3GPP TSG-RAN WG2 Meeting #113 electronic R2-21xxxxx

Online, Jan 25 – Feb 5, 2021

Agenda Item: 6.4.3

Source: vivo

Title: Summary of [AT113-e][713][V2X/SL] TX resource (re)selection w/ HARQ feedback consideration (vivo)

Document for: Discussion, Decision

# Introduction

This is for the following email discussion.

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| * [AT113-e][713][V2X/SL] TX resource (re)selection w/ HARQ feedback consideration (vivo)   **Scope:** discuss what the problem is to reflect RAN1 decision and how to specify it (if no problem). Includes both single-shot case and multi-shots case. R2-2102260 CR can be baseline.  **Intended outcome:** agreeable 38.321 CR in R2-2102192 and discussion summary in R2-2102193 (if needed). CR will be approved by email.  **Deadline:** Feb 04 0430 (UTC) |

# Discussion

In RAN2 #112-e meeting, it was discussed in offline-713[1] about the issue proposed by the CR[2] about the misalignment between RAN1 agreement and RAN2 specification in resource (re-)selection. However, there was no consensus reached.

In RAN2 #113-e meeting, based on the contribution [3], this issue is re-discussed with the following working assumption:

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| * Working assumption: RAN2 will update MAC to RAN1 decision at least for single-shot case. |

Therefore, the following questions are to confirm and clarify companies’ understanding on both single-shot case and multi-shot case, and to pursue an agreeable CR.

## Issue-1: Confirmation for background

First, RAN1 agreement on resource (re-)selection is as follows:

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| RAN1 #98 Agreements:   * The resource (re-)selection procedure includes the following steps   + Step 1: Identification of candidate resources within the resource selection window     - FFS details   + Step 2: Resource selection for (re-)transmission(s) from the identified candidate resources     - FFS details   RAN1 #102e Agreements:  In Step 2, a UE ensures a minimum time gap Z = a + b between any two selected resources of a TB where a HARQ feedback for the first of these resources is expected |

Then in RAN2 MAC specification, following is an example how we capture it now (similar text is also for multiple MAC PDU case as well as in TX resource (re-)selection check procedure)

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| 1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmission(s) of a single MAC PDU, and if SL data is available in a logical channel, a SL-CSI reporting is triggered:  …  2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check:  …  3> if one or more HARQ retransmissions are selected:  4> if there are available resources left in the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7] for more transmission opportunities:  5> randomly select the time and frequency resources for one or more transmission opportunities from the available resources, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier by ensuring the minimum time gap between any two selected resources in case that PSFCH is configured for this pool of resources and that a retransmission resource can be indicated by the time resource assignment of a prior SCI according to clause 8.3.1.1 of TS 38.212 [9]; |

If we follow the RAN2 specification, the UE would be forced to ensure the minimum time gap in resource (re-)selection if PSFCH is configured, even if all the logical channels are HARQ-disabled (in this case, the UE may still select a pool of PSFCH configured, according to the pool selection procedure). First, rapporteur would like to reconfirm the understanding of companies whether there exists a misalignment and needs to be fixed.

**Q1: Do you think there exists a misalignment between RAN2 specification and RAN1 agreement and should be fixed?**

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| Company | Yes/No | Comment |
| OPPO | Yes |  |
| Apple | Yes |  |
| LG | No | If you fully follow RAN1 agreement, this change would occur some problem in MAC, which needs to be discussed and possibly solved by RAN2.  [Rapporteur] on the other hand, if we wrongly captured RAN1 agreements, RAN1 need to be informed and impacts on resource (re-)selection may need to be further evaluated by RAN1, which we think is not desired. E.g. UE would be forced to ensure the minimum time gap even all LCHs are HARQ-disabled and potential delay can be caused. It can even cause more problems. |
| CATT | Yes | From the literal meaning, there is actually misalignment between RAN1 agreement and RAN2 specification. |
| ZTE | No | We agree that current MAC Spec does not fully follow RAN1’s agreement. RAN1’s agreement only describes how to select resource for HARQ-enabled TB, and current MAC Spec covers HARQ-enabled TB and HARQ-disabled TB. If SL grant with PSFCH resources is selected to transmit HARQ -disabled TB, the only impact is undesirable delay. However ,as per current LCP procedure, LCH with HARQ-disabled can also use the SL grant with HARQ enabled, which means the undesirable latency caused by useless PSFCH is acceptable for HARQ-disabled TB. We think this is not a critical issue.  And if we fully follow RAN1’s agreement, we share the same view with LG, it has large impacts on MAC. |
| ASUSTeK | Yes |  |

## Issue-2: Single-shot transmission

If the misalignment is confirmed, the next step would be whether it is possible to fix it in the MAC specification. The key point here is whether the UE can know the HARQ FB attribute of the logical channel. According to TS 38.321, the TX resource (re-)selection may be triggered after selected sidelink grant is created and there is data in a logical channel:

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| 1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmission(s) of a single MAC PDU, and if SL data is available in a logical channel, a SL-CSI reporting is triggered:  …  2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check: |

Rapporteur thinks at the time to trigger TX resource (re-)selection, the UE has already acquired the configurations of logical channels with HARQ FB attributes, so that the data can be put into the right logical channel based on the reliability requirement.

**Q2-1: For transmission(s) of a single MAC PDU, do you think the UE has already known the HARQ FB attribute of the logical channel when TX resource (re-)selection is triggered?**

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| Company | Yes/No | Comment |
| OPPO | Yes |  |
| Apple | Yes |  |
| LG | No | If UE creates a SL grant for FB disabled LoCH on a pool with PSFCH, the SL grant can be still used by FB enabled LoCH by LCP as follows (because the SL grant is not linked only to FB disabled LoCH).    It means that even for a single MAC PDU, UE may transmit FB enabled TB without ensuring the minimum time gap, which makes FB useless. Accordingly, you need to change the LCP to avoid useless FB, which is not desirable.  (Note that if UE creates a SL grant for FB enabled LoCH on a pool with PSFCH, the SL grant can be still used by FB disabled LoCH by LCP because the SL grant is not linked only to FB enabled LoCH. But, this case seems not problematic. UE may transmit FB disabled TB with ensuring the minimum time gap, possibly with potential delay.)  [Rapporteur] we don’t think ‘*If UE creates a SL grant for FB disabled LoCH on a pool with PSFCH, the SL grant can be still used by FB enabled LoCH*’, because considering the following proposed CR, we can consider the highest priority LCH is HARQ enable or disable. So if it is HARQ disabled, the other LCH with HARQ-enabled will NOT be multiplexed later after LCP procedure.  And in our understanding, even if a LCH with HARQ enable has data arrival after current resource selection trigger time, and has higher priority than current highest one, it should trigger another resource (re-)selection, and have no impact on current resource selection procedure. |
| CATT | Yes |  |
| ZTE | Partially Yes | We agree that UE knows the HARQ FB attribute of the logical channel when TX resource (re-)selection is triggered. However, it is not necessary whether UE knows the HARQ FB attribute of the logical channel when TX resource (re-)selection is triggered. Because UE can not use the SL grant immediately after selecting the resource. There is a time gap between resource selection and LCP. When RX resource (re-)selection is triggered, UE doesn't know the HARQ FB attribute of the logical channel that will be multiplexed into the MAC PDU, and which LCH is selected is determined during LCP.  Since UE doesn't which LCH will use the selected resource, we think it is not necessary to capture this CR. |
| ASUSTeK | Yes | Since the UE can already perform resource pool selection based on logical channel attribute, it is implied that the UE can select resources based on the logical channel FB attribute as well. |

If yes to Q2-1, then the working assumption for single-shot case can be considered to be regarded as an agreement, considering we should align with RAN1 agreement and it is technically feasible to do that.

**Q2-2: If Yes to Q2-2, do you think the working assumption can be taken as an agreement?**

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| Working assumption: RAN2 will update MAC to RAN1 decision at least for single-shot case. |

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| Company | Yes/No | Comment |
| OPPO | Yes |  |
| Apple | Yes |  |
| LG | No | See the above comment in Q2-1. You have additional impact on LCP to avoid useless FB. |
| CATT | Yes |  |
| ZTE | No | See comment in Q1 and Q2-1. It has large impact on MAC. |
| ASUSTeK | Yes |  |

If we are going to update MAC, we can change the condition to ensure minimum time gap in resource selection to ‘whether HARQ is enabled’. Moreover, with some offline discussions with other companies, it is suggested that it is the logical channel with the highest priority which should be considered when we decide the HARQ attribution, which is not yet reflected in [4]. From rapporteur’s point of view, it is reasonable because if the highest priority logical channel with data is HARQ-disabled, there is no need to ensure the minimum time gap when doing resource selection because the final multiplexed MAC PDU would be no HARQ feedback according to LCP procedure.

**Q2-3: If Yes to Q2-3, do you agree the following CR?**

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| 1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmission(s) of a single MAC PDU, and if SL data is available in a logical channel, a SL-CSI reporting is triggered:  …  2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check:  …  3> if one or more HARQ retransmissions are selected:  4> if there are available resources left in the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7] for more transmission opportunities:  5> randomly select the time and frequency resources for one or more transmission opportunities from the available resources, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier by ensuring the minimum time gap between any two selected resources in case that *sl-HARQ-FeedbackEnabled* has been set to *enabled* for the highest priority logical channel(s) with data and that a retransmission resource can be indicated by the time resource assignment of a prior SCI according to clause 8.3.1.1 of TS 38.212 [9];  …  NOTE 3B: If retransmission resource(s) cannot be selected by ensuring that the resource(s) can be indicated by the time resource assignment of a prior SCI, how to select the time and frequency resources for one or more transmission opportunities from the available resources is left for UE implementation by ensuring the minimum time gap between any two selected ‎resources in case that *sl-HARQ-FeedbackEnabled* has been set to *enabled* for the highest priority logical channel(s) with data . |

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| Company | Yes/No | Comment |
| OPPO | Yes |  |
| Apple | Yes |  |
| LG | No | If we need to allow the above change, we need to change LCP as well. In addition, we have a concern on the highest logical channel because only single logical channel can trigger “1> if the MAC entity has selected to create…”  So, we prefer to keep the current text. The consequence of keeping the current text is that when UE transmits FB disabled TB for a pool with PSFCH, UE may have potential delay because of ensuring the minimum time gap.  [rapporteur] no change to LCP if we consider highest logical channel, as replied in Q2-1. And even if it is a single LCH to trigger “1> if the MAC entity has selected to create…”, at the triggered time, the UE can know the current highest priority LCH with data and can do the resource-selection based on its HARQ attribute. |
| CATT | Yes |  |
| ZTE | No | According to current spec, as shown in following, UE only takes the LCH configuration into consideration and ignores the buffer status of logical channel during resource selection :  3> select the number of HARQ retransmissions from the allowed numbers that are configured by RRC in *sl-MaxTxTransNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped in *sl-MaxTxTransNumPSSCH* indicated in *sl-CBR-PriorityTxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to clause 5.1.27 of TS 38.215 [24] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;  3> select an amount of frequency resources within the range that is configured by RRC between *sl-MinSubChannelNumPSSCH* and *sl-MaxSubchannelNumPSSCH* included in *sl-PSSCH-TxConfigList* and, if configured by RRC, overlapped between *MinSubChannelNumPSSCH* and *MaxSubchannelNumPSSCH* indicated in *sl-CBR-PriorityTxConfigList* for the highest priority of the logical channel(s) allowed on the carrier and the CBR measured by lower layers according to clause 5.1.27 of TS 38.215 [24] if CBR measurement results are available or the corresponding *sl-defaultTxConfigIndex* configured by RRC if CBR measurement results are not available;  However, this CR takes both LCH configuration and buffer status into account, as we discussed above, it is not necessary for UE to take buffer status into consideration during resource selection.  *sl-HARQ-FeedbackEnabled* has been set to *enabled* for the highest priority logical channel(s) with data |
| ASUSTeK | Yes but | when performing resource pool selection, the UE doesn’t check the highest priority LCH but “the” logical channel:  1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmission(s) of a single MAC PDU, and if SL data is available in a logical channel, or a SL-CSI reporting is triggered:  2> if SL data is available in the logical channel:  3> if *sl-HARQ-FeedbackEnabled* is set to *enabled* for the logical channel:  4> select any pool of resources configured with PSFCH resources among the pools of resources;  We generally agree with the change but we think checking the highest priority LCH may not be needed for resource selection. |

## Issue-3: Multi-shot transmission

When it comes to Multi-slot transmission, the case can be complex. First, for multi-shot transmission, we can assume this happens in periodical resource reservation when there is periodical service traffic pattern. E.g.:



Figure 1.

When the resource (re-)selection happens, multiple resources are reserved for multiple MAC PDUs, and the main concern is that when the UE reserves the grant, it may have no information about whether all the MAC PDUs which is to be carried by the grant, would require HARQ feedback or not. The MAC PDU may be of the same service data with periodical transmission such as #2, #3, or some other new data such as #4 (e.g. non-periodical transmission or transmissions with new QoS requirement which arrives before #4 and may be multiplexed at #4), and they are transmitted on these selected resources.

The UE’s behaviour is not clear on whether to ensure minimum gap in multi-shot transmissions. The following question would be to confirm companies’ understanding that whether the UE CAN know the HARQ FB attribute of all logical channels associated to multiple MAC PDUs transmission when doing resource selection for these multiple MAC PDUs.

**Q3-1: For transmission(s) of multiple MAC PDUs, do you think the UE can know the HARQ FB attribute of all logical channels associated to the multiple MAC PDUs when TX resource (re-)selection is triggered?**

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| Company | Yes/No | Comment |
| OPPO | Yes | As mentioned by email rapporteur, if one believes that the UE may fail to judge the LCH attributive of FB (enabled/disable) when performing resource (re)selection, the UE may already fail to judge that when performing resource pool selection, which happens before resource (re)selection.. |
| Apple | Yes | Agree with OPPO. Since UE has a chance to know that all the LCHs are HARQ FB disabled. UE shall be allowed to reserve multi-shot SL grant w/o considering minimum gap requirements. |
| LG | No | If UE creates a SL grant for FB disabled LoCH on a pool with PSFCH, the SL grant can be still used by FB enabled LoCH by LCP as follows (because the SL grant is not linked only to FB disabled LoCH).    It means that UE may transmit FB enabled TB on the selected sidelink grant without ensuring the minimum time gap, which makes FB useless. Accordingly, you need to change the LCP to avoid useless FB, which is not desirable. |
| CATT | See comment | As rapporteur descripted above” The MAC PDU may be of the same service data with periodical transmission such as #2, #3, or some other new data such as #4”. I am doubt whether and how UE can forecast some other new data such as #4 at the resource (re)selection time? |
| ZTE | No | We share the view as LG. |
| ASUSTeK | Yes | Agree with OPPO.  In addition, we observe the main concerning scenario for ensuring minimum gap based on LCH attribute is that if the UE selects multiple resources without ensuring minimum gap, then later a LCH with FB enabled has data available for transmission via the selected resources, no feedback can be useful for such data. However, in our point of view, this case has been identified by RAN1 (as also quoted by rapporteur below):  RAN1 #103 e Agreements:   * If the time between PSFCH reception and next scheduled PSCCH/PSSCH retransmission is less than Tprep + delta, the UE is allowed to drop the PSCCH/PSSCH retransmission with SL HARQ feedback enabled.   Since the main goal here is to align specification and agreement, and the shortcoming is acceptable by RAN1, we think it is ok to change the spec for both single shot and multi-shot cases. |

**Q3-2: If Yes to Q3-1, do you agree the following CR (same as we did in single MAC PDU case)?**

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| 1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmissions of multiple MAC PDUs, and SL data is available in a logical channel:  …  2> if the TX resource (re-)selection is triggered as the result of the TX resource (re-)selection check:  …  3> if one or more HARQ retransmissions are selected:  4> if there are available resources left in the resources indicated by the physical layer according to clause 8.1.4 of TS 38.214 [7] for more transmission opportunities:  5> randomly select the time and frequency resources for one or more transmission opportunities from the available resources, according to the amount of selected frequency resources, the selected number of HARQ retransmissions and the remaining PDB of SL data available in the logical channel(s) allowed on the carrier by ensuring the minimum time gap between any two selected resources in case that *sl-HARQ-FeedbackEnabled* has been set to *enabled* for the highest priority logical channel(s) with data and that a retransmission resource can be indicated by the time resource assignment of a prior SCI according to clause 8.3.1.1 of TS 38.212 [9]; |

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| Company | Yes/No | Comment |
| OPPO | Yes with comment | here one cannot judge based on the LCH of highest prio, but should be based on all LCH, so the “highest priority” should be removed. |
| Apple | Yes | I think checking highest priority LCH is correct. |
| LG | No | If we need to allow the above change, we need to change LCP as well. In addition, we have a concern on the highest logical channel because only single logical channel can trigger “1> if the MAC entity has selected to create…”  So, we prefer to keep the current text. The consequence of keeping the current text is that when UE transmits FB disabled TB for a pool with PSFCH, UE may have potential delay because of ensuring the minimum time gap. |
| CATT | No | We share the same view as LG for multi shot transmission. |
| ZTE | No | Share the view with LG. |
| ASUSTeK | Yes but | When performing resource pool selection, the UE doesn’t check the highest priority LCH but “the” logical channel:  1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmissions of multiple MAC PDUs, and SL data is available in a logical channel:  2> if the MAC entity has not selected a pool of resources allowed for the logical channel:  3> if *sl-HARQ-FeedbackEnabled* is set to *enabled* for the logical channel:  4> select any pool of resources configured with PSFCH resources among the pools of resources;  We generally agree with the CR but checking the highest priority may not be needed for resource selection either. |

If No to Q3-1, which means the UE cannot know the HARQ FB attribute of LCH in next transmission for multi-shot case, then the UE behaviour and the specification impact should be considered. The problems would happen only when the current MAC PDU is HARQ-disabled and the UE didn’t ensure the minimum gap, but not vice versa. Because if the current MAC PDU is HARQ enabled, the UE would ensure the minimum gap and no matter the remaining transmissions have HARQ feedback or not, the selected resource can be used.

The UE may have following two options:

* **Option-1: Only consider the current MAC PDU when doing resource (re-)selection.**

If UE adopts this option, it may happen that when doing resource (re-)selection, the LCH is HARQ-disabled and the minimum gap is not ensured, and in later transmissions some LCH with HARQ-enabled is needed for transmission, and the minimum gap condition will not be satisfied. According to RAN1 agreement:

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| RAN1 #103 e Agreements:   * If the time between PSFCH reception and next scheduled PSCCH/PSSCH retransmission is less than Tprep + delta, the UE is allowed to drop the PSCCH/PSSCH retransmission with SL HARQ feedback enabled.   + Note: it is RAN1 understanding that the UE is allowed to drop the PSCCH/PSSCH retransmission only if the UE can not complete the PSFCH processing and the preparation of the next PSCCH/PSSCH retransmission in the time between PSFCH reception and the next scheduled PSCCH/PSSCH retransmission |

The UE is allowed to drop the PSCCH/PSSCH retransmission if the minimum gap condition is not fulfilled. Therefore, the consequence is that some transmissions may be dropped.

* **Option-2: Consider the** **current MAC PDU as well as following MAC PDUs which may be potentially HARQ-enabled when doing resource (re-)selection.**

If UE adopts this option, as the UE cannot know the HARQ FB attribute of all logical channels associated to the multiple MAC PDUs, the UE may only choose to always ensure the minimum gap condition in resource (re-)selection. Or, the UE may depend on all the logical channels in current MAC PDU (not only the one of highest priority), and if at least one of them is HARQ enabled, the UE should ensure the minimum gap because that LCH could be transmitted in following MAC PDUs.

But at the same time, it should be noticed that, in current pool selection procedure, it seems also only the current MAC PDU is considered by the UE in multi-shot transmission, if we the answer for Q3-1 is No (i.e. UE CANNOT know the HARQ FB attribute of all logical channels associated to the multiple MAC PDUs when TX resource (re-)selection is triggered):

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| 1> if the MAC entity has selected to create a selected sidelink grant corresponding to transmissions of multiple MAC PDUs, and SL data is available in a logical channel:  2> if the MAC entity has not selected a pool of resources allowed for the logical channel:  3> if *sl-HARQ-FeedbackEnabled* is set to *enabled* for the logical channel:  4> select any pool of resources configured with PSFCH resources among the pools of resources;  3> else:  4> select any pool of resources among the pools of resources; |

Therefore, the potential impact by option-2 is that the current pool selection procedure may also need to be modified, e.g. if the UE consider current MAC PDU as well as following MAC PDUs which may be potentially HARQ-enabled when doing resource (re-)selection, the UE should select the pool with PSFCH configuration at the very beginning even the current LCH is HARQ-disabled.

**Q3-3: If No to Q3-1, what do you think is the intended UE behaviour in resource (re)selection for transmission(s) of multiple MAC PDUs when** **TX resource (re-)selection is triggered?**

* **Option-1: Only consider the current MAC PDU when doing resource (re-)selection.** **(i.e. same as the case in single MAC PDU).**
* **Option-2: Consider the current MAC PDU as well as following MAC PDUs which may be potentially HARQ-enabled when doing resource (re-)selection.**

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| Company | Options | Comment |
| LG | No option | In 5.22.1.1, UE creates a SL grant, not MAC PDU. MAC PDU will be created by LCP based on the created SL grant. Thus, neither the current MAC PDU nor the following MAC PDUs make sense.  As have been specified before, in 5.22.1.1, the MAC entity has selected to create a selected sidelink grant which can transmit potential multiple MAC PDUs not created yet. Once again, no MAC PDU is created in 5.22.1.1. MAC PDU will be created after 5.22.1.1.  [Rapporteur] I agree that the MAC PDU is created after LCP. The key point here is, for current MAC PDU, we can know if we should ensure minimum gap by knowing current highest priority logical channel is HARQ enable or disabled. (because after LCP all other LCH with different HARQ attribute would not be selected).  But for multiple MAC PDU that are not created now and is potentially transmitted, the UE may not know the related LCHs are HARQ enable or disable. |
| CATT | See comment | We share the same view as LG. |
| ZTE | See comment | We share the same view as LG. |
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**Q3-4: If option-2 is chosen, what is your suggested Text Proposal to implement option-2?**

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| Company | TP for Option-2 |
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# Conclusion

We have the following proposals

[Proposal 1 xxx.](#_Toc62216175)

# Reference

1. R2-2010950, [AT112-e][713][V2X] MAC corrections, LG Electronics Inc. (Rapporteur), 3GPP TSG-RAN WG2 #112-e, Electronics, 2– 13 November, 2020
2. R2-2010491, Correction on resource re-selection, vivo, 3GPP TSG-RAN WG2 Meeting #112 electronic, Online, November 2nd - 13th, 2020
3. R2-2100791, Left issues on TX resource (re-)selection, vivo, OPPO, Apple, 3GPP TSG-RAN WG2 Meeting #113-e, E-Meeting, 25th January - 5th February 2020
4. R2-2102260, Correction on resource re-selection, vivo, 3GPP TSG-RAN WG2 Meeting #113-e, E-Meeting, 25th January - 5th February 2020

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