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

**e-Meeting, August 16th – 27th, 2021**

**Agenda Item: 7.2.4**

**Source: Moderator (Apple)**

**Title: Summary of [106-e-NR-5G\_V2X-11] Discussion on Reply LS to** [**R1-2106406**](file:///C:\Users\Docs\R1-2106406.zip)

**Document for: Discussion and Decision**

# Introduction

RAN2 sent an LS [1] on resource reselection trigger sl-reselectAfter with the following questions:

*Question 1: In NR V2X, whether “unused retransmission opportunities in case of HARQ feedback is enabled” shall be counted towards “consecutive unused transmission opportunities” to trigger resource reselection?*

*Question 2: In NR V2X, according to RAN1 agreement, is it the correct understanding that only the resources already indicated in SCI shall be counted towards “consecutive unused transmission opportunities” to trigger resource reselection?*

In this contribution, we discuss the resource reselection trigger sl-reselectAfter for the LS from RAN2.

The discussion for this reply LS can be found in the following email thread: [106-e-NR-5G\_V2X-11] Reply LS to [R1-2106406](file:///C:\Users\Docs\R1-2106406.zip) (LS on resource reselection trigger sl-reselectAfter, RAN2) by August 20 – Chunxuan (Apple)

The 1st point is planned as following, companies are highly appreciated to provide their inputs before this check point:

* 1st check point: 8.17 (UTC 11:59 PM, August 17)

The 2nd point is planned as following, companies are highly appreciated to provide their inputs before this check point:

* 2nd check point: 8.17 (UTC 11:59 AM, August 19)

# Discussions

## Round 1 discussion

There are contributions from 12 companies, discussing the topic of resource reselection trigger [2]-[15].

Based on the proposals in these contributions, the moderator thinks majority companies’ views on Question 1 are quite aligned. In principle, the answer to Question 1 is No.

From the current specification in TS38.321 (Clause 5.22.1.1), if Tx UE receives ACK from Rx UE, the remaining retransmission resource(s) of the MAC PDU will be cleared from the selected sidelink grant. It is preferred not to count the cleared resource(s) in the consecutive unused transmission opportunities.

*Question 1-1: Do you agree that “unused retransmission opportunities, due to the reception of sidelink HARQ-ACK (or, no reception of sidelink HARQ-NACK in case of NACK-only HARQ feedback), should* ***NOT*** *be counted towards consecutive unused transmission opportunities for resource reselection trigger”?*

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| Company | Answer to Question 1-1 | Comments |
| Intel | Yes, we do | Our understanding of the intention of the procedure related to sl-reselectAfter, is to count unused transmission periods, not every potential resource for a TB. Thus, retransmission resources should not be counted. |
| Ericsson | Yes, we agree | In our view, for the case of HARQ feedback enabled, skipped retransmissions opportunities – when HARQ feedback has indicated that retransmission of the MAC PDU is not needed, i.e., the transmission has been successful – shall not be counted to trigger resource re-selection. |
| Qualcomm | Agree | We share Intel’s understanding. |
| Samsung | Yes |  |
| NTT DOCOMO | Yes | The intention is to count transmission failure. Count in case of HARQ feedback enabled is not aligned with this. |
| Sharp | Yes | We share Intel’s understanding. |
| LG Electronics | Yes |  |
| Huawei, HiSilicon | See comments | Frequent resource re-selection leads to over-booking of resources and degrades the performance of mode 2, so it is preferred not to count unused retransmission opportunities, in case of HARQ feedback is enabled.  However, it is not clear the difference between the Question 1-1 and the Question 1 in RAN2 LS. If there is no difference, we suggest to use the original wording, asking the Question 1 in RAN2 LS directly, to avoid unnecessary misunderstanding between RAN1 and RAN2. |
| OPPO | Comments | In our understanding, the functionality of sl-reselectAfter based resource reselection is to prevent UE from using resources not reserved by SCI for several periods and colliding with other UEs.  According to 38.321, “if Tx UE receives ACK from Rx UE, the remaining retransmission resource(s) of the MAC PDU will be cleared from the selected sidelink grant”, however, it is unclear for us whether the retransmission resources cleared from the selected sidelink grant can be used for new MAC PDUs in following periods or not.  If it cannot be used for MAC PDUs in following periods, we agree with majority companies that the resource(s) should not be counted towards sl-reselectAfter. Otherwise, it is problematic if the resources are not counted, as UE may not use the resource(s) for several periods due to ACK (and no reservation by SCI) and use the resources again in a following period due to NACK. |
| vivo | Comments | It seems RAN2’s question is only partially covered by Q1-1. The original question is asking whether any unused resources should be counted or not, but Q1-1 only addresses the case of unused resources after successful transmission, but not considers others such as been dropped or deprioritized, etc. |
| ZTE,Sanechips | Yes | We share similar views as Intel. We think the intention of ***sl-reselectAfter*** is to count the unused transmissions per sidelink grant, not per resource. |
| CATT, GOHIGH | Yes | As mentioned by RAN2 LS, when HARQ feedback has indicated that retransmission of the MAC PDU is not needed, the related retransmission resource(s) is cleared from the SL grant. Therefore, these retransmission resource(s) being cleared from SL grant cannot be counted as “consecutive unused transmission opportunities”. |
| Nokia, NSB | Yes | We share Intel’s view of the intention. |

*Question 1-2: Is there anything else to be included in the reply LS for question 1?*

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| Company | Comments |
| OPPO | We think RAN1’s response to Question 1 in RAN2 LS is related to the question below, if RAN1 cannot reach consensus on the question, it is necessary to ask RAN2 in the reply LS.  *If Tx UE receives ACK from Rx UE, whether the retransmission resource(s) cleared from the selected sidelink grant can be used for new MAC PDUs in following periods or not.* |

Based on the proposals in the contributions, the moderator thinks companies’ views on Question 2 can be categorized to the following 3 alternatives.

Alt 1: Answer to Question 2 is Yes: only the resources already indicated in SCI, which are not used for transmission, shall be counted towards consecutive unused transmission opportunities to trigger resource reselection.

Alt 2: Answer to Question 2 is No: only the resource for initial transmission of a TB, which is not used for transmission, shall be counted towards consecutive unused transmission opportunities to trigger resource reselection.

Alt 3: Answer to Question 2 is No: any resources, which are not used for transmissions, shall be counted towards consecutive unused transmission opportunities to trigger resource reselection.

*Question 2-1: What is your understanding among the three alternatives?*

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| Company | Alternative | Comments |
| Intel | Alt 2 | This will effectively count unused periods, that was the intention of the counter in LTE. |
| Ericsson | Alt 1 |  |
| Qualcomm | Alt 2 | The intention of the counter is for the UE to trigger resource reselection when it is not using periodic transmission opportunities for a number of periods, not depending on how many resources are used within each period. Therefore, only resources for initial transmissions of TBs are counted. |
| Samsung | Alt 1 |  |
| NTT DOCOMO | Alt 2 | Agree with Intel/QC. |
| Sharp | Alt 2 | We share views with Intel and QC. |
| LG Electronics | Comments for Alt 1 and Alt 2. | **Comment for Alt 1**:  We don’t understand how Alt 1 works. For convenience of explanation, let’s assume that **only one resource** is reserved within a reservation period. For this example case, if TX UE omitted SL transmission (e.g., due to UL/SL prioritization) on the reserved resource within the 1st period, it is not fully convinced why it should not be counted towards consecutive unused transmission opportunities to trigger resource reselection. Note that it is impossible for the resource (i.e., initial transmission resource) reserved within the 1st period to be indicated by a prior SCI.  **Comment for Alt 2**:  We think that the current description of Alt 2 is technically incorrect. For convenience of explanation, let’s assume that **two resources** are reserved within a reservation period. Within a given period, if TX UE omitted SL transmission of a TB (e.g., due to UL/SL prioritization) on the 1st reserved resource but performed SL transmission of the same TB on the 2nd reserved resource, we think that it is desirable not to count it towards consecutive unused transmission opportunities to trigger resource reselection. However, when the current version of Alt 2 is applied, a problem arises that it is incorrectly counted towards consecutive unused transmission opportunities to trigger resource reselection. Therefore, our proposal is as follows:   * ***Only if all resources reserved for a TB are not used for transmission, it shall be counted towards one of consecutive unused transmission opportunities to trigger resource reselection*** |
| Huawei, HiSilicon | See comments | According to the following agreements in RAN1#98 (copied below), resources that are not indicated in SCI are either not detectable by other UEs or not actually to be used by the UE itself, thus they shall not be counted towards “consecutive unused transmission opportunities”.  However, for the resource indicated by SCI, whether only for the initial transmission or both initial and retransmission are counted should be decided by RAN2. Therefore, the Alt.2 is beyond the range that RAN2 asks RAN1 to reply.  Agreements:   * In Mode-2, SCI payload indicates sub-channel(s) and slot(s) used by a UE and/or reserved by a UE for PSSCH (re-)transmission(s) * SL minimum resource allocation unit is a slot * FFS whether when the resource allocation is multiple slots, the slots can be aggregated   FFS whether in case of multiple slots, the indicated slots are contiguous or not |
| OPPO |  | We think Question 2 is related to RAN1’s response to Question 1, we suggestion to discuss and conclude Question 1 first. |
| Vivo | Alt 1 with comment | We would like to be clarified whether these alternatives are only for HARQ-based transmission, or for any transmission (including HARQ disabled case).  It seems Alt-1 is the way used in LTE. In NR, if Alt 1 is also reused for HARQ disabled case, it seems simpler to apply the same approach to all the cases. |
| ZTE,Sanechips | See comments | Actually we share similar view as LG. The preferred reply as proposed in our contribution[R1-2108077](to be revised, void due to potential system issue):  Alt 4: Answer to Question 2 is No: Only if all of the resources of grant, including already and not yet indicated in SCI are unused, it shall be counted one time of “consecutive unused transmission opportunities” to trigger resource reselection. |
| CATT, GOHIGH | See comments | From our understanding, MAC layer only care about the SL grant regardless of SCI indicated or not. Therefore, alt 3 could be update as following:  Alt 3’: Answer to Question 2 is No: any resources belonging to SL grant, which are not used for transmissions, shall be counted towards consecutive unused transmission opportunities to trigger resource reselection.  In LTE-V2X, the consecutive unused transmission opportunities are counted based on both initial transmission and retransmission, we think this principle should be reused.  With the above update, we prefer alt 3’. |
| Nokia, NSB | Alt 2 with comment | RAN2’s question seems ambiguously worded, so we prefer to avoid answering yes or no. Instead we can just give the main part of Alt2, “only the resource for initial transmission of a TB, which is not used for transmission, shall be counted towards consecutive unused transmission opportunities to trigger resource reselection”. |

## Round 1 summary

A total of 13 companies provided comments in the first round.

For Question 1-1, majority of the companies agreed with the proposed wording. Some comments were raised:

Huawei asked the difference between Question 1-1 and Question 1 (from RAN2). In moderator’s understanding, there are different reasons of unused retransmission opportunities, e.g., unused due to reception of ACK, no data to transmit, etc. The main difference from LTE V2X is the unused resources due to the reception of ACK, which is discussed in Question 1-1. This is also the focus on Question 1, as it is mentioned “*in case of HARQ feedback is enabled.*” Vivo pointed out the gap between Question 1-1 and Question 1. For the other causes of unused retransmission opportunities, we think they are either covered in a legacy way or is related to Question 2. For example, consider 2 resources are reserved in each period. The first resource is used for transmission and NACK is received and the second resource is not used due to prioritization. Whether the unused resource is counted in this case depends on the conclusion of Question 2. Hence, they are not included in the response of Question 1.

OPPO raised a question: “whether the retransmission resources cleared from the selected sidelink grant can be used for new MAC PDUs in following periods or not” In moderator’s understanding, the retransmission resources cleared due to reception of ACK in a period should be used for new MPDUs in following periods. However, this does not affect the counting of consecutive unused transmission opportunities.

For Question 1-3, companies have different understandings:

Alt 1 (4): Ericsson, Samsung, HW, vivo

Alt 2 or its variations (7): Intel, Qualcomm, DCM, Sharp, LG, ZTE, Nokia

Alt 3 or its variation (1): CATT

The main reasons of Alt 1 are

* + - * 1. Resources not indicated in SCI are not detectable by other UEs or not used by the UE itself.
        2. Align with the HARQ feedback disabled case

The main reasons of Alt 2 or its variation are

* + - * 1. Intention is to count unused periods, not depending on how many resources are used in each period.
        2. Alt 1 does not work when no data is transmitted in the first period. (i.e., the first period should also be counted even if it is not indicated in SCI)

The main reasons of Alt 3 are

1. MAC layer only cares about SL grant, regardless of SCI indication of not
2. In LTE V2X, the consecutive unused transmission opportunities are counted based on both initial transmission and retransmission

In moderator’s view, Alt 3 follows LTE V2X principle. However, in NR V2X, the maximum number of selected sidelink grant for HARQ retransmissions could be as large as 32. If all the selected sidelink resources for HARQ retransmissions are counted towards consecutive unused transmission opportunities for resource reselection trigger, then it is easily reaching the value of *Sl-ReselectAfter*, whose largest value is 9 in the current specification. In other words, this mechanism may not work well in the existing system, unless some parameters are re-designed. To avoid large specification impact, we may not pursue this approach.

One potential problem of Alt 1 is that the number of resources indicated in SCI in one period could be still large. Consider an example that a UE uses 10 resources for initial transmission and retransmissions of a single TB in a period. If the UE does not have data to transmit in the next period, then all 10 resources in the next period will be counted, which already exceeds the value of *Sl-ReselectAfter*.

Note Alt 2 is different from LTE V2X design. In LTE V2X, the counter is based on the unused resources, while in Alt 2, the counter is based on the unused periods. Considering the possible large number of retransmissions in NR V2X and the majority of companies support this alternative, we may check whether this alternative is acceptable to all companies.

Furthermore, Alt 2 is based on the usage of initial transmission resource. As LG mentioned in an example that it may not be accurate if the initial transmission resource is unused while the retransmission resource is used. It is general understanding that this case should not be counted in *Sl-ReselectAfter*. Hence, the variation of Alt 2 is to be checked in the next round.

One question regarding Alt 2 is whether the similar rule is applied to both HARQ feedback enabled case or HARQ feedback disabled case. It is moderator’s understanding that the same rule applies to both cases. One comment is Alt 2 should be decided in RAN2. The understanding is that in RAN1’s response to Question 2, we should provide the proper understanding if RAN2’s understanding is improper.

## Round 2 discussion

*Proposed response to Question 1:*

*Unused retransmission opportunities, due to the reception of sidelink HARQ-ACK (or, no reception of sidelink HARQ-NACK in case of NACK-only HARQ feedback), should* ***NOT*** *be counted towards consecutive unused transmission opportunities for resource reselection trigger.*

**Please check if you can accept the above response. If not, please provide the modifications.**

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| **Company** | **Acceptable?** | **If not, any modifications?** |
| **vivo** | **Comment** | HARQ-ACK is the general HARQ feedback information including ACK and NACK. It is better to simply use ACK and NACK respectively instead. |
| **Intel** | **Agree** |  |
| **ZTE,Sanechips** | **Yes** |  |
| **LG Electronics** | **Yes** |  |
| **NTT DOCOMO** | **OK with comment** | Agree with vivo. HARQ-ACK is not ACK normally. HARQ-ACK is high-level information type and includes ACK and NACK. HARQ-ACK/HARQ-NACK should be updated as ACK/NACK, respectively. |
| **Sharp** | **Yes** | Agree with vivo. |

*Proposed response to Question 2:*

*Only if all resources reserved for a TB are not used for (re)transmission, no matter whether they are indicated in SCI, it shall be counted towards one of consecutive unused transmission opportunities to trigger resource reselection.*

**Please check if you can accept the above response. If not, please provide the modifications.**

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| **Company** | **Acceptable?** | **If not, any modifications?** |
| **vivo** | **No** | We prefer Alt 1 to have a consistent behavior for LTE and for NR with both HARQ enabled and disabled cases, especially in this maintenance stage. The current proposal (based on Alt 2) is an unnecessary optimization.  Regarding the abovementioned “potential problem of Alt 1”, we don’t think it is a real problem. A single SCI can only reserve up to 3 resources, thus it is not possible to reserve 10 resources in the initial reservation SCI. If due to some problem, more resources are used for retransmission in one period, it is unnecessary (actually undesirably) to preserve the same number of retransmission resources in the next period, especially when there may be no transmission in the next period. |
| **Intel** | **Yes** | This is aligned with our initial preference.  We don’t see the need for ‘consistent’ behavior between LTE and NR. The limited range of the parameter for sl-reselectAfter assumes that each periods adds ~1 to the counter. This is achieved by current version of reply to Q2. |
| **ZTE,Sanechips** | **Yes** |  |
| **LG Electronics** | **Yes** |  |
| **NTT DOCOMO** | **Yes** |  |
| **Sharp** | **Yes** |  |

# Conclusion

TBD

# References

1. R1-2106406 LS on resource reselection trigger sl-reselectAfter Apple
2. R1-2106849 Draft reply LS on resource reselection trigger sl-reselectAfter Samsung
3. R1-2106995 Draft Reply LS on resource reselection trigger sl-reselectAfter CATT, GOHIGH
4. R1-2107222 Draft reply LS on resource reselection trigger sl-reselectAfter OPPO
5. R1-2107305 Draft Reply to RAN2 LS on resource reselection trigger sl-reselectAfter Qualcomm Incorporated
6. R1-2107565 Discussion on RAN2 LS on resource reselection trigger sl-reselectAfter Intel Corporation
7. R1-2107699 Draft Reply LS on Resource Reselection Trigger sl-reselectAfter Apple
8. R1-2107702 Discussion on RAN2 LS on Resource Reselection Apple
9. R1-2107955 Draft reply LS on resource reselection trigger sl-reselectAfter vivo
10. R1-2108077 Discussion on RAN2 LS on resource reselection trigger sl-reselectAfter ZTE, Sanechips
11. R1-2108127 [Draft] Reply LS on resource reselection trigger sl-reselectAfter Ericsson
12. R1-2108132 Discussion on RAN2 LS on resource reselection trigger sl-reselectAfter Ericsson
13. R1-2108180 Discussion of RAN2 LS on resource reselection trigger sl-reselectAfter Nokia, Nokia Shanghai Bell
14. R1-2108183 Discussion on RAN2 LS on resource reselection trigger sl-reselectAfter Huawei, HiSilicon
15. R1-2108197 Discussion on LS on resource reselection trigger sl-reselectAfter LG Electronics, Hyundai Motors