similar view with DCM that not up to implementation would be better. FL: Regarding “for a given reservation periodicity”, it means the UE should monitor in the same way for every reservation periodicity configured for the resource pool. |
| Intel | In our opinion defining Alt. 2 in this way is essentially leads to Alt. 1 in practical implementation. In our view periodic-based partial sensing should provide partial sensing and complexity reduction. UEs operating in full sensing mode do not consider multiple preceding occasions for a given transmission period and thus it should not be required for periodic-partial sensing. We see the following drawbacks in supporting multiple k values: 1) increase of UE complexity, 2) increase of UE power consumption 3) implies more specification efforts 4) is not aligned with baseline sensing operation principle. Considering above drawbacks, it is sufficient to support k = 1 only.We support Alt.1 due to reasons provided above.  |
| OPPO | Not support the proposal. In our view, alt.1 is preferred.It is necessary to clarify that the main design target for partial sensing is to reduce power consumption. Alt.2 will result in higher power consumption compared to alt. 1. And from our simulation results, it shows that the PRR performance of Alt1 is almost the same as full sensing. Although some results show better PRR performance for alt 2, it is at the cost of higher power consumption which conflicts with the design target for power saving mechanism. Therefore, we prefer Alt 1 which has similar performance as full sensing and can reduce more power than Alt 2.On the other hand, if partial sensing with alt 2 can provide better PRR performance and less power consumption compared to full sensing, do we need to do similar optimization for full sensing, such as UE needs to monitor more periodicities for full sensing to improve PRR performance further. Otherwise, that will confuse the producer or chip vendor why full sensing is needed if partial sensing has better PRR and power consumption benefit?Furthermore, when we discuss period-based partial sensing, UE needs to sense the slots $t\_{y-k\*P\_{reserve}}$, the assumption is that the triggering slot n is predicable, such as based on the periodicity of the data packet. While there are some other conditions defined in RAN2 (section 5.22.1.2 in TS38.321) which can trigger L1 to perform resource (re)selection. The triggering timing of most of trigger conditions is not predicable. In that case, it is hardly for the UE to pre-select Y slots and performs period-based partial sensing in advance. Therefore, we suggest to add a note as follows:* Note: this is applied to the case when slot n is predicable

FFS when slot n is not predicable. |
| Sharp | Regarding 2nd sub-bullet, we don’t think it is necessary, if proposal 1-3 is going to be agreed. For 3rd sub-bullet, we propose a similar method as LTE partial sensing, i.e. a bitmap, only with the clarification that UE monitors $t\_{y-(k\_{0}+k-1)×P\_{reserve}}^{SL}$ if the k-th bit is set to 1 and $t\_{y-k\_{0}×P\_{reserve}}^{SL}$ denotes the most recent occasion before the first slot of the Y candidate slots. |
| CMCC | We are fine with the main bullet. Regarding the 1st sub-bullet, we don’t think it should be left to UE implementation. |
| Ericsson | We propose the following modification to this proposal. In our view, k=1 has to be mandatory as indicated in the proposal, but values of k are up to UE implementation without the need to have (pre-)configuration.FL: I assume what is proposed here as a compromise is Alt. 1 with up to UE implementation to monitor additional k value(s). |
| Huawei, HiSilicon | Agree the main sub-bullet. Similarly as for *P*reserve determination, PRR performance is important in addition to power reduction for partial sensing. Sensing k = 1 occasion only does not perform well in every cases in different situations. As illustrated by the simulation result in our contribution, with high traffic density and high-interfered scenario, k = {1,2} provides PRR gain over k = 1 only, whilst in less traffic density and less-interfered scenario, PRR performance for k = 1 only may be even close to that for full-sensing. Hence, configurability on multiple values, which covers k = 1 only work well in wider scenarios.On the first sub-bullet, leaving UE implementation on deciding between one or multiple k values will make the interference level totally un-controlled. The conditions could to be further studied, particular the impact to those with high priority transmission. It is too early to decide it as UE implementation.FL: It is not clear to me is why by sensing more k values with up to UE implementation would make the interference level totally un-controlled. If monitoring only in the most recent sensing occasion can offer a performance that is very close to full sensing (negligible difference), by sensing additional k value up to UE implementation will not create un-controlled interference.For the second sub-bullet, it is not clear if the most recent sensing occasion before the first slot of the set of Y candidate slots, why k is not equal to 1. Clarification are needed from feature lead.FL: For a Ty slot other than the first slot, the corresponding most recent sensing occasion even before the first slot of the Y candidate slots may not be k=1 when a given reservation periodicity is small.For the third sub-bullet, it is not needed if the reference point is the first slot of the set of Y candidate slots, as according to FL proposal 1-3. But even if the reference time is slot n, the third sub-bullet would exclude n\*Preserve\*k (e.g. 2\*Preserve\*k, 3\*Preserve\*k, …) for some values of n which there does not seem to be a reason for excluding. Overall, this 3rd bullet can be removed.FL: If you agree with the second sub-bullet, then the third sub-bullet makes sense and needed, so that it is not mandated that a UE must perform periodic-based partial sensing within the Y candidate slots for the resource (re)selection triggering at slot n.Therefore, the second and third sub-bullet are related to the reference point setting, which will be discussed and decided in the FL proposal 1-3, so we suggest to discuss proposal 1-3 first, after having a common understanding in the proposal 1-3, then RAN1 can come back to this proposal.FL: This is not really related to the reference point setting. The second and third sub-bullets are meant to restrict the UE from performing periodic-based partial sensing after the reference point, regardless if the reference point is set at the triggering slot n or before the first slot of the set of Y candidate slots. |
| Fraunhofer | We agree with the main bullet, but do not agree to leave the selection of multiple values of k to UE implementation. It would be preferable to link the multiple values to the priority of the UE’s transmission, thereby providing the UE with the option to carry out sensing in more time slots for higher priorities, while sacrificing power saving gains. |
| Futurewei | We support Alt 2 and the multiple k values, as it improves the PRR performance and offers a flexibility between power saving and performance. Alt 2 is indeed a superset of Alt 1. We assume that the details of the signalling are still open, for example the maximum number of k values can be set to address any power savings concerns. For the first sub-bullet, we are not clear on the necessity of “up to UE implementation” part, as the alt 2 specifies “k is (pre)configured”, it may be good to discuss that a bit more. |
| Apple  | We agree with the main bullet, but do not agree the determination of k values is based on UE implementation. We think a system wide and unified (over all UEs) design is preferred to keep the system performance more stable.  |
| InterDigital | Not support the proposal. We prefer Alt. 1.We think that k=1 is enough. Moreover, if multiple k is configured, the UE may need to buffer long sensing window (e.g., if k=2, for 1000ms reservation period, the UE may need to buffer 2000ms sensing window), which is not desirable. |
| Nokia, NSB | We’d like to support Alt 1. Suggest having this modification for this proposal:Support the most recent sensing occasion for a given reservation periodicity. The values of k can have multiple values, which are up to UE implementation.  |
| MediaTek | We support Alt.2. But we don’t agree with ‘up to UE implementation’ part. For simpler configuration, k can be pre-configured as ‘most recent X occasions’ where X is an integer.  |
| Bosch | We support the main bullet. However, we have a concern leaving selection of k up to UE implementation if k value is already (pre-)configured. |
| Qualcomm | We disagree with the proposal.This requirement is more stringent than what is required of full-sensing UEs and of LTE partial sensing UEs.It is a reliability enhancement and we’d be ok to discuss it as such and in the context of all UEs, but from a power savings point of view, we don’t support this proposal and support Alt 1. |
| CATT | We support alt1 and think alt2 have multiple issues. There are simulation result showing performance-wise alt1 is enough, alt2 will lead to more power usage. Leaving it to UE implementation means most likely alt1 based solution will be adopted by the UE , but it also could result in some undesirable consequences if UE fails to sense the most recent location. |
| Fujitsu | Do not support. We still prefer Alt. 1. Firstly, supporting multiple sensing occasions by Alt. 2 does not necessarily improve reliability. Supporting multiple sensing occasions implies that if periodic traffic is sensed within one of the sensing occasions, the periodic traffic will be excluded during resource selection. However, it can happen that periodic traffic is transmitted on an older sensing occasion y-k1\*Preserve, but not transmitted on the most recent sensing occasion y-k0\*Preserve (k0<k1) due to resource re-selection. In this case, the correct decision is that periodic traffic is not excluded during resource selection. The correct decision (i.e., no exclusion) can only be made by monitoring the most recent sensing occasion since only the most recent occasion reflects the latest situation. A wrong decision (i.e., exclusion) will be made if using both older sensing occasions and the most recent sensing occasion.Secondly, the principle of using the most recent sensing occasion only (Alt. 1) has been used in full sensing from Rel-14 LTE V2X to Rel-16 NR V2X. In full sensing, even if SCI is received in an older sensing occasion, it is not used for resource selection. Only SCI received the most recent sensing occasion is used for resource selection. The same principle (Alt. 1) should be used in partial sensing. |
| NEC | No. We're not convinced by that alt.2 contains alt.1 and provides more flexibility. We don't know why this flexibility is needed because only the most recent one provided the reservation information. On the other hand, use the most recent one is aligned with legacy sensing procedure which is used to exclude SPS reservation. We don’t see why this not proper and why we need to change it. |
| ZTE,Sanechips | We have some further comments are to the scope this agreement should be applied – we copied the main bullet below for better explanation. 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 For all periodicity configured, the UE should monitor the sensing occasion corresponding to the selected slot. This should be built on the assumption that the selected slot/triggering slot is known in advance. Thus we prefer to reflect that as a note to the agreed alternative for k value.In the meantime, under the assumption that the selected slot/triggering slot n is unknown/unpredictable, we think further discussion is needed based on simulation results whether the legacy LTE mechanism of monitoring on a sensing gap basis should guarantee all the sensing occasions covering the configured periodicity should safeguard decent performance, thus we prefer to capture an FFS to reflect that.* For the k value in periodic-based partial sensing,
	+ Alt. 2 from RAN1#104b-e is selected, where k is (pre-)configured, including multiple values and the most recent sensing occasion for a given reservation periodicity
		- It is up to UE implementation to decide one or multiple k values per reservation periodicity and at least the most recent sensing occasion for a given reservation periodicity shall be monitored.
		- Note that 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 may correspond to a k value other than k=1.
		- When the k value corresponds to the most recent sensing occasion for a given reservation periodicity is not k=1, the UE does not monitor a (pre-)configured k value that is smaller than it for that given reservation periodicity.
		- Note that the monitoring is based on the assumption that the selected slot y/triggering slot n is known in advance
		- FFS how to ensure all the sensing occasions are monitored for the case when selected slot y/triggering slot n is unknown/unpredictable.
 |
| vivo | We support alt.2, but we are confused about the proposal. In the main bullet, it says that k can be (pre-)configured, while in the first sub-bullet, it says that it is up to the UE to determine one or more values of k. It seems that the main bullet and the first sub-bullet are contradictory to each other. Or does FL mean that one or more K values are (pre)configured, but it is up to the UE to select them all or a subset from them or just one of them?FL: Yes, to the question. |
| Spreadtrum | We support Alt.2 which is more flexible, but we have some concern on “up to UE implementation”. For Alt.1, when Preserve is small, the sensing maybe performed after slot n in which resource (re-)selection is triggered. Because of the lack of some sensing occasions in slot n, UE may not have reliable sensing results when doing resource selection.  |
| Sony | We agree with the main bullet. On the first sub-bullet, we can further discuss the k values determination. |
| Xiaomi | We are supportive to the FL proposal. A suggested revision on the last subbullet:* + - When the k value corresponds to the most recent sensing occasion for a given reservation periodicity is not k=1, ~~the UE does not monitor a~~ (pre-)configured k value that is smaller than it for that given reservation periodicity is not applied.

As UE may still monitor these slots for pre-emption/re-evaluation procedures. |
| ETRI | We support Alt 1. With Alt. 2 for proposal 1-1, most recent one will be enough. |
| Samsung | We prefer Alt.1. In LTE partial sensing, since SL-RSSI measurement is used to order candidate resources, monitoring multiple periods is used for averaging RSSI. However, in NR full sensing, only RSRP-based resource exclusion is used, and resource exclusion based on multiple periods are not specified, so we don’t see the need of monitoring multiple periods in partial sensing as well. It will increase power consumption of sensing but the performance gain is unclear. |
| LGE | Not support.There is no reason to monitor more than one slot per periodicity. The only case we imagine that sensing multiple slots provides better performance than sensing a single slot may be the case where it happens e.g. the most recent occasion cannot be monitored by any reason, such as UL transmission in that slot. Monitoring multiple slots to solve this problem is not a solution, but just a redundant operation. The solution is to define more clearly the meaning of ‘the most recent occasion’. If the most recent occasion from the reference timing (e.g. the first candidate slot) cannot be monitored by UE, the next most recent occasion can be monitored, which applies iteratively if necessary. By this definition, there should be no case where UE misses monitoring occasion per periodicity, and there should also be no performance difference between monitoring a single and multiple slots.Finally, we need to separate discussion on sensing for resource (re)selection from that for resource re-evaluation and pre-emption checking. As we don’t have any agreement on whether periodic-based partial sensing is used for resource re-evaluation or pre-emption checking, FL proposal is applied only to the case of resource (re)selection at this stage of discussion.As a conclusion, we suggest the following proposal.**Proposal 1-2:*** For the k value in periodic-based partial sensing for resource (re)selection,
	+ Option 1 as in RAN1#104-e: 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.
	+ The most recent sensing occasion is the latest slot that can be monitored by UE before the reference timing described above.
 |
| Lenovo | Not support the proposal. Alt. 1 is our preference. |

**Proposal 1-3:**

* In periodic-based partial sensing, the UE shall monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.

|  |  |
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| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Panasonic | We are supportive with FL’s proposal. |
| Intel | We would like to clarify the main point of this proposal. Is that to define periodic based partial sensing behaviour or determine the last sensing occasion according to candidate slots Y?FL: I agree that this point was not very clear, as also pointed out by LGE below. The intention is related to the last periodic sensing occasion according to the Y candidate slots after the resource (re)selection trigging slot n.  |
| OPPO | OK |
| Sharp | Agree. |
| CMCC | Support |
| Ericsson | Support the current bullets, but an additional bullet is necessary: * In periodic-based partial sensing, the UE shall monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.
	+ After the triggering, the UE continuously monitors for the purpose of re-evaluation and pre-emption

FL: I agree the scope/intention of the original proposal is not very clear. This is intended to cover only the case when resource (re)selection is triggered at slot n and Y candidate slots are selected within the resource selection window [n+T1, n+T2]. So the periodic sensing occasions to be monitored after the triggering and before the first slot of the set of Y candidate slots are intended for the initial resource (re)selection. How about the following modification?* + After the ~~triggering~~ resources are (re)selected, the UE continue~~ously~~ to perform resource monitoring~~s~~ for the purpose of re-evaluation and pre-emption
 |
| Huawei, HiSilicon | Agree. Sensing should be performed (subject to processing time restriction) till the first possible slot can be selected for transmission in the resource selection window, i.e. the first slot of the selected Y candidate slots. Otherwise, there could be slots un-monitored between slot n and first slot of the selected Y candidate slots, which degrades partial sensing performance. |
| Fraunhofer | We support the FL’s proposal. |
| Futurewei | We are ok with the proposal |
| Apple | Just want to mention that sensing before the resource selection trigger is used for resource selection, while sensing between the resource selection trigger and the first slot of the selected candidate slots is used for resource re-evaluation or pre-emption. This may simplify the implementation at PHY layer, since PHY layer does not need to hold the resource selection procedure till the processing time before the first slot of the selected candidate slots. FL: I understand the intention, but if “sensing between the resource selection trigger and the first slot of the selected candidate slots is used for resource re-evaluation or pre-emption” then not all periodic sensing occasions and 32 slots prior to the Y candidate slots will be taken into account during the initial resource selection when the Y candidate slots are not selected close to or immediate after the triggering slot. Since the Y candidate slots can be selected anywhere within the selection window [n+T1, n+T2], e.g., take into account of SL DRX active period of RX UE, in most cases there will be a gap between the triggering slot n and the first slot of the set of Y candidate slot. If this gap is more than 32 slots, then no aperiodic reservation from other UEs can be taken into account during the initial resource selection. If only relying on re-evaluation and per-emption checking to perform sensing during this gap, most likely there will be frequent resource re-selection needs to be performed by the TX UE, which will cause more UE processing and result in more resources wastage when they are reserved but then re-selected later-on during pre-emption checking. Furthermore, currently the details of re-evaluation and pre-emption checking are not agreed. It is so far unclear whether the entire period of this gap will be sensed by re-evaluation and pre-emption checking. If this gap is more than 32 slots (e.g., 50 slots), then contiguous partial sensing will cover only up to 32 slots before the first slot of the Y candidate slot set. Then the first 18 slots after the triggering slots will not be covered by the contiguous partial sensing. This is another reason why periodic-based partial sensing needs to continue until the first slot of the Y candidate slot. |
| InterDigital | Support |
| Nokia, NSB | Support |
| MediaTek | We are ok with this proposal |
| Bosch | We support the modification by Ericsson and Apple: after resource selection trigger, the UE monitors (until the first slot of candidate resources) for the purpose of re-evaluation and pre-emption.FL: Please see my response to Ericsson and Apple in above. |
| Qualcomm | We disagree with the proposal.In current periodic resource selection procedure, resource selection is performed at resource selection trigger time. Additional monitoring between Slot n and the selected resource set, Y, is already supported as part of re-evaluation and we don’t see the need to introduce a parallel mechanism to achieve the same outcome.FL: Based on Tdoc review in this meeting, there is wide range of proposals and conditions in which re-evaluation and pre-emption checking should be performed after the initial resource selection. There is no guarantee that re-evaluation and pre-emption checking will be performed for all (re)transmissions and in all periods. For other technical reasons, please see my responses to Ericsson and Apple in above. |
| CATT | Agree with Apple/Ericsson view. The proposal needs corresponding change.FL: Please see my responses to Ericsson, Apple and QC in above. |
| Fujitsu | We support this proposal. “Sensing before the first slot of the selected Y candidate slots” can obviously provide more sensing results compared with “sensing before the resource (re)selection trigger”, then it can make the resource selection procedure more reliable. |
| NEC | Agree |
| Convida Wireless | We are fine with the proposal. |
| ZTE,Sanechips | Considering the first slot of Y may not be known in some cases, we prefer UE shall monitor in periodic sensing occasion(s) for a given reservation periodicity before the resource (re)selection trigger slot n. |
| vivo | support |
| Spreadtrum | We support the proposal. |
| Sony | We support the proposal. |
| Xiaomi | We are not sure the intention of the proposal. We agree with Ericsson and Apple that sensing results before the trigging slot n should be used in the triggered resource (re)selection; while the sensing results after the slot n should still be used for later re-evaluation and preemption (since we already agree to support them). If so, it is true that the main bullet is correct. However, what proposed in the main bullet is not complete. Why only those partial sensing occasions before the 1st slot of Y candidates should be monitored? If for preemption and reevaluation purpose, all partial sensing occasions before the selected resource(s) should monitored by the UE, and the selected resource(s) may not be in the 1st slot of Y candidate slots.FL: I agree the scope / intention of this proposal is not clear to everyone as also pointed out by Intel and perhaps mis-understood by Ericsson and Apple. I will clarify in the next version. For other reasons, please see my response to Intel, Ericsson, Apple, QC in above. |
| ETRI | We support the proposal. |
| Samsung | We are fine with the principle of considering processing time restriction, but we prefer that UE monitoring is before the trigger slot n, rather than the selected Y candidate slots.  |
| LGE | Support with modification.We need to separate discussion on sensing for resource (re)selection from that for resource re-evaluation and pre-emption checking. As we don’t have any agreement on whether periodic-based partial sensing is used for resource re-evaluation or pre-emption checking, FL proposal is applied only to the case of resource (re)selection at this stage of discussion.As a conclusion, we suggest the following modification.**Proposal 1-3:*** In periodic-based partial sensing for resource (re)selection, the UE shall monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.

FL: Thank you for the good suggestion. I think this point was missing and causing some confusions with sensing for re-evaluation and pre-emption checking. |
| Lenovo | Support. |

### Proposals before 2nd check point

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

* **On Proposal 1-1 (*Preserve*):**
	+ Support (14) vs. Non-support/non-prefer (15)
	+ Reasons for non-supporting
		- Alt. 2 is superset of Alt.1 and flexibility
		- For balance power saving and performance
		- Not much performance degradation when certain periodicities are dominant
	+ According to the discussion during the 2nd GTW session, it was commented that the remaining details (related FFS points) for Alt. 2 should be known before a hard selection can be made. To this end, please find below Question 1-1 trying to address this.
	+ For your reference, a copy of the agreement from RAN1#104b-e is provided at the beginning of Section 3.1 of this document.

**Question 1-1:**

* In periodic-based partial sensing, if Alt.2 of *Preserve* is to be adopted, please indicate which one(s) of the following options in each of the FFS issue should be selected. Feel free to add additional / modify option(s).
1. FFS if support multiple sets of *P*reserve values based on one or more metrics
	* + Option 1-1: Only a single full set/sub-set of *P*reserve values (e.g.,
		+ Option 1-2: Multiple sets of *P*reserve values can be (pre-)configured based on
			- Option 1-2-1: L1 priority of the TB to be transmitted
			- Option 1-2-2: CBR measurement of the indicated Tx resource pool
			- Option 1-2-3: A subset or a common divisor (e.g., 100ms) is used for configured reservation periodicities [100…1000]; Another sub-set for configured periodicities within [1…99].
2. FFS whether/how to restrict the set of values
	* + Option 2-1-1: only restricted within the set of the (pre-)configured set *sl-ResourceReservePeriodList.*
		+ Option 2-1-2: At least X% of the (pre-)configured values from the set *sl-ResourceReservePeriodList* (e.g., X = 50, 80 and etc).
		+ Option 2-1-3: It is not expected a reservation periodicity smaller than Yms from the (pre-)configured set of *sl-ResourceReservePeriodList* is included for the set of *P*reserve values (e.g., Y = 32ms).

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| **Company** | **Comments** |
| NTT DOCOMO | Support Option 1-1.Option 1-2-X seems not good way. Option 1-2-1 is not OK since high priority transmission by option 1-2-1 could collide with full sensing UE’s transmission with higher priority. It is unreasonable. Option 1-2-2 is not OK since even if channel is not busy, sufficient sensing is needed; otherwise, it could collide with full sensing UE’s transmission with higher priority. Option 1-2-3 is not OK since it is against to ‘k’ definition, i.e. most recent occasion.Support Option 2-1-1.Our view is that operator/regulator should select full set or subset in Option 2-1-1 if we go with Alt2. No extra rule is necessary. |
| Intel | For Alt.2, we do not see the need for additional FFS. We assume it can be simply left up to configuration. |
| OPPO | Support Option 1-1.If only partial periods are monitored, that will degrade PRR performance. Then full set of Preserve should be monitored. In that case, no necessary to specify the details, such as how to set the subset, how UE select which subset to monitor, etc. |
| Panasonic | Support Option 1-2. We think no further sub-options ore restrictions need to be decided currently.  |
| vivo | Option 1-1.Option 2-1-1.How to determine the subset can be up to (pre-)configuration. |
| CMCC | In our view, one major concern from the opponent of Alt. 2 is that, (pre-)configuring a subset would cause collision and be harmful for the PRR performance, therefore, some further rules can be defined to guarantee the sensing performance:Regarding the 1st bullet, we think that Option 1-2-3 is a good choice, where a common divisor can be used for reservation periodicities [100, …, 1000] just as the rule in LTE-V, and another *full-set/sub-set* is configured for short reservation periodicities [1, …, 99].Regarding the 2nd bullet, we prefer Option 2-1-1. |
| ZTE,Sanechips | Option 1-1 seems to miss the example, we propose the following complement * + - Option 1-1: Only a single full set/sub-set of *P*reserve values (e.g., a subset includes a common divisor (e.g., 100ms) is used for configured reservation periodicities [200…1000];)

The rational for the example is to include 100 ms as the configured P\_reserve given it's the common divisor of 200,300,...1000 regardless of whether the original set contains 100 ms or not. |
| Nokia, NSB | Support Option 1-1, if Alt 2 is adopted (our preference would be Alt 1). For Option 2-1-1, this “restriction” seems to indicate a subset of the full set that the RRC message “*sl-ResourceReservePeriodList-r16*” allows. If this is the case, it is covered in Option 1-1. |
| Ericsson | We are mainly supportive of Option 1-1. However, for the sake of progress, we could compromise on Opt. 1-2, if it includes the following:The set of Preserve to be used for sensing is (pre-)configurable and must be part of the set of Preserve that are allowed for transmission in that pool.(Pre-)configuration is part of the pool (pre-)configuration and is up to the operator.If the parameter is not configured by higher layer, then the full set of Preserve allowed for transmission in that pool is also used for sensingIf Option 1-1 is selected, in our view, there is no need to include any extra restrictions, so Option 2 is not needed, i.e., all the values from Preserve are considered. |
| Huawei, HiSilicon | We support Alt.1. Based on the comments in our previous reply and simulation results, only sense part *P*reserve values of the (pre-) configured set *sl-ResourceReservePeriodList*, no matter one subset or multiple subsets will lead to the PRR performance degradation. |
| Fraunhofer | Support Option 1-2-1.In our understanding, each of the (pre-)configured sets of *P*reserve values would be mapped to a transmission priority, where the highest priority is mapped to the full set of periodicity values from *sl-ResourceReservePeriodList*, and as the priority decreases, smaller subsets are (pre-)configured. This would enable UEs transmitting high priority transmissions to ensure that sensing is carried out in more slots, at the expense of power saving gain. On the other hand, low priority transmissions would require the UE to carry out sensing only on a subset of slots, resulting in higher power saving gain.We disagree with Docomo’s interpretation of this option, since a high priority transmission would use the full set of values, and its collision probability with a full sensing UE would be same as that of using Alt. 1.Option 1-1, if the full set is supported, is essentially Alt. 1, and if a single subset is (pre-)configured, it would only deteriorate the PRR performance of the UE. In either case, it robs the system of the flexibility in prioritizing power saving over reliability, or vice versa.  |
| Apple | For the first FFS, we support Option 1-2 (either Option 1-2-1 or Option 1-2-2). We think at least two sets of $P\_{reserve}$ values could be supported. The first set of $P\_{reserve}$ values corresponds to all values from *sl-ResourceReservePeriodList*, while the second set of $P\_{reserve}$ values corresponds to a subset of values from *sl-ResourceReservePeriodList*. The selection between two sets of $P\_{reserve}$ values may depend on channel busy ratio (CBR). In general, the chance of resource collision is higher when sidelink channels are crowded. Sensing over all values from *sl-ResourceReservePeriodList* is beneficial in alleviating the resource collision chance. On the other hand, when sidelink channels are less crowded, sensing over a subset of values from *sl-ResourceReservePeriodList* is beneficial in saving device powers. The selection between two sets of $P\_{reserve}$ values may also depend on priority level of data to be transmitted.For the second FFS, we support Option 2-1-3, and think the small reservation periodicity could be covered by contiguous partial sensing.  |
| MediaTek | Support Option 1-1.Performance benefit of multiple sets is not clear to us. Support Option 2-1-1. Firstly, Option 2-1-1 is the superset of Options 2-1-2 and 2-1-3.Secondly, we expect that the network configuration will pre-configure sensible set of values for Preserve. With such correct pre-configuration, power saving can be improved without any performance degradation. For example, let’s say that network pre-configured *sl-ResourceReservePeriodList* = {50ms, 100ms, 200ms} and k = {1, 2, 3, 4} (i.e., the most recent 4 sensing occasions). If operator pre-configures Preserve as {50ms}, all periodicity values of 50ms, 100ms, and 200ms will be covered on at least one sensing occasion.  |
| CATT | Option 1-1.Option 2-1-1.Can be supported, while other options can be FFS. |

* **On Proposal 1-2 (k value):**
	+ Support (15) vs. Non-support/prefer Alt. 1 (13)
	+ Reasons for non-supporting
		- “Up to UE implementation” is not OK
		- Prefer Alt. 1 with additional k up to UE implementation
		- Use a bitmap
		- Add FFS when n is not predictable
	+ FL comments:
		- The intention of leaving the selection of k up to UE implementation within the set of (pre-)configured values (to resolve the FFS issue in Alt. 2) is meant as a compromise to the camp that strongly prefers Alt. 1 which requires the least amount of sensing power. At the same time, it resolves the FFS issue in Alt. 2. It is recommended to consider this compromised way forward.
		- Alternatively, Alt. 1 can be modified in such way that the UE is not restricted to monitor only the most recent sensing occasion for a given reservation periodicity.

**Proposal 1-2 (II):**

* For the k value in periodic-based partial sensing for resource (re)selection,
	+ Option 1: Alt. 1 from RAN1#104b-e is selected with the following modifications,
		- ~~Only~~ At least the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger or the set of Y candidate slots subject to processing time restriction.
		- The most recent sensing occasion is the latest slot that can be monitored by UE before a reference timing described above.
		- It is up to UE implementation to monitor additional periodic sensing occasions for other k values.
	+ Option 2: Alt. 2 from RAN1#104b-e is selected, where k is (pre-)configured, including multiple values and the most recent sensing occasion for a given reservation periodicity
		- It is up to UE implementation to decide one or multiple k values per reservation periodicity and at least the most recent sensing occasion for a given reservation periodicity shall be monitored.
		- Note that 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 may correspond to a k value other than k=1.
		- When the k value corresponds to the most recent sensing occasion for a given reservation periodicity is not k=1, ~~the UE does not monitor~~ a (pre-)configured k value that is smaller than it for that given reservation periodicity is not applied.
		- FFS: max number of k can be (pre-)configured
		- FFS weather/how to ensure all the sensing occasions are monitored for the case when selected slot y / triggering slot n is unknown/unpredictable

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| **Company** | **Option (1, 2, or none)** | **Comments** |
| NTT DOCOMO | Option 1 | From operator/regulator perspective, achievable performance in the resource pool should be predictable; otherwise, they cannot promote which service is possible. In that sense, if some k values are up to UE implementation, predicted performance is just based on ‘most recent occasion’. In other words, optimization for ‘up to UE implementation’ is unnecessary (meaningless), so Option 1 should be fine rather than Option 2. |
| Intel | Option 1 | In our view periodic-based partial sensing should provide partial sensing and complexity reduction. UEs operating in full sensing mode do not consider multiple preceding occasions for a given transmission period and thus it should not be required for periodic-partial sensing. We see the following drawbacks in supporting multiple k values: 1) increase of UE complexity, 2) increase of UE power consumption 3) implies more specification efforts 4) is not aligned with baseline sensing operation principle. Considering above drawbacks, it is sufficient to support Alt.1 onlyRegarding the part “It is up to UE implementation to monitor additional periodic sensing occasions for other k values.” We suggest removing it and strive for common behavior across UEs. |
| OPPO | Option 1 | As a comprise, we can live with option 1. Whether to monitor k>1 periods is left to UE implementation. No specification is needed for that.  |
| Sharp | Option 2 (partially) | As commented in last round, if k is (pre)configured via a bitmap, k=1 is applied starting from the most recent sensing occasion before the first slot of Y candidate slots, which means only with the clarification that UE monitors $t\_{y-(k\_{0}+k-1)×P\_{reserve}}^{SL}$ if the k-th bit is set to 1 and $t\_{y-k\_{0}×P\_{reserve}}^{SL}$ denotes the most recent occasion before the first slot of the Y candidate slots. In this way, 2nd and 3rd sub-bullet are not necessary. Thus, we propose as follows,* + Option 2: Alt. 2 from RAN1#104b-e is selected, where k is (pre-)configured, including multiple values and the most recent sensing occasion for a given reservation periodicity
		- It is up to UE implementation to decide one or multiple k values per reservation periodicity and at least the most recent sensing occasion for a given reservation periodicity shall be monitored.
		- ~~Note that 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 may correspond to a k value other than k=1.~~
		- ~~When the k value corresponds to the most recent sensing occasion for a given reservation periodicity is not k=1, the UE does not monitor a (pre-)configured k value that is smaller than it for that given reservation periodicity is not applied.~~
		- k is (pre-)configured via a bitmap, wherein for a given periodicity $P\_{reserve}$, the 1st bit is always set to 1 and the 1st bit in the bitmap corresponds to the most recent sensing occasion before the first slot of the Y candidate slots (denoted as $t\_{y-k\_{0}×P\_{reserve}}^{SL}$), the 2nd bit corresponds to the sensing occasion $t\_{y-(k\_{0}+1)×P\_{reserve}}^{SL}$, and so on.
		- FFS: max number of k can be (pre-)configured
		- FFS weather/how to ensure all the sensing occasions are monitored for the case when selected slot y / triggering slot n is unknown/unpredictable
 |
| vivo | Option2 | We prefer option 2 because it provides additional flexibility and configurability not only for the UE but also for the gNB and OEM. But we do not agree with the "performed by UE" part.If a k value set is (pre)configured, the UE just performs sensing based on this k value set, it is not clear to us why the UE still has to select one or more values from this set. And, different set sizes may result in different PRR performances, and it is not good for the system to leave the choice and control of PRR performance entirely to the UE implementation. |
| CMCC | Option 2 | For the 1st sub-bullet of Option 2, not OK for leaving it up to UE implementation. |
| ZTE,Sanechips | Comments | We think the FFS bullet should be added to option 1 as well. In our updated contribution R1-2106122, we provided simulation comparison on using the legacy LTE sensing gap 100ms to ensure the alignment of sensing occasions which leads to better performance eventually |
| Nokia, NSB | Option 1 | We are fine with this compromise “It is up to UE implementation to monitor additional periodic sensing occasions for other k values.” This should address some concerns on extra sensing occasions other than the most recent one. |
| Ericsson | Option 1 | We are supportive of the compromise of having up to UE implementation the additional sensing occasions. |
| Huawei, HiSilicon | Option 2 | It is confusing at the difference between option 1 and option 2, if the “only” is changed to “at least” in option 1. It seems option 1 with “at least most recent one + UE implementation to monitor the additional” is almost same as Option 2 “multiple values + UE implementation to decide one or multiple k values”. This two options cause confusions.Regarding the FL’s feedback to our concerns about un-controlled interference level, the FL’s assessment may be based on low interference and light/medium traffic cases that partial sensing is close to full sensing. However, when in other cases, some with different k values can have different PRR performance. In a sensing based system, UE implementation on whether to sense more or less, for example, a less sensing UE may select a resource has reserved by other more sensing UE but not detected due to less sensing. So not only the transmission of less sensing UE, but also the transmission for more sensing UE would be impacted. Therefore, it would cause system-level performance degradation, even by UEs with a good implementation. Hence, the first sub-bullet of option 2 needs to be removed.For the last FFS, in our understanding, the Y candidate slots are determined by UE implementation, and UE could decide the candidate slots by its own prediction. So we do not need to specify anything that how to ensure the service is predicable. If the determined sensing occasions based on Y candidate slots, a mismatch between Y and slot n could happen, that is the insufficient resource issue discussed in our contribution. At that case, UE can select resource randomly in a mix RA schemes resource pool based on priority or exceptional resource pool. On the other hand, this is not an issue belong to option 2 only, option 1 and CPS have the same problem.Based on submitted simulation results, it can be observed in lower-interfered and light/medium-traffic case, k = 1 only seems sufficient, but in higher-interfered and heavy-traffic case, k = 2 in addition to k = 1 achieves PRR gain. Configuration, including k = 1, can provide flexibility to adapt different use cases. The power reduction ratio defined in Rel-17 evaluation methodology, taking into account mixed traffic models, compared to the Rel-16 baseline, both k = 1 and k = {1,2} achieve significant power saving gain, and the power reduction gap between them is marginal. As per the UE complexity comment of option 2 from Intel, we disagree. In full-sensing RA, the sensing window can be up to 1100ms, i.e. a UE already support monitor multiple k values, but with only one being used for determination for resource exclusion. K = multiple values does not increase UE complexity compared to Rel-16. R17 features will anyway need to be captured in the spec, this modification based on Rel-16 is within the scope in Rel-17. |
| Fraunhofer | Option 2 | We support that multiple k values are (pre-)configured, and at least the most recent sensing occasion for a given reservation periodicity has to be monitored. However, we are unsure of how the UE can select more k values without specifying a basis for monitoring more time slots that the most recent sensing occasion. |
| Apple | None | We are not fine with the “UE implementation” in both options. We think a system wide and unified (over all UEs) design is preferred to keep the system performance more stable. In Option 2, if k is pre-configured, we do not see the necessity that the determination of one or multiple k values per reservation periodicity is based on UE implementation.  |
| MediaTek | See comment | With ‘up to UE implementation’ in both alternatives, we are not sure how these two options are different. The selection of k values should not be left to UE implementation in Alt-2. Instead, either a bitmap configuration or a set of k values or a number of most recent occasions should be pre-configured by NW.  |

* **On Proposal 1-3 (sensing before set of Y candidate slot):**
	+ Support (21) vs. Non-support/non-prefer (7)
	+ Although I believe most companies understood the proposal came from past discussions and unresolved FFS point in the last two meeting, I admit the scope/intention of the proposal was not very clear as pointed out by Intel and implied by LGE. Some confusions may have caused to 2 or 3 companies based on their responses. In the new proposal 1-3 (II) below, it is clarified at the beginning using the agreed wording from RAN1#104-e.
	+ For other technical concerns raised and relation to re-evaluation/pre-emption, please see my reply to those immediately below their comments.
	+ Based on comments/concerns received regarding the newly added sub-bullet during the 2nd GTW session, it is now removed. Let’s continue to look at details for re-evaluation and pre-emption checking in the next meeting.
	+ Some re-arrangement on the first sentence to avoid giving an impression that periodic-based partial sensing is only performed after the resource (re)selection is triggered at slot n, by using the similar wording used in RAN1#104-e.

**Proposal 1-3 (II):**

* If UE performs periodic-based partial sensing and when resource (re)selection is triggered at slot n, the UE shall monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.
	+ ~~After the resources are (re)selected, the UE continue to perform resource monitoring for the purpose of re-evaluation and pre-emption~~

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| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Intel | Support |
| OPPO | Support |
| Sharp | Support |
| Panasonic | Support |
| vivo | This proposal is to specify the latest periodic-based partial sensing occasion to be monitored, we share a similar view that the periodic based sensing occasions before Y may be available, but regarding the wording ‘UE shall’ in the main bullet, if a derived periodic sensing occasion which is after slot n and before Y slots is located in DRX off time, does the proposal mean that UE shall wake up and perform sensing in the occasion even in the off time? We suggest considering the latest periodic-based partial sensing occasion to be monitored and the interaction between sensing and DRX separately, and would like to modify the proposal as following so that the proposal is valid for the case without DRX* For the case without SL DRX, If UE performs periodic-based partial sensing and when resource (re)selection is triggered at slot n, the UE shall monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.
	+ ~~After the resources are (re)selected, the UE continue to perform resource monitoring for the purpose of re-evaluation and pre-emption~~
	+ FFS the case with SL DRX
 |
| CMCC | Support |
| Nokia, NSB | Support.However, it seems that this text in Proposal 1-2 (II) overlaps with this proposal.“The most recent sensing occasion is the latest slot that can be monitored by UE before a reference timing described above” |
| Ericsson | We are supportive of this proposal in general. We propose a small modification to the main bullet to be aligned with proposal 1-2. Moreover, we propose to add the following FFSs to address the future study (as pointed out by FL) of re-evaluation and pre-emption checking and the potential combination of contiguous and periodic partial sensing:**Proposal 1-3 (II):*** If UE performs periodic-based partial sensing and when resource (re)selection is triggered at slot n, the UE shall at least monitor 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.
	+ The processing time restriction includes $T\_{proc,0}^{SL} $ and $T\_{proc,1}^{SL}$.
	+ ~~After the resources are (re)selected, the UE continue to perform resource monitoring for the purpose of re-evaluation and pre-emption~~
	+ FFS relationship to re-evaluation and pre-emption operation for periodic-based partial sensing
	+ FFS how to combine with contiguous partial sensing
 |
| Huawei, HiSilicon | We are fine with the direction, but current wording has an indication that when resource (re)selection is triggered at slot n, which implies UE stars to sense after slot n, the resource selection is trigger. However, this is not correct. Sensing has to be done before slot n and sensing results are available for candidate resource set determination. Hence suggest to modify the proposal as follows:* If UE performs periodic-based partial sensing ~~and when resource (re)selection is triggered at slot n~~, the UE shall monitor 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.
 |
| Fraunhofer | Support |
| Apple | We prefer to keep the second sub-bullet. If the concern is we do not have corresponding agreement for sensing for re-evaluation and pre-emption, then we suggest the following second sub-bullet.* + FFS periodic-based partial sensing for re-evaluation and pre-emption.

Of course, this sub-bullet is not needed if the last sub-bullet in Proposal 2-2 (II) is agreed.  |
| MediaTek | Support |

## Topic #2: Contiguous partial sensing – triggering conditions, TA and TB value range, and definition for selection and candidate resource set

**Background**: In RAN1#104-e, it was agreed to further study the condition(s) in which contiguous partial sensing is performed by UE. During the RAN1#104b-e meeting, a set of conditions was defined for the periodic-based partial sensing. Following the same principal and based on Tdoc review in this meeting, a similar set of conditions can be defined for the contiguous partial sensing as well. The only difference is that UE performing contiguous partial sensing is not conditioned by whether the mode 2 resource pool is (pre-)configured with periodic reservation for another TB (sl-MultiReserveResource) enabled. That is, the intention is to support contiguous partial sensing regardless of the triggering traffic type. **The corresponding proposal is in Proposal 2-1.**

Furthermore, in RAN1#104-e, it was also agreed to further study the range of *TA* and *TB* values, including the possibility of equal to zero, positive or negative. Based on Tdoc review in this meeting, many companies expressed the following operating scenarios for the *TA* and *TB* values.

* + - * + *TA*, *TB* being zero: When aperiodic transmission is triggered and the remaining PDB is short, there may not be sufficient time for the UE to perform contiguous partial sensing. In this case, L1 may report a full set of candidate resources (similar to random selection) or perform resource exclusion based on periodic-based partial sensing results only, if available.
				+ *TA*, *TB* being positive: When aperiodic transmission is triggered and the remaining PDB is sufficient for the UE to perform contiguous partial sensing to detect aperiodic reservations from other UEs. In another scenario where the selected Y candidate slots from periodic-based partial sensing is not immediately after the triggering slot n such that the UE should continue to perform contiguous partial sensing just before the first slot of the set of Y candidate slots.
				+ *TA*, *TB* being negative: When the resource (re)selection triggering slot n is predictable (e.g. for periodic traffic), the UE would be able to perform contiguous partial sensing in advance / prior to the triggering slot n. In another scenario, if contiguous partial sensing is supported for resource re-evaluation and pre-emption checking, the contiguous partial sensing would be performed before the triggering slot m-T3.

Based on the above expressed views, it is proposed to conclude that *TA* and *TB* values can be zero, positive or negative depending on operating scenarios. However, the expressed values or range for *TA* and *TB* are still quite wide spread among the companies. This is mainly due to some details in periodic-based partial sensing are still not yet finalized. **Therefore, a corresponding proposal for this aspect is made in Proposal 2-2.**

From the Tdoc review in this meeting, it is also clear as expressed by many companies that at least when the resource (re)selection procedure is triggered for periodic transmission, both periodic-based and contiguous partial sensing processes would be performed by the UE in order to exclude from the candidate resource set (*SA*) both periodic and aperiodic reserved resources from other UEs. And the same candidate resource set (*SA*) is used in both partial sensing mechanisms. However, there are less and divergent views expressed for the case when the resource (re)selection procedure is triggered for aperiodic transmission. **Therefore, a corresponding proposal for this aspect is made in Proposal 2-3.**

### Proposals before 1st check point

**Proposal 2-1:** Condition(s) in which contiguous partial sensing is performed by UE, at least all of the followings are met:

* L1 is triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool
* The resource pool is (pre-)configured to enable partial sensing
* Partial sensing configured by higher layer in the UE

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| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Panasonic | We are generally ok with it. We’d like to know if the 2nd bullet applies pool enabled with mixed full/partial sensing, and whether any restriction for Rx pool.FL: as long as partial sensing is configured for the TX pool. The RX pool does not matter as it is only for reception, not transmission. |
| Intel | OK. We have one question. Should we clarify that it is applicable to both dynamic and semi-persistent sidelink transmissions with partial sensing?FL: It was intentionally left out since it should be applied to both transmissions.  |
| OPPO | For the 1st sub-bullet, does it exclude the case TA and TB can be negative? According to the wording, it seems only C-PS can be performed when L1 is triggered to perform resource selection. It that will cause confusing, better to remove it. FL: Yes, it can be negative. Here “L1 is triggered to perform resource (re)selection” would include both case of periodic transmission and aperiodic transmission. The proposal does not say “when” or “after” L1 is triggered to perform … . This first condition should not be removed, otherwise it implies the contiguous partial sensing should be performed regardless if UE is trigger to perform resource (re)selection. A clarification note is added after the sub-bullet as:* L1 is triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool
	+ Note, it is not restricted that contiguous partial sensing can be only performed after the resource (re)selection trigger.
 |
| Sharp | We don’t agree with the 1st condition which reveals contiguous partial sensing is performed after slot n on which L1 is triggered. For the rest of 2 conditions, we agree.FL: please see response to OPPO in above. |
| CMCC | For the 1st bullet, we have similar concerns as commented by other companies. We think that the contiguous partial sensing can be performed on top of the periodic based partial sensing to take the aperiodic reservations into account. In such a case, the T\_A and T\_B would be negative, and the contiguous partial sensing occasion can be in advance to the triggering slot n. However, the 1st bullet seems to say that the contiguous partial sensing occasion can only occur after the triggering slot n.FL: please see response to OPPO in above. |
| Ericsson | We are supportive of this proposal |
| Huawei, HiSilicon | The motivation of the first bullet is not clear. As we stated in GTW, it appears to imply that CPS can be performed only upon/after slot n, however, it is not true. When RP enables periodic reservation (aperiodic traffic is assumed always existing), both PBPS and CPS shall be performed to detect periodic and aperiodic reservation from other UEs, respectively. It does not rely on the trigger for resource selection in PHY layer. So the first bullet should be deleted. On the second and third bullet, we are fine with them. Given that aperiodic reservation cannot be disabled in a RP, CPS should be always performed.FL: please see response to OPPO in above. |
| Fraunhofer | We support the FL’s proposal, but it is unclear whether this is restricted to periodic transmissions alone, or if it is applicable for aperiodic transmissions as well.FL: please see response to Intel in above. |
| Futurewei | We are ok with proposal.  |
| Apple | We do not see the necessity of the first bullet. In the corresponding agreement for periodic-based partial sensing, we do not see the similar condition. Probably, we could borrow the similar wording from periodic-based partial sensing as follows:*When contiguous 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:** *The resource pool is (pre-)configured to enable partial sensing*
* *Partial sensing configured by higher layer in the UE*

FL: As already explained in the background section, the current wording is already reused from the last meeting’s agreement for periodic-based partial sensing. Regarding the first bullet/condition please see response to OPPO above. |
| InterDigital | We support FL’s proposal. |
| Nokia, NSB | Based on the text “…, at least all of the followings are met:”, these conditions are minimal conditions to make the contiguous partial sensing happen. Therefore, suggest to remove the first bullet, as it might cause confusion as indicated by other companies.FL: please see response to OPPO in above.  |
| MediaTek | We don’t agree with the 1st bullet point. As mentioned by other companies, UE should be able to start performing contiguous sensing before resource selection trigger ‘n’.FL: please see response to OPPO in above.  |
| Bosch | We have the same concern as commented by some companies above: can we clarify that contiguous partial sensing is performed by UE for periodic (SPS) and aperiodic reservations? FL: please see response to Intel and OPPO in above. |
| Qualcomm | We agree with the general direction of the proposal. However, it seems that the first bullet could contradict other proposals and could be interpreted to force the UE to always perform sensing after resource selection trigger even when it enough existing sensing results to proceed with selection.Completely removing it on the other hand, could also be interpreted as the UE having to perform sensing all the time and not partially.We propose the following change to clarify:* L1 is triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool and the UE does not have sufficient sensing results.

FL: Although I agree with your intention, but it then becomes hard to quantify the condition that the UE does not have sufficient sensing results. Please see response to OPPO in above. |
| CATT | We have similar view with some other companies that the first bullet may indicate T\_A and T\_B cannot be negative value. While for the contiguous partial sensing should be able to be performed on top of the periodic based partial sensing to take the aperiodic reservations into account, which means negative T\_a and T\_b value. Other two bullet looks fine.FL: please see response to OPPO in above. |
| Fujitsu | We are generally fine with this proposal. But for the first sub-bullet, if the traffic type is periodic, the contiguous partial sensing can be performed before the slot “n” when L1 is triggered to perform resource (re)selection. So, we propose to do the following modification on the proposal:**Proposal 2-1:** Condition(s) in which contiguous partial sensing is performed by UE, at least all of the followings are met:* L1 is triggered or can predict to be triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool
* The resource pool is (pre-)configured to enable partial sensing
* Partial sensing configured by higher layer in the UE

FL: please see response to OPPO in above. |
| NEC | ok |
| Convida Wireless | We are generally fine with the proposal. |
| ZTE,Sanechips | OK. The first bullet is similar to the rel-16 mechanism. |
| vivo | Combining sub-bullet2 with previous agreement on the condition for performing PBPS, for a pool enabling partial sensing, is it possible that UE only performs CPS but does not perform PBPS?FL: Yes, whenever any one of the conditions for PBPS is not fulfilled, the UE only performs CPS. |
| Spreadtrum | We support the proposal. |
| Sony | We are basically OK with the proposal. But we also have similar concern about the first bullet as stated by other companies.FL: please see response to OPPO in above. |
| Xiaomi | We are generally fine with the proposal except the 1st subbullet. We have similar understanding as other companies that partial sensing can be performed either before or after the resource (re)selection is triggered. We suggest to revise the bullet as :L1 is triggered or to be triggered to perform resource (re)selection procedure in a mode 2 Tx resource poolFL: Thanks for the suggestion, please see response to OPPO in above. |
| ETRI | We support the proposal. |
| Samsung | We also prefer to remove the 1st bullet since it may restrict scenarios of contiguous partial sensing. The other 2 bullets are not very clear for us, since the condition set seems quite similar to periodic-based partial sensing, and the relationship of periodic-based partial sensing and contiguous partial sensing seems ambiguous. In addition, we need to clarify whether the configuration is related to partial sensing or only contiguous partial sensing.FL: As it was already discussed back in RAN1#103-e, the use of the term contiguous partial sensing may be only within RAN1 discussion and may not appear in the spec. Hence the general term “partial sensing” is configured. For other point, please see response to Intel and OPPO in above. |
| LGE | Support with modification.We share other companies’ concerns on the first sub-bullet. In addition, We need to separate discussion on sensing for resource (re)selection from that for resource re-evaluation and pre-emption checking. As we don’t have any agreement on whether contiguous partial sensing is used for resource re-evaluation or pre-emption checking, FL proposal is applied only to the case of resource (re)selection at this stage of discussion.As a conclusion, we suggest the following modification.**Proposal 2-1:** ~~Condition(s) in which contiguous partial sensing is performed by UE, at least all of the followings are met:~~At least all of the following condition(s) are met for contiguous partial sensing to be performed by UE for resource (re)selection:* ~~L1 is triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool~~
* The resource pool is (pre-)configured to enable partial sensing
* Partial sensing configured by higher layer in the UE

FL: please see response to OPPO in above. Regarding the modification in the main sentence, it is already clarified in the first bullet (if not removed). |
| Lenovo | Support. |

**Proposal 2-2:** In contiguous partial sensing, *TA* and *TB* values can be zero, positive or negative

* When *TA* and *TB* are not zero, they can’t be equal
* FFS whether *TA* and *TB* values or range should be further restricted base on different operating scenarios or conditions (e.g., periodic/aperiodic traffic, predictability of triggering slot n, remaining PDB, re-evaluation/pre-emption checking, etc)
* FFS: whether and details of how periodic-based partial sensing and contiguous partial sensing can be supported 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.

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| **Company** | **Comments** |
| NTT DOCOMO | Generally OK.One question: why ‘When T\_A + T\_B are not zero’ is needed? I think just ’T\_A and T\_B cannot be equal’ will be OK.FL: When *TA* and *TB* are not zero, it means the UE would be doing some sensing. If they are equal, then no sensing is performed. It will be then essentially the same as *TA* = *TB* = zero. |
| Panasonic | Ok |
| Intel | We are not clear how TB can be negative. Suggest adding TB > TA. Except these aspects we are OK, but we prefer to debate/converge further this meeting. FL: Please check the background section. If the described scenarios/conditions are not agreeable, then we can further discuss. |
| OPPO | OK  |
| Sharp | Not agree. The 1st sub-bullet was already agreed in RAN1#104e.FL: please indicate which part of agreement in RAN1#104e is the same as the 1st sub-bullet. |
| CMCC | Support. |
| Ericsson | We are in general supportive of this proposal, but some modifications are needed in our view.* For the second bullet, we think that the word restricted should be changed to adjusted/adapted, since *TA* and *TB* will not only be reduced – as the word restricted indicates – but could also be increased, and therefore, we think that adjusted/adapted is a better wording for the intention of this proposal.
* Moreover, the partial sensing operation shall be defined in terms to obtain a trade-off between power saving and reliability obtained by performing sensing. Therefore, we think that for the definition of *TA* and *TB*, these values should be also adjusted based on the reliability of the previous transmission, i.e., HARQ feedback, and on the CBR/CR parameter which indicates the system congestion.

Therefore, we suggest modifying the proposal as follows:* ~~FFS whether~~ *TA* and *TB* values or range should be further ~~restricted~~ adjusted/adapted based 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, etc).

FL: Suggested modifications are OK with me. It is not quite clear why “FFS whether” should be removed. As explained in the background section, currently there is a wide range of proposal on how to set/restrict/adjust/adapt the TA and TB values. I think it is necessary to study further. |
| Huawei, HiSilicon | We have concerns on the first sub-bullet. T\_A and T\_B cannot be equal regardless of their values are zeros or not. When CPS is enabled, sensing during the window shall be performed, and the window must have some non-zero extent. So T\_A = T\_B implies there is no sensing between T\_A and T\_B, and should be precluded. This bullet should simply say: TA ≠ TB.FL: It is mentioned in quite some contributions that TA=TB=zero is for the case when there is insufficient PDB for the UE to perform contiguous partial sensing after the resource (re)selection trigger. If you disagree with this point, we can further discuss. |
| Fraunhofer | We support the FL’s proposal. |
| Futurewei | We are generally ok with the proposal. For the second FFS, the partial sensing for resource selection shall be discussed first as a lot of timing issues are to be discussed. Re-eval/pre-emption shall be discussed later if needed. FL: sure |
| Apple | We support this proposal in general. It is preferred to determine the TA, TB values or range, based on different scenarios or conditions, since otherwise the system may not be stable due to different UE behaviours. Hence, we suggest to remove “FFS whether” from the first bullet.FL: As explained in the background section, currently there is a wide range of proposal on how to set/restrict the TA and TB values. I think it is necessary to study further. |
| InterDigital | We are supportive of the proposal.  |
| Nokia, NSB | We are okay with the direction of this proposal. We also support FFS on the Ta/Tb restrictions.  |
| MediaTek | We are generally fine with this proposal. |
| Bosch | We agree with Ericsson modification to replace restricted with “adjusted or adapted”. We also support adding HARQ and CBR/CR parameters. |
| Qualcomm | We support the proposal except the last FFS.RAN1 already agreed in RAN1 103 to support re-evaluation and pre-emption checking by UEs that do sensing; hence, the last FFS in the proposal isn’t necessary.Agreement:* ….
* 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

 If an FFS is kept for clarification, it can be reworded to not contradict the agreement:* FFS: ~~whether and~~ details of how periodic-based partial sensing and contiguous partial sensing ~~can be supported~~ 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.
 |
| CATT1 | We agree with the proposal. |
| Fujitsu | We are generally fine this proposal. Besides, for the 2nd FFS, we think it may also need to take the different operating scenarios or conditions into account, e.g., pre-emption enabled/disabled, HARQ-ACK enabled/disabled, etc. For example, if pre-emption is disabled, only re-evaluation can be done in the resource pool and sensing in the slots only for pre-emption checking can be skipped, then more power efficiency can be obtained compared to pre-emption enabled case. So, we propose to do the following modification on the proposal:**Proposal 2-2:** In contiguous partial sensing, *TA* and *TB* values can be zero, positive or negative.* When *TA* and *TB* are not zero, they can’t be equal.
* FFS whether *TA* and *TB* values or range should be further restricted base on different operating scenarios or conditions (e.g., periodic/aperiodic traffic, predictability of triggering slot n, remaining PDB, re-evaluation/pre-emption checking, etc)
* FFS: whether and details of how periodic-based partial sensing and contiguous partial sensing can be supported 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 (pre-emption enabled/disabled, HARQ-ACK enabled/disabled, etc).
 |
| NEC | OK |
| Convida Wireless | We are generally fine with the proposal. |
| ZTE,Sanechips | We think *TA* and *TB* values can be zero, positive, but not negative. Considering the coordination between MAC and PHY, we think contiguous partial sensing should be triggered by MAC layer. Then, *TA* and *TB* values should be positive, i.e. after triggering slot n. If *TA* and *TB* values are both zero, that means no contiguous partial sensing is performed.FL: Please check the background section. If the described scenarios/conditions are not agreeable, then we can further discuss. |
| vivo | ok |
| Spreadtrum | We are OK with the proposal. |
| Sony | We are generally OK with the proposal. For the first bullet, “they can’t be equal” could be “T\_A < T\_B”.FL: please check previous reply on the first sub-bullet to others. |
| Xiaomi | We do not see the necessity to agree the proposal but we are fine to accept it if majority wants to agree on it. For the 2nd bullet we suggest to add “how”, * FFS whether/how *TA* and *TB* values or range should be further restricted base on different operating scenarios or conditions (e.g., periodic/aperiodic traffic, predictability of triggering slot n, remaining PDB, re-evaluation/pre-emption checking, etc)

And we agree with QC that “whether” in the 3rd bullet is not needed.  |
| ETRI | We support the proposal. |
| Samsung | For 1st sub-bullet, adding TB > TA seems fine for us. In addition, we suggest to clarify the meaning of *TA* =*TB* =0 in the proposal to make it more clear.For 2nd sub-bullet, we prefer to simplify the main sentence as “FFS: *TA* and *TB* values or range” to avoid restricting the scope of following discussions.FL: For the case when *TA* =*TB* =0, the usage and scenarios expressed by other companies can be found in the background section.  |
| LGE | Not support.FL proposal seems too conceptual at this stage. We may go further details to make a progress. I think most companies have common understanding on the followings:* Random resource selection: T\_A=T\_B=0
* Contiguous partial sensing when resource (re)selection triggering time is not known in advance (eg. aperiodic traffic): T\_B>T\_A>0
* Contiguous partial sensing when resource (re)selection triggering time is known in advance (eg. periodic traffic): T\_B≠T\_A

The reference timing can be different depending on whether contiguous partial sensing is used for periodic or aperiodic transmission. The UE processing time considered in periodic-based partial sensing can also be reused for contiguous partial sensing. Also, FL proposal is limited to resource (re)selection case at this stage.We share the proposal from Qualcomm for the last sub-bullet.As a conclusion, we suggest the following proposal.**Proposal 2-2:** In contiguous partial sensing for resource (re)selection, *TA* and *TB* values can be zero, positive or negative * Random resource selection: TA=TB=0
* Contiguous partial sensing when resource (re)selection triggering time is not known in advance (e.g., aperiodic traffic): TB > TA >0
* Contiguous partial sensing when resource (re)selection triggering time is known in advance (e.g., periodic traffic): TA and TB can be zero, positive or negative, and TB> TA.
	+ TB is not later than the first candidate slot subject to UE processing time.
* FFS whether *TA* and *TB* values or range should be further restricted base on different operating scenarios or conditions (e.g., periodic/aperiodic traffic, predictability of triggering slot n, remaining PDB, re-evaluation/pre-emption checking, etc)
* FFS: ~~whether and~~ details of how periodic-based partial sensing and contiguous partial sensing ~~can be supported~~ 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.

FL: Thanks for the suggestions. Technically I agree with the additional bullets. But right now, I am not sure if everybody shares the same understanding as there is a very wide spread of proposals for different TA and TB values. Since it was agreed in RAN1#103-e meeting to FFS on whether TA and TB values can be zero, positive or negative, I think firstly we can take a small step in this meeting. And companies have the opportunity during the summary break to study further and refine their proposals based on this agreement. |
| Lenovo | We agree with QC’s comment. FFS in the proposal is not necessary. |

**Proposal 2-3:** When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing.

* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered.
* FFS the RSW definition and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled

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| **Company** | **Comments** |
| NTT DOCOMO | OKSmall comment: ‘RSW’ would be resource selection window. The abbreviation should be avoided or corresponding definition should be added so that misunderstanding does not happen. |
| Panasonic | We are ok with FL’s proposal. |
| Intel | Our interpretation of this proposal is that resource selection window size and set Y is the same for periodic-based and contiguous partial sensing. If it is the intention, we are OK with the proposal.FL: Yes, this is exactly the intention. |
| OPPO | OK |
| Sharp | Not agree. Once partial sensing is configured by higher layers, UE would determine the RSW and the Y candidate slots, which are not separated for periodic-based partial sensing and contiguous partial sensing. Thus, we are not sure what the main bullet is about.FL: That’s the intention. Only one/the same RSW and Y candidate slots should be used between periodic-based partial sensing contiguous partial sensing. I believe our intentions are aligned/the same. If you have different / better wording, please suggest. |
| CMCC | As per the FL’s explanation in the background part, we understand that the intention of this proposal is to make consensus that when the contiguous partial sensing is performed on top of the periodic based partial sensing to further exclude the aperiodic reservations by other UEs in the RP, the same RSW and candidate resource set should be used. And we agree with the intention.However, as what we discussed several times during previous meetings, we don’t think the condition should be limited to periodic transmissions. In other words, for a RP that allows both periodic and aperiodic transmissions, both partial sensing schemes can be performed by a UE no matter what the traffic type is. Even when an actual aperiodic transmission comes, as long as the Y candidate slots meet the requirement of the remaining PDB, the above rule works.In addition, for the FFS bullet, we also don’t think it should be a case for the aperiodic transmission. In our view, the RSW definition and the initialization of candidate resource set (*SA*) should be considered for the following cases: 1) when a RP allows both periodic and aperiodic traffic, but the resource selection triggered in slot n with an urgent remaining PDB where the Y candidate slots cannot meet the requirement; 2) when a RP with reservation for another TB (when carried in SCI) disabled.FL: Fully appreciate your comments and your intention is well understood since the last meeting. From the Tdoc review and other comments received, I have to say that not everybody shares the same understanding and preference on using the same set of Y candidate slots (and subsequently the same candidate resource set *SA*) from the periodic-based partial sensing for contiguous partial sensing when resource (re)selection is triggered for aperiodic transmission. And hence, it is intended here to firstly agree for the case of periodic transmission and FFS for the aperiodic transmission. Please note that it is not the intention in any way to preclude the UE from performing periodic-based partial sensing in the case of aperiodic transmission. It is already agreed to use all available sensing results even during contiguous partial sensing. The main concern from others during the last meeting was related to finding only a partial or no Y candidate slots within the remaining PDB for aperiodic transmission (within the remaining PDB). And therefore, I think I can modify the FFS point along the line of what you suggested here. |
| Ericsson | We would like to ask for some clarification regarding this proposal. Is the intention of this proposal to include contiguous partial sensing on top of the periodic-based partial sensing for periodic transmissions?In this regard, we propose the following modification to the proposal:When a resource (re)selection procedure is triggered ~~for periodic transmission~~ in a mode 2 Tx pool with reservation for another TB ~~(when carried in SCI)~~ enabled, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing.* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered. This will be considered separately.
* ~~FFS the RSW definition and the initialization of candidate resource set (~~*~~S~~~~A~~*~~) for the case when resource (re)selection procedure is triggered for aperiodic transmission~~
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled~~

FL: To your first question, yes, it was the intention. Please see my explanation to CMCC just in the above. Regarding the suggested modifications, I can understand the same intention as CMCC. I will reword the FFS part as explained. |
| Huawei, HiSilicon | We understand the intention of the proposal, but we think the selection window setting and Y candidate slots determination does not relate to the traffic type UE performs. Once PBPS and CPS are enabled, both kind of partial sensing would performed based on the same resource selection window and the same set of Y candidates. So we suggest to modify the proposal as following:**Proposal 2-3:** ~~When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~ ~~~~When periodic reservation for another TB (*sl-MultiReserveResource*) is enabled for the resource pool, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing.* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered.
* FFS the RSW definition and the initialization of candidate resource set (*SA*) ,~~for the case when resource (re)selection procedure is triggered for aperiodic transmission~~ when periodic reservation for another TB (*sl-MultiReserveResource*) is disabled for the resource pool.

FL: Fully understood your understanding and preference here. However, as explained to CMCC in the above, not everybody shares the same. Due to the explained technical concern, I will update the FFS bullet. |
| Fraunhofer | We support the FL’s proposal, as long as the intention is for the UE to carry out partial as well as contiguous partial sensing for periodic transmissions.  |
| Futurewei | We do not support this proposal.We have not decided the sensing time for contiguous based partial sensing. Since contiguous partial sensing could continue within the Y slots for the periodic traffic, the initial candidate resource set can be different.FL: I think what you have described here (“contiguous partial sensing could continue within the Y slots”) is contiguous partial sensing for re-evaluation and pre-emption checking. This proposal is meant to focus on the case of resource (re)selection triggered in slot n. The note in the second bullet clarifies that re-evaluation and pre-emption checking is not covered by this proposal. I will add the suggestion from Ericsson to further clarify this bullet. |
| Apple | We agree with the intention of this proposal: the contiguous partial sensing is used for periodic traffic. Maybe the last bullet and its sub-bullets need further clarification.FL: Yes, the FFS bullet will be modified according to the above discussion points from CMCC, Ericsson and HW. |
| InterDigital | We are supportive of FL’s proposal. In our view, both periodic based partial sensing and contiguous partial sensing should be supported for periodic traffic and the set *SA* should be selected from the set of candidate slots in periodic based partial sensing. We can further discuss the resource selection window for aperiodic traffic.  |
| Nokia, NSB | Support the intention. Suggest to have a wording change:When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled, the same resource selection window or candidate slots shall be used for both partial sensing schemes.FL: Thanks for the good suggestion. |
| MediaTek | We are supportive. |
| Bosch | In general, we support the proposal. However, the last sub-bullet needs more clarification. |
| Qualcomm | We support the idea of applying both periodic-based partial sensing and contiguous partial sensing results when the UE is performing a periodic transmission. In this case, the sensing results from both types are applied jointly to the candidate resource set. If this the intention, the wording can be simplified:When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool ~~with reservation for another TB (when carried in SCI) enabled~~, both periodic-based partial sensing and contiguous partial sensing results are applied to the set of Y candidate slots~~the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing~~.* ~~Only one candidate resource set (~~*~~S~~~~A~~*~~) is to be initialized based on the Y candidate slots from the periodic-based partial sensing~~
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered.
* ~~FFS the RSW definition and the initialization of candidate resource set (~~*~~S~~~~A~~*~~) for the case when resource (re)selection procedure is triggered for aperiodic transmission~~
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
		- ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled~~

We don’t agree with extending the proposal to aperiodic transmissions at this point. This would either increase the latency and reduce the available time to perform the aperiodic (re)transmissions of TB, degrading performance, or force the UE to select the set Y such that it occurs with small period, increasing power consumption. We think further evaluation is needed first.FL: I tend to share the same concern to extend the proposal as it is to aperiodic transmissions, as also explained to CMCC. Therefore, an additional FFS sub-bullet is added to study the case when there is partial/insufficient number of Y candidate slots can be found within the remaining PDB in aperiodic transmissions. |
| CATT | We need some clarification about the intention of this proposal before any agreement. It looks like the intention is for periodic traffic when both periodic sensing and contiguous sensing is triggered, RSW and Y shall be the same. But then the problem is we need to first discuss the condition to trigger this scenario.FL: If this agreement is made, the original proposal in (Proposal 2-3) means whenever a periodic traffic is triggered, both periodic-based and contiguous partial sensing shall be performed by the UE. Other triggering conditions for periodic-based partial sensing are covered by last meeting’s agreement. Other triggering conditions for contiguous partial sensing are covered by Proposal 2-1 (II). |
| Fujitsu | We are generally fine with this proposal. But we propose to add a sentence in the main bullet according to FL’s description, and change the last sentence in the main bullet as another sub-bullet to make the intention of this proposal clearer: **Proposal 2-3:** When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled, both periodic-based and contiguous partial sensing are performed.* The same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing.
* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered.
* FFS the RSW definition and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled

FL: Thanks for the suggestions. Due to the concern on the applicability of extending this proposal to cover also aperiodic transmissions, other technical modifications to the proposal are needed to be addressed first. I continue to appreciate any further wording suggestions to the updated proposal. |
| NEC | OK to support |
| Convida Wireless | We are ok with the proposal. |
| ZTE,Sanechips | Firstly, we think whether to trigger contiguous partial sensing should be up to MAC implementation. If contiguous partial sensing is triggered, the same logic of RSW and Y can be reused for contiguous partial sensing. If the triggering slot is different as before, the RSW is not exactly the same due to PDB.FL: Generally, if may be sufficient for the MAC layer to configure L1 to perform partial sensing. Whether periodic-based partial sensing and/or contiguous partial sensing should be performed can be up to L1 to decide, e.g. based on the indicated resource pool and potentially also the traffic type. But since all SCI will contain aperiodic reservations of up to 32 slots, contiguous partial sensing would be necessary whenever a resource (re)selection procedure is triggered in all resource pools. Also, in generally, there would be only one trigger in slot n which is related to resource (re)selection. There can be another trigger for re-evaluation and pre-emption checking. But so far, I believe there is no need to have a separate trigger for L1 to perform contiguous partial sensing. |
| vivo | ok |
| Spreadtrum | We are OK with the proposal. |
| Sony | We are OK with the proposal. |
| Xiaomi | We are fine with the proposal. |
| ETRI | We support the proposal. |
| Samsung | Based on FL’s explanation of background, we can understand the intention of this proposal. However, according to the proposal itself only, the intention cannot be clearly reflected and it may lead to ambiguous understanding. In addition, we don’t think this should be only for periodic transmissions. Periodic partial sensing could be supported when the resource pool allows periodic reservations for period or aperiodic traffic. Therefore, we suggest to remove “for periodic transmission” in the main bullet.FL: I believe both concerns raised are addressed in the updated proposal 2-3 (II). Please let me know if ambiguity still remained. If this is the case, please indicate exactly the ambiguity and any suggestion for rewording. |
| LGE | Support with modification.We basically agree with FL proposal, but one clarification is needed. FL proposal assumes the case where UE performs both periodic-based contiguous partial sensing. This points needs to be clarified in the proposal.As a conclusion, we suggest the following modification.**Proposal 2-3:** When a resource (re)selection procedure is triggered for periodic transmission in a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled, if UE performs both periodic-based and contiguous partial sensing, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots from periodic-based partial sensing shall be used in contiguous partial sensing.* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered.
* FFS the RSW definition and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled
 |
| Lenovo | The ‘set of Y candidate slots’ is selected in resource selection window and determined based on the PDB of one periodic packet. But we can’t ensure the periodic packet and aperiodic packet (using contiguous partial sensing) have same PDB requirement (i.e., same ‘set of Y candidate slots’ ) , or two periodic packets (one using periodic-based partial sensing and the other using contiguous partial sensing) have same PDB requirement.FL: Well explained and I fully appreciate the concern. Based on previous comments and responses, please check the updated proposal 2-3 (II) trying to address this point. |

### Proposals before 2nd check point

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

* **On Proposal 2-1 (conditions for contiguous partial sensing):**
	+ All support, except for mostly one concern, for which it is now clarified in a sub-bullet.
		- In the first condition, it is not clear if contiguous partial sensing is only performed after the resource (re)selection trigger.

**Proposal 2-1 (II):** Condition(s) in which contiguous partial sensing is performed by UE, at least all of the followings are met:

* L1 is triggered to perform resource (re)selection procedure in a mode 2 Tx resource pool
	+ Note, it is not restricted that contiguous partial sensing can be only performed after the resource (re)selection trigger.
* The resource pool is (pre-)configured to enable partial sensing
* Partial sensing configured by higher layer in the UE

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| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Intel | Support |
| OPPO | Support  |
| Sharp | We wonder whether the 1st condition includes the case of re-evaluation and pre-emption check, since FL’s explanation in other topics seem to separate re-evaluation and pre-emption from resource (re-)selection. If no, when L1 is triggered to perform re-evaluation or pre-emption check, there would be no contiguous partial sensing with the above listed conditions. |
| Panasonic | Support |
| Vivo | OK |
| CMCC | Support |
| ZTE,Sanechips | Support |
| Nokia, NSB | Support the intention. It seems that these 3 conditions are sufficient conditions for contiguous partial sensing. Other conditions, such in the case of re-evaluation/pre-emption, contiguous partial sensing would happen. Therefore, suggest to have an editorial change to the top sentence:~~Condition(s) in which c~~ Contiguous partial sensing is performed by UE~~,~~ when at least all of the followings are met:… |
| Ericsson | Support |
| Fraunhofer | Support |
| Apple | We can accept this proposal.  |
| MediaTek | Support |
| CATT | OK. |

* **On Proposal 2-2 (*TA* and *TB* values):**
	+ All support except for one.
	+ FL comments: The most expressed concern is related to the first sub-bullet. Since I have provided responses in above, let’s further consider if this sub-bullet can be agreed.

**Proposal 2-2 (II):** In contiguous partial sensing for resource (re)selection, *TA* and *TB* values can be zero, positive or negative

* [When *TA* and *TB* are not zero, they can’t be equal]
* FFS ~~whether~~/how *TA* and *TB* values or range should be further ~~restricted~~ adjusted/adapted based 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, etc)
* FFS: ~~whether and~~ details of how periodic-based partial sensing and contiguous partial sensing ~~can be supported~~ 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.

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| **Company** | **Comments** |
| NTT DOCOMO | OK except the first sub-bullet.In our understanding, if contiguous partial sensing is not applied due to some reasons, e.g. insufficient PDB, it means that no value is set to TA and TB. I’m not sure why we use no contiguous partial sensing as TA and TB are zero. It leads to misunderstanding as TA and TB can be zero even when contiguous partial sensing shall be performed, i.e. actually contiguous partial sensing is not performed.Reviewing background section, main motivation seems insufficient PDB case. Then how about adding one condition in Proposal 2-1 rather than Proposal 2-2 as ‘sufficient PDB is remaining. FFS details.’ |
| Intel | We still unclear on negative TB.There is a following explanation in background section of FL summary:*“TA*, *TB* being negative: When the resource (re)selection triggering slot n is predictable (e.g. for periodic traffic), the UE would be able to perform contiguous partial sensing in advance / prior to the triggering slot n.”In terms of monitoring window, it should be applicable to TA only, i.e. start of monitoring window. For TB, it is not applicable since UE continue monitoring till the end of transmission. |
| OPPO | Support the proposal in principleTo address some companies concern about TA and TB are equal to 0, how about to modify the proposal as follows:* ~~[~~When *TA* and *TB* are ~~not~~ equal to zero, no contiguous partial sensing is performed. ~~they can’t be equal]~~
* When *TA* and *TB* are not equal, contiguous partial sensing is performed.
 |
| Sharp | For 1st sub-bullet, we wonder since the agreement in RAN1#104e “the UE monitors slots between [*n*+*T*A, *n*+*T*B]” already revealed *T*A, *T*B are not equal to us, it is not necessary and suggest to remove it. For the other two sub-bullets, basically we are fine except for they both include re-evaluation and pre-emption check which are separated from the main bullet (i.e. for resource selection), thus, we suggest to remove “for resource (re-)selection” in the main bullet. |
| Vivo | OK |
| CMCC | Regarding the 1st bullet, we kind of understand the point raised by DCM and some other companies. When no contiguous partial is performed, there is no need to configure *TA* and *TB*, and therefore no need to define the values (both equal to zero, or equal to each other). We only need to define the *TA* and *TB* values when contiguous partial sensing is performed, which is that *TA* and *TB* are not equal. |
| ZTE,Sanechips | For the negative values of T\_A/T\_B, this seems only feasible when Y/n can be predictable. We prefer either capture the note that this is applicable only under the case Y/n is predictable or leave it FFS. Our understanding of the triggering for contiguous partial sensing may or may not be the triggering slot n for the report of periodic sensing results. We prefer to capture an FFS to reflect that,FFS: the relationship with triggering slot n for contiguous partial sensing.  |
| Nokia, NSB | Support, although it is not necessary to have these two FFS. |
| Ericsson | We would like to ask for clarification about the next steps: are all the different values supported or are we going to discuss the specific conditions under which each of the cases can happen? |
| Huawei, HiSilicon | T\_A and T\_B cannot be equal regardless of their values are zeros or not. As the FL explained that if the PDB is insufficient, random selection can be applied by UE in a resource pool which is allowed to transmit based on priority or exceptional resource pool.For T\_A = 0 = T\_B, it should be clear that, if this is the (pre-) configuration, CPS has not been (pre-) configured in fact, and it is not part of this proposal, which is “Proposal 2-2 (II): In contiguous partial sensing for resource (re)selection”. There is thus a necessary assumption that TB-TA ≠ 0 and that at least one of TB and TA is non-zero. If there is a case where, despite TB ≠ 0 or TA ≠ 0, with TB-TA>0, CPS is not applied is a different question which does not appear to be included in the FL proposal. Thus the first sub-bullet does not have application. |
| Fraunhofer | We support the FL’s proposal. |
| Apple | We still do not see the necessity of keeping the first sub-bullet. Otherwise, the proposal looks good to us.  |
| MediaTek | OK with the proposal in principle.We share similar concerns as companies on the 1st bullet. If T\_A and T\_B are equal, UE just cannot perform contiguous sensing. For the 1st FFS, I don’t think that we have made an agreement to adapt T\_A and T\_B values yet. We suggest the following wording for 1st FFS:* FFS ~~whether~~/how *TA* and *TB* values or range should be ~~further restricted~~ ~~adjusted/adapted~~ defined based 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, etc)
 |

* **On Proposal 2-3 (selection window and candidate resource set for contiguous partial sensing):**
	+ Main concerns
		- The proposal is limited to periodic transmissions only, but should also cover the case of aperiodic transmissions as well, or the main proposal should be traffic type agnostic. As commented at least by CMCC, Ericsson, HW/HiSi, and Samsung.
		- On the other hand, if the main proposal is extended to cover also aperiodic transmissions, then some concerns or FFS are raised by at least CMCC, Qualcomm and Lenovo due to potential latency, power saving concern and only insufficient/partial Y candidate slots can be found within the remaining PDB.
	+ FL comments:
		- It is recognized this fundamental difference in applicability of the Y candidate slots in contiguous partial sensing for aperiodic transmissions. My suggestion is to further study how to initialize the candidate resource set (SA) when there is partial/insufficient number of Y candidate slots.

**Proposal 2-3 (II):** When a resource (re)selection procedure is triggered ~~for periodic transmission~~ in a mode 2 Tx pool with reservation for another TB ~~(when carried in SCI)~~ enabled, if UE performs both periodic-based and contiguous partial sensing, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots ~~from periodic-based partial sensing shall be used in contiguous partial sensing~~ shall be used in both periodic-based and contiguous partial sensing schemes.

* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
	+ FFS whether the candidate resource set (*SA*) is initialized based on the Y candidate slots when there is partial/insufficient number of Y candidate slots can be found within the remaining PDB (e.g., for the case of aperiodic transmission)
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered. This will be considered separately.
* FFS ~~the RSW~~ definition for the resource selection window and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled

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| **Company** | **Comments** |
| NTT DOCOMO | OK in general.Regarding the last removed part, I understand that some companies have concern to differentiate rule between periodic transmission and aperiodic transmission. But current main bullet is just saying ‘if UE performs both periodic-based and contiguous partial sensing’. This means that whether differentiate or not is still FFS, right? If so, one separate FFS should be added to clarify this proposal’s intention. |
| Intel | Support |
| OPPO | Support  |
| Sharp | Support |
| Vivo | support this proposal in general. But it is not clear in the main bullet whether PBPS and CPS are for the same resource (re)selection process or not. In our understanding, PBPS and CPS that are for the same resource (re)selection process should maintain the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots so that resources with potential conflicts with either periodic reservations or aperiodic reservations from other UE can be excluded. But for PBPS and CPS that are associated with different resource (re)selection processes, there is no need to introduce such a restriction on RSW and Y. Therefore, we would like to propose the following modifications.**Proposal 2-3 (II):** When a resource (re)selection procedure is triggered ~~for periodic transmission~~ in a mode 2 Tx pool with reservation for another TB ~~(when carried in SCI)~~ enabled, if UE performs both periodic-based and contiguous partial sensing for the resource (re)selection procedure, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots ~~from periodic-based partial sensing shall be used in contiguous partial sensing~~ shall be used in both periodic-based and contiguous partial sensing schemes.* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
	+ FFS whether the candidate resource set (*SA*) is initialized based on the Y candidate slots when there is partial/insufficient number of Y candidate slots can be found within the remaining PDB (e.g., for the case of aperiodic transmission)
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered. This will be considered separately.
* FFS ~~the RSW~~ definition for the resource selection window and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled
 |
| CMCC | Support |
| ZTE,Sanechips | * FFS ~~the RSW~~ definition for the resource selection window and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled

We prefer to remove the FFS because we prefer to reuse the Rel-16 logic of RSW |
| Nokia, NSB | Support. |
| Ericsson | We do not think it is needed to consider the add the FFS for the first bullet. Therefore, we propose to modify the proposal:**Proposal 2-3 (II):** When a resource (re)selection procedure is triggered ~~for periodic transmission~~ in a mode 2 Tx pool with reservation for another TB ~~(when carried in SCI)~~ enabled, if UE performs both periodic-based and contiguous partial sensing, the same resource selection window [n+T1, n+T2] and the same set of Y candidate slots ~~from periodic-based partial sensing shall be used in contiguous partial sensing~~ shall be used in both periodic-based and contiguous partial sensing schemes.* Only one candidate resource set (*SA*) is to be initialized based on the Y candidate slots from the periodic-based partial sensing
	+ ~~FFS whether the candidate resource set (~~*~~S~~~~A~~*~~) is initialized based on the Y candidate slots when there is partial/insufficient number of Y candidate slots can be found within the remaining PDB (e.g., for the case of aperiodic transmission)~~
* Note, this does not cover the case when the re-evaluation and pre-emption checking is triggered. This will be considered separately.
* FFS ~~the RSW~~ definition for the resource selection window and the initialization of candidate resource set (*SA*) for the case when resource (re)selection procedure is triggered for aperiodic transmission
	+ ~~In a mode 2 Tx pool with reservation for another TB (when carried in SCI) enabled~~
	+ In a mode 2 Tx pool with reservation for another TB (when carried in SCI) disabled
 |
| Huawei, HiSilicon | We are generally fine with the proposal, except the last FFS. We can understand other concerns about the aperiodic traffic, but as we have explained in previous email, the partial sensing procedure are used for detecting reservation by others, it is irrelevant with the traffic type. So we do not think the last FFS is needed, we are open to hear the explanation from the proponents of this FFS. |
| Fraunhofer | Support |
| Apple | We are fine with the proposal. |
| MediaTek | We support this proposal. We prefer to keep the last FFS. But, we suggest removing the sub-bullet under the last FFS for the following reason: Periodic reservations may be enabled in a resource pool while a UE still has no periodic traffic transmission. Without any periodic traffic, a UE will not trigger periodic partial sensing. Therefore, we need to study how to initialize candidate resource set for a UE transmitting only aperiodic traffic in a resource pool with periodic reservations as enabled. |

## Topic #3: Random resource selection – timing restrictions and low priority transmissions in a mixed RA pool

**Background**: From the Tdoc review, it has been proposed again by some companies that the two timing restrictions for resource (re)selection (i.e. max distance separation of 32 slots and min HARQ feedback time gap) with sensing from R16 should be adopted for random resource selection in R17. These were discussed in the last meeting without conclusion due to these timing restriction rules would automatically apply in R17 since they are already adopted in R16. However, based on further checking of MAC and RRC specs, these rules currently apply only in the case when sensing/resource exclusion is performed in L1. Random resource selection procedure, at least in FL’s understanding, is never described in either MAC or RRC specs. Since RA based on random resource selection is supported in a resource pool with mixed RA scheme (partial sensing and full sensing), therefore, these timing restrictions should be also supported for randomly selected resources.

Additionally, the issue of random resource selection for low priority transmissions by a UE which does not perform sensing / re-evaluation and pre-emption checking in a resource pool with mixed RA schemes received a lot of interests during the Tdoc review. While there are simulation results showing this is an issue that need to be resolved and many different solutions were proposed, there was also an opposite view that no special indication or treatment is needed. Since there is a strong interest, it is worthwhile to investigate this further. **Therefore, a corresponding proposal for these aspects related to random resource selection is made in Proposal 3.**

From the FL, it is recommended for others to double check the MAC and RRC spec on the random resource selection in R16.

### Proposals before 1st check point

**Proposal 3:**

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

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| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Panasonic | We are ok with the proposal.  |
| Intel | We agree with the FL about the aspects of the first bullet and its sub-bullets that R16 signalling and timing requirements should be preserved due to backward compatibility. |
| OPPO | OK |
| CMCC | Support |
| Ericsson | We are supportive of the first main bullet. However, for the second one we have the following objections and comments:* We do not think that the impact of random resource selection should be limited only to low priority transmissions. We have not agreed anything on restricting the type of transmission a UE performing random resource selection can perform, and therefore, all priorities should be considered.
* Moreover, in our contribution, we have simulation results showing that the impact of the random resource selection UEs in a shared resource pool is quite high for both sensing and non-sensing UEs for any priority and cannot be neglected.
	+ The impact in PRR comes from the matter that random resource selection UEs do not perform re-evaluation or pre-emption.
	+ If there are not extra restrictions, e.g., minimum time gap, between the resources a random resource selection UE can select/reserve for blind retransmissions, it impacts the performance of all UEs within the shared resource pool.

Therefore, we suggest modifying second bullet of the proposal as follows:RAN1 to specify solutions to reduce the impact when random resource selection is performed ~~for low priority transmissions~~ by a UE which does not perform sensing / re-evaluation and pre-emption checking in a resource pool with mixed RA schemesFFS details considering at least minimum gap between reservations for blind re-transmissions for random resource selection UEs and any other study potential solution(s)FL: I noticed this issue have been brought up in Ericsson’s contribution for at least two meetings already, but so far I have not noticed other company raise the same issue (maybe IDC), besides LGE wanting to introduce a reduced maximum time gap for partial sensing UEs to minimize the power consumption required for re-evaluation and pre-emption. On the other hand, the issue raised here for low priority randomly selected transmissions has been raised by multiple companies and gained strong interests (please see identified issue 2 in Section 4.3). On the other hand, it is also recognized that there are at least 2 other companies who do not share the same concern. Therefore, it is proposed to further study/analyse the impact of random selection in a mixed RA pool. I think it is still bit early to say that RAN1 will definitely specify solutions and considering at least minimum time gap between reservations. Let’s consider all potential solutions together. Please check the updated proposal 3 (II). |
| Huawei, HiSilicon | Based on TS 38.321/331, random selection is performed in the configured exceptional resource pool when sensing result is not available. Based on the TS 38.321, clause 5.22.1.1, the minimum time gap and resource indication in SCI are applied for both sensing and random selection. Hence first bullet and its sub-bullets are features in Rel-16, which are assumed to be reused in Rel-17, unless specified otherwise. There is no point on re-agreeing Rel-16 features in Rel-17. Hence first bullet and its sub-bullets are redundant and should be removed.TS 38.321, clause 5.22.1.1

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| --- |
| If the MAC entity has been configured with Sidelink resource allocation mode 2 to transmit using pool(s) of resources in a carrier as indicated in TS 38.331 [5] or TS 36.331 [21] based on sensing or random selection, the MAC entity shall for each Sidelink process: |

FL: I am well aware of this sentence in the MAC spec, and also the sentence where it says random selection is applied in the exceptional pool in the RRC spec. But it is nowhere in either the MAC or RRC spec where it says that when random resource selection is applied, the two R16 timing restrictions shall be ensured. So far, the 3 description in the MAC spec where the two R16 timing restrictions shall be applied is only for the case when L1 reports a subset of resources (candidate resource set *SA*) after performing the sensing and resource exclusion operation. I would really appreciate if linkage can be provided in either the MAC or RRC spec where it shows the two R16 timing restrictions are applied when random resource selection is performed (without L1 reporting a set of available resources after the sensing operation). Second FFS needs be addressed, as per our simulations in [R1-2104236](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104236.zip) (see below), we already identify the problem of simply mixing random selection UEs with full-sensing UEs in the same pool regardless of the priority, which causes significant PRR degradation to full-sensing UEs. Similarly to the pre-emption design in Rel-16, random selection is equivalent to pre-empting reserved resources, only the transmission with higher priority could pre-empt the resources reserved by others. Therefore, randomly selected resource should be controlled in the resource pool via a random selection priority threshold similar to the pre-emption threshold.F2Figure 12 Average PRR from full-sensing V-UEs only perspective, when in a resource pool for mixed types of RA where random selection UEs are admitted if priority < priority threshold. |
| Fraunhofer  | We support the FL’s proposal. |
| Futurewei | We are ok with the first main bullet. But for the second sub-bullet we suggest a change as * + The minimum HARQ feedback time gap (Z) shall be respected between any two ~~randomly~~ selected resources of a TB where a HARQ feedback for the first of these resources is expected, as defined in R16 for full sensing operation.

We support the FFS on the low priority transmissions in a shared resource pool with mixed RA.FL: I think it is better to be very specific in this case that the minimum HARQ feedback time gap is intended for two randomly selected resources. Otherwise, as pointed out by HW, for the case when L1 reporting a set of available resources after sensing, this minimum HARQ feedback time gap is already supported since R16 and will continue to be supported in R17. |
| Apple | We are fine with the FL’s proposal. |
| InterDigital | We are ok with the first bullet.Regarding the second bullet, we share the similar view with Ericsson that we need to specify solutions to reduce impact of random selection for all transmissions (i.e., not necessary for low priority transmissions only). We support Ericsson’s modification of the proposal.FL: Please see response to Ericsson’s comment in above and the updated proposal 3 (II). |
| Nokia, NSB | Agree. |
| MediaTek | OK |
| Bosch | We support the FL’s proposal direction. However, we prefer if random resource selection and transmission (in a mixed resource pool) is performed periodically or with a “pattern” only. Therefore, we suggest adding the following FFS.FFS: whether random resource selection by UEs with no sensing/re-evaluation/pre-emption checking is performed periodically (or with a pattern) in a resource pool with mixed RA schemes.FL: In proposal 3 (II), it is included as one of example solutions. |
| Qualcomm | We agree with the first main bullet but not the FFS. Our evaluation results show that the impact of random selection is largely limited to UEs doing random selection and that the performance of full sensing UEs in the pool isn’t noticeably affected.Therefore, we propose to remove the FFS.* ~~FFS the impact when random resource selection is performed for low priority transmissions by a UE which does not perform sensing / re-evaluation and pre-emption checking in a resource pool with mixed RA schemes~~
	+ ~~Including study potential solution(s) if the impact is not negligible~~

FL: Since it is raised by at least more than 10 companies (please see Section 4.3 identified issue 2) and some showed performance impact to full sensing UEs, I think it is fair to conduct further study by more companies on the performance impact. |
| CATT1 | We support the FL’s proposal. |
| Fujitsu | We support this proposal. |
| NEC | OK to support |
| Convida Wireless | We are ok with the proposal. |
| ZTE, Sanechips | For the second bullet, “for low priority transmissions” should be removed, because we don’t have a conclusion that the impact for high priority transmissions have been resolved. |
| vivo | ok |
| Spreadtrum | We support this proposal. |
| Sony | We are OK with the proposal. |
| Xiaomi | We are supportive to the FL proposal. |
| ETRI | We support the proposal. |
| Samsung | OK with the 1st bullet. The necessity of second bullet is unclear for us and we prefer to remove it.FL: Since it is raised by at least more than 10 companies (please see Section 4.3 identified issue 2) and some showed performance impact to full sensing UEs, I think it is fair to conduct further study by more companies on the performance impact. |
| LGE | Not support.First, we analysed in our proposal (R1-2105204) that the shorter max. distance between any two resources signalled by a single SCI provides a significant power saving gain in sensing for resource re-evaluation or pre-emption checking, compared to the larger distance between the resources.We also performed simulation to see whether a shorter max. distance between two resources signalled by a single SCI has any effect on the PRR performance, compared to 31 slots defined in Rel.16 NR-V2X (a revised proposal will be uploaded soon). Under UMa/60kmph channel condition, we see the PRR performances are almost same between max. distance of 31 slots and 16 slots.So limiting a maximum distance between any two resources signalled by a single SCI is quite helpful for power saving without performance effect, so needs further investigation. This is beneficial not only for random resource selection, but also for partial sensing based resource allocation. As a result, the (pre-)configured maximum distance needs to be discussed also in partial sensing agenda.Second, we don’t have any agreement on the use of HARQ feedback for the transmission with randomly selected resources. The second sub-bullet can only be discussed after we have agreement on HARQ feedback with random resource selection. In our opinion, at least for UE type-B, HARQ feedback should be supported to be used with random resource selection.The last FFS point is unclear so removed to be discussed later.As a conclusion, we suggest the following proposal.**Proposal 3:*** For random resource selection,
	+ At least support the maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI, which was defined in R16 for full sensing operation.
* FFS whether/how maximum distance<32 slots is applied
	+ HARQ feedback enabled transmission is supported.
	+ ~~The minimum HARQ feedback time gap (Z) shall be respected between any two randomly selected resources of a TB where a HARQ feedback for the first of these resources is expected~~
* ~~FFS the impact when random resource selection is performed for low priority transmissions by a UE which does not perform sensing / re-evaluation and pre-emption checking in a resource pool with mixed RA schemes~~
	+ ~~Including study potential solution(s) if the impact is not negligible~~

FL: Some good points raised and reflected in proposal 3 (II). On the last bullet (FFS), since it has been raised by at least more than 10 companies (please see Section 4.3 identified issue 2) and some showed performance impact to full sensing UEs, I think it is fair to conduct further study by more companies on the performance impact. |
| Lenovo | Support. |

### Proposals before 2nd check point

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

* Main concerns
	+ First main bullet:
		- All are fine except for one company claimed that both timing restrictions (minimum HARQ time gap and max distance separation) are already supported for random selection in R16.
	+ Second main bullet:
		- All except 3 companies are OK/prefer to further study the impact when random resource selection is performed in a resource pool with mixed RA schemes.
		- Some suggested to extend the study covering randomly selected high priority transmissions (any priority) as well.
* FL comments:
	+ At least based on my checking of MAC and RRC spec, it is still necessary to agree on the first main bullet. In addition, LGE raised a good point that we haven’t agreed on supporting SL HARQ feedback enabled transmissions for the random resource selection scheme. Since almost everyone is OK with the minimum HARQ feedback time gap for random selection, it is better to include this as well suggested by LGE.
	+ Based on Tdoc review in this meeting, there is very significant interest to further investigate the second main bullet. Since there is more than one company wish to cover the study for any priority level, it is also reflected in the updated proposal.

**Proposal 3 (II):**

* For random resource selection,
	+ ~~Reuse~~ At least support the maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI, which was defined in R16 for full sensing operation.
		- FFS whether/how maximum distance < 32 slots should be supported
	+ SL HARQ feedback enabled transmission is supported.
		- The minimum HARQ feedback time gap (Z) shall be respected between any two randomly selected resources of a TB where a HARQ feedback for the first of these resources is expected.
* FFS the impact when random resource selection is performed ~~for low priority transmissions~~ 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, and etc.).

|  |  |
| --- | --- |
| **Company** | **Comments** |
| NTT DOCOMO | OK |
| Intel | Support |
| OPPO | Support  |
| Panasonic | Support |
| Vivo | OK |
| CMCC | Support |
| ZTE,Sanechips | We prefer to capture the solution in our paper as an additional example under the last FFS subbullet* FFS the impact when random resource selection is performed ~~for low priority transmissions~~ 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, and a priori SCI reserving initial transmissions).At least support the maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI for the same TB |
| Nokia, NSB | Agree with FL’s proposal. |
| Ericsson | We are not supportive of the first sub-bullet regarding the issue of modifying the HARQ operation. In our view, we shall re-use the mechanism defined in Rel-16 where the maximum distance separation is 32 logical slots. Therefore, the first sub-bullet can be modified as:* For random resource selection,
	+ ~~Reuse At least support~~ Reuse the maximum distance separation of 32 logical slots for a HARQ retransmission resource reserved by a prior SCI, which was defined in R16 for full sensing operation.
		- ~~FFS whether/how maximum distance < 32 slots should be supported~~

 We are OK with the other points of the proposal. |
| Huawei, HiSilicon | Our understanding is that reusing Rel-16 basic physical layer features are redundant to be re-agreed. But If the majority would like to re-confirm that, we are fine.However, based on companies replies, the first FFS (i.e. “FFS whether/how maximum distance < 32 slots should be supported”) seem be related to the contiguous partial sensing issue, not the random selection issue. Since the 1st main bullet is about random resource selection, this FFS is not needed and should be removed. And “at least support” can be reverted back to “Reuse”. |
| Fraunhofer | We are supportive of the FL’s proposal.We have a question for clarification - Is it right to assume that the proposal supporting HARQ feedback enabled transmissions would be applicable only for type B/D UEs that are capable of PSFCH reception, and not for type A UEs, that do not have any reception capability? |
| Apple | Fine with the proposal. Although we prefer not including the first FFS sub-bullet, but we could accept it for progress. |
| MediaTek | Support |
| CATT | Support the main bullet. Agree that ‘FFS whether/how maximum distance <32slot …” should be removed since otherwise multiple max distance value will have to be supported. |

Contribution summary for power saving RA

## Periodic-based partial sensing

* Set of reservation periods, *P*reserve, to determine periodic sensing occasions
	+ Alt. 1: *P*reserve corresponds to all values from the configured set *sl-ResourceReservePeriodList*
		- Reasons: Better reliability
		- [2/Nokia, NSB], [3/FW], [4/HW, HiSi], [10/QC], [13/OPPO], [14/Lenovo, MotM], [20/LGE], [22/NEC], [27/ZTE, Sanechips], [32/DCM], [33/ASUSTeK], [35/E///] **16**
	+ Alt. 2: $ P\_{reserve}$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 and whether/how to restrict the set of values
		- Reasons: Alt. 2 is a superset of Alt. 1. Better power saving, flexibility based on priority or CBR when more than 1 set is configured, a common divisor can be used in some cases combined with a bitmap for k, and sensing occasions with small periodicities can be covered by contiguous partial sensing.
		- [5/vivo], [6/Spreadtrum], [7/CATT, GOHIGH], [8/Fraunhofer], [9/CMCC], [11/Zhejiang Lab], [15/Intel], [16/Fujitsu], [18/Apple], [19/Sony], [21/ETRI], [23/Samsung], [24/MTK], [25/Xiaomi], [28/ Hyundai], [29/Sharp], [30/ITL], [31/IDC], [34/BOSCH] **20**
* Selection of k
	+ Alt. 1: Option 1 as in RAN1#104-e (Only the most recent sensing occasion for a given reservation periodicity before the resource (re)selection trigger or the set of Y candidate slots subject to processing time restriction)
		- Reasons: provides negligible difference to full sensing performance; better power saving; aligning to R16 resource reservation principle; missed detection of the most recent SCI is low
		- [2/Nokia, NSB], [7/CATT, GOHIGH], [11/Zhejiang Lab], [13/OPPO], [14/Lenovo, MotM], [15/Intel], [16/Fujitsu], [20/LGE], [21/ETRI], [22/NEC], [23/Samsung], [24/MTK], [31/IDC], [35/E///] **17**
	+ 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)
		- Reasons: better flexibility and reliability;
		- [3/FW], [4/HW, HiSi], [5/vivo], [6/Spreadtrum], [8/Fraunhofer], [9/CMCC], [12/CAICT], [18/Apple], [19/Sony], [25/Xiaomi], [27/ZTE, Sanechips], [28/ Hyundai], [29/Sharp], [32/DCM] **16**
* Simulation results for finalizing *P*reserve and k values
	+ [4/HW, HiSi]:
		- For *Preserve* set, it is observed that, the power reduction ratio compared to the Rel-16 baseline for full set case is around 47%, and this will be added around 10% further power reduction for subset case, as shown in Figure 1. From PRR perspective, it is observed that full set case increase communication range by around 16 m over subset case at PRR = 99%, as shown in Figure 2, due to consistent ignorance of periodic reservations (half of the total periodic values are not detected) from other UEs in subset case.
		- For k value, the observed power reduction ratio by around 46% is achieved when k = {1,2}. The additional reduction of sensing slots when k = {1} adds around 10% further power reduction. On the other hand, it is observed k = {1,2} outperforms k = {1} with an increase by around 20m commination range at PRR = 99%.
	+ [5/vivo]: The average PRR with multiple Pstep configuration is better than that of single Pstep when multiple periods packets were configured in the resource pool, while the power consumption is comparable under these two configurations.
	+ [7/CATT, GOHIGH]: No performance gain can be observed when two sensing occasions are supported.
	+ [13/OPPO]: Fig. 2, PRR performance of k=1 is very close to full sensing with negligible loss. Not necessary to optimize PRR performance further by considering other periodic sensing occasions. When more k values are monitored, the power saving gain is degraded. The power reduction ratio for k=1 and k=2 is 0.96 and 0.94, respectively. It costs 50% more power consumption when k=2 compared to k=1.
	+ [23/Samsung]: PRR degradation of monitoring only a subset is acceptable compared with the full set. The power saving from monitoring a subset, even with additional power consumption of HARQ re-Tx, is 28% less than monitoring the full set.
* Remaining details: Sensing for identification of candidate resources
	+ Option 1: Sensing until the resource (re)selection trigger slot n subject to processing time restriction
		- Reasons for support:
			* Align with R16 and LTE design of reporting to higher layer and resource selection timing
		- Reasons for against:
			* Sensing occasions between the triggering slot n and Y candidate slots are not monitored for the initial resource selection
		- Supporting company: [18/Apple] (if resource is selected at triggering slot n), [25/Xiaomi] **2**
	+ Option 2: Sensing until the first slot of Y candidate slots sub. to processing time restriction
		- Reasons for support:
			* All corresponding periodic sensing occasions are taken into account during the initial resource selection to minimize collision probability
			* The most recent periodic sensing occasions are monitored, containing the most accurate/reliable reservation information.
		- Reasons for against:
			* Periodic sensing occasions between the triggering slot n and the first Y candidate slots can still be monitored during the re-evaluation/pre-emption checking before the SL transmission
		- Supporting company: [2/Nokia, NSB], [4/HW, HiSi], [6/Spreadtrum], [7/CATT, GOHIGH], [9/CMCC], [13/OPPO], [16/Fujitsu], [18/Apple] (if contiguous sensing ends before Y candidate slots), [22/NEC], [31/IDC] **13**
* Identification / selection of Y candidate slots (within resource selection window)
	+ The minimum number of candidate slots Y for partial sensing is
		- Selected from the (pre-)configured set based on the configured X% and a measured available resource ratio X’; Specify a new list of X for partial sensing or set new rules for partial sensing on X with the existing list sl-TxPercentageList [3/FW]
		- (Pre)-configured based on CBR value [7/CATT, GH], [16/Fujitsu], [20/LGE]
			* CBR can be measured by UE in M periodic sensing occasions, where M could be a subset of the total sensing occasions.
		- (Pre)-configured per priority level [15/Intel], [16/Fujitsu], [20/LGE], [31/IDC]
	+ [10/QC]: Define a set of periodic partial sensing resource sets partitioning a resource pool. UE performs partial sensing over a single or multiple resource sets. reservation of a resource in a given set can only be signalled from another slot associated with the same resource set. The resource selection window is determined within a set of resources formed by the intersection of resources in a given resource set for partial sensing and those in-between n+T1 and when the remaining PDB of a packet expires.



* + If SL-DRX configuration of the target Rx UE is known, the selection of Y slots within resource selection window should include the slots within Rx UE’s DRX ON duration as much as possible. [13/OPPO]
	+ If a monitored resource by periodic-based partial sensing associated to the transmission of a TB (e.g. (n+1)-th TB) later than n-th TB in periodic transmission conflicts with other UE’s reserved resource, before resource reselection for n-th TB transmission, the monitored resource is excluded from the idle set of resources for n-th TB transmission. [20/LGE]
	+ When PSFCH is configured, the impact of the HARQ RTT related timing restriction should also be considered when UE determines the “Y” candidate slots. [16/Fujitsu]
		- RAN1 needs to discuss whether UE should decide partial sensing/candidate slots for all possible HARQ (re)transmissions of the same TB.
	+ Minimum number of Y candidate slots is (pre)configured per the number of PSCCH/PSSCH resources to be selected. [18/Apple]
	+ 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. [17/Pana]
	+ Support multiple range sets of Y values in high layer. E.g., each set per priority/SCS and a minimum value for Y is (pre-)configured from a proper set. [22/NEC]
	+ Slots hypothetically reserved by non-monitored slots due to SL transmissions are excluded from Y candidate slots. Selected Y candidate slots are not overlapped with off-durations of the RX UE(s). [22/NEC]

## Contiguous partial sensing

* Conditions to perform contiguous partial sensing
	+ All traffic types: periodic and aperiodic (without periodic reservation) transmissions
		- [2/Nokia, NSB], [3/FW], [4/HW, HiSi], [13/OPPO], [15/Intel], [20/LGE], [21/ETRI], [23/Samsung], [24/MTK], [31/IDC], [33/ASUSTeK]
	+ Conditions/cases in which a UE performs contiguous partial sensing: [20/LGE]
		- When the priority value of a packet is above a threshold (e.g. pre-emption priority value)
		- When the congestion/interference level in a resource pool is above a threshold
		- When the required reliability level of a packet transmission is above a threshold
		- When the number of retransmissions of a packet is below a threshold
		- When aperiodic transmission is triggered
		- When periodic transmission is triggered, and the number of periodic-based partial sensing slots is below a threshold
	+ After receiving a NACK that the previous transmission was not successful. [35/E///]
* Sensing window [n+*TA*, n+*TB*] (values for *TA* and *TB*)
	+ *TA* and *TB* values can be zero, positive and negative: [2/Nokia, NSB], [3/FW], [6/Spreadtrum], [13/OPPO], [9/CMCC], [20/LGE], [21/ETRI], [23/Samsung], [32/DCM], [31/IDC]
		- Depending on periodic or aperiodic traffic: [3/Nokia, NSB], [32/DCM]
		- Up to UE implementation: [13/OPPO]
		- Positive values if priority < threshold and PDB > threshold: [23/Samsung]
	+ For periodic transmissions,
		- [3/FW]: *n*+*T*A ≤ $t\_{y0}^{SL}-31$and *n*+*T*B = *n*+[*T*B,min *T*B,max], where *T*B,min = $t\_{y0}^{SL}-T\_{proc,1}^{SL}$ and *T*B,max = -n+ max($t\_{y0}^{SL}-T\_{proc,1}^{SL}$, $t\_{y0}^{SL}-Y-1-T\_{proc,1}^{SL}- $T′CPS,offset)
		- [4/HW, HiSi]: *n*+*T*A = $t\_{y0}^{SL}-31$and *n*+*T*B = $t\_{y0}^{SL}-T\_{proc,0}^{SL}-T\_{1}$
		- [13/OPPO]: *n*+*T*A ≥ $t\_{y0}^{SL}-31$ and *n*+*T*B ≤ $t\_{y0}^{SL}- T\_{proc,0}^{SL}-T\_{proc,1}^{SL}$
		- [24/MTK]: *n*+*T*A = $t\_{y}^{SL}-31$ and *n*+*T*B = *n-T*2 *-T*3
		- [16/Fujitsu]: $n+T\_{A}=t\_{y0}^{SL}-31$ and$n+T\_{B}=n-T\_{proc,0}^{SL}$
		- [25/Xiaomi]: $ n+T\_{A}=m-31$ and$n+T\_{B}=n-T\_{proc,0}^{SL}$, where m is slot of a candidate resource
		- [15/Intel]:
			* TA within a range: -max(tn-32, resource selection window size) ≤ TA ≤ 1 slot, or
			* TA within a range: –max((∆A + tn-32), resource selection window size) ≤ TA ≤ 1 slot
		- [18/Apple]: $T\_{A}=t\_{y}-31$and$T\_{B}=max⁡\{T\_{A},t\_{y}-T\_{proc,0}-T\_{proc,1}\}$
		- [23/Samsung]: $n+T\_{A}=t\_{y0}^{SL}-31$ and $n+T\_{B}=n-T\_{proc,0}^{SL}$
		- [20/LGE]: *n+TA ≤* $t\_{y\_{0}}$*-31* and *n+TB ≤* $t\_{y\_{0}}$*-* $T\_{proc,0}-T\_{proc,1}$
		- [29/Sharp]: $T\_{A}=-P\_{reserve}$ (subject to processing time) and $T\_{B}=-P\_{reserve}+31$
		- [22/NEC]: [yk -31, yk – T1 – Tproc,0]
		- [32/DCM]: $n+T\_{A}=t\_{y\_{1}}-31$ and $n+T\_{B}=\left(n+T\_{C}\right)-\left(T\_{proc,0}^{SL}+1\right)$, where $n+T\_{C}\geq t\_{y\_{1}}-T\_{proc,1}^{SL}$ is the resource selection timing
		- [27/ZTE, Sanechips]: [*n*1+*T*proc, *n*2-*T*proc], where n1 and n2 are respectively the triggering times for the start and end of the contiguous partial sensing window
	+ For aperiodic transmissions,
		- [3/FW]: $T\_{A}=1$and$T\_{B}\leq 31-T\_{proc,1}^{SL}$
		- [4/HW, HiSi]: *n*+*T*A = $max\left(n,t\_{y0}^{SL}-31\right)$and *n*+*T*B = $t\_{y0}^{SL}-T\_{proc,0}^{SL}-T\_{1}$
		- [24/MTK]: *n*+*T*A = $n+1$ and *n*+*T*B = *n-T*2 *-T*3
		- [13/OPPO, 16/Fujitsu]: $T\_{A}$ and$T\_{B}$are zero or positive integers and$T\_{B}-T\_{A}\leq 31$
		- [18/Apple]: $T\_{A}=1$and$T\_{B}= 32-T\_{proc,0}$
		- [23/Samsung]: $n+T\_{A}=n'-31$ and $n+T\_{B}=n-T\_{proc,0}^{SL}$, where n’ is n or n+T1
		- [32/DCM]: $n+T\_{A}=n+T\_{proc,2}^{SL}$ and $n+T\_{B}=\left(n+T\_{C}\right)-\left(T\_{proc,0}^{SL}+1\right)$, where $T\_{proc,2}^{SL}=[1]$ and $n+T\_{C}\geq t\_{y\_{1}}-T\_{proc,1}^{SL}$ is the resource selection timing
		- [15/Intel]:
			* ∆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
		- [35/E///]:
			* The values TA and TB are adaptive and based on the received HARQ feedback by the UE performing the sensing operation. The minimum duration of partial sensing window is (pre-)configured (which can be zero slot) and is used initially. If NACK is received, the sensing window is increased up to a maximum predetermined value (i.e., min (32, PDB)).
	+ Continuous sensing window should be defined as [max(n, n+T1-32), n+T2-T3] [5/vivo]
	+ Define n + TB as the resource selection time for contiguous partial sensing based resource selection. [7/CATT, GH]
		- If there are sufficient available sensing results when packet arrives, resource selection time is n where TB is equal to 0.
		- If there are no sufficient available sensing results when packet arrives, resource selection time is n + L– M, where L is the (pre-)configured contiguous partial sensing (minimum) duration and M = |TA| + 1.
			* TA depends on the actual sensing starting time, and |TA |+1 means that the UE has performed a contiguous sensing until slot n.
			* If there are no available sensing results, contiguous partial starts at the next logical slot, i.e., TA = 1.
		- Introduce a higher layer parameter to indicate the minimum contiguous partial sensing duration before resource selection.
	+ Sensing from the past 32 slots that are within the intersection of the sensing window and the same selected/configured resource set [10/QC]



* + Adopt predefined windowing with sensing occasions to detect periodic reservations in the pool when UE is transmitting aperiodic traffic [24/MTK]
	+ The maximum contiguous partial sensing window is 32 slots. The minimum contiguous partial sensing window is (pre-)configured per priority and can be zero. [31/IDC]
	+ Maximum TA and TB values can be (pre-)configured. It is up to UE implementation to select an actual value. [34/BOSCH]
	+ Include alignment to the contiguous partial sensing when coexisting with the periodic-based partial sensing, e.g., window size of the contiguous partial sensing or triggering time (or slot) of the contiguous sensing. [35/E///]
* Definition of resource selection window (RSW)
	+ UE selected Y candidate slots after resource (re)selection trigger slot n, regardless of periodic reservation is enabled/disabled for the resource pool: [4/HW, HiSi], [32/DCM]
		- Y candidate slots is selected with a constraint of $t\_{y\_{1}}\geq n+X\_{y\_{1}}$, where $X\_{y\_{1}}$ is (pre-)configured. [32/DCM]
	+ RSW for aperiodic transmissions is between [n+T1, n+T2]
		- [3/FW], [13/OPPO]
	+ RSW window or a set of slots for selection is confined within a selected/configured resource set. [10/QC]

## Random resource selection

* Identified issue 1: Persistent collision / consecutive packet loss between a random resource selecting UE with other UEs due to same reservation period [2/Nokia, NSB], [3/FW], [4/HW, HiSi], [7/CATT, GH]
	+ Random selecting UE makes resource reservation for a new TB in the next period with a pseudo-random frequency hopping, i.e. reserve the resource R\_(x+A,y+P) where P denotes the reservation period in logical SL slots in the pool converted from the reservation period in milliseconds and A denotes the frequency hopping offset determined pseudo-randomly e.g. by the CRC bits of the associated PSCCH. 1 bit in SCI format 1-A to indicate (ON/OFF) the enhanced resource reservation. [3/Nokia, NSB]
		- Conditions in which the UEs may use random resource selection per a TB or more than one consecutive TBs, CBR conditions, priorities of SL transmissions, uses of SL HARQ Option-2 so that the UEs using random resource selection may reselect resources based on HARQ NACKs when persistent collisions happen.
	+ For random resource selection with periodic traffic, the Tx UE uses two different resources for two consecutive transmissions [3/FW]
	+ 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. [4/HW, HiSi], [7/CATT, GH]
* Identified issue 2: Low priority randomly selected transmission (with no reception capability and no re-evaluation and pre-emption checking) colliding with high priority transmitted from full/partial sensing UE due to mixed configuration of full/partial/no sensing in a same pool [2/Nokia, NSB], [3/FW], [4/HW, HiSi], [5/vivo], [7/CATT, GH], [9/CMCC], [13/OPPO], [32/DCM]
	+ [10/QC]: Based on simulation results, PRR performance of sensing UEs is not impacted in a mixed pool, but the PRR performance of random selection UEs is degraded. No special indication or treatment is needed for resources chosen using random selection.
	+ Increase the priority of UEs performing random resource selection [2/Nokia, NSB], [3/FW], [5/vivo (sim)], [6/Spreadtrum], [22/NEC], [24/MTK]
		- Use the corresponding priority value in the priority field in the 1st-stage SCI [2/Nokia, NSB], [3/FW], [22/NEC]
		- An extra field is added in SCI for indicating the original priority value associated with QoS requirement [2/Nokia, NSB]
		- A 1-bit field in the SCI indicates that the UE is performing random resource selection. [3/FW], [9/CMCC]
			* The offset of priority increase is applied by receiver [3/FW]
			* Resources reserved by random selection are all excluded without RSRP increment [9/CMCC], [19/Sony], [32/DCM],
		- The priority of random selection resources is increased by a (pre-)configured value [5/vivo]
	+ A priority threshold is configured for a resource pool, at which reduced sensing UEs can select resources in a pool configured for mixed types of RA [2/HW, HiSi (sim)], [22/NEC]
	+ For UEs perform sensing are restricted in its usage of resource pools with random resource selection enabled. [8/Fraunhofer]
	+ When pre-emption is enabled in a resource pool, set priority of UE with random resource selection to lowest priority; Otherwise, set the priority lower than $prio\_{pre}$. [13/OPPO]
	+ Different RSRP thresholds or increased RSRP threshold value is (pre-)configured for different resource selection scheme; [9/CMCC], [18/Apple], [31/IDC] Or UE reports whether one candidate resource overlaps with resources reserved by random resource selection UE to higher layer for further resource selection. [9/CMCC]
	+ For random resource selection, partitioning of SL resources / resource pool
		- For random resource selection selects the resource from a sub-pool [3/FW], [17/Pana]
		- For high priority traffic / assigning a priority threshold [3/FW], [19/Sony], [23/Samsung]
	+ SCI indicates at least one of the following information using the reserved bits. [20/LGE]
		- Type of UE: power-saving UE or vehicle UE [31/IDC]
	+ Random selection UE with high priority reserves the resource by sending reservation indication before data transmission. [27/ZTE, Sanechips]
	+ Prioritization is applied for selection of resource allocation schemes in case the UE is capable of multiple resource allocation schemes enabled in a resource pool. [29/Sharp]
* Conditions on dynamic switching random selection or partial sensing for resource selection should be specified, and it may include RSSI/RSRP measurement results, ACK/NACK and QoS requirement (e.g., priority, PDB). [3/FW], [5/vivo], [24/MTK], [11/Zhejiang Lab], [26/Convida], [31/IDC]
* Assistant information from RSU based on CBR measurement on the selection of resource pool to use can be provided via sidelink signalling to the UEs performing random selection. [6/Spreadtrum]
* The 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. [7/CATT, GH]
* 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. [8/Fraunhofer]
* R16 principles of resource (re)selection should be followed for random resource selection is used (e.g., Type A and/or B UEs): [13/OPPO], [15/Intel]
	+ Maximum distance separation in logical slots should be 32 for any two resources indicated in a SCI
	+ HARQ feedback time gap (Z) between PSSCH-to-PSFCH-to-PSSCH is respected (i.e., Type B UE with PSFCH reception)
* The frequency that a UE performs random resource selection should be restricted (e.g., a minimum duration can be defined between two consecutive triggering of random selections) [25/Xiaomi]
* Conditions / criteria to use random resource selection [15/Intel]
	+ UE does not have sidelink RX chain to perform sidelink sensing (i.e., Type A and B UE)
	+ UE is configured to operate in power saving resource allocation mode
	+ Dependent on priority level
* Conditions / cases in which the UE perform random resource selection when it is enabled in a resource pool: [20/LGE]
	+ When resource (re)selection is triggered within a threshold from the start of SL DRX ON duration
	+ When congestion/interference level in a resource pool is below a threshold
	+ When the priority value of a packet is below a threshold (e.g. pre-emption priority value)
	+ When PDB is smaller than a (pre-)configured threshold if periodic transmission is not allowed in a resource pool
* 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. [20/LGE]
* PSFCH resources associated with the randomly selected resources are separately configured from those with the resources based on partial sensing. [20/LGE]
* A non-sensing UE sharing a resource pool with sensing UEs 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, i.e., trigger resource re-evaluation/re-selection or pre-emption. [35/E///], [31/IDC]
* For random resource selection, support periodic transmission only for UEs with no sensing capabilities. Aperiodic and periodic transmission can be supported for UEs with PSCCH and/or PSFCH decoding capabilities [34/BOSCH]

## Re-evaluation and pre-emption checks

* No re-evaluation and pre-emption checks for UE performing random resource selection
	+ [3/FW], [4/HW, HiSi], [7/CATT, GH]
* 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.
	+ [2/HW, HiSi]
* For the purpose of pre-emption, whether periodic-based partial sensing should be performed or not depends on pre-emption enable or disable. [7/CATT, GH]
* For the purpose of re-evaluation, there is no need to perform periodic-based partial sensing for packet transmission in the duration that a TB arrives but resource (re)selection is not triggered. [7/CATT, GH]
* Introduce random selection with subsequent re-evaluation in NR sidelink. [10/QC], [11/Zhejiang Lab], [13/OPPO], [18/Apple], [26/Convida], [31/IDC], [32/DCM]
* At least for resource(s) selected by period-based partial sensing, when performing re-evaluation or pre-emption, [25/Xiaomi]
	+ Option 1: reuse the set of candidate slots in resource (re)selection
	+ Option 2: the set of candidate slots only includes the slots of transmission resource for re-evaluation or pre-emption
* For pre-emption check in case of periodic-based partial sensing, support configurability among the following two options [15/Intel]
	+ Option 1: Pre-emption check and periodic-based partial sensing are enabled for every TB transmission
	+ Option 2: Pre-emption check and periodic-based partial sensing are enabled for resource reselection events
* For a UE performs partial sensing, re-evaluation/pre-emption and the corresponding resource re-selection is also based on partial sensing. Partial sensing procedure should be enhanced by the mechanism of either the priority adjustment or signalling, to support re-evaluation / pre-emption checking while maintaining the power saving performance. [16/Fujitsu]
* Support re-evaluation and pre-emption checking based on partial sensing (including both periodic-based partial sensing and contiguous partial sensing) after the resource selection. [18/Apple]
* Both re-evaluation and pre-emption checking with power saving mode(s) can be enabled/disabled by resource pool (pre-)configuration. [23/Samsung]
* The procedure of pre-emption check and re-evaluation check in Rel-16 NR V2X is reused for Rel-17 power saving mode with a fixed sensing window size of W=31 slots 🡺 [m-W, m-T3-Tproc,0). [23/Samsung]
* RAN1 should discuss whether a partial sensing UE can select resources in noncandidate slots defined by periodic-based partial sensing slots. [19/Sony]
* A partial sensing UE should conduct re-evaluation or pre-emption checking in subsequent periods after initial selection of periodic sidelink grant. [19/Sony]
* A partial sensing UE should conduct periodic-based partial sensing for re-evaluation or pre-emption checking in subsequent period after initial selection of periodic sidelink grant. [19/Sony]
* Conditions and cases in which the UE should perform re-evaluation and pre-emption checking: [20/LGE]
	+ When random resource selection is performed before resource (re)selection by UE that is capable of sensing
		- if additional sensing is possible within remaining PDB
		- if there are any sensing results available for transmission of other packets
	+ When the number of the periodic-based partial sensing slots before resource (re)selection is below a threshold
	+ When only the contiguous partial sensing is performed before resource (re)selection in a resource pool where the periodic transmission is enabled
	+ When the priority value of a packet is above a threshold (e.g., pre-emption priority value)
	+ When the congestion/interference level in a resource pool is above a threshold
	+ When the required reliability level of a packet transmission is above a threshold
	+ When the number of retransmissions of a packet is below a threshold
	+ For selected resources for which sensing results more than a threshold in a contiguous partial sensing window are not available (e.g., the resources selected in the latter part of a selection window)
* UE continues periodic-based partial sensing after resource selection by monitoring the slots of the timing below within PDB:$t\_{s\_{y}+m×P\_{reserve}}$ where$s\_{y}$is the most recent monitoring occasion for candidate slot *y* for resource selection, and m is an integer greater than zero. [20/LGE]
* UE performs contiguous partial sensing over the window *[*$t\_{r}-T\_{C}$*,* $t\_{r}-T\_{D}$*]*, where $t\_{r}$is the timing of every selected resource,$T\_{C}\geq W\_{CPS}$*,* $T\_{D}\geq T\_{proc,0}+T\_{proc,1}$and *WCPS* is the length of contiguous partial sensing window (e.g. 31 SL logical slots)*.* [20/LGE]
* In determining the idle resources (SA) or in resource reselection based on resource re-evaluation or pre-emption checking in a resource pool where periodic-based partial sensing is configured, a resource is reselected according to the priority below (lower priority number means higher priority). [20/LGE]
	+ Priority 1. Idle resources in Y candidate slots in the range (RCPS), where the conflict with other UE’s transmission resource can be detected by contiguous partial sensing
	+ Priority 2. Idle resources in Y candidate slots outside the range RCPS
	+ Priority 3. Idle resources except Y candidate slots in the range RCPS
	+ Priority 4. Idle resources except Y candidate slots outside the range RCPS
* The pre-emption priority for power saving UE is separately (pre-)configured from that for vehicle UE. [20/LGE]
* For re-evaluation/pre-emption check of a resource at UE performing periodic-based partial sensing and contiguous partial sensing, [32/DCM]
	+ The UE uses the same set of Y candidate slots as that determined in the corresponding resource selection.
		- Sensing slots for periodic-based partial sensing are the same.
		- Sensing slots for contiguous partial sensing includes additionally slots within$\left(n+T\_{B}, m-T\_{proc,0}^{SL}\right)$
* For re-evaluation/pre-emption check of a resource at UE performing random resource selection [32/DCM]
	+ When a UE selects at slot *n* resource(s) randomly from a window of *[n+T1, n+T2]*, the UE monitors slots of *[n+*$T\_{proc,2}^{SL}$*, m−*$T\_{proc,0}^{SL}$*]* and performs re-evaluation/pre-emption check at slot *m*, where
		- $T\_{proc,2}^{SL}$ *= [1]* and *m+*$T\_{proc,1}^{SL}$ is the slot index of the selected/reserved resource
	+ A set of Y candidate slots within *[m+T1, m+T2]* is determined in the same way as partial sensing.
* For semi-persistent reservation, the UE can skip pre-emption for certain reservation periods. The number of skip periods is (pre-)configured per priority. [31/IDC]
* For random resource selection of UEs with PSCCH reception capabilities, support re-evaluation and pre-emption based on a short sensing period. The short sensing starts shortly after resource selection trigger and stops directly before (re-)transmission. [34/BOSCH]

References

1. [RP-202846](http://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_90e/Docs/RP-202846.zip) WID revision: NR sidelink enhancement LG Electronics
2. R1-2104176 Sidelink resource allocation for power saving Nokia, Nokia Shanghai Bell
3. [R1-2104192](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104192.zip) Power consumption reduction for sidelink resource allocation FUTUREWEI
4. [R1-2104236](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104236.zip) Sidelink resource allocation to reduce power consumption Huawei, HiSilicon
5. [R1-2104385](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104385.zip) Resource allocation for sidelink power saving vivo
6. [R1-2104440](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104440.zip) Discussion on sidelink resource allocation for power saving Spreadtrum Communications
7. [R1-2104489](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104489.zip) Discussion on resource allocation for power saving CATT, GOHIGH
8. [R1-2104560](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104560.zip) NR Sidelink Resource Allocation for UE Power Saving Fraunhofer HHI, Fraunhofer IIS
9. [R1-2104630](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104630.zip) Discussion on resource allocation for power saving CMCC
10. [R1-2104693](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104693.zip) Power Savings for Sidelink Qualcomm Incorporated
11. [R1-2104706](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104706.zip) Discussion on resource allocation for power saving Zhejiang Lab
12. [R1-2104724](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104724.zip) Considerations on partial sensing in NR V2X CAICT
13. [R1-2104755](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104755.zip) Power saving mechanisms in NR sidelink OPPO
14. [R1-2104869](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104869.zip) Sidelink resource allocation for power saving Lenovo, Motorola Mobility
15. [R1-2104926](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2104926.zip) Sidelink Power Saving Schemes Intel Corporation
16. [R1-2105066](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105066.zip) Considerations on partial sensing and DRX in NR Sidelink Fujitsu
17. [R1-2105070](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105070.zip) Discussion on Sidelink Resource Allocation for Power Saving Panasonic Corporation
18. [R1-2105126](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105126.zip) On Sidelink Resource Allocation for Power Saving Apple
19. [R1-2105177](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105177.zip) Discussion on sidelink resource allocation for power saving Sony
20. [R1-2105204](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105204.zip) Discussion on resource allocation for power saving LG Electronics
21. [R1-2105228](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105228.zip) Discussion on resource allocation for power saving ETRI
22. [R1-2105253](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105253.zip) Discussion on resource allocation for power saving NEC
23. [R1-2105334](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105334.zip) On Resource Allocation for Power Saving Samsung
24. [R1-2105380](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105380.zip) Discussion on sidelink power saving MediaTek Inc.
25. [R1-2105544](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105544.zip) Discussion on sidelink resource allocation enhancement for power saving Xiaomi
26. [R1-2105598](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105598.zip) NR SL Resource Allocation for Power Saving Convida Wireless
27. [R1-2105614](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105614.zip) Discussion on resource allocation for power saving ZTE, Sanechips
28. [R1-2105615](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105615.zip) Discussion on resource allocation for power saving Hyundai Motors
29. [R1-2105645](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105645.zip) Discussion on resource allocation for power saving Sharp
30. [R1-2105651](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105651.zip) Resource allocation for power saving with partial sensing in NR sidelink enhancement ITL
31. [R1-2105674](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105674.zip) Sidelink resource allocation for power saving InterDigital, Inc.
32. [R1-2105718](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105718.zip) Discussion on sidelink resource allocation for power saving NTT DOCOMO, INC.
33. [R1-2105845](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105845.zip) Discussion on partial sensing and SL DRX impact ASUSTeK
34. [R1-2105866](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105866.zip) Further discussion on power saving for sidelink ROBERT BOSCH GmbH
35. [R1-2105893](file:///C%3A%5C3GPP%5CRAN1_Meetings%5CTdocs%5C2021%5CR1-2105893.zip) Resource allocation procedures for power saving Ericsson

Appendix (past meeting outcomes)

## 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}$ *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: $P\_{reserve}$ *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 $n –T\_{0}$
	+ 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