**3GPP TSG RAN WG1 Meeting #100bis-E R1-2003035**

**e-Meeting, April 20th – 30th, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Outcome of [100b-e-NR-5G\_V2X\_NRSL-Mode-2-01]**

**Agenda item: 7.2.4.2.2**

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

Introduction

This document provides discussion on issues in the first email discussion on V2X Mode-2 during RAN1#100bis-e.

[100b-e-NR-5G\_V2X\_NRSL-Mode-2-01] Email discussion/approval w.r.t. re-evaluation including aspects:

* Whether/how to ensure the timing restrictions in re-evaluation, including potential change of pre-selected resources
* Whether to mandate every slot re-evaluation

till 4/27, with potential TPs till 4/30 (Intel, Sergey)

Outcome

Agreements:

* It is up to UE implementation to reselect any pre-selected but not reserved resource which is still in the identified resource set after Step 1 in order to ensure the timing restrictions during reselection triggered by re-evaluation and/or pre-emption
  + The timing restrictions at least include the HARQ RTT related minimum gap Z agreed in RAN1#100e
  + FFS how to handle the case that there is no resources satisfying the timing restrictions in the identified resource set after Step 1

No consensus on concluding every slot re-evaluation

Discussion

The first aspect relates to the issue of ensuring the timing restrictions between selected but not reserved resources during re-evaluation. Since the re-evaluation can trigger resource reselection of the resource which is not in the candidate set after Step 1, there could be situations of violation of the timing restrictions between selected resources. The following timing restrictions are considered:

* HARQ RTT minimum gap Z = a + b
* If introduced, a maximum gap between two consecutive resources in order to reserve resources for HARQ retransmissions

These timing restrictions are integral parts of sensing and resource selection and better to be ensured. If those need to be ensured, there are several options to do that:

* Allow change of other pre-selected resources. Companies argue that there is no issue to do that since these resources are not yet reserved and are part of the internal UE procedures.
* Do not change the re-evaluated resource if no candidate found that fulfils the timing restrictions together with the pre-selected resources. This option can lead to RSRP larger than a threshold, but such events are anyway considered to be rare.
* Do not change the pre-selected resources but drop the re-evaluated resource.

Based on above context, the following options considered:

**Q1: Which of the following options is preferred?**

* Option 1
  + A UE shall ensure timing restrictions between pre-selected and re-selected resources when re-evaluation is triggered
    - Option 1a: it is allowed to change the pre-selected but not reserved resources which are still in the candidate resource set in order to ensure the timing restrictions
    - Option 1b: the re-evaluated resource is left unchanged if the change can violate the timing restrictions
    - Option 1c: the re-evaluated resource is dropped if the change can violate the timing restrictions
* Option 2
  + A UE is not required to ensure the timing restrictions during reselection of a resource which is not in the candidate set after Step 1 during re-evaluation

Please provide the supported option and technical justification:

|  |  |  |  |
| --- | --- | --- | --- |
| Source | Option | Comment |  |
| Ericsson | 1a | Pre-selected but not reserved resources are only known by the UE itself. |  |
| Intel | Option 1a is preferred | Ensuring timing restrictions is important for stable system performance and better KPIs. |  |
| ZTE, Sanechips | Option 1a | When HARQ feedback is expected, HARQ RTT should be guaranteed between two selected resources of a TB. Therefore, we support Option 1.  Due to its flexibility, we prefer Option 1a. |  |
| Futurewei | Option 1 | We agree that something (option 1 or option 2) needs to be specified in order to make sure that UEs have the same behavior when sensing/selection resources. While option 1a appears to be the best option, it is unclear to us how to test for the suboptions of option 1. Thus, we are not sure we need to specify more than option 1. |  |
| NTT DOCOMO | 1a | Agree with ZTE |  |
| Qualcomm | Option 1a | The pre-selected, but not-reserved resources are only known internally to the UE. Changing them does not impact other UEs in the system and provides the simplest method to ensure timing restrictions are met.  We would like to clarify that Option 1a does not imply that the UE would first have to search for resources that can be selected without violating timing restriction, but instead can go ahead and reselect all unreserved resources during reevaluation, as long as timing restrictions are ensured in the end. |  |
| Panasonic | Option 1a | As it is not reserved, to change the pre-selected but not reserved resources should be allowed |  |
| Apple | Option 1a | The change of pre-selected but not reserved resources does not affect other UEs in the system. |  |
| Lenovo&MM | Option 1a | To ensure the time restriction for same behavior as resource selection is acceptable to us. |  |
| vivo | Option 1a | Option 1a is UE internal processing, should be allowed |  |
| MediaTek | Option 1 | We support specifying Option-1 as ensuring timing restrictions is necessary.  However, we don’t see a need to specify any of the sub-bullets under Option-1. At least, Option-1a and Option-1c should both be possible and left to UE implementation as neither Option-1a nor Option-1c impact other UEs. |  |
| OPPO | Option 1 | We are in favor of ensuring timing restrictions between pre-selected and re-selected resources. But we have concern with each of the sub-option.  For option 1a (seems to be the most popular one), when pre-selected resources are allowed to change, it means the first pre-selected resource may be changed to a later slot to comply the timing restrictions. In this case, it will need to be re-evaluated again at a new ‘m-T3’. If resource reselection is triggered again, then the whole selection window is shifted. Then there could be a situation where this selection window is kept on shifting and the pre-selected and re-selected resources are further delayed. Furthermore, by allowing to change pre-selected resources does not guarantee the timing restrictions (HARQ RTT and 32-slot time gap) can always be satisfied.  For option 1b, as FL pointed out this will force to increase the RSRP threshold. But if this is a rare event, it may not be so bad. But still not our preference.  For option 1c, needless to say this will break the chain.  Overall, we are not sure if we need to mandate/specify certain UE behavior. This can be largely leave it to UE implementation / best effort by not allowing to change the pre-selected but not reserved resources which are still in the candidate resource set. |  |
| Samsung | Option 1 | Share the same view with Futurewei, MediaTeK, and OPPO. |  |
| Xiaomi | Option1 | Option 1 is enough. There is no need to further discuss how UE guarantee the timeline. |  |
| NEC | Option 1 | We agree with option 1 to introduce timing restriction. However, we don't think current option 1a and 1b/1c are contradictory. Assume we allow change (option 1a), but if the change violate the timing restrictions, then we can still adopt option 1b/option 1c. So, do you mean,   * Option 1a: it is allowed to change the pre-selected but not reserved resources which are still in the candidate resource set if no resource could be selected to satisfy the timing restriction * Option 1b: the re-evaluated resource is left unchanged if no resource could be selected to satisfy the timing restriction * Option 1c: the re-evaluated resource is dropped if no resource could be selected to satisfy the timing restriction   Or I misunderstood it? |  |
| Bosch | Option 1 | Option 1 should be enough without specifying the details how a UE preserves the timeline. |  |
| TCL | Option 1 | Option 1 is enough as such. If need for refinement, 1a |  |
| CATT | Option 1a | The pre-selected but not-reserved resources are only known by UE internally, it should be allowed to change.  Besides, both the timing restriction for HARQ RTT and resource reservation window(32 slots) should be ensured. |  |
| Fraunhofer | Option 1a or 1c | Pre-selected resources are not known to other UEs, and only to the UE carrying out resource selection. Hence, changes in pre-selected resources do not affect other UEs. | Fraunhofer |
| Huawei/HiSilicon | Option 1a | The UE is not permitted to violate other parts of the specification when performing re-evaluation. However, it seems that none of 1a, 1b, 1c can be tested for, nor, perhaps, usefully specified for. If nothing is specified for this, then it would seem that all the other parts of the spec still apply, and the intention of 1a is achieved – but with the difference that “by following spec” does not equal “up to implementation”. It would seem sufficient to have a Conclusion such as:   * *RAN1 will not specify relaxations to the resource selection procedure during re-evaluation.*   With the effect of this being to enforce option 1 without diving into the sub-options. |  |
| InterDigital | Option 1a | HARQ RTT between two consecutive resources should be guaranteed to ensure a simple HARQ procedure (e.g., the Tx UE receives HARQ feedback and generates retransmission if necessary). Option 1a is more flexible and should be allowed for HARQ enabled TB. |  |
| Spreadtrum | Option 1 | We think it’s better to guarantee timing restrictions such as HARQ RTT as much as possible, however, if the timing restrictions are not guaranteed in some cases, current mechanism by indicating RX UE not sending HARQ feedback will still solve the problem. Therefore, it is not necessary to change the pre-selected but not reserved resources which are still in the candidate resource set in order to ensure the timing restriction, causing additional processing time. |  |
| LG Electronics | Modified Option 1 (i.e., clarifying resource reselection behaviour) | According to the current outcome of MAC CR email discussion in RAN2, it is assumed that if **a certain** pre-selected but not reserved resource is triggered to be reselected by the re-evaluation procedure, then **all** the pre-selected but not reserved resources are reselected. Please see the relevant contents below (marked with yellow) from MAC CR. We think that there is no reason not to follow this operation (already discussed in RAN2), and it is up to UE implementation on how to ensure the necessary timing restriction when reselecting resources. On top of this, it is not sure what additional agreement is necessary to mandate UE behaviour.  < Contents captured from current MAC CR>  1> if there is a configured sidelink grant which is not in the resources indicated by the physical layer for re-evaluation as specified in TS 38.214 [7]; or  1> if a sidelink transmission is scheduled by any received SCI indicating a higher priority than the prority of the logical channel and expected to overlap with a resource of the configured sidelink grant, and a measured result on SL-RSRP associated with the sidelink transmission is higher than [threshold]:  2> clear the configured sidelink grant associated to the Sidelink process, if available;  2> trigger the TX resource (re-)selection. |  |

From the replies so far, it is a consensus that the timing restrictions should be respected during re-evaluation. Most of the companies are fine with allowing to re-select the pre-selected resources, however other companies argue that it may not need to be stated in the specification, at least in RAN1. Based on this, the following is proposed:

Proposal 1

* A UE is expected to follow the timing restrictions between selected resources during the re-evaluation procedure
  + Note: this does not have impact on RAN1 specification
  + Note: this may or may not have impact on RAN2 specification

The second aspect is related to the FFS whether to mandate a UE to perform Step 1 checking every slot before ‘m-T3’. Based on companies’ contributions, there are several pros and cons views:

* No need to trigger every slot, the UE complexity may be high, while the performance gain may be uncertain
* Every slot re-evaluation enhances latency, as shown in [13] evaluation results
* Every slot re-evaluation enhances PRR, as shown in [27] evaluation results

**Q2: Whether the FFS to mandate a UE to perform Step 1 checking every slot before ‘m-T3’ can be positively confirmed or not?**

|  |  |  |  |
| --- | --- | --- | --- |
| Source | Support or not | Comment |  |
| Ericsson | Do not support | We do not see in point in evaluating multiple times it the last evaluation overwrites all previous evaluations. Leaving it up to UE implementation (as per current agreements) is enough. |  |
| Intel | Support | With proper step-2 implementation, it is beneficial to reduce latency, improve reliability, and overall system performance in case of pre-emption |  |
| ZTE, Sanechips | Do not support by spec | It can be up to UE implementation. Mandating step-1 checking in every slot before m-T3 requires higher implementation complexity. |  |
| Futurewei | Do not support | No need. The current agreement (without the FFS) leaves it up to the UE implementation. That is enough |  |
| NTT DOCOMO | Do not support | No need to mandate. Although Step 1 checking every slot before ‘m-T3’ is beneficial to reduce latency, not all UEs require such low latency. Leaving it up to UE implementation is sufficient. |  |
| Qualcomm | Support | We observed significant system performance gain when re-evaluation is performed every slot by all UEs. The operation of checking if a resource is still in the candidate set can also be shared/reused with the pre-emption mechanism to limit complexity. |  |
| Panasonic | Do not support | Up to UE implementation is enough |  |
| Apple | Do not support | The evaluation at every slot will increase UE implementation complexity. |  |
| Lenovo&MM | Do not support | Multiple re-evaluations introduce much more complexity for UE operation. On the other hand, one shot re-evaluation at the moment ‘m-T3’ has same effect as re-evaluating all before moments. Therefore, we do not support to mandate every slot re-evaluation. |  |
| vivo | Do not support | Agree with ZTE |  |
| MediaTek | Do not support | Should be left to UE implementation |  |
| OPPO | Do not support | Same view as Ericsson and ZTE |  |
| Samsung | Do not support | Every slot Step 1 checking before ‘m-T3’ should not be mandated for re-evaluation procedure since this requires increased UE processing burden. |  |
| Xiaomi | Do not support | It can be up to UE implementation. |  |
| NEC | Do not support | Agree with Ericsson's comment. |  |
| Bosch | Support | For the sake of system performance enhancement, we agree with the FFS. We also agree with Qualcomm that part of the complexity can easily be shared with the pre-emption. |  |
| TCL | Do not support | This is a good feature for UEs but no need to be mandatory. |  |
| CATT | Support | UE performing fast reselection has more candidate resources and is easier to re-select suitable resource(s), thus may reduce latency and improve reliability. |  |
| Huawei/HiSilicon | Support | It is beneficial that UE can detect collision earlier and perform re-selection earlier, leading to lower latency.  To address Docomo’s concern that “… not all UEs require such low latency … ”, we want to point out that earlier reselection not only means lower latency, but also means more retransmission chances can be guaranteed, which can ensure the successful delivery of the packet in a given PDB.  As for the complexity, since the UE anyway will performs pre-emption detection in every slot, we think the complexity overhead here is ignorable. |  |
| InterDigital | Do not support | When/how often the UE trigger the resource re-evaluation should be up to UE implementation. |  |
| Spreadtrum | Do not support | No need. It is up to UE implementation. Checking every slot will increase complexity. |  |
| LG Electronics | Do not support | It seems enough to leave it up to UE implementation. |  |

There is overwhelming majority to no support every slot re-evaluation (17 vs 5). It seems there is no chance to update the already agreed part that more frequent re-evaluations are up to UE implementation. In the same time, there so some interest to “early in time” initial resource selection in [100b-e-NR-5G\_V2X\_NRSL-Mode-2-03] which can give similar or even better effect in performance.

**Conclusion 2**

* Do not mandate a UE perform Step 1 check for re-evaluation every slot

Summary of proposals on the relevant issues

Finalization of re-evaluation and pre-emption requires closure of the following items, where some issues have contribution sources listed:

1. Ensure the timing restrictions or not
   * Supported: [5][7][13][16]
   * Not supported: [11][18]

Change of pre-selected resources

* + Supported: [1][5][6][7][13][17][19][24]
  + Not supported: [3][18]

1. Every slot re-evaluation
   * Up to UE implementation: [3][4][8][9][11][16][17][18][19][21][24]
   * Mandatory: [1][5][13][15][27]
     + [13] and [27] show results in support if it

References

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