**3GPP TSG-RAN WG2 Meeting #117 electronic R2-220xxxx**

**Online, February, 2022**

**Agenda item: 8.15.2**

**Source: OPPO**

**Title: Summary of 706**

**Document for: Discussion and Decision**

# Introduction

This document is for the following left issue from Post-116b [705]

* [AT117-e][706][V2X/SL] TP for SL DRX active time indication to PHY and resource (re)selection in SL DRX (OPPO)

      **Scope:** Make a compromised TP with the consideration to avoid too much specification efforts and to clarify the UE behaviour enough.

      **Intended outcome:** Endorse TP in R2-2203678 and discussion summary in R2-2203679 (if needed)

**Deadline:** 2/28 13:00 UTC

Specifically, it is for the following left issues.

**NOTE-vs-Normative-text for DRX-vs-resource-(re)selection**

**Recommendation 2.3.3-1a [17/18]: Capture the “MAC layer provides active-time to PHY layer” in normative text as baseline (further discussion on the wording can be done in running-CR discussion).**

**Recommendation 2.3.3-1b [?/15]: For the step of MAC layer providing active-time to PHY layer, RAN2 further discuss whether/how to specify the left details besides the normative text of Recommendation 2.3.3-1a, e.g., via either a NOTE or a normative text (a TP is to be provided for either case).**

**Recommendation 2.3.3-2a [10/17]: Capture resource selection “within SL DRX Active time where SL DRX timers that are running and will be running in the future” in normative text as baseline (further discussion on the wording can be done in running-CR discussion).**

**Recommendation 2.3.3-2b [?/16]: For the step of MAC layer perform resource (re)selection based on the resource set reported by PHY layer, RAN2 further discuss the issue on resources (re)selection for initial/re-transmission for group-cast.  Other than that, RAN2 further discuss whether/how to specify the left details besides the normative text of Recommendation 2.3.3-2a, e.g., via either a NOTE or a normative text (a TP is to be provided for either case).**

The specification impacts on resource selection and LCP procedure caused by SL DRX has been discussed in Q2.3.3-1b/2b of [POST116bis-e][705], where both the NOTE-based approach and the normative-text based approach are discussed and 2 types of draft-CRs are generated in the offline discussion.

The 2 draft-CRs are of quite similar shape except the following 2 aspects:

* Whether to specify destination-selection during active time generation and resource selection;
* Whether to use NOTE or normative text for defining active time;

Besides the above 2 issues, one issue raised in the offline discussion is whether/how to capture the cast-type based differentiation.

Therefore, the above issues will be discussed in this document, and the intention is finding a way out to merge these 2 approaches (normative-text-based approach and NOTE-based approach) and come up with a final shape which can be accepted by both sides.

# Discussion

On the one hand, based the offline discussion, two sets of draft-CR are generated, one is for NOTE-based approach, and the other is for normative-text-based approach. On the other hand, by comparing the two, the key difference is at two aspects.

Firstly, on the dimension of destination-selection

In NOTE-based approach, no normative-text is used

3> if one or multiple SL DRX is configured in the destination UE(s) receiving SL-SCH data:

4> indicate to the physical layer SL DRX active time in the destination UE(s) receiving SL-SCH data, as specified in clause 5.x.2.

In normative-text based approach, a normative-text is used:

3> if one or multiple SL DRX is configured of a destination UE receiving SL-SCH data which has at least one of the MAC CE and the logical channel with the highest priority and is allowed on the carrier:

4> indicate to the physical layer the SL DRX active time in the destination UE as specified in clause 5.x.2.

**Q1: Which option do you prefer w.r.t specification for destination-selection?**

**Option-1: NOTE-based approach**

**Option-2: Normative-text based on approach**

**Option-3: Compromise-way (if this option is selected, please clarify the compromise way)**

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| Company | Option | Comment |
| OPPO | 1 or 3 | We do not think option-2 is the correct way-out logically: if we apply this, it means the UE perform destination selection firstly before resource selection, and secondly at LCP, and then the selected UE “with LCH of highest prio” in the first step may not cover the UE “with LCH of highest prio” in the second step, leading to the result that the real UE “with LCH of highest prio” not covered, yet the selected UE in the first step may already have no data in the buffer when it comes to LCP step, so lead to resource waste. We believe **a reasonable UE implementation should, at the first step (during resource selection), maximize the probability of resource usefulness to the UEs, e.g., to select the resources as an intersection of active-time of multiple UE (not necessarily all)**. On the other hand, we **cannot** make it captured using a deterministic algorithm, **since no one can ensure that we can find the intersection of ALL UEs, so an implementation-based method that aim at as many UEs as possible** is the reasonable way-out.So we would like to have the spec allowing the implementation above, i.e., option-1 is OK. Or, if we go with option-3, we can change the description in normative-text based approach to the following under “e.g.,”3> if one or multiple SL DRX is configured for a destination UE (e.g., which has at least one of the MAC CE and the logical channel with the highest priority and is allowed on the carrier) receiving SL-SCH data:4> indicate to the physical layer the SL DRX active time in the destination UE as specified in clause 5.x.2. |
| InterDigital | 2 | We think the use of the destination with highest priority to determine the active time is the most straightforward, since the destination selected to indicate the active time to the PHY layer and the destination selected during LCP will most often be the same. There are other cases where we use the highest priority logical channel during resource selection (e.g. selecting number of HARQ retransmissions, number of frequency resources), so highest priority LCH is consistent with what we do already.[OPPO] There are indeed this legacy similar thing, i.e., when UE has to figure out the sensing input, yet the impact is just the subchannel number / re-tx number and etc.. so does not put a major impact to resource selection anyway. However, here we are talking about resource availability, in time domain, so the harm is in different levelsIn the corner cases where they are not the same – mentioned by OPPO – existing reselection triggers from Rel16 can avoid resource wastage. OPPO: Corner or not we hold different view^^ and we are not sure how the “existing reselection triggers from Rel16” can avoid the resource waste since resource selection procedure is exactly the procedure we are talking about here, and by having this, the impact is for all resource selection procedures.Furthermore, it is unclear how to “maximize the probability of resource usefulness” or to select resources that are the intersection of active times of multiple UEs without making specification difficult, which is contrary to the goal of this email discussion.OPPO: “maximize the probability of resource usefulness” means we can leave some flexibility to UE implementation, i.e. use the text mentioned in our reply, which includes the UE behaviour to select the destination with highest priority but also leave some space for the UE to handle the various situation considering the time gap between the beginning of resource selection and LCP. |
| Xiaomi | Option 1 | We think option 2 is confusing, since SL DRX is configured per destination. Destination selection is performed the same in legacy. So, we don’t need to repeat the destination selection during DRX active time determination. |
| vivo | 1 | Agree with the rapporteur. Option 2 may cause some unexpected situations, e.g. the selected destination in the first step is not the real-time destination “with LCH of highest priority” in the second LCP step or even resource waste. Another reason is that when we do resource pool selection at the very beginning, we don’t consider the destinations. So, if we select a pool (e.g. just based on HARQ attribute) and then we don’t include the active time from multiple UEs but just one, there is risk that no useful candidate resources can be selected by PHY layer.Option 1 can rely on an implementation method to take the active times of multiple destinations into account for resource efficiency. |
| Apple | Option 2 | We think the normative approach can work well. It is also essential to have requirements in UE side to ensure the scheme work as it intends to be. Informative NOTES are not UE requirements. OPPO: We agree with “It is also essential to have requirements in UE side to ensure the scheme work”, and we already have the normative text to restrict Tx UE behaviour, e.g., “The UE transmitting SL-SCH Data should keep aligned with its intended UE receiving the SL-SCH Data regarding the SL DRX Active time as specified in clause 5.x.1. ” and “or among logical channels and MAC CE(s), *SL-DRX-Config*, if configured, includes *sl-DRX-Config-GC-BC* or *SL-DRX-ConfigUC-Info*, PSCCH duration(s) and PSSCH duration(s) associated with the PSSCH transmission occasions fall in the active time as specified in clause 5.x.1”Therefore, we think the scheme can already work well. If we just use NOTES, resource selections can be abused by some reckless UEs, then not only those reckless UEs suffer power-inefficiency, but all other mode 2 UEs will suffer as well due to wasteful resource reservations. Regarding the concen of destination selection are not the same issue, we can refine the above text with some further options, as shonw below* + - * Alt 1: mdoe 2 SL DRX UE skip the “destination selection” part in LCP procedure (5.22.1.4.1)
			* Alt 2: Also Consider *SBj & sl-HARQ-FeedbackEnabled* to ensure the same destination is chosen in both 5.22.1.1. and 5.22.1.4.1.

For this 2 Alts, our understanding is:* Alt 1 may not be feasible since in case when the LCP is to be done, it happened that the previously selected destination (selected during resource selection step) has no data to send? i.e., the destination selection @ LCP should be ultimate step/reference, since it is anyway needed for MAC-PDU generation, while the other possible destination-selection before that step is just not reliable.
* We are not sure about how can Alt 2 to ensure the same destination is chosen in both 5.22.1.1. and 5.22.1.4.1.. considering that they are anyway performed at different time point
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| LG | Option 2 | If the destination selected by the UE during resource selection (or before selecting the resource) is different from the destination selected in LCP, UE can select the resource again. The concept of this behavior is already supported by the R16 resource selection procedure. That is, if the UE have reserved periodic transmission resources for transmitting multiple MAC PDUs, but the reserved resources do not satisfy the QoS of the destination in the next period, the UE does not use the reserved periodic transmission resources and reselect a grant for single MAC PDU transmission (among 12 HARQ process IDs for single MAC PDU transmission). So if we follow this legacy conception for resource selection considering SL DRX active, there are absolutely no problems with the operation. |
| Ericsson | Option 2 | Actually, option 2 is exactly aiming to maximize utilization of the resources that will be selected. Therefore, destination selection in the first place and in LCP need to apply the same criteria. We share the same view as IDT, mismatch between the firstly select destination and secondly selected destination is corner case. but in order to address the concern raised by OPPO, we may adopt alternatives proposed by Apple. In addition, we may directly refer to the LCP procedure when determining a destination firstly before resource selection. In this way, all other conditions such as SBj & HARQ-feedbackEnabled which may cause mismatch will be also considered when firstly select a destination. |
| Huawei, HiSilicon | Option 1 | In legacy, the SL data in a logical channel triggers UE to perform resource selection. Since providing active time to PHY is within resource selection procedure, it is straightforward that the active time can be the destination associated to the SL data that triggers resource selection. It is strange that providing active time of a different destination to PHY from the one triggers resource selection. It may result in no SL grant is selected for the SL data triggers resource selection. With this thinking, it is tricky to specify the UE behaviour as in Option 2 and we can accept that the destination of active time can be up to UE implementation as in Option 1.  |
| Nokia | Comments | We do agree that option 2 can be confusing as utilising the destinations may be confusing, as this may change the legacy order in terms of destination select before resource selection. However, we think there may be another option; i.e. sending the active time for not a single destination, but multiple destinations with coming active times.Is the intention of the question to allow the UE to provide “whichever active time it sees fit”, and then later in the destination selection select the proper resource?We already know from RAN1 that they may provide resources which does not fit within the UE active time, so we don’t see a reason for further limiting the resource selection at this point.One approach could be to strictly define how the active time is selected, which may not be based on destination selection, but rather just take the minimum start, and maximum end points of the current destinations.Another approach would be to leave the above procedure to UE implementation, thus adding a note on what is expected of the active time, and in this case we can agree to a note. If this is the actual intention of this question, we agree with option 1.OPPO: Yes that (i.e. leave the above procedure to UE implementation) is the intention of option 1. |
| ZTE | Option1 | Option2 breaks current UE procedure of resource selection and LCP. From our view, the reason why highest priority LCH is selected to determine the HARQ retransmission number/frequency resource is that only one HARQ retransmission number/freqeuncy resource can be indicated to PHY layer to perform sensing. In other words, MAC can not indicate two different HARQ retransmission number to PHY layer.However, for active time, it is obviously that active time of more than one destination can be indicated to PHY layer. In this case, limit only active time of destinatoin with highest priority LCH is indicated to PHY layer is not flexible. |
| Intel | 1 or 3 | We share the view with OPPO that if we go with the normative text based approach, we will essentially have to do the destination selection step before resource selection. While there is no blocking problem in doing so in itself, depending on the gap between the destination selection before resource selection and subsequently during LCP, the chosen destination may be different if we have incoming data during this gap.If the majority wants to go with the normative text based approach, then we think we should explicitly refer to the destination selection step in the text highlighted as green by OPPO  |

Secondly, there is a left issue on how to handle the resource selection for initial-transmission resource selection for group-cast.

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| R2-2200938 | Ericsson | Proposal 20 For groupcast, the TX UE can only select the resources for the initial transmission associated with the time in which the on-duration timer at the TX UE is running. |
| R2-2200483 | Huawei, HiSilicon | Proposal 5: For SL groupcast, initial transmission is only allowed during the time when onduration timer or inactivity timer is running, and retransmission of a SL process is only allowed during the time when onduration timer, inactivity timer, or the retransmission timer of this SL process is running. |

**Q2-1: Which option do you prefer w.r.t specification for resource selection for GC initial transmission,**

**Option-1a: use normative text to limit the resource selection to the time when on-duration timer is running**

**Option-1b: use normative text to limit the resource selection to the time when on-duration timer, or inactivity timer is running**

**Option-1c: use normative text to limit the resource selection to the time when on-duration timer, inactivity timer, or retransmission timer is running**

**Option-2: using NOTE to capture the restriction if any**

**Option-3: no specific restriction need to be captured**

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| Company | Option | Comment |
| OPPO | 2 or 3 | Option-1a is not reasonable since in this way, inactivity timer is only used for re-tx, which seems like to say inactivity timer is not needed for GC, i.e., on-duration timer is used for initial transmission and re-transmission timer is used for re-tx. If the doubt on reliability of inactivity timer holds, the same doubt for the reliability of re-tx timer holds as well, which means we should revisit the agreement on inactivity timer and re-tx timer usage in GC.For option-1b, as we discussed in 116, For GC: * Option1: Initial transmission is allowed during the time when on-duration and inactivity timer run.
* Option2: Initial transmission is allowed during any active time.

Option 1: Qualcomm, Lenovo, IDT, Huawei, Ericsson (5)Option 2: LG, OPPO, Nokia, Intel, Apple, MediaTek, NEC, ZTE, Fraunhofer, ASUSTek (10)There is no majority support on this issue, considering the root issue is anyway the SCI reachability in GC is doubtable for both inactivity timer and retransmission timer to work in a reliable way, so it is preferred to leave it to Tx-UE implementation to solve this issue. |
| InterDigital | 1c, with 1a, 1b possible | Our understanding is that the current draft of the normative approach already reflects 1c, which is acceptable. If companies are concerned about the reliability of the initial transmission, 1a or 1b can be considered. However, we don’t think this issue is specific to groupcast and would also be the case for unicast (i.e. SCI reception reliability can be affected by half-duplex, UL/SL prioritization for unicast as well as groupcast)OPPO: Rapporteur understanding is Option 1c= Option 3, please let me know if any misunderstanding here. |
| Xiaomi | Option 2 |  |
| vivo | 2 or 3 | The restriction can be left to smart TX UE implementation. |
| Apple | Option 1b | We think it cause more problem, but bring less benefits, when allowing SL DRX Retransmisison timer to be considered for initial transmisisons. We think only onDuration and inactivityTimers to be considered. |
| LG | Option 1c | We also think that option 1c = option 3. |
| Ericsson | Option 1a and possible 1b | Due to uncertainness and reliability issue, we prefer Option 1, we propose that a UE only performs initial transmission for GC when the on-duration timer is running to avoid packet loss due to active time misalignment between TX UE and RX UEs. But, we are also ok to option 1b if there is majority support on it. |
| Huawei, HiSilicon | Option 1b | It should be noted that here **the groupcast-specific issue is NOT about SCI reception reliability**. The issue of SCI reception reliability has been discussed before. A possible impact is that RX UE mis-detects the SCI for new transmission from TX UE and thus does not start inactivity timer, while TX UE starts inactivity timer after the SCI transmission. By contrast, for the groupcast-specific issue here, we assume RX UE does detect the SCI from TX UE, while whether to start retransmission timer is different among the RX UEs in a group, which comes from the different status of RX UEs on whether the data are decoded successfully or not. It is understandable that such un-alignment among different RX UEs in a group could be more common than SCI mis-detection, considering better PHY protection on SCI. Therefore, it is not reasonable to ignore this groupcast-specific issue. In this groupcast-specific issue, if an initial transmission is performed in TX UE when only the timer corresponding to the retransmission timer is running, the RX UE that has not started the retransmission timer may be in inactive time and thus experience packet loss. So it is reasonable for initial transmission to be only allowed when onduration timer or inactivity timer is running. |
| Nokia | Option 3, or 2 | We think that for alignment between the Tx and Rx UE, it will be better to have some kind of guidelines. But as a note, as to allow for power saving, we should ensure that the Tx UE should be aware that Rx UE does not necessarily have i.e. more than the on-duration and inactivity timer to transmit the initial transmission. Thus, transmitting in any other part of the active time may not be received. |
| ZTE | Option2, or 3 | From our view, the issue is caused by DRX timer mismatch which has been left to UE implementation. Therefore, we do not see too much benefits to capture this into normative text. |
| Intel | Option 2 | In order to avoid non-ending discussion on how to capture this case, we think it is simpler to go with option 2 |

Thirdly, on whether to have normative text on the definition of the active-time w.r.t the DRX timers.

In NOTE-based approach, a NOTE is used:

NOTE X: UE transmitting SL-SCH Data determines SL DRX active time associated with the destination UE(s) receiving SL-SCH data based on SL DRX timers running now or that will be running in the future (at least including *sl-drx-onDurationTimer*), as specified in clause 5.x.1. How to consider other SL DRX active time, as specified in clause 5.x.1, is left to UE implementation.

In normative-text based approach, a normative-text is used (including a NOTE for the initial/re-transmission case differentiation):

Furthermore, the UE transmitting SL-SCH Data determines the SL DRX active time based on SL DRX timers that are running (i.e., *sl-drx-onDurationTimer*, *sl-drx-InactivityTimer*, *sl-drx-RetransmissionTimer*) or will be running in the future (i.e., *sl-drx-onDurationTimer* *sl-drx-InactivityTimer*, *sl-drx-RetransmissionTimer*) in the UE(s) receiving SL-SCH data.

NOTE: A UE may assume a resource for retransmission is in the active time if the initial transmission causes the *sl-drx-RetransmissionTimer* to be started in the receiving UE.

**Q1: Which option do you prefer w.r.t specification for definition of active-time?**

**Option-1: Normative-text based approach**

**Option-2: NOTE-based approach**

**Option-3: Compromise-way (if this option is selected, please clarify the compromise way)**

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| Company | Option | Comment |
| OPPO | 2 or 3 | If we go with option-1, it seems to be an endless optimization, since 1) one can ask for specification in even more dimensions, e.g., to add more non-timer based active time, to differentiate single/multi-shot transmission, to differentiation the initial/non-initial transmission within multi-shot transmission, and 2) even for a single case (e.g., UC, single-shot), one can dig into many detailed aspect (e.g., non-timer based active time, the triggering of re-transmission timer) and etc.. so finally we doubt whether the specification effort covering all possibility is meaningful, compared to a NOTE-based approach which allows different implementation (since the resource selection is finally a Tx-UE internal problem).If we go with option-3, we can change “i.e.,” in normative-text based approach to “e.g.,”Furthermore, the UE transmitting SL-SCH Data determines the SL DRX active time based on SL DRX timers that are running (e.g., *sl-drx-onDurationTimer, sl-drx-InactivityTimer, sl-drx-RetransmissionTimer*) or will be running in the future (e.g., *sl-drx-onDurationTimer sl-drx-InactivityTimer, sl-drx-RetransmissionTimer*) in the UE(s) receiving SL-SCH data. |
| InterDigital | 1  | We think the current draft of the normative approach is sufficient to handle all cases (apart for the multishot transmission case, for which we first need to confirm the working assumption). We can start with this as the initial draft and then consider how to add the multishot case in light of the working assumption.Also, there is sufficient flexibility at the TX UE on how to determine how the UE determines whether the timers will be running in the future based on the resources selected at the time of transmission or existing grants. No need to over-specify these details. |
| Xiaomi | 2 | The proposed text may not be accurate, since there may be non-timer based active time, e.g. announced transmission resource.Note based solution may be more forward comptiable |
| vivo | Option 2/3 with comments | Both option 2 and option 3 (as proposed by OPPO) are acceptable to us. For option-3, use ‘e.g.’ is ok since besides these DRX timers, there are some other situations for active time, e.g. periodic reservation had been agreed to be considered as active time, CSI reporting period is also considered as active time, and so on.For option-1, general description may be ok because it would be hard to define how the UE determines ‘will be running in the future’. If we would like to adopt option-1, we could only indicate the current active time and MAC can just inform PHY when those ‘future active time’ are indeed starting to be running so they can also be categorized as ‘current active time’. In this way, option-1 would not cause many spec efforts and may be acceptable to us. |
| Apple | Option 1 or 3 | For compromise, we are fine to change i.e. to e.g., but still prefer a notmative text approach |
| LG | Option 1 |  |
| Ericsson | Option 1 or 3 | Option 1 is preferred, but, we are also ok to compromise with option 3.  |
| Huawei, HiSilicon | Option 1 |  |
| Nokia | 2/3, with comments | We can accept the note for simplicity, but as mentioned earlier, we think that the SL DRX operation in general would benefit a lot from clear definition of what is active time and what is not. In any other case, a Tx UE may transmit within what the Rx UE does not consider active time, or the Rx UE may think that it needs to be in active time when it should not.The NOTE X: example seems a bit contradictory, as it seems to be more UE interpretation than implementation. However, we do like the notation being “(at least including *sl-drx-onDurationTimer*)” as this should be the most important message of the specification.Suggest to delete “How to consider other SL DRX active time, as specified in clause 5.x.1, is left to UE implementation.” and then handle the “up to UE specification aspect within 5.x.1, if it is necessary |
| ZTE | 2 or 3 | Share the same view with OPPO. Considering we may have some non-timer based active time, how to define current and furture active is too complicated.And the corresponding description is related to how to indicate active time to PHY layer, this is a inter layer operation, and considering we have a clear definition of UE’s active time, the inter layer operation can be left to UE implementation. |
| Intel | 3 | We can see the point of having to over-specify the active time definition and wonder that even if we go with option 1, we may have to leave the door open for further changes. With that in mind, we think the compromise way proposed by OPPO can be a good way forward, which covers all such cases and at the same time gives the UE enough flexibility without compromising on DRX operation. |

# Summary

#  Reference

1. R2-2202900 Draft-CR for NOTE-based approach for Q2.3.3-1b in [POST116bis-e][705] OPPO
2. R2-2202901 Draft-CR for normative-text-based approach for Q2.3.3-1b in [POST116bis-e][705] OPPO
3. R2-2202902 Draft-CR for NOTE-based approach for Q2.3.3-2b in [POST116bis-e][705] OPPO
4. R2-2202903 Draft-CR for normative-text-based approach for Q2.3.3-2b in [POST116bis-e][705] OPPO