**3GPP TSG RAN WG1 #104bis-e R1-210xxxx**

**e-Meeting, April 12th – 20th, 2021**

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**Source:** Moderator (LG Electronics)

**Title:** Feature lead summary for AI 8.11.1.2 Inter-UE coordination for Mode 2 enhancements

**Document for:** Discussion and information

1. **Contents to be discussed in Tuesday’s GTW (Apr. 13th)**

After reviewing contributions submitted in this meeting, FL observed that the following two approaches can be considered for the inter-UE coordination.

* *Approach 1: Inter-UE coordination to help UE-B’s resource selection procedure*
  + *UE-A explicitly sends the set of resources preferred and/or non-preferred for UE-B’s transmission*
    - *The information includes time-and-frequency resources preferred and/or non-preferred for UE-B’s transmission*
  + *SCI or higher layer signaling is used to transmit the coordination information*
  + *Request signaling or pre-defined event/condition triggers the transmission of coordination information*
* *Approach 2: Inter-UE coordination to confirm a validity of UE-B’s selected/reserved resources*
  + *UE-A implicitly sends the set of resources non-preferred for UE-B’s transmission and/or the set of resources where the resource conflict is detected*
    - *The information includes the presence of expected/potential and/or detected resource conflict on UE-B’s transmission resource*
  + *PSFCH format is used to transmit the coordination information*
  + *Pre-defined event/condition triggers the transmission of coordination information*

Based on the observations mentioned above, the following draft proposals were made from FL’s perspective:

***FL’s proposal****:*

* *Support the following schemes of inter-UE coordination in Mode 2:*
  + *Inter-UE Coordination Scheme 1:* 
    - *UE-A sends to UE-B the set of resources preferred and/or non-preferred for UE-B’s transmission*
      * *The coordination information includes time-and-frequency resources preferred and/or non-preferred for UE-B’s transmission*
        + *FFS on details including a possibility of down-selection between the preferred resource set and the non-preferred resource set*
        + *FFS whether or not to introduce additional information*
      * *Down select to one among the following tree options for the container of coordination information*
        + *1st SCI*
        + *2nd SCI*
        + *Higher layer signaling (e.g., MAC CE, PC5 RRC)*
  + *Inter-UE Coordination Scheme 2:* 
    - *UE-A sends to UE-B the set of resources non-preferred for UE-B’s transmission and/or the set of resources where the resource conflict is detected*
      * *The coordination information includes the presence of expected/potential and/or detected resource conflict on UE-B’s transmission resource*
        + *FFS on details including a possibility of down-selection between the expected/potential conflict and the detected resource conflict*
        + *FFS whether or not to introduce additional information*
      * *PSFCH format is used to convey the coordination information*
        + *FFS on details including whether to (pre)configure separately PSFCH resource set from that of SL HARQ feedback*

***FL’s proposal****:*

* *For Inter-UE Coordination Scheme 1, at least the following information is used to determine the time-and-frequency resources preferred and/or non-preferred for UE-B’s transmission*
  + *UE-A’s sensing result* 
    - *FFS on details including how to obtain it*
  + *UE-A’s SL resources selected for multiple transmissions of different TBs*
  + *UE-A’s configured resources for UL*
* *For Inter-UE Coordination Scheme 2, at least the following information is used to determine the set of resources non-preferred for UE-B’s transmission and/or the set of resources where the resource conflict is detected*
  + *Time resource conflict between UE-B and other UE(s) in the same group*
    - *FFS on details including which information (e.g., destination ID) is used to determine it*
  + *UE-A’s sensing result* 
    - *FFS on details including how to obtain it*

***FL’s proposal****:*

* *Down select one or more of following options for determining UE-A (transmitting the inter-UE coordination information) and UE-B (receiving and using the inter-UE coordination information):*
  + *Option 1: UE-A is the intended receiver of UE-B*
  + *Option 2: UE-A (e.g., RSU, platooning header) and UE-B are determined by higher layer*
  + *FFS on applicable scenarios/inter-UE coordination schemes for each option*

1. **Email discussion before 1st check point (Apr. 15th)**

**First of all, as per Chairman’s guideline during Tuesday’s GTW session, we can have the email discussion with keeping the direction of draft proposal below (i.e., support two schemes of inter-UE coordination)**. From my perspective, the key point of Scheme 2 is that UE-A informs UE-B of the presence of expected/potential and/or detected resource conflict on the transmission resources indicated by UE-B’s SCI. This means that UE-A generates the coordination information after receiving the SCI transmitted from UE-B. On the other hands, in case of Scheme 1, UE-A can inform UE-B of the set of resources preferred and/or non-preferred for UE-B’s transmission even before receiving the SCI transmitted from UE-B.

***FL’s proposal****:*

* *Support the following schemes of inter-UE coordination in Mode 2:*
  + *Inter-UE Coordination Scheme 1:* 
    - *UE-A sends to UE-B the coordination information which includes the set of resources preferred and/or non-preferred for UE-B’s transmission* 
      * *FFS on details including a possibility of down-selection between the preferred resource set and the non-preferred resource set*
      * *Down select one or more of following three options for the container of coordination information*
        + *1st SCI*
        + *2nd SCI*
        + *Higher layer signaling (e.g., MAC CE, PC5 RRC)*
  + *Inter-UE Coordination Scheme 2:* 
    - *UE-A sends to UE-B the coordination information which includes the presence of expected/potential and/or detected resource conflict on the transmission resources indicated by UE-B’s SCI*
      * *FFS on details including a possibility of down-selection between the expected/potential conflict and the detected resource conflict*
      * *PSFCH format is used to convey the coordination information*
        + *FFS on details including whether to (pre)configure separately PSFCH resource set from that of SL HARQ feedback*

Please provide comment, if any, on the above draft proposal (**including applicable scenario(s) of each scheme**) **by April 14th, 11:59am UTC**. To prepare the updated draft proposal that will be used in Thursday’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

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| Company | Comment |
| vivo | We can support the proposal as the chairman’s guideline. Our favour is scheme 1. |
| NTT DOCOMO | We accept to support both as compromise while applicable scenario is not so different.  Our understanding is same as FL/companies that scheme 1 is proactive one and scheme 2 is reactive one. But this difference is from mechanism perspective. Not from scenario perspective. As scenario, scheme 1 would be used for periodic transmission due to the coordination latency. Connection Scheme 2 can be used for both aperiodic and periodic transmissions. Regarding connection/connection-less, both schemes are applicable for both, based on companies’ comments in GTW. Regarding backward compatibility, both schemes can be specified to consider this perspective. |
| FUTUREWEI | We are fine with the proposal in general. The applicable scenarios were clear: scheme 1 may be a normal coordination proactively, and scheme 2 can be complementary on top of that to react and recover from some exceptional situations. We disagree with the companies that say scheme 1 is a subset of scheme 2. Scheme 1 is especially important when one UE acts as a resource coordinating cluster head, such as for platooning or for public safety.  One necessary addition as discussed in the GTW is that a high-level bullet should be added: For each scheme, determine the conditions under which UE B must follow the coordination information and when UE treats the coordination information as a recommendation. This is not simply an "FFS details" of the mechanism of sending the coordination information. Some details are included in our comments for the later proposal.  For some other changes that were discussed on the GTW, we note that we are also OK to remove most or all of the FFS, as we can do this naturally as we progress the designs. For scheme 1, OK to simplify that the container if SCI and/or higher layer. |
| InterDigital | We support the proposal to include both Scheme 1 and Scheme 2. Each scheme can be applied in specific scenarios. For example, Scheme 1 can address issues such as hidden node and half-duplex (e.g., when UE A is the intended receiver). It also provides power saving benefit when UE B does not perform sensing. Scheme 1 can be used with an initial transmission of an aperiodic TB if PDB allows. Scheme 2 can improve reliability by indication of conflict on an announced resource reservation with low signaling overhead and latency. However, the announced reservation means that the UE B performs its own sensing and thus there is no power saving benefit with Scheme 2. Also, Scheme 2 does not apply to an initial transmission of an aperiodic TB. Therefore, both schemes should be supported. |
| Convida Wireless | We support the proposal to consider both Scheme 1 and Scheme 2. |
| Sony | We are OK with the chairman’s guideline though we prefer to option 1. We agree with other companies’ comments on the advantage of option 1 (e.g. solution for hidden node problem, power saving for UE-B). |
| Qualcomm | We provide results for Type C and Type B schemes, using techniques reclassified under both Schemes 1 and 2, with realistic assumptions and show that they are complementary and provide cumulative gains based on traffic type, distance, and PRR. Our results also showed that both schemes improved performance for both periodic and aperiodic traffic.  We also noted that Type C (now part of Scheme 2) also improved the performance of Rel-16 UEs in the pool. In our view, specifying complementary schemes is helpful to improve Mode 2 reliability but redundant schemes should be avoided.  As we discussed online, while we prefer and have evaluated certain variants of the schemes, we’re ok with the direction of the proposal as a way forward for RAN1 to start working on specifying the details of the schemes. As part of that goal, we think the FFSs on down-selection should be removed, otherwise, discussions would continue to focus on which schemes to remove/adopt instead of on developing complete schemes in the remaining WI time.  Online, a comment was made that Scheme 2 included three different types. We’d like to point out that for Type A, included in Scheme 1, there were hierarchical vs. distributed schemes; schemes that used SCI vs. schemes that used MAC-CE vs. schemes that used PC5-RRC (those aren’t merely signalling details but have different latency and impact the benefit and applicability of a scheme), and other variants. Both Schemes 1 and 2 should be treated similarly in the proposal in our view and prefer the path of not listing all the details at this point.  Higher layer signalling doesn’t need to be grouped together but can be listed separately, like SCI-1 and SCI-2.  We propose the following changes to the proposal:   * *Support the following schemes of inter-UE coordination in Mode 2:*   + *Inter-UE Coordination Scheme 1:*      - *UE-A sends to UE-B the coordination information which includes the set of resources preferred and/or non-preferred for UE-B’s transmission*        * *FFS on details ~~including a possibility of down-selection between the preferred resource set and the non-preferred resource set~~*       * *Down select one or more of following ~~three~~ options for the container of coordination information*         + *1st SCI*         + *2nd SCI*         + *MAC-CE*         + *PC5 RRC*         + *~~Higher layer signaling (e.g., MAC CE, PC5 RRC)~~*   + *Inter-UE Coordination Scheme 2:*      - *UE-A sends to UE-B the coordination information which includes the presence of expected/potential and/or detected resource conflict on the transmission resources indicated by UE-B’s SCI*       * *FFS on details ~~including a possibility of down-selection between the expected/potential conflict and the detected resource conflict~~*       * *PSFCH format is used to convey the coordination information*         + *FFS on details including whether to (pre)configure separately PSFCH resource set from that of SL HARQ feedback* |
| ZTE | According to the chairman’s guidance, it’s fine to define these two scheme in high level although there is not clear difference on the applicable scenario. In our views, it’s still preferred to refine the definition of solution from mechanism perspective, e.g., “conflict avoidance” or “conflict recover”. And decoupling of these two from scheme 2 is needed. |
| Sharp | We are fine with the general direction of the proposal to include both schemes. Regarding the container for scheme 2, we think it is too early to conclude now that a PSFCH format will be used to convey the coordination information. We think a formulation similar to the one for the container for scheme 1 should be used in the proposal. |

***FL’s proposal****:*

* *For Inter-UE Coordination Scheme 1, at least the following information is used to determine the set of resources preferred and/or non-preferred for UE-B’s transmission (FFS whether to down-selection between the preferred resource set and the non-preferred resource set)*
  + *UE-A’s sensing result* 
    - *FFS on details including how to obtain it*
  + *UE-A’s SL resources selected for multiple transmissions of different TBs*
  + *UE-A’s configured resources for UL*
* *For Inter-UE Coordination Scheme 2, at least the following information is used to determine the presence of expected/potential and/or detected resource conflict on the transmission resources indicated by UE-B’s SCI (FFS whether to down-selection between the expected/potential conflict and the detected resource conflict)*
  + *Time resource conflict between UE-B and other UE(s) in the same group*
    - *FFS on details including which information (e.g., destination ID) is used to determine it*
  + *UE-A’s sensing result* 
    - *FFS on details including how to obtain it*

Please provide comment, if any, on the above draft proposal **by April 14th, 11:59am UTC**. To prepare the updated draft proposal that will be used in Thursday’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

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| Company | Comment |
| vivo | Comment 1  For scheme 1, the 2nd and 3rd sub-bullet is trying to include semi-static resource for UE-A transmission. We think both semi-static and dynamic resource for UE-A’s transmission can be considered to determine type A resource, since dynamic resource can be known to UE-A in advance. Therefore, we suggest following modification.   * UE-A’s SL resources selected for TB transmission * UE-A’s scheduled resource for UL transmission   Comment 2  For scheme 2, The first bullet is trying to describe TX/RX or TX/TX overlap of SL transmissions, it includes UE-A indicates conflict between UE-B and other UEs in the same groupcast group as described in the bullet. Moreover, UE-A can also indicate conflict between UE-B and UE-A as pair-UE. Furthermore, the conflict between LTE SL transmission and NR SL transmission should be considered as well to avoid inter-RAT overlapping. We suggest to add the missing cases.  Comment 3  For scheme 2, if our understanding is correct, the second bullet is trying to describe the resource collision judgement. In our understanding, UE-A needs to decode 2nd SCI to acquire destination ID of UE-B’s transmission, which is beyond sensing concept. It is suggested to modify as “UE-A’s SCI decoding and/or measurement result”  Comment 4  For scheme 2, UL transmission needs to be taken into account for resource conflict judgement as proposed by companies, we suggest to add another bullet accordingly. |
| NTT DOCOMO | On scheme 2,  Firstly, 1st bullet and second bullet should be wrote from the same level. If information of the first bullet is obtained from sensing result, the second bullet includes it. We feel it is better to update the classification.  For the 1st bullet, we have two comments. First one is that ‘other UE’ should include UE-A as well. This should be clarified as a note. Second comment is that ‘in the same group’ is unclear for us. Now main bullet intends any cast type. If that part is intended for groupcast, it should be clearly mentioned.  For the 2nd bullet, we think ‘Time-and-frequency resource conflict between UE-B and other UE(s)’ is accurate one, for same level as the first bullet.  In addition, we have same view as vivo’s comment 4. UL transmission should be included in scheme 2 as well as scheme 1. |
| FUTUREWEI | We are ok with the proposal. |
| InterDigital | We agree with the proposal for Scheme 1. For Scheme 2, we’d like to suggest to add information about resources subject to half-duplex issue at UE A and SL/UL conflict into the minimum set of information for Scheme 2 as well (they are currently spelled out in Scheme 1 proposal). In our view, these information are helpful in both schemes, albeit in Scheme 1 the resources are explicitly indicated and in Scheme 2 the resources are indirectly used to determine the conflict. |
| Convida Wireless | We are fine with the proposal. |
| Sony | We are fine with the proposal. |
| Qualcomm | We’d prefer to discuss this proposal after the discussion on Proposal 1 concludes.  Similar to Proposal 1, we’d like to remove the FFSs on down-selection to move the discussion forward.  The second sub-bullet for Scheme 1 isn’t very clear. Does it only apply to periodic reservation? We show in our simulation results that indicating the initial transmission of a TB as a non-preferred resource is very beneficial to performance in aperiodic transmissions.  Why is the third sub-bullet for Scheme 1 limited to configured UL resources instead of also including dynamically scheduled resources? We would like to discuss this point further.  The text on Scheme 2 limits its applicability to groupcast, which isn’t case.  The first sub-bullet for Scheme 2 excludes collisions and only includes half-duplex.   * *For Inter-UE Coordination Scheme 1, at least the following information is used to determine the set of resources preferred and/or non-preferred for UE-B’s transmission ~~(FFS whether to down-selection between the preferred resource set and the non-preferred resource set)~~*   + *UE-A’s sensing result*      - *FFS on details ~~including how to obtain it~~*   + *UE-A’s SL resources selected for ~~multiple~~ at least an initial transmission~~s~~ of ~~different~~ a TB~~s~~*   + *UE-A’s configured resources for UL* * *For Inter-UE Coordination Scheme 2, at least the following information is used to determine the presence of expected/potential and/or detected resource conflict on the transmission resources indicated by ~~UE-B’s~~ SCI ~~(FFS whether to down-selection between the expected/potential conflict and the detected resource conflict)~~*   + *Time resource conflict ~~between UE-B and other UE(s) in the same group~~*     - *FFS on details ~~including which information (e.g., destination ID) is used to determine it~~*   + *Time-frequency resource conflict*     - *FFS on details*   + *UE-A’s sensing result*      - *FFS on details ~~including how to obtain it~~* |
| ZTE | For the inter-UE coordination scheme-1, we are supportive on this bullet. And it should be noticed that combination of the items in the sub-bullet should not be precluded.  For inter-UE coordination scheme-2, the usage of each item for corresponding determination (e.g., *expected/potential and/or detected resource conflict*) is related to the decision on how to select the UE-A/B. Potential combination of items may not be needed. |
| Sharp | On scheme 1, “the following information” should not be restricted to only “resources”. Other information should also be considered, e.g. constraints on the resources as requested by UE-B.  On scheme 2, we think determination of “other UE(s)” should be further studied. For example, it can simply say “*Time resource conflict for UE-B, FFS definition of conflict*”. |

***FL’s proposal****:*

* *Down select one or more of following options for determining UE-A (transmitting the inter-UE coordination information) and UE-B (receiving and using the inter-UE coordination information):*
  + *Option 1: UE-A is the intended receiver of UE-B*
  + *Option 2: UE-A (e.g., RSU, platooning header) and UE-B are determined by higher layer*
  + *FFS on applicable scenario(s)/inter-UE coordination scheme(s) for each option*

Please provide comment, if any, on the above draft proposal **by April 14th, 11:59am UTC**. To prepare the updated draft proposal that will be used in Thursday’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

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| Company | Comment |
| vivo | We support the proposal, but the example in option 2 can be removed (e.g., RSU, platooning header), anyway the applicable scenario is FFS. |
| NTT DOCOMO | We are OK with the proposal. Note that the FFS is important since this aspect will be dependent on the actual mechanism of inter-UE coordination. At least different option might be taken between scheme 1 and scheme 2. |
| FUTUREWEI | Since both 1 and 2 can be supported, we suggest remove the words “Down select” in the main bullet and rephase it as “One or more of following options are supported …..” |
| InterDigital | We support the proposal |
| Convida Wireless | We are Ok with the proposal. |
| Sony | We support both options 1 and 2. We agree with FUTUREWEI’s suggestion to rephrase the main bullet. |
| Qualcomm | We’d prefer to discuss this proposal after the discussion on Proposal 1 concludes.  The listed options seem to focus only on unicast transmissions. For some coordination schemes, any UE can provide the coordination information since this information would constructively combine from multiple sources.   * *Down select one or more of following options for determining UE-A (transmitting the inter-UE coordination information) and UE-B (receiving and using the inter-UE coordination information):*   + *Option 1: UE-A is the intended receiver of UE-B*   + *Option 2: UE-A (e.g., RSU, platooning header) and UE-B are determined by higher layer*   + *Option 3: UE-A is not an intended receiver of UE-B*   + *FFS on applicable scenario(s)/inter-UE coordination scheme(s) for each option if needed* |
| ZTE | Option-1 should be supported at least.  For the Option-2, the assistant information from other UEs than the intended receiver may not be well matched with the realistic condition for final transmission, the benefits of this scenarios is limited. Also prefer to remove the example in Option-2. |
| Sharp | We agree with other companies that examples are part of applicable scenarios and should be removed in the proposal. |

***FL’s proposal****:*

* *When UE-B receives the inter-UE coordination information from UE-A, down select one or more of following options for UE-B’s to take it into account in the resource selection for its own transmission:*
  + *Inter-UE Coordination Scheme 1*
    - *Option 1-1: UE-B determines candidate resource set to be used for its transmission resource selection based on both UE-B’s Rel-16 Mode 2 sensing result and the received coordination information*
    - *Option 1-2: UE-B determines candidate resource set to be used for its transmission resource selection based only on the received coordination information*
    - *Option 1-3: UE-B determines resource(s) to be re-selected among its selected resources based on the received coordination information*
  + *Inter-UE Coordination Scheme 2*
    - *Option 2-1: UE-B determines resource(s) to be re-selected among its resources indicated by UE-B’s SCI based on the received coordination information*
    - *Option 2-2: UE-B determines resource(s) to be retransmitted among its resources indicated by UE-B’s SCI based on the received coordination information*
  + *FFS on details including applicable scenario(s)/condition(s) for each option*

Please provide comment, if any, on the above draft proposal **by April 14th, 11:59am UTC**. To prepare the updated draft proposal that will be used in Thursday’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

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| Company | Comment |
| vivo | For scheme 1 option 1, we should avoid to mention Rel-16 mode 2 sensing, since we have partial sensing and random selection in Rel-17, ‘UE-B’s Rel-16 Mode 2 sensing result’ can be replaced by ‘UE-B’s autonomous resource selection procedure’  For scheme 1 option 3, it is not sure whether autonomously selected resource come first or the suggested resource come first, it is better not to mention re-selection of the autonomously selected resource. We prefer more general wording for option 3, e.g., UE-B determines transmission resource from autonomously selected resource and/or coordination information |
| NTT DOCOMO | We are generally fine with the current proposal, but one comment.  Regarding scheme 2, it seems that option 2-1 intends pre-collision indication and option 2-2 does post-collision indication. They are possibly supported in current situation. So no down-selection between option 2-1 and option 2-2 should also be possible. |
| FUTUREWEI | As comment before, for each scheme, one critical issue should be discussed first before discussing the list options here. Upon receiving the coordination information, UE B can 1) use the coordination information in a strictly following manner, e.g., select resource from preferred resource set from UE A either with or without its own sensing results, or 2) use the coordination information in a recommendation manner, e.g., select recourse based on its own sensing results if there is a conflict between its sensing results and received coordination information. We support to adopt both. FFS the conditions for UE B using 1) or 2). This shall be another proposal or a high-level bullet item.  As for the proposal, since listed options may not be mutually exclusive, we suggest remove “down select” from the main bullet. Maybe add “FFS down select one or more of the options below” in the end of main bullet. |
| InterDigital | We agree with proposals for Scheme 1 and Option 2-1 for Scheme 2. However, we need further clarification regarding what Option 2-2 means. Specifically, we are not sure how to interpret “resource(s) to be retransmitted”. Does it mean UE-B determines which resources to be used as reserved? Or “resources to be retransmitted” has anything to do with HARQ or blind retransmissions? Note Option 2-1 includes cases in which UE-B re-select all reserved resources or some of the reserved resources based on the information provided in the received coordination message. In the latter case, when UE-B determines which reserved resources to be re-selected, the rest of the reserved resources will be kept, i.e., used as reserved. We would thus like Option 2-2 to be re-formulated/clarified to have a better understanding for the discussion. |
| Convida Wireless | We are generally fine with the FL’s proposal. For Inter-UE Coordination Scheme 1  Option 1-2: UE-B determines candidate resource set to be used for its transmission resource selection based only on the received coordination information, does this include UE-B follows exactly the resources that are indicated by UE-A ‘s indication? Some clarification may be good. |
| Sony | We are fine with the proposal basically.  But for the main bullet, since it is unclear for us, we suggest to modify it to “support one or more of following options for UE-B’s resource selection for its own transmission when UE-B receives the inter-UE coordination information from UE-A:”. |
| Qualcomm | We’d prefer to discuss this proposal after the discussion on Proposal 1 concludes. |
| ZTE | W.r.t UE-B’ behaviour on how to use the received assist information, it should be up to UE-B’s implementation and there is no need to specify it. |
| Sharp | We agree with FUTUREWEI on discussing the high level principles of using the coordination information first before going to the details. |

1. **Summary of contributions**

* How UE-A and UE-B are determined
  + Option 1: UE-B is a PSCCH/PSSCH TX UE for data transmission, and UE-A is the intended receiver of UE-B [OPPO,3] [Spreadtrum,4] [vivo,5] [Fraunhofer,12] [CMCC,14] [Xiaomi,16] [Intel,17] [Samsung,20] [Sony,22] [LG,24] [Lenovo,29] [DCM,30]
  + Option 2: UE-A and UE-B are determined via higher layer (e.g. application layer) [Huawei,1] [vivo,5] [Apple,18] [Sony,22] [LG,24]
  + Option 3: UE-A is pre-defined, and UE-B is UEs that can receive inter-UE coordination information from other UE [LG,24]
* How/when UE-A determines the contents of “A set of resources”, including consideration of UL scheduling?
  + Type of “A set of resources”
    - For Type A and/or Type B
      * based on its sensing result of UE-A [Huawei,1] [Nokia,2] [OPPO,3] [vivo,5] [MediaTek,8] [Fujitsu,9] [Fraunhofer,12] [CMCC,14] [ZTE,15] [Xiaomi,16] [Intel,17] [Apple,18] [InterDigital,28] [Lenovo,29]
      * based on UE-A’s transmission [vivo,5] [Fraunhofer,12] [ZTE,15] [Apple,18] [Qualcomm,19] [LG,24] [NEC,27]
        + SL transmission [vivo,5] [Qualcomm,19] [LG,24]
        + UL transmission [vivo,5] [LG,24]
      * based on UE-A’s decision in higher layer [Huawei,1] [LG,24]
      * based on semi-static information [Intel,17] [LG,24]
    - For Type B and/or Type C
      * based on expected/potential resource conflict [vivo,5] [MediaTek,8] [Fujitsu,9] [Fraunhofer,12] [Xiaomi,16] [Intel,17] [Apple,18] [Qualcomm,19] [LG,24] [NEC,27] [DCM,30] [Ericsson,34]
        + PSSCH TX and PSSCH RX [vivo,5] [Intel,17] [Apple,18] [LG,24] [DCM,30]
        + PSSCH TX and PSSCH TX [vivo,5] [Apple,18] [LG,24]
        + PSFCH TX and PSFCH RX [vivo,5] [Apple,18] [DCM,30]
        + PSFCH TX and PSFCH TX [vivo,5] [Apple,18] [DCM,30]
        + SL TX and UL TX [vivo,5] [Intel,17] [LG,24] [DCM,30]
        + SL RX and UL TX [vivo,5] [Intel,17] [LG,24] [DCM,30]
      * based on detected resource conflict [Intel,17] [Apple,18] [Qualcomm,19] [LG,24] [NEC,27] [Ericsson,34]
        + PSSCH TX and PSSCH RX [Intel,17] [Apple,18] [Qualcomm,19] [LG,24]
        + PSSCH TX and PSSCH TX [Apple,18] [Qualcomm,19] [LG,24]
        + PSFCH TX and PSFCH RX [Apple,18]
        + PSFCH TX and PSFCH TX [Apple,18]
        + SL TX and UL TX [Intel,17] [Qualcomm,19] [LG,24]
        + SL RX and UL TX [Intel,17] [Qualcomm,19] [LG,24]
  + Other information in the inter-UE coordination information
    - For Type A and/or B
      * Recommended TX parameters [MediaTek,8]
      * Sensing information [Fujitsu,9] [Apple,18] [Hyundai,32] [ASUSTeK,33]
      * Source ID of UE-B [Fujitsu,9] [Hyundai,32]
      * Destination ID associated with UE-B [Fujitsu,9] [Hyundai,32]
      * Resource conflict type [Fujitsu,9] [Apple,18]
      * Indication of information type (e.g. Type A or Type B) [Fraunhofer,12] [Convida,25]
      * Indication about the intended recipient UE [Fraunhofer,12] [LG,24]
      * Resource pool index [Fraunhofer,12]
    - For Type B and/or Type C
      * Resource conflict type (e.g., resource collision or half-duplex restriction) [Intel,17] [LG,24]
      * Indication of information type (e.g. Type B or Type C) [Intel,17] [LG,24]
* When UE-A sends ”A set of resources” to UE-B, including which UE(s) sends it
  + For Type A and/or Type B
    - Explicit Trigger-based based coordination procedures [Huawei,1] [Nokia,2] [OPPO,3] [Spreadtrum,4] [vivo,5] [CATT,7] [Fujitsu,9] [FUTUREWEI,10] [Zhejiang Lab,11] [Fraunhofer,12] [Mitsubishi,13] [CMCC,14] [ZTE,15] [Xiaomi,16] [Apple,18] [Samsung,20] [ITL,21] [Sony,22] [LG,24] [Sharp,26] [NEC,27] [InterDigital,28] [Lenovo,29]
      * Information carried by the explicit triggering
        + the parameters related to the sensing procedure of UE-B [Huawei,1] [Nokia,2] [OPPO,3] [CATT,7] [Fujitsu,9] [Fraunhofer,12] [ZTE,15] [Xiaomi,16] [InterDigital,28] [Lenovo,29]
        + A set of preferred or non-preferred resources determined at UE-B [Nokia,2] [OPPO,3]
      * Container of the explicit triggering
        + SCI format [Huawei,1] [OPPO,3] [Fujitsu,9] [FUTUREWEI,10]
        + PSFCH format [Apple,18]
        + Higher layer signaling [OPPO,3] [Fujitsu,9] [LG,24]
    - Event-trigger based coordination procedures [Huawei,1] [Fujitsu,9] [FUTUREWEI,10] [Zhejiang Lab,11] [Fraunhofer,12] [Mitsubishi,13] [CMCC,14] [Xiaomi,16] [ITL,21] [Sony,22] [LG,24] [NEC,27] [InterDigital,28] [Lenovo,29]
      * Based on (pre)configured periodicity [Huawei,1] [ITL,21] [LG,24]
      * Based on RSRP measurement [MediaTek,8] [CMCC,14] [ITL,21]
      * Based on distance between UE-A and UE-B [Mitsubishi,13] [CMCC,14] [Xiaomi,16] [ITL,21]
      * When the coordination information is updated for UE-B [LG,24]
      * Based on decision in higher layer [LG,24]
      * Based on congestion status [LG,24]
      * Based on SL HARQ-ACK state at UE-A side [Lenovo,29]
  + For Type B and/or Type C
    - Explicit Trigger-based based coordination procedures [Intel,17]
      * Container of the explicit triggering
        + 1st SCI format [Intel,17]
    - Event-trigger based coordination procedures
      * Based on detection of resource conflict [Spreadtrum,4] [vivo,5] [MediaTek,8] [Fujitsu,9] [Xiaomi,16] [Intel,17] [Apple,18] [LG,24] [InterDigital,28] [Lenovo,29]
    - Validity check of transmitting inter-UE coordination information
      * Based on distance between UE-A and UE-B(s) [Intel,17] [LG,24]
      * Based on RSRP from UE-A to UE-B(s) [Intel,17] [LG,24] [Lenovo,29]
      * Based on L2 ID(s) from UE-B [Huawei,1] [LG,24]
      * Based on distance between UE-Bs [LG,24]
      * Based on communication range requirement [LG,24]
* How UE-A sends ”A set of resources” to UE-B, including container used for carrying it, implicitly or explicitly or both
  + For Type A and/or Type B
    - 1st SCI format [Nokia,2] [Spreadtrum,4] [MediaTek,8] [FUTUREWEI,10] [Xiaomi,16] [Lenovo,29]
    - 2nd SCI format [Huawei,1] [OPPO,3] [Spreadtrum,4] [vivo,5] [CAICT,6] [MediaTek,8] [Fraunhofer,12] [CMCC,14] [Xiaomi,16] [Samsung,20] [Sony,22] [Lenovo,29]
    - Higher layer signaling (e.g. MAC CE and/or PC5-RRC) [OPPO,3] [Spreadtrum,4] [vivo,5] [MediaTek,8] [Fraunhofer,12] [ZTE,15] [Intel,17] [LG,24] [NEC,27] [Lenovo,29]
    - PSFCH format [OPPO,3] [Sony,22]
  + For Type B and/or Type C
    - PSFCH format [vivo,5] [CAICT,6] [MediaTek,8] [Xiaomi,16] [Intel,17] [Apple,18] [LG,24] [NEC,27] [Lenovo,29] [DCM,30]
      * Priority is inherited by the priority indicated by TX UE [Intel,17] [LG,24] [Lenovo,29]
  + Further consideration of using a single signaling to transmit one or multiple “set of resources” to multiple of UEs [OPPO,3] [LG,24]
  + Retransmission of the inter-UE coordination information
  + Further consideration on whether shared or dedicated resource is used for inter-UE coordination signaling [Nokia,2]
* How/when/whether UE-B receives “A set of resources” and takes it into account in the resource selection for its own transmission
  + For Type A and/or Type B
    - How UE-B performs resource (re)selection procedure upon receiving the inter-UE coordination information
      * Combine UE-B’s sensing results and resource set provided from UE-A [Huawei,1] [OPPO,3] [vivo,5] [CATT,7] [FUTUREWEI,10] [Fraunhofer,12] [CMCC,14] [Xiaomi,16] [Apple,18] [ETRI,23] [LG,24] [Convida,25] [NEC,27] [InterDigital,28] [Lenovo,29] [Hyundai,32]
      * Use resource set provided from UE-A without a consideration of UE-B’s sensing results [Huawei,1] [vivo,5] [FUTUREWEI,10] [Fraunhofer,12] [Apple,18] [ETRI,23] [Convida,25] [InterDigital,28] [Hyundai,32]
      * Reselect UE-B’s reserved resources [OPPO,3] [Apple,18] [LG,24] [Lenovo,29]
      * It is up to UE-B how to use it [Zhejiang Lab,11] [ZTE,15] [Samsung,20]
    - Cast type of UE-B that can use inter-UE coordination information
      * Unicast [Huawei,1] [OPPO,3] [Spreadtrum,4] [vivo,5] [Fujitsu,9] [Fraunhofer,12] [Mitsubishi,13] [Xiaomi,16] [Samsung,20] [ETRI,23] [LG,24] [Convida,25] [Lenovo,29]
      * Groupcast with HARQ-ACK feedback Option 1 [Spreadtrum,4] [vivo,5] [Fujitsu,9] [Fraunhofer,12] [Mitsubishi,13] [Samsung,20] [LG,24] [Convida,25] [Lenovo,29]
      * Groupcast with HARQ-ACK feedback Option 2 [Huawei,1] [OPPO,3] [Spreadtrum,4] [vivo,5] [Fujitsu,9] [Fraunhofer,12] [Mitsubishi,13] [Samsung,20] [ETRI,23] [LG,24] [Lenovo,29]
      * Broadcast [Spreadtrum,4] [vivo,5] [Fujitsu,9] [Mitsubishi,13] [LG,24] [Convida,25] [Lenovo,29]
    - Validity check of the received inter-UE coordination information at UE-B side
      * Based on RSRP in coordination information [Fujitsu,9]
      * Based on distance between UE-A and UE-B [Fujitsu,9] [Fraunhofer,12] [Mitsubishi,13] [LG,24]
      * Based on RSRP from UE-A to UE-B [Fraunhofer,12] [LG,24]
      * Based on information about target UE of the inter-UE coordination information [Fraunhofer,12] [LG,24]
      * Based on whether the indicated resource set is inside UE-B’s selection window
  + For Type B and/or Type C
    - How UE-B performs resource (re)selection procedure upon receiving the inter-UE coordination information
      * UE-B performs retransmission on the already selected resource(s) [Intel,17] [Qualcomm,19]
      * UE-B reselect all or a subset of its own selected resource(s) [vivo,5] [MediaTek,8] [Fujitsu,9] [Intel,17] [LG,24] [NEC,27] [DCM,30]
      * Continue to use the selected resource(s) [Intel,17]
      * Skip all or a subset of its own selected resource(s) [Intel,17]
      * Further consideration on what is the non-preferred resource set for the resource conflict indication [LG,24]
    - Cast type of UE-B that can use inter-UE coordination information
      * Unicast
      * Groupcast with HARQ-ACK feedback Option 1 [Fujitsu,9] [Qualcomm,19]
      * Groupcast with HARQ-ACK feedback Option 2
      * Broadcast
    - Validity check of the received inter-UE coordination information at UE-B side
      * Resources for initial transmission of UE-B [LG,24]
      * Resources for retransmission of UE-B of which HARQ-ACK state is not ACK [LG,24]
      * Based on HARQ-ACK state at UE-B side [LG,24]
      * Based on the number of (re)transmission of the same TB at UE-B side [LG,24]
* Others
  + Further consideration of indication to UE-A of ID(s) used by UE-B and the intended receiver(s) of UE-B’s transmission [Nokia,2]
  + Further consideration of congestion control for inter-UE coordination signaling [Fujitsu,9] [Zhejiang Lab,11] [Intel,17] [LG,24]
  + Further consideration on the unmonitored slot at UE-B side [Fujitsu,9] [LG,24]
  + Further consideration on the impact on Rel-16 UE sharing the same resource pool with UEs using inter-UE coordination operation [Samsung,20] [Panasonic,31]
  + Further consideration on SL DRX to determine “A set of resources” at UE-A side [ASUSTeK,33]

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34. R1-2103648 Discussion on V2X mode 2 enhancements ASUSTeK
35. R1-2103705 Mode 2 enhancements using Inter-UE coordination Ericsson
36. **Appendix**

**4.1 Conclusions made in RAN1#103-e meeting**

* ***Conclusion****:*
  + *The schemes of inter-UE coordination in Mode 2 are categorized as being based on the following types of “A set of resources” sent by UE-A to UE-B:*
    - *UE-A sends to UE-B the set of resources preferred for UE-B’s transmission*
      * + *e.g., based on its sensing result*
    - *UE-A sends to UE-B the set of resources not preferred for UE-B’s transmission*
      * + *e.g., based on its sensing result and/or expected/potential resource conflict*
    - *UE-A sends to UE-B the set of resource where the resource conflict is detected*
    - *FFS: details of resource conflict, e.g., including type of resource conflict*
    - *FFS: details of sensing operation at UE-A side*
    - *FFS: which type(s) of resource set information is(are) beneficial/feasible to which cast type(s)*
    - *Note: these different types may be used in combination with each other*
  + *From RAN1 perspective, further study on the feasibility/benefit of inter-UE coordination is required*
  + *Send an LS to RAN plenary*
    - *Final LS in* [*R1-2009841*](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_103\Docs\R1-2009841.zip)
* ***Conclusion****:*
  + *For the schemes of inter-UE coordination identified as feasible/beneficial, at least the following aspects are further discussed.*
    - *How/when UE-A determines the contents of ”A set of resources”, including consideration of UL scheduling*
    - *When UE-A sends ”A set of resources” to UE-B, including which UE(s) sends it*
    - *How UE-A and UE-B are determined*
    - *How UE-A sends ”A set of resources” to UE-B, including container used for carrying it, implicitly or explicitly or both*
    - *How/when/whether UE-B receives “A set of resources” and takes it into account in the resource selection for its own transmission*
    - *How/whether to define the relationship between support/signaling of inter-UE coordination and cast type*

**4.2 Conclusions made in RAN1#104-e meeting**

* ***Conclusion****:*
  + *RAN1 concludes that the inter-UE coordination in Mode 2 is feasible, and is beneficial (e.g., reliability, etc.) compared to Rel-16 Mode 2 RA, and thus recommends specification of the feature.*
    - *The detailed observations can be found in the attachment of the LS*
* *Draft LS in* [*R1-2102165*](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2102165.zip)*, along with the attachment* [*R1-2102166*](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104\Docs\R1-2102166.zip)*, is approved (with a typo fix)* 
  + *Final LS in R1-2102168*