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

**e-Meeting, January 25th – February 5th, 2021**

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**Source:** Moderator (LG Electronics)

**Title:** Feature lead summary for AI 8.11.1.2 Feasibility and benefits for mode 2 enhancements

**Document for:** Discussion and information

1. **Summary of evaluation results**

In RAN1#103-e meeting, RAN1 listed up three types of “A set of resources” for inter-UE coordination in Mode 2:

* Type A: UE-A sends to UE-B the set of resources preferred for UE-B’s transmission
  + e.g., based on its sensing result
* Type B: 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
* Type C: UE-A sends to UE-B the set of resource where the resource conflict is detected

The summary of evaluation results is as follows:

* For Type A without sensing at UE-B,
  + When a UE-A transmits multiple Type A information to multiple UE-B(s),
    - It is assumed that R16 Mode 2 RA is used to determine resources for inter-UE coordination signalling.
      * 5.4% PRR gain is observed in highway scenario for periodic unicast traffic at 320m [Huawei, R1-2100206].
        + Coverage of 200m is extended in highway scenario at PRR=0.95.
  + When a UE-A is the intended RX UE of UE-B,
    - Assumptions on latency and signalling overhead of transmitting and processing coordination information
      * R16 Mode 2 RA is used to determine resources for inter-UE coordination signalling,
        + PRR loss is observed in highway and urban scenarios for aperiodic unicast traffic at 320m and 150m accordingly [Intel, R1-2100673].
      * No latency and no signalling overhead (genie-aided modelling)
        + PRR gain is observed in highway and urban scenarios for aperiodic unicast traffic at 320m and 150m accordingly [Intel, R1-2100673]
        + 3.4% PRR gain is observed in highway scenario for aperiodic unicast traffic at 300m [Samsung, R1-2101232].

Coverage of 5m is extended in highway scenario at PRR=0.95.

* For Type A and/or Type B with sensing at UE-B,
  + When a UE-A transmits Type A information to multiple UE-B(s),
    - It is assumed that UE-A performs inter-UE coordination signalling once at the beginning of the evaluation in advance of UE-B’s transmission.
      * 4.96% PRR gain is observed in urban scenario for periodic broadcast traffic at 150m [LGE, R1-2101786].
        + Coverage of 10m is extended in urban scenario at PRR=0.95.
  + When a UE-A is the intended RX UE of UE-B,
    - Assumptions on latency and signalling overhead of transmitting and processing coordination information
      * R16 Mode 2 RA is used to determine resources for inter-UE coordination signalling,
        + [1-4.3]% PRR gain is observed in highway scenario for periodic unicast traffic at 320m [Huawei, R1-2100206].

Coverage of [10-100]m is extended in highway scenario at PRR=0.95.

* + - * + No PRR gain is observed in highway and urban scenario for periodic unicast traffic at 320m and 100m [Intel, R1-2100673]
      * UE-A’s data transmission resources are used for inter-UE coordination signalling,
        + 0.2% PRR gain is observed in urban scenario for aperiodic groupcast traffic from 99.3% to 99.5% in 50m [Qualcomm, R1-2100746]

Coverage is extended from 33m to 38m at PRR=0.99.

Coverage is extended from 18m to 25m at PRR=0.995.

99.9% reliability communication is not possible

* + - * PSFCH format is used to indicate pre-conflict,
        + 0.3% PRR gain is observed in highway scenario for aperiodic groupcast traffic at 320m [Ericsson, R1-2101804].

Coverage of 40m is extended in highway scenario at PRR=0.99 and 50m for PRR=0.975.

* + - * + When sensing and non-sensing UEs are present in the scenario,

1% PRR gain is observed in highway scenario for aperiodic groupcast traffic at 320m [Ericsson, R1-2101804].

Coverage of 70m is extended in highway scenario at PRR=0.99 and 100m for PRR=0.975.

* + - * Combination of R16 Mode 2 RA and PSFCH format for inter-UE coordination signalling,
        + 3% PRR gain is observed in highway scenario for periodic unicast traffic at 50m [MediaTek, R1-2100606].
        + Coverage of 10m is extended in highway scenario at PRR=0.95.
      * No signalling overhead and latency of 3ms+2 slots,
        + 7.6% PRR gain is observed in urban scenario for periodic unicast traffic at 150m [OPPO, R1-2100142].

Coverage of 20m is extended in highway scenario at PRR=0.95.

* + - * No signalling overhead and latency of 2ms,
        + 20% PRR gain is observed in highway scenario for periodic unicast traffic at 320m [CATT, R1-2100352].

Coverage of 20m is extended in highway scenario at PRR=0.95.

* + - * + No PRR gain is observed in highway scenario for aperiodic unicast traffic [CATT, R1-2100352].
      * Latency of N= 1, 2, 4 logical slots and no signaling overhead
        + N= 1 slot: 3.2% PRR gain is observed in highway scenario for periodic groupcast traffic at 320m [Mitsubishi, R1-2100828].

Coverage extension of 50m in highway scenario at PRR=0.95.

* + - * + N= 2 slots: 2.2 % PRR gain is observed in highway scenario for periodic groupcast traffic at 320m [Mitsubishi, R1-2100828].

Coverage extension of  30m in highway scenario at PRR=0.95.

* + - * + N= 4 slots: 2 % PRR gain is observed in highway scenario for periodic groupcast traffic at 320m [Mitsubishi, R1-2100828].
        + Coverage extension of  30m in highway scenario at PRR=0.95.
      * No latency and 1 sub-channel in a slot for signalling overhead of transmitting and processing coordination information
        + 3% PRR gain is observed in urban scenario for aperiodic unicast traffic at 150m [vivo, R1-2101791].

No coverage is extended in highway scenario at PRR=0.95.

* + - * + 4.3% PRR gain is observed in urban scenario for periodic unicast traffic at 150m [vivo, R1-2101791].

Coverage of 15m is extended in highway scenario at PRR=0.95.

* + - * + If 20% of slots are used for UL TX of UE-A,

9% PRR gain is observed in urban scenario for periodic unicast traffic at 150m [vivo, R1-2101791].

Coverage of 40m is extended in highway scenario at PRR=0.95.

* + - * + If 50% of slots are UL TX of UE-A,

46% PRR gain is observed in urban scenario for periodic unicast traffic at 150m [vivo, R1-2101791].

* + - * Latency with range of [1~10] slot and 10 RBs in a slot for signalling overhead of transmitting and processing coordination information
        + When the UE-A is further determined by UE-B via PC5-RRC, and fixed overhead (10RB/100bit) are assumed without latency

2.6% PRR gain is observed in highway scenario for periodic broadcast traffic at 320m [ZTE, R1-2100925].

Coverage of 40m is extended in highway scenario at PRR=0.95.

5.8% PRR gain is observed in urban scenario for periodic broadcast traffic at 150m [ZTE, R1-2100925].

Coverage of 10m is extended in urban scenario at PRR=0.95.

* + - * 10% of resources are used for signalling related to coordination and latency of 10 slots,
        + PRR loss is observed in highway scenario for periodic groupcast traffic at 320m [Fujitsu, R1-2100746].
      * No latency and no signalling overhead (genie-aided modeling)
        + No PRR gain is observed in highway and urban scenario for aperiodic unicast traffic [Intel, R1-2100673]
        + 2.5% PRR gain is observed in highway scenario for periodic unicast traffic at 320m [Intel, R1-2100673]
        + 1.5% PRR gain is observed in urban scenario for periodic unicast traffic at 100m [Intel, R1-2100673]
        + 6% PRR gain is observed in highway scenario for periodic unicast traffic at 320m [Mitsubishi, R1-2100828].

Coverage extension of 50m in highway scenario at PRR=0.95.

* + - * + 3.2% PRR gain is observed in highway scenario for periodic groupcast traffic at 320m [Mitsubishi, R1-2100828].

Coverage extension of 50m in highway scenario at PRR=0.95.

* + - * + 1.2% PRR gain is observed in highway scenario for periodic groupcast traffic at 320m [Fujitsu, R1-2100746].

Coverage of 20m is extended in urban scenario at PRR=0.95.

Coverage of 40m is extended in urban scenario at PRR=0.99.

* For Type C,
  + Evaluation assumptions
    - UE-A is one of the RX UE of UE-B within the communication range requirement from the UE-B, if any.
    - PSFCH format is used for convey resource conflict indication.
  + When the communication range requirement is smaller than or equal to 200m,
    - For the post-conflict indication,
      * [0.4-1.3]% PRR gain is observed in highway scenario for aperiodic and periodic groupcast traffic at 50m [Intel, R1-2100673 (aperiodic traffic only)] [Fujitsu, R1-2100746].
        + Coverage of [5-25]m is extended in highway scenario at PRR=0.95.
        + Coverage of [50-60]m is extended in highway scenario at PRR=0.99.
      * 1.2% PRR gain is observed in highway scenario for aperiodic groupcast traffic at 300m [Intel, R1-2100673].
      * 1% PRR gain is observed in urban scenario for periodic groupcast traffic at 50m [Fujitsu, R1-2100746].
        + Coverage of 10m is extended in highway scenario at PRR=0.95.
      * 0.7% PRR gain is observed in urban scenario for aperiodic groupcast traffic at 50m [Fujitsu, R1-2100746].
        + Coverage of 25m is extended in highway scenario at PRR=0.99.
      * 0.5% PRR gain is observed in urban scenario for aperiodic groupcast traffic from 99.3% to 99.8% in 50m [Qualcomm, R1-2101486]
        + Coverage of 10m is extended from 33m to 44m at PRR=0.99.
        + Coverage of extended from 18m to 36m at PRR=0.995.
        + Enable 99.9% reliability communication range up to 20m
      * PRR gain of Mode 2 enahcement with ensuring the minimum number of retransmission is higher than that of Type C in highway scenario for aperiodic groupcast traffic [Intel, R1-2100673].
  + When the communication range requirement is larger than or equal to 240m,
    - For the post-conflict indication,
      * [0.1-0.5]% PRR gain is observed in highway scenario for aperiodic groupcast traffic at 320m [Intel, R1-2100673] [Ericsson, R1-2101804].
        + Coverage of 25m is extended in highway scenario at PRR=0.95.
        + Coverage of [10-50]m is extended in highway scenario at PRR=0.99 and 20m for PRR=0.975.
      * PRR gain of Mode 2 enahcement with ensuring the minimum number of retransmission is higher than that of Type C in highway scenario for aperiodic groupcast traffic [Intel, R1-2100673].
    - For the mix of pre-conflict (Type B) and post-conflict indication (Type C),
      * 0.6% PRR gain is observed in highway scenario for aperiodic groupcast traffic at 320m [Ericsson, R1-2101804].
        + Coverage of 70m is extended in highway scenario at PRR=0.99 and 100m for PRR=0.975.

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| **Source (tdoc number)** | **Evaluation Scenario** | **What is the relationship between UE-A and UE-B, including additional latency and signaling overhead model** | **How UE-A determines the set of resources, including the form of the information** | **When UE-A sends the set of resources to UE-B** | **How UE-A sends the set of resources to UE-B, including container and signaling overhead model** | **How/when UE-B takes the received set of resources into account in the resource selection for its own transmission, including additional latency model** | **Gain over Rel.16 Mode-2 RA** |
| OPPO [R1-2100142] | Unicast,  Urban,  Periodic  (UUP) | UE-A is receiver of UE-B. | Type B. | 2 slots after UE-A receiving the triggering signalling from UE-B | Not modelled | The latency of transmitting and processing coordination information is set to 3ms.  UE-B precludes resources overlapping with the indicated set, and selects resource from the remaining. | PRR gain is 1% at the range of 50m.  PRR gain is 7.6% in the range at 150m.  PIR gain is 5ms in average in the range of [100m,240m].  Coverage of 20m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| Huawei [R1-2100206] | Unicast,  Highway,  Periodic  (UHP) | **Scheme 1:**  UE-A is the UE closest the center of UE group in geographical sense.  UE-B(s) are other UEs in the UE group.  **Scheme 2&3:**  UE-A is receiver of UE-B. | Type A.  **Scheme 1:**  The set of resources is the resources for UE-B’s transmission.  **Scheme 2&3:**  The set of resources is the identified candidate resource set obtained by UE-A’s sensing and resource exclusion procedure. | When UE-A receives the trigger information from UE-B.  The request signalling occupies one sub-channel in a slot.  **Scheme 1:**  Resources for the request are (pre)configured by UE-A.  **Scheme 2&3:**  Resources for the request are obtained by UE-B’s sensing and exclusion procedure. | The signalling of the set of resources occupies one sub-channel in a slot.  Resources for the signalling are obtained by UE-A’s sensing and exclusion procedure. | **Scheme 1:**  UE-B uses the transmission resources provided by UE-A.  **Scheme 2:**  UE-B takes the union of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set  **Scheme 3:**  UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | **Scheme 1:**  PRR gain is 5.4% at the range of 320m.  Coverage of 200m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **Scheme 2:**  PRR gain is 4.3% at the range of 320m.  Coverage of 100m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **Scheme 3:**  PRR gain is 1% at the range of 320m.  Coverage of 10m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| CATT [R1-2100352] | Unicast,  Highway,  Periodic  (UHP) | UE-A is receiver of UE-B. | A mix of Type A and Type B.  UE-A determines the possible transmission occasions of UE-A as Type B resource set. | When UE-A receives the trigger information from UE-B. | Not modelled | The latency of transmitting and processing coordination information is set to 2ms.  UE-B takes the intersection of UE-B’s S\_A and Type A resource set to obtain the final candidate resource set.  UE-B will preclude all the resources of Type B resource set. | **Type A only:**  PRR gain is 11% at the range of 300m  Coverage of 50m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **Type B only:**  PRR gain is 9% at the range of 300m  Coverage of 50m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **Mix of Type A and B:**  PRR gain is 20% at the range of 300m.  Coverage of 100m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| CATT [R1-2100352] | Unicast,  Highway,  Aperiodic  (UHA) | UE-A is receiver of UE-B. | A mix of Type A and Type B.  UE-A determines the possible transmission occasions of UE-A as Type B resource set. | When UE-A receives the trigger information from UE-B.  Resources for the request are obtained by UE-B’s sensing and exclusion procedure. | Not modelled | The latency of transmitting and processing coordination information is set to 2ms.  UE-B takes the intersection of UE-B’s S\_A and Type A resource set to obtain the final candidate resource set.  UE-B will preclude all the resources of Type B resource set. | No PRR gain. |
| vivo [R1-2101791] | Unicast,  Urban,  Aperiodic and periodic  (UUA and UUP) | UE-A is receiver of UE-B. | Type A. | Once resource (re)-selection is triggered at UE-B, the assistance info is provided by UE-A | 1 sub-channel and 1 slot signalling overhead is assumed; 0ms latency is assumed | Based on mixed candidate resource set derived by TX UE and RX UE | 3% PRR gain at the range of 150m.  Coverage of 10m is extended at PRR=0.95.  No coverage is extended at PRR=0.99. |
| vivo [R1-2101791] | Unicast, Urban, Aperiodic and Periodic (UUA and UUP) | UE-A is receiver of UE-B. | Type-B | UE-A inform its SL transmission resource to UE-B |  | UE-B preclude the occasion of UE-A’s transmission | 2%-3% PRR gain at the range of 150m.  Coverage of 5m is extended at PRR=0.95. |
| vivo [R1-2101791] | Unicast,  Urban,  Aperiodic and Periodic  (UUA and UUP)  UL/SL coexistence | UE-A is receiver of UE-B. | Type B.  UE-A determines Type A resource set to further consider half-duplex problem and TX/TX overlap b/w UL and SL. | UE-A inform its UL transmission resource to UE-B |  | TX UE further precluding on UE-A’s SL occasion which incur SL TX and UL RX occasion overlap or SL TX and UL TX occasion overlap | **No UL slot:**  4.3% PRR gain at the range of 150m.  Coverage of 15m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **20% UL slot:**  5.4% PRR gain at the range of 50m.  9% PRR gain at the range of 150m.  Coverage of 40m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  **50% UL slot:**  46% PRR gain in 150m. |
| MediaTek [R1-2100606] | Unicast,  Highway,  Periodic  (UHP) | UE-A is receiver of UE-B.  UE-B can include TX UEs other than the intended TX UE of UE-A. | Type B.  When UE-A determines the resources reserved by UE-B as non-preferred resources, then the UE-A transmits non-preferred resource indication to UE-B.  Otherwise, the UE-A will transmit the resource reserved by UE-B as non-preferred resource for other TX UE’s transmission. | Upon receiving a new reservation. | PSFCH format is used for non-preferred resource indication. | Upon receiving an inter-UE coordination message, a UE drops the concerned reservation and reselects resources | 3% PRR gain in 50m.  []% PRR gain in 320m.  Coverage of 10m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| Intel [R1-2100673] | Groupcast (Option 1 with target range of 200m),  Highway,  Aperiodic  (GHA) | UE-A is another receiver of UE-B within the target range. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | **Reference is R16 Mode 2:**  0.4% PRR gain in 50m.  1.2% PRR gain in 300m.  Coverage of 25m is extended at PRR=0.95.  Coverage of 60m is extended at PRR=0.99.  **Reference is Mode 2 RA with minimum (re)transmissions of 2:**  0.1% PRR loss in 50m.  2% PRR loss in 300m.  Coverage of 20m is reduced at PRR=0.95.  No coverage is extended at PRR=0.99. |
| Intel [R1-2100673] | Groupcast (Option 1 with target range of 400m),  Highway,  Aperiodic  (GHA) | UE-A is another receiver of UE-B within the target range. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | **Reference is R16 Mode 2:**  0.5% PRR gain in 320m.  0% PRR gain in 400.  Coverage of 25m is extended at PRR=0.95.  Coverage of 50m is extended at PRR=0.99.  **Reference is Mode 2 RA with minimum (re)transmissions of 2:**  0.5% PRR loss in 320m.  1% PRR loss in 400m.  No coverage is extended at PRR=0.95.  No coverage is extended at PRR=0.99. |
| Intel [R1-2100673] | Unicast (AN disabled),  Highway,  Periodic  (UHP) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B.  Signalling for the request is not modelled. | Resources for the signalling are obtained by UE-A’s sensing and exclusion procedure. | UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 0% PRR gain. |
| Intel [R1-2100673] | Unicast (AN disabled),  Highway,  Aperiodic  (UHA) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B.  Signalling for the request is not modelled. | Resources for the signalling are obtained by UE-A’s sensing and exclusion procedure. | **Scheme 2:**  UE-B uses the transmission resources provided by UE-A. | **Scheme 2:**  15% PRR loss in 300m. |
| Not modelled | **Scheme 1:**  UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set.  **Scheme 2:**  UE-B uses the transmission resources provided by UE-A. | **Scheme 1:**  0% PRR gain.  **Scheme 2:**  5% PRR gain in 300m. |
|  | Unicast (AN disabled),  Urban,  Periodic  (UUP) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B.  Signalling for the request is not modelled. | Resources for the signalling are obtained by UE-A’s sensing and exclusion procedure. | UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 0% PRR gain. |
|  | Unicast (AN disabled),  Urban,  Aperiodic  (UUA) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B.  Signalling for the request is not modelled. | Resources for the signalling are obtained by UE-A’s sensing and exclusion procedure. | **Scheme 2:**  UE-B uses the transmission resources provided by UE-A. | **Scheme 2:**  9% PRR loss in 150m. |
| Not Modelled | **Scheme 1:**  UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set.  **Scheme 2:**  UE-B uses the transmission resources provided by UE-A. | **Scheme 1:**  0% PRR gain.  **Scheme 2:**  8% PRR gain in 150m. |
| Ericsson [R1-2101804] | Groupcast (Option 1 with target range of 500m)  Highway,  Aperiodic | Any UE. | Type B or Type C (future conflict).  **Scheme 1:**  Type C.  A UE detects that a collision has taken place on a sub-channel or it detects that two UEs from the same group are in a half-duplex situation  **Scheme 2:**  Type B.  A UE checks if the reservation overlaps some other reservation received earlier. If there is an overlap and the RSRP associated new reservation exceeds a certain threshold, the UE sends one bit.  **Scheme 3:**  Combination of Scheme 1 and 2. | **Scheme 1:**  When UE-A observes a collision on a sub-channel or a half-duplex restriction for the same UE group.  **Scheme 2:**  Upon receiving a new (overlapping) reservation.  **Scheme 3:**  Combination of Scheme 1 and 2. | PSFCH format is used, and it can be shared with multiple UE-A(s) for the same problematic resources. | **Scheme 1:**  Upon receiving NACK from UE-A, UE-B performs retransmission.  **Scheme 2:**  Upon receiving an inter-UE coordination message, a UE drops the concerned reservation and reselects resources  **Scheme 3:**  Combination of Scheme 1 and 2. | **R16 Mode 2 RA:**  **Scheme 1:**  0.1% PRR gain in 320m.  Coverage of 20m is extended at PRR=0.975.  Coverage of 10m is extended at PRR=0.99.  **Scheme 2:**  0.3% PRR gain in 320m.  Coverage of 50m is extended at PRR=0.975.  Coverage of 40m is extended at PRR=0.99.  **Scheme 3:**  0.6% PRR gain in 320m.  Coverage of 100m is extended at PRR=0.975.  Coverage of 70m is extended at PRR=0.99.  **Gain over Random RA (Scheme 2):**  1% PRR gain in 320m.  Coverage of 100m is extended at PRR=0.975.  Coverage of 70m is extended at PRR=0.99. |
| Fujitsu [R1-2100746] | Groupcast (Option 1 with target range of 100m)  Highway,  Periodic  (GHP) | UE-A is another receiver of UE-B. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | 1% PRR gain in 50m.  Coverage of 5m is extended at PRR=0.95. |
| Fujitsu [R1-210746] | Groupcast (Option 1 with target range of 100m)  Urban,  Periodic  (GUP) | UE-A is another receiver of UE-B. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | 1% PRR gain in 50m.  2% PRR loss in 100m.  Coverage of 10m is extended at PRR=0.95. |
| Fujitsu [R1-210746] | Groupcast (Option 1 with target range of 100m)  Highway,  Aperiodic  (GHA) | UE-A is another receiver of UE-B. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | 1.3% PRR gain in 50m.  Coverage of 50m is extended at PRR=0.99. |
| Fujitsu [R1-210746] | Groupcast (Option 1 with target range of 100m)  Urban,  Aperiodic  (GUA) | UE-A is another receiver of UE-B. | Type C. | When UE-A observes half-duplex restriction for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused. | Upon receiving NACK from UE-A, UE-B performs retransmission. | 0.7% PRR gain in 50m.  Coverage of 25m is extended at PRR=0.99. |
| Fujitsu [R1-210746] | Groupcast (Option 1 with target range of 320m)  Highway,  Periodic  (GHP) | UE-A is receiver of UE-B. | Type A and B. | When UE-A receives the trigger information from UE-B. | Not modelled. | UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 1% PRR gain in 320m.  Coverage of 40m is extended at PRR=0.99.  Coverage of 20m is extended at PRR=0.95. |
| Fujitsu [R1-210746] | Groupcast (Option 1 with target range of 320m)  Highway,  Periodic  (GHP) | UE-A is receiver of UE-B. | Type A and B. | When UE-A receives the trigger information from UE-B. | 10% of PRBs in a RP is always reserved for the signalling of the inter-UE coordination and the request. | The latency of transmitting and processing coordination information is set to 10 slots in average.  UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 1% PRR loss in 320m.  Coverage of 30m is reduced at PRR=0.95. |
| Mitsubishi [R1-2100828] | Unicast (AN disabled),  Highway,  Periodic  (UHP) | UE-A is receiver of UE-B. | Type B. (an ordered /prioritized list of non-preferred resources with RSRP above a pre-defined /preconfigured RSRP threshold) | Once resource (re)-selection is triggered at UE-B, the assistance info is provided by UE-A | Not modelled. | UE-B will preclude all the resources of Type B resource set.  In the case of blocking situation (not enough remaining resources), RSRP-based thresholding at UE-B may re-integrate some of the excluded resources in the inverse order from the ordered list provided by UE-A. | 6% PRR gain in 320m.  Coverage extension of 50m at PRR=0.95.  Coverage extension of []m at PRR=0.99.  7% PRR gain at 420m. (comm range) |
| Mitsubishi [R1-2100828] | Groupcast,  Highway,  Periodic  (GHP) | UE-A(s) is/are selected candidate(s) out of the receivers of UE-B. | Type B. (an ordered /prioritized list of non-preferred resources with RSRP above a pre-defined /preconfigured RSRP threshold) | Once resource (re)-selection is triggered at UE-B, assistance info is provided by UE-A(s) within a certain range from UE-B. | Not modelled. | When the TX (UE B) receives the assistance reports from the candidate UE A(s), it carries out a second round of prioritization of the non-preferred resources based on the number of occurrences of a given non preferred resource in the received assistance reports.  UE-B will preclude all the resources of Type B resource set.  In the case of blocking situation (not enough remaining resources), RSRP-based thresholding at UE-B may re-integrate some of the excluded resources in the inverse order from the ordered/prioritized list of non-preferred resources | 3.2% PRR gain in 320m.  Coverage extension of 50m at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  7% PRR gain in 420m. (comm range) |
| Mitsubishi [R1-2100828] | Groupcast,  Highway,  Periodic  (GHP) | UE-A(s) is/are selected candidate(s) out of the receivers of UE-B. | Type B. (an ordered/ prioritized list of non-preferred resources with RSRP above a predefined/ preconfigured RSRP threshold) | Once resource (re)-selection is triggered at UE-B, the assistance info is provided by UE-A(s)  within a certain range from UE-B, with a delay of N= 1,2 or 4 logical slots | Not modelled. | When the TX (UE B) receives the assistance reports from the candidate UE A(s), it carries out a second round of prioritization of the non-preferred resources based on the number of occurrences of a given non preferred resource in the received assistance reports.  UE-B will preclude all the resources of Type B resource set.  In the case of blocking situation (not enough remaining resources), RSRP-based thresholding at UE-B may re-integrate some of the excluded resources in the inverse order from the ordered/prioritized list of non preferred resources | Latency N= 1 Slot: 3.2% PRR gain in 320m.  Coverage extension of 50m at PRR=0.95.  Coverage extension of []m at PRR=0.99.  5% PRR gain in 420m. (comm range)  Latency N= 2 Slots: 2.2% PRR gain in 320m.  Coverage extension of 30m at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  3% PRR gain in 420m. (comm range)  Latency N= 4 Slots: 2% PRR gain in 320m.  Coverage extension of 30m at PRR=0.95.  Coverage of []m is extended at PRR=0.99.  1% PRR gain in 420m. (comm range) |
| ZTE [R1-2100925] | Broadcast,  Highway,  Periodic  (BHP) | UE-A is receiver of UE-B, which is further selected by UE-B via PC5-RRC. | Type A. |  | Information bits: 300 bits  Resource overhead: 10 RB  Latency within [1~10] slot | UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 2.6% PRR gain in 320m.  Coverage of 40m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| ZTE [R1-2100925] | Broadcast,  Urban,  Periodic  (BUP) | UE-A is receiver of UE-B, which is further selected by UE-B via PC5-RRC. | Type A. |  | Information bits: 300 bits  Resource overhead: 10 RB  Latency within [1~10] slot | UE-B takes the intersection of UE-B’s S\_A and UE-A’s S\_A to obtain the final candidate resource set. | 5.8% PRR gain in 150m.  Coverage of 10m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| Samsung [R1-2101232] | Unicast,  [Highway],  Periodic  (UHP) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B. | Not modelled. | UE-B uses the transmission resources provided by UE-A. | 60% PRR gain in 300m.  No coverage is extended at PRR=0.95.  No coverage is extended at PRR=0.99. |
| Samsung [R1-2101232] | Unicast,  Highway,  Aperiodic  (UHA) | UE-A is receiver of UE-B. | Type A. | When UE-A receives the trigger information from UE-B. | Not modelled. | UE-B uses the transmission resources provided by UE-A. | 3.4% PRR gain in 300m.  Coverage of 5m is extended at PRR=0.95.  Coverage of []m is extended at PRR=0.99. |
| Qualcomm [R1-2101486] | Groupcat (Option 1 with target range of 60m)  Urban  Aperiodic  (GUA) | UE-A is another receiver of UE-B. | Type C. | When UE-A observes resource conflict for the same UE group.  (Post-conflict indication) | PSFCH resource for groupcast HARQ-ACK feedback is reused.  Accounting for PSFCH half duplex, Maximum PSFCH transmission and reception capability, MPR and IBE | Upon receiving NACK from UE-A, UE-B performs retransmission. | 0.5% PRR gain from 99.3% to 99.8% in 50m.  Coverage of extended from 33m to 44m at PRR=0.99.  Coverage of extended from 18m to 36m at PRR=0.995.  Enable 99.9% reliability communication range up to 20m |
| Qualcomm [R1-2101486] | Groupcat (Option 1 with target range of 60m)  Urban  Aperiodic  (GUA) | UE-A is receiver of UE-B. | Type B. | Whenever forwarding UEs have data to transmit | Not modelled. | UE-B will preclude all the resources of Type B resource set. | 0.2% PRR gain from 99.3% to 99.5% in 50m.  Coverage is extended from 33m to 38m at PRR=0.99.  Coverage is extended from 18m to 25m at PRR=0.99.5.  99.9% reliability communication is not possible |
| LGE [R1-2101786] | Broadcast,  Urban,  Periodic  (BUP) | UE-A is RSU deployed in the center of each intersection of the urban grid.  UE-B(s) are other vehicle UEs along the street. | Type A.  UE-A can provide the set of preferred resource to UE group. | UE-A can provide inter-UE coordination information periodically. | It is assumed that UE-A can provide inter-UE coordination information periodically in long-term manner (i.e. relevant overhead and latency can be negligible.) | UE-B takes the intersection of UE-B’s S\_A and the set of preferred set provided by UE-A to obtain the final candidate resource set. | 4.96% PRR gain in 150m.  Coverage of 10m is extended at PRR=0.95. |

Please check whether the above evaluation methodology and gain are correctly captured or not, and provide input, if any, **by January 26th, 4:59pm UTC**. You can also make correction directly in the above summary of evaluation results.

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | See corrections above. Given that our scenario has PRR>0.95 for almost every simulated case, we have included results at PRR=0.975 instead.  We have also clarified that the scheme in our contribution fits under the categories of Type B and Type C. |
| vivo | See correction above. |
| ZTE | Updates on the details simulation methodology including overhead modelling and scenario. |
| Fujitsu | * Some corrections are made to align the summary and the table. * Some irrelevant results are deleted. E.g., for a simulation with the target range of 100m, the results for a range larger than 100m is not so relevant and thus deleted. * Another result with ideal coordination information report is added. In the contribution, we also provided the result for an ideal case. This is newly added in the summary and the table. |
| LGE | We updates our contribution and add our evaluation methodology and results in the above table. |
| QC | We do not agree with this comparison as captured:   * + - * PRR loss is observed in highway scenario for aperiodic groupcast traffic compared to R16 Mode 2 RA with minimum number of (re)transmissions of 2 [Intel, R1-2100673].   PRR gain should be listed in comparison to Rel-16 baseline. We can list the schemes with 2 blind retransmissions in a separate category; but 2 blind transmissions is not R16 Mode 2 RA and saying Type C technique incur a loss compared to R16 Mode 2 RA is incorrect.  Delete irrelevant data (beyond targeted communication range).  We would like to emphasize that only type C achieves 99.9% reliability communication in our simulation. Neither the baseline nor Type B achieved 99.9% reliability.  For some of the schemes, there is no information on the assumed delay. We are not sure if that means delay associated with coordination messages are not modelled. We think that it would be very beneficial to have explicit confirmation if delay is being modelled or not.  It is important to put the PRR gain in context of the absolute PRR by including the original PRR value and the enhanced PRR value. For example, 1 % gain from 98% to 99% is more significant than 1% gain from 10% to 11%, yet listing only the PRR gain would treat the two cases equally. This could also be addressed by looking at the PER. |

1. **FL’s observation on evaluation results (version 1)**

In this RAN1 meeting, it needs to make conclusion on the feasibility/benefit of inter-UE coordination and send an LS to RAN plenary meeting. In this sense, FL made the following observation after reviewing the submitted evaluation results.

***FL’s observation on evaluation results****:*

* *Type A and/or B*
  + *For the case when one UE-A indicates the preferred resource set to each of multiple UE-Bs,*
    - *one company claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA.*
  + *For the case when UE-A is the intended receiver of UE-B,* 
    - *nine companies claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA*
      * *One company claimed that the gain of this solution becomes larger under the scenario where UL transmission can overlap with SL transmission/reception.*
    - *three companies claimed that the inter-UE coordination has no gain under certain scenarios (e.g., highway and/or urban scenario for aperiodic unicast traffic, highway scenario for periodic groupcast traffic)*
* *Type C*
  + *For the case when UE-A indicates the resource conflict in previous transmission (i.e., post conflict),*
    - *five companies claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA*
      * *one company claimed that the inter-UE coordination has a lower gain with Rel-16 Mode 2 RA with ensuring the minimum number of (re)transmissions.*
  + *For the case when UE-A indicates the resource conflict in future (i.e., pre-conflict),*
    - *one company claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA and the gain is higher than the case when UE-A indicates the resource conflict in previous transmission*
  + *For the case when UE-A indicates the resource conflict in the past (i.e., post conflict) and in the future (i.e., pre conflict)*
    - *one company claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA and that the gain is greater than the combination of the individual gains of the post-conflict and pre-conflict schemes.*

Please provide comment, if any, on the above FL’s observation **by January 26th, 4:59pm UTC**. Note that after finishing checking this observation, FL has a plan to provide/discuss potential conclusions on the feasibility/benefit of inter-UE coordination.

|  |  |
| --- | --- |
| Company | Comment |
| NTT DOCOMO | Firstly, thank you so much for your efforts on evaluations.  Then, three comments from our side.  - In our understanding, pre-collision indication is a part of type B, and post-collision indication is intended as type C. However, the above FL’s observation seems to include pre-collision indication in both type-B (UL vs SL) and type C (second bullet). Correct categorizing is preferred.  - In the above FL’s observation, type A and type B are treated in the same bullet. However, as abovementioned, type B includes pre-collision indication. This implies that achievable gain is different among type A and type B. Separate analysis is preferable.  - Regarding type A, many companies show some gain under periodic traffic, not aperiodic. As presented in QC’s contribution, sharing latency is a key aspect for discussion on ‘beneficial or not’. From this perspective, type A is good scheme only for periodic transmission. As you know, NR-SL supports aperiodic transmission, which is one of the important features. For aperiodic transmissions, pre/post collision indication achieves performance gain as some companies kindly evaluated. This point should be included in the above observation and corresponding conclusion should consider it. |
| CATT, GOHIGH | Thanks for the summary.  Regarding the categorizing the observations, it would be better to separate the observations of each resource coordination type for periodic transmission and aperiodic transmission. For example, from our evaluation results, there is no gain for the aperiodic transmission with resource coordination type A and/or type B. |
| vivo | Thank you for the summary. Our view is as below  1. Firstly, we prefer to list the observation based on each type, i.e., A,B and C  2.For type-A, UE-A can assist multiple UE-Bs which is connected to UE-A from our perspective. We do not think it is reasonable to distinguish whether ‘UE-B is multiple UE’ or ‘target receiver’  3.For type-C, we prefer to add the following observation: type B based solution set upper bound of performance gain for type-C based solution, which proves that type-C based solution is beneficial. The reason is as following  Type B (non-preferred resource set) is trying to avoid the resource conflict due to collision, HD or TX/TX overlap, while type C is based on conflict detection/resolution. In our understanding, for some solution, type B based solution can set performance upper bound for type C based solution (In our simulation, the type-B based solution to address HD and TX/TX overlap issue can be implemented in a way to notify the future resource conflict, i.e., Type-C based pre-conflict indication). |
| Fujitsu | In our contribution, we provide two simulation results for inter-UE coordination. The simulation results show the gain for one scenario, but no gain for the other scenario. However, only the result “without gain” is counted in the above observation. To also capture the result “with gain”, for the observation “eight companies claimed that the inter-UE coordination is beneficial compared to Rel-16 Mode 2 RA”, the wording “eight companies” should be changed to “nine companies”. |
| OPPO | We share the view that post-collision should go to Type B rather than Type C. According to the definition of Type B and Type C (reproduced below), expected/potential resource conflict pre-conflict in the future is covered by Type B, resource conflict happened in the past is covered by Type C.   * *Type B: 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* * *Type C: UE-A sends to UE-B the set of resource where the resource conflict is detected* |
| Samsung | Even though we have listed up 3 Types in the last meeting. In our understanding, it is not clear the difference between Type B and C. As OPPO commented, there is a confusion. This should be discussed in this meeting and we should make it clear in order to discuss evaluation results and also decide final inter-UE coordination schemes in next time. |
| Huawei, HiSilicon | We share similar view with Docomo that pre-collision is part of Type-B since it indicates future resources which are not preferred for UE-B’s transmission. Post-collision can be Type-C. So we suggest to put pre-collision under Type-B to be more accurate.  Type-A and Type-B are different solutions, and better to be analysed separately. |
| Ericsson | We have captured one missing point in the observations regarding the different Type-C schemes (pre-collision + post-collision).  It is clear from the preceding answers that the categorization in terms of Type A/B/C is not mutually exclusive. We agree with the comment from DCM and OPPO that pre-conflict schemes could fit well under Type-B. At the same time, the commonalities with the other Type-C scheme are clear too.  In any case, the importance of the classification is relative at this point. What really matters is the way forward regarding the specification.  Proposal:  RAN1 to specify:   * Alt. 1: UE-A indicates (not) preferred set of resources to UE-B. * Alt. 2: UE-A indicates resource conflict using 1 bit.   We suggest focusing on this and, if necessary, revisit the FL’s observations later. |
| Nokia, NSB | We agree with the FL’s current split into Types A/B (which may be viewed as preventing a conflict from happening in the first place) and Type C (which may be viewed as resolving a conflict that has actually taken place, or is about to take place). Conflict prevention (Type A, Type B) is more feasible when transmissions are semi-persistent (i.e., predictable). Conflict resolution (Type C) can take care of those conflicts that could not be prevented. |
| QC | Types A and B should be listed separately as they are 2 different mechanisms, addressing different use cases, different UE-B behavior and having different content of coordination message.  Even within one category, it should also be clearly stated how many results are with modelling of delay/overhead associated with coordination messages and how many make ideal assumptions. Benefit/feasibility of each mechanism cannot be decided based only on idealistic assumption. The current grouping makes this aspect unclear.  We also agree with CATT that distinction of periodic/aperiodic/cast type is needed. |
| IDCC | We also consider that resources pertaining to pre-collision should be categorized under Type B resources, since it deals with resources in which conflicts are “expected” and thus can be prevented. Type C is specific to resources in which conflicts are “detected” and thus already happened. So we think the definition of the resource types is good and we should proceed with further details.  We suggest to prioritize the study the of scenarios with UE A as the intended RX UE, as most of the simulation demonstrating the performance gain has UE A as RX UE and in connection with this, we can evaluate which cast type of UE B transmission can benefit from each resource type. Both periodic and aperiodic traffic should be considered.  Additionally, we agree with Ericsson to consider an indication of the resource set. Explicit resource information is suitable to Type A and Type B. On the other hand, Type C resources are resources in which collision is detected, so if a collision is detected, the resources are already reserved and thus there is no need for UE A to explicitly indicate the resources. However, the implicit indication e.g. using a PHY channel, should carry information to ensure the UE B can associate this indication with the applicable resources. |
| Apple | For the different types of resource sets, our view is that Type A and Type B are proactive resource set, i.e. before UE-B’s resource reservation, while Type C is reactive resource set, i.e., after UE-B’s resource reservation.  Overall, we share the views of QC that each resource type has its use cases. Type A resource set is more suitable for unicast where this set of preferred resources are good only for a particular UE-B. Type B resource set is more suitable for groupcast or broadcast, where every UE-B can make use of for its own resource selection. Type C resource set is suitable that a UE-A is the receiver UE from UE-B, since the inter-UE coordination could be transmitted in PSFCH-like channel. |
| Bosch | Most of the results show some benefits for both post-conflict (Type C) and pre-resolution (Type A/B) schemes in different conditions. However, for Type A/B (i.e., pre-resolution), we still believe that the latency presented in some results is considering rather idealistic values to fit aperiodic traffic (i.e., feasibility issue) and the gain was mainly counted for periodic traffic in this case (i.e., benefit issue).  Therefore, we support the following traffic/cast types for the different (reduced) resource sets in order to conclude on benefits/feasibility:   * Type C (i.e., post-conflict, e.g., to a certain number of slots in the past) for:   + Aperiodic and periodic traffic   + For unicast, groupcast (Option 2 or 1 (e.g., re-using PSFCH design)) * Type A/B (i.e., pre-resolution) for   + periodic traffic   + unicast, groupcast Option 2   We also agree with Ericsson, that Type C may be indicated implicitly with references to, e.g., physical slots and Type A/B may be indicated explicitly with a set (many bits). In the latter case, periodic resources may minimize the resource set size. |
| Xiaomi | We share other companies view that periodic traffic and aperiodic traffic should be analysed separately. Also, it would be better to separately list the observations of each resource coordination type. Finally, we think pre-collision should be covered by observation of Type B, since pre-collision indicates future resources which are not preferred for UE-B’s transmission. Post-collision should be covered by Type-C, as it indicates resource which the resource conflict is detected. |
| Spreadtrum | Agree with Apple. We think that the three types should be categorized according to whether the resources has already reserved by UE-B.  Type A and Type B are the resources set before UE-B’s resource reservation. And type C is the resource conflict indication after UE-B’s resource reservation, mainly including two situations: the same resources are reserved but not used by different TX UEs and the resource conflict has already happened. |
| Convida Wireless | Each resource type such as Type A, Type B and Type C may have the associated and corresponding use case(s). We are fine that Types A and/or B and Type C are separately discussed for clearness. |
| Fraunhofer | Based on the observations from the simulation results, there is a clear benefit for supporting inter-UE coordination.  In terms of feasibility, we agree with most of the companies that each type has an advantageous use case. Type A shows gains when it is the intended recipient UE, and the gain can be maximized by optimizing the means to transmit the assistance information, instead of using an entire time slot for its transmission.  We also agree that type B should include the pre-collision cases. It is possible to categorize type B and C together as collision indicators, with a restriction on the time when the pre- and post-collisions occur, thereby optimizing the size of the assistance information.  The separation of results based on periodic/aperiodic traffic is preferable. |
| Intel | Thanks a lot for the efforts on summary of evaluation results. We have the following comments:   1. Results with some genie-aided/idealistic assumptions should be separated from evaluations that consider all practical aspects 2. We suggest to draw observations for different scenarios separately at least for the following aspects    1. Traffic type: Periodic or Aperiodic    2. Communication type: Unicast only, Groupcast only, Broadcast only, etc. 3. In our view, coarse categorization on Type A/B/C is not sufficient. It is better to discuss specific evaluated options/design principles under each category 4. Enhancements of Rel.16 solutions well fit Type B categorization and should be also reflected in observations relative to R16 design 5. WID requested RAN1 to analyze latency benefits. We propose to also capture evaluation results that have shown latency advantage.   “Study the feasibility and benefit of solution(s) on the enhancement(s) in mode 2 for enhanced reliability and reduced latency in consideration of both PRR and PIR defined in TR37.885 (by RAN#91), and specify the identified solution(s) if deemed feasible and beneficial [RAN1, RAN2]”   1. If RAN1 is supposed to reach conclusions based on observations then it should be done on a per scheme / design principle basis and not on a basis of broad categories |

1. **FL’s observation on evaluation results (version 2)**

Considering companies’ comments until now, FL’s observation on evaluation is updated as follows. Note that the pre-conflict indication is categorized as Type B. This means that Type C represents the post-conflict indication only.

***FL’s observation on evaluation results****:*

* *Type A*
  + *Periodic traffic*
    - *For the case where signaling overhead and latency are considered for the coordination, depending on how UE-B uses Type A information,* 
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic broadcast traffic*
    - *Two companies claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic without a consideration of signaling overhead for the coordination.*
      * *One company assumes latnecy for the coordination, and other company assumes no latency for the coordination.*
    - *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic broadcast traffic without a consideration of latency for the coordination.*
* *Type A*
  + *Aperiodic traffic*
    - *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic with a consideration of latency and signaling overhead for the coordination.*
    - *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic without a consideration of signalling overhead for the coordination.*
    - *Two companies claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic without a consideration of latency for the coordination.*
      * *One company assumes signalling overhead for the coordination, and other company assumes no signalling overhead for the coordination.*
    - *One companies claimed that depeding on how UE-B uses Type A information, whether or not to acheive the gain of Type A coordination compared to Rel-16 Mode 2 RA will change for aperiodic unicast traffic without a consideration of latency and signaling overhead for the coordination.*
* *Type B*
  + *Periodic traffic*
    - *Five companies claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic.*
      * *One company assumes both signaling overhead and latency for the coordination.*
      * *two companies assume latency but no signalling overhead for the coordination.*
      * *One company assumes signaling overhead but no latency for the coordination.*
      * *One company assumes neither signaling overhead nor latency for the coordination.*
    - *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic groupcast traffic not only when signaling overhead for the coordination is not consrdered, but also when latency and signaling overhead for the coordination are not considered.*
    - *One company claimed that the gain of Type B coordination becomes larger under the scenario where UL transmission can overlap with SL transmission/reception for periodic unicast traffic without a consideration of latency for the cooridnation..*
* *Type B*
  + *Aperiodic traffic*
    - *Two companies claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1 with consideration of latency and signaling overhead for the cooridnation.*
    - *One company claimed that the Type B coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic traffic of unicast with SL HARQ-ACK feedback disabled without consideration of signaling overhead for the cooridnation.*
* *Type C*
  + *Periodic traffic*
    - *One company claimed that the Type C coordination is beneficial compared to Rel-16 Mode 2 RA for groupcast with SL HARQ-ACK feedback Option 1 with consideration of latency and signaling overhead for the cooridnation.*
* *Type C*
  + *Aperiodic traffic*
    - *Four companies claimed that the Type C coordination is beneficial compared to Rel-16 Mode 2 RA for groupcast with SL HARQ-ACK feedback Option 1 with consideration of latency and signaling overhead for the cooridnation.*
    - *One compay claimed that PRR gain of Mode 2 enahcement with ensuring the minimum number of retransmission is higher than that of Type C for groupcast with SL HARQ-ACK feedback Option 1.*
* *Type A and B*
  + *Periodic traffic*
    - *One compay claimed that combination of Type A and B coordination is beneficial compared to Rel-16 Mode 2 RA and Type A only/Type B only for periodic unicast traffic without consideration of signaling overhead for the cooridnation.*
    - *One compay claimed that combination of Type A and B coordination is not beneficial compared to Rel-16 Mode 2 RA for periodic traffic of groupcast with SL HARQ-ACk feedback Option 1 with consideration of latency and signaling overhead for the cooridnation.*
    - *One compay claimed that combination of Type A and B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic traffic of groupcast with SL HARQ-ACk feedback Option 1 without consideration of latency and signaling overhead for the cooridnation.*
* *Type A and B*
  + *Aperiodic traffic*
    - *One compay claimed that combination of Type A and B coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic without consideration of signaling overhead for the cooridnation.*
* *Type B and C*
  + *Aperiodic traffic*
    - *Two compaies claimed that combination of Type B and C coordination is beneficial compared to Rel-16 Mode 2 RA and Type B only/Type C only for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1 with consideration of latency and signaling overhead for the cooridnation.*

1. **Proposed conclusion**

Based on the updated version of observation on evaluation results in Section 3, the following conclusion on the feasibility/benefit of inter-UE coordination is proposed.

***Proposed conclusion***

* *RAN1 concludes that the inter-UE coordination in Mode 2 is feasible, and its benefit compared to Rel-16 Mode 2 RA is identified in the following cases:*
  + *When UE-A sends to UE-B the set of resources preferred for UE-B’s transmission, the inter-UE coordination is beneficial for periodic traffic when the signaling overhead is small (e.g. using semi-static signaling).*
  + *When UE-A sends to UE-B the set of resources not preferred for UE-B’s transmission, the inter-UE coordination is beneficial for periodic and aperiodic traffic when the signaling overhead is small (e.g. using semi-static signaling or an indicator with limited bit(s)).*
  + *When UE-A sends to UE-B the set of resources where the resource conflict is detected, the inter-UE coordination is beneficial for periodic and aperiodic traffic with SL groupcast HARQ-ACK feedback Option 1 (i.e. NACK-only).*

1. **Email discussion after Wed’s GTW**

Based on companies’ comments and chairman’s guideline, it would be better to additionally enclose the following summary of detailed evaluation results in LS to RAN plenary. By doing so, when discussing how to update the objective of Mode 2 enhancement(s) in RAN plenary meeting, companies can refer to this summary for more detailed information of evaluation results.

***Summary of evaluation results (i.e., it wiil be enclosed in LS to RAN plenary)****:*

* *Type A: UE-A sends to UE-B the set of resources preferred for UE-B’s transmission*
  + e.g., based on its sensing result
* *Type B: 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
* *Type C: UE-A sends to UE-B the set of resource where the resource conflict is detected*
* *Type A*
  + *Periodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination, depending on how UE-B uses Type A information,* 
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for periodic groupcast traffic with SL HARQ-ACk feedback Option 1*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic broadcast traffic*
    - *For the case where latency is considered for the coordination,*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
    - *For the case where additional signaling overhead is considered for the coordination,*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic broadcast traffic*
    - *For the case where neither additional signaling overhead nor latency are considered for the coordination,*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for periodic groupcast traffic with SL HARQ-ACk feedback Option 1*
* *Type A*
  + *Aperiodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination, depending on how UE-B uses Type A information,* 
      * *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic*
    - *For the case where latency is considered for the coordination,*
      * *One company claimed that the Type A coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic*
    - *For the case where additional signaling overhead is considered for the coordination,*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic*
    - *For the case where neither additional signaling overhead nor latency are considered for the coordination,*
      * *One company claimed that the Type A coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic*
      * *One company claimed that depeding on how UE-B uses Type A information, whether or not to acheive the gain of Type A coordination compared to Rel-16 Mode 2 RA will change for aperiodic unicast traffic*
* *Type B*
  + *Periodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination,* 
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
    - *For the case where latency is considered for the coordination,*
      * *Two companies claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic groupcast traffic*
    - *For the case where additional signaling overhead is considered for the coordination,*
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the gain of Type B coordination becomes larger under the scenario where UL transmission can overlap with SL transmission/reception for periodic unicast traffic*
    - *For the case where neither additional signaling overhead nor latency are considered for the coordination,*
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic unicast traffic*
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for periodic groupcast traffic*
* *Type B*
  + *Aperiodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination,* 
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1*
    - *For the case where latency is considered for the coordination,*
      * *One company claimed that the Type B coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic traffic of unicast with SL HARQ-ACK feedback disabled*
      * *One company claimed that the Type B coordination is beneficial compared to Rel-16 Mode 2 RA for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1*
* *Type C*
  + *Periodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination,* 
      * *One company claimed that the Type C coordination is beneficial compared to Rel-16 Mode 2 RA for groupcast with SL HARQ-ACK feedback Option 1*
* *Type C*
  + *Aperiodic traffic*
    - *For the case where additional signaling overhead and latency are considered for the coordination,* 
      * *Four companies claimed that the Type C coordination is beneficial compared to Rel-16 Mode 2 RA for groupcast with SL HARQ-ACK feedback Option 1*
      * *One compay claimed that PRR gain of Mode 2 enahcement with ensuring the minimum number of retransmission is higher than that of Type C for groupcast with SL HARQ-ACK feedback Option 1.*
* *Type A and B*
  + *Periodic traffic*
    - *For the case where latency is considered for the coordination,*
      * *One compay claimed that combination of Type A and B coordination is beneficial compared to Rel-16 Mode 2 RA and Type A only/Type B only for periodic unicast traffic*
* *Type A and B*
  + *Aperiodic traffic*
    - *For the case where latency is considered for the coordination,*
      * *One compay claimed that combination of Type A and B coordination is not beneficial compared to Rel-16 Mode 2 RA for aperiodic unicast traffic*
* *Type B and C*
  + *Aperiodic traffic*
    - *For the case where additional signaling overhead and latency are considered for both Type B and C coordination,* 
      * *One compay claimed that combination of Type B and C coordination is beneficial compared to Rel-16 Mode 2 RA and Type B only/Type C only for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1*
    - *For the case where additional signaling overhead and latency are considered for Type C, but latency is considered for Type B,* 
      * *One compay claimed that combination of Type B and C coordination is beneficial compared to Rel-16 Mode 2 RA and Type B only/Type C only for aperiodic traffic of groupcast with SL HARQ-ACK feedback Option 1*

Please provide comment (including different view on enclosing this summary in LS to RAN plenary), if any, on the above summary of evaluation results **by January 28th, 4:59pm UTC**. To prepare the updated version of summary on evaluation results that will be used in Fri’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

|  |  |
| --- | --- |
| Company | Comment |
| QC | We’d like to clarify that our results for resource information sharing as Type B assumed realistic latency (multiplexed with data) but zero overhead or impact on the decodability of data. Also it assumes that when there multiple transmissions of the same data packet, the content of resource information in each retransmission can be changed.   For where to place pre-collision indication, we think it can also be categorized under Type C. It uses a similar mechanism to other conflict indicators and also indicates a resource where a conflict is detected. The detection itself has occurred in the past but the conflict could be in the past (post-collision) of future(pre-collision). |
| Fujitsu | Move our results under the bullet of Type A periodic traffic. No matter how preferred resources are signalled (we assume a bitmap indicates preferred and non-preferred resources), we simulate that the intersection of the preferred resources between UE B and UE A is used for resource selection. Therefore, our results actually belong to the Type A coordination. |
| ZTE | We’d like to clarify that in our simulation, in addition to the signalling overehead (provided in the previous feedback), the latency (e.g., from triggering to acception of reporting) is also modelled as the distribution within [1~10] slot. So, we prefer to move our source under the 2nd level sub-bullet for Type A periodical traffic, since both latency and overhead are considered |

In general, when SID is converted to WID, the precise contents of conclusion in RAN WG is not a prerequisite to determine the objective of WID. In this sense, it would be possible to update the objective of Mode 2 enhancement(s) with the high level conclusion provided by RAN1, and the discussion on detailed schemes (including narrow downing solution(s)) can be taken in RAN1. Rather I think that if the contents of conclusion’s sub-bullet is described in more detail, RAN1 is more difficult to agree it. Also as the summary of detailed evaluation results mentioned above will be additionally enclosed in LS to RAN plenary, it would be possible to provide sufficient information when the relevant discussion (i.e., how to update the objective of Mode 2 enhancement(s)) is performed in RAN plenary. Please consider these aspects, when companies makes comment on the proposed conclusion.

***Proposed conclusion:***

* *RAN1 concludes that the inter-UE coordination in Mode 2 is feasible, and its benefit compared to Rel-16 Mode 2 RA is identified in the following cases:*
  + *When UE-A sends to UE-B the set of resources preferred for UE-B’s transmission, the inter-UE coordination is beneficial for periodic traffic when the signaling overhead is small (e.g. using semi-static signaling).*
  + *When UE-A sends to UE-B the set of resources not preferred for UE-B’s transmission, the inter-UE coordination is beneficial for periodic and aperiodic traffic when the signaling overhead is small (e.g. using semi-static signaling or an indicator with limited bit(s)).*
  + *When UE-A sends to UE-B the set of resources where the resource conflict is detected, the inter-UE coordination is beneficial for periodic and aperiodic traffic with SL groupcast HARQ-ACK feedback Option 1 (i.e. NACK-only).*

Please provide comment, if any, on the above proposed conclusion **by January 28th, 4:59pm UTC**. To prepare the updated version of proposed conclusion that will be used in Fri’s GTW, it would be highly appreciated if companies make comments, if any, as soon as possible.

|  |  |
| --- | --- |
| Company | Comment |
| QC | The conclusion could be shortened to the main bullet, now that a detailed observation is also included:  Proposed conclusion:   * RAN1 concludes that the inter-UE coordination in Mode 2 is feasible, and is beneficial compared to Rel-16 Mode 2 RA |
| Fujitsu | Agree in principle. However, the examples given in the bracket seem not to be reflected by the previous summary of the evaluation results, and more belong to details. Therefore, the brckets should be removed. In addition, “when the signalling overhead is small” may be modified as “when it is assumed the signalling overhead is small”. |
| Xiaomi | We prefer to a more general conclusion on the benefit of inter-UE coordination, such as the conclusion suggested by QC. Even if detailed observation is included, the examples in the sub-bullets are not necessary. We suggest to remove them. |
| NTT DOCOMO | We think the conclusion is not accurate. For each mechanism, some campanies observed ‘beneficial’ but some companies observed ‘not beneficial’. So we cannot say simply ‘beneficial’ for each mechanism as the current conclusion.  Now we will enclose the detailed observations above, in this case, the main conclusion can be that suggested by QC, where saying inter-UE coordination is feasible and beneficial as general principle. |
| ZTE | Agree with the proposal. The details including sub-bullet and example are benefical for further RAN level discussion and can provide the general overview of current situation. |

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 [1] [2] [4] [5] [6] [10] [16] [19] [27]
  + Option 2: UE-A and UE-B is determined via higher layer (e.g. application layer) [3] [5] [7]
  + Option 3: UE-A is pre-defined, and UE-B is UEs that can receive inter-UE coordination information from other UE [7]
  + Further consideration on the case when a leading-UE to suggest transmission resources to other UE(s) in a UE group [3] [5] [7] [18] [22] [33]
* How/when UE-A determines the contents of “A set of resources”, including consideration of UL scheduling?
  + Type of “A set of resources”
    - Type A: UE-A sends to UE-B the set of resources preferred for UE-B’s transmission
      * e.g., based on its sensing result
    - Type B: 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
    - Type C: UE-A sends to UE-B the set of resource where the resource conflict is detected
    - Companies views
      * Option 1: Support Type A only [3] [5] [27]
      * Option 2: Support both Type A and Type B [2] [4] [6] [7] [10] [13] [14] [15] [17] [18] [19] [24] [25] [28] [29] [36]
      * Option 3: Support Type C [10] [14] [22] [28] [32]
      * Option 4: Support Type B only [35]
      * Option 5: Type B + Type C [12]
  + Other information in the inter-UE coordination information
    - Type indicator for a set of resources [6] [7] [13] [28][4]
    - Indication about the intended recipient UE [13]
    - Resource pool index [13] [23]
    - Source ID of UE-B [14] [21]
    - Destination ID associated with UE-B [14] [21]
    - Associated RSRP [21] [28] [34]
    - Associated RX priority [28] [34]
    - Common DRX configuration [29]
    - Recommended TX parameters [29]
  + Further consideration on the assumption of the behavior of UE-A to determine the inter-UE coordination information [8]
* When UE-A sends ”A set of resources” to UE-B, including which UE(s) sends it
  + Explicit Trigger-based based coordination procedures [2] [3] [4] [5] [6] [13] [14] [15] [16] [17] [19][20] [22] [24] [25] [26] [27] [28] [30] [33]
    - Condition that UE-B transmit the triggering
      * When UE-B triggers resource selection procedure [2] [5] [7]
      * When UE-B fails TB reception [20]
      * Upon receiving scheduling request [20]
    - Information carried by the explicit triggering
      * the parameters related to the sensing procedure of UE-B [3] [4] [14] [19][22] [28]
      * the parameters related to TX packet of UE-B [7]
    - Container of the explicit triggering
      * 2nd SCI format [3] [14]
      * MAC CE [14]
      * PSFCH format [7] [28]
  + Event-trigger based coordination procedures [3] [5] [6] [7] [12] [13] [14] [16] [17] [20] [24] [25] [26] [28] [29] [30] [32] [33] [35]
    - Based on (pre)configured periodicity [3] [7] [29] [30]
    - Based on detection of resource conflict [5] [12] [13] [16] [20] [26] [28] [29] [32] [35]
    - When the coordination information is updated for UE-B [7]
    - Based on decision in higher layer [7] [20]
    - Based on congestion status [13]
    - Based on distance between UE-A and UE-B [17] [24] [26] [29]
    - Based on RSRP measurement [24]
* How UE-A sends ”A set of resources” to UE-B, including container used for carrying it, implicitly or explicitly or both
  + Container
    - SCI format 1-A [1] [24] [26] [29]
    - 2nd SCI format [1] [2] [3] [13] [14] [18] [24] [26] [27] [29] [33] [36]
    - MAC CE [7] [14] [20] [29] [33] [36]
    - PC5-RRC [2] [19] [20] [33] [36]
    - PSFCH format [2] [12] [14] [18] [20] [28] [32]
  + Retransmission of the inter-UE coordination information
  + Further consideration on whether shared or dedicated resource is used for inter-UE coordination signaling [8] [32]
* How/when/whether UE-B receives “A set of resources” and takes it into account in the resource selection for its own transmission
  + Whether UE-B can skip sensing operation
    - UE-B does not perform its own sensing operation
    - UE-B performs its own sensing operation [7] [24]
  + 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 [2] [3] [7] [13] [14] [20] [21] [22] [24] [25] [26] [28] [31][4]
    - Use resource set provided from UE-A without a consideration of UE-B’s sensing results [2] [3] [13] [21] [22] [25] [28] [31]
    - UE-B performs retransmission on the already selected resource(s) [32]
    - UE-B reselect all or a subset of its own selected resource(s) [2] [7] [10] [12] [20] [28] [31] [32] [35]
    - It is up to UE-B how to use it [6] [27]
  + Cast type of UE-B that can use inter-UE coordination information
    - Unicast [2] [3] [5] [6] [7] [12] [13] [14] [16] [17] [19][25] [26] [27] [31] [33] [36][4]
    - Groupcast with HARQ-ACK feedback Option 1 [5] [6] [7] [12] [13] [14] [16] [17] [19][22] [27] [31] [32] [33] [36]
    - Groupcast with HARQ-ACK feedback Option 2 [2] [3] [5] [6] [7] [12] [13] [14] [16] [17] [19][22] [25] [27] [31] [33] [36]
    - Broadcast [6] [7] [12] [14] [16] [17] [22] [31] [33]
  + Validity check of the received inter-UE coordination information at UE-B side
    - Based on distance between UE-A and UE-B [7] [13] [14]
    - Based on RSRP from UE-A to UE-B [7] [13] [14]
    - Based on information about target UE of the inter-UE coordination information [7]
    - Based on whether the indicated resource set is inside UE-B’s selection window [7] [13]
* Others
  + Further consideration of using a single signaling to transmit one or multiple “set of resources” to multiple of UEs [2] [14] [22]
  + Further consideration on the case when UE-B receives multiple inter-UE coordination information from one or multiple UE-A(s) [6] [7] [13] [33]
  + Further consideration of congestion control for inter-UE coordination signaling [7] [29]
  + Further consideration on the unmonitored slot at UE-B side [7] [14]
  + Additional inter-UE coordination schemes do not show noticeable gain when practical evaluation assumptions are considered [11]
  + Further consideration of using inter-UE coordination for UE with limited RX capability [12]
  + Further consideration on the impact on Rel-16 UE sharing the same resource pool with UEs using inter-UE coordination operation [23] [29]
  + Further consideration of retransmission of inter-UE coordination signaling [29]
  + Further consideration on SL DRX to determine “A set of resources” at UE-A side [34]

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