**3GPP TSG-RAN WG2 Meeting #116bis electronic R2-22xxxxx**

**Online, 17 – 25 January 2022**

**Source: LG**

**Title:** **Summary of [POST116bis-e][707][V2X/SL] Open issues on IUC, Phase 1**

**Agenda Item:** **8.15.3**

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

# Introduction

This contribution summarizes the Phase-1 discussion on open issue list review of the following email discussion:

* [POST116bis-e][707][V2X/SL] Open issues on IUC (LG)

 **Scope:** 1st phase: Make an open issue lists with the proposed candidate options or rapporteur suggestion. Open issue lists can include pre-identified issues (e.g. FFS, not decided or skipped from previous offline/email discussion) and new issues raised in company contributions at RAN2#116bis. For new issues that have not discussed before, rapporteur can collect companies’ inputs (e.g. whether it is essential issue that need to be considered and closed in Rel-17) and based on that, determine whether to be included in the open issue list or not.

2nd phase: email discussion on the identified open issues with collecting companies’ inputs on the candidate options or rapporteur’s suggestion.

 **Intended outcome:** Open issue list with the proposed candidate options or rapporteur’s suggestion from 1st phase (in R2-2201807). Discussion summary for the identified open issues from 2nd phase.

 **Deadline:** 1st phase (1/21 – 1/28 UTC), 2nd phase (2/9 – 2/14 UTC)

The discussion is focusing on the open issue list (i.e., IUC issues RAN2 starts discussion) identified in [2] and missing RAN2 specific IUC issues not discussed in the #116b-e meeting.

**Contact list**

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| --- | --- | --- |
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# Review on open issue list for IUC

The identified “RAN2 specific IUC issues” in [2] are needed to be discussed for WI completion. Companies are invited to provide views on the suggested way of treatment/handling for each of them (i.e. Company input into Pre117-e-offline, Company tdocs invited, CR rapporteur handled issue, Other [1]).

* **#116b-e agreements:**

Agreement on resource allocation enhancements RAN2 scopes:

1: Inter-UE coordination (IUC) issues RAN2 mainly relies on RAN1:

 - HARQ retransmission number for inter-UE coordination information

 - Information and length of information of IUC MAC CE. The information indicated in RAN1 LS should be taken into account as baseline.

 - UE-B procedure (e.g. final selection of resources) to the (non-)preferred resource set in IUC

 - Scheme 2 inter-UE coordination design

 - Condition for the UE-A to transmit IUC

 - Signaling design and trigger conditions for the request from UE-B to UE-A

 - Cast types (UC/GC/BC) of inter-UE coordination

 - Transmission of inter-UE coordination MAC CE on dedicated resource

 - L1 parameters/configurations for IUC in Uu RRC (including L1 configurations per resource pool)

 - Whether UE-A can be in mode1 or mode2 (interested companies are invited to raise/discuss the issue directly in RAN1)

2. IUC issues RAN2 starts discussion:

 - LCP for inter-UE coordination MAC CE, support for standalone inter-UE coordination MAC CE/multiplex MAC CE and MAC SDU in a MAC PDU

 - Timer to handle latency bound for inter-UE coordination

 - Priority value/priority order of inter-UE coordination MAC CE. RAN1 progress can be taken into account in phase-2 discussion.

 - HARQ feedback option of inter-UE coordination MAC CE

3. IUC in SL DRX is deprioritized in Rel-17 from RAN2 point of view

## Issue 1. LCP for inter-UE coordination MAC CE, i.e., support for standalone inter-UE coordination MAC CE/multiplex MAC CE and MAC SDU in a MAC PDU

RAN2 should discuss whether the MAC CE for reporting IUC information can be multiplexed with the MAC SDU or whether it should be transmitted alone. Following this decision, the HARQ Feedback option for MAC CE can be discussed as a follow-up issue.

**Q1. If any, please comment if you have any missing issues or any suggestions for handling phase 2 discussion on this issue.**

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| **Company** | **Comments, if any (missing issues or suggestions for handling this issue)** |
| **Ericsson** | The UE should be able to transmit the MAC CE alone using a grant without any data from any LCH. In one case, there is no data available from any LCH. In another case, there is data in some LCHs, however, due to the LCHs not matching the LCP restrictions associated with the grant, that data is not selected to be transmitted together with the MAC CE using the grant. |
| **InterDigital** | This issue seems very similar to the discussion of CSI report MAC CE, and DRX Command MAC CE. Is there any reason to have a different conclusion for these questions? |
| **Xiaomi** | **Same handling as other SL MAC CE.**  |
| **vivo** | Suggest to detail the issue(s) in a more specific form, lest people have different understanding on what specific issues to be discussed during Phase-2. Suggestions as follows, and **up to the Rapp on how/where to handle this issue**. Issue A. Do companies agree that IUC MAC CE can be transmitted in a stand-alone manner (e.g. when there is no data)?Issue Aa. If “yes” is selected to Issue A, do companies agree that HARQ FB should be disabled (as CSI reporting MAC CE)? |
| **CATT** | RAN1 has agreed that IUC MAC CE can be multiplexed with other MAC SDU.

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| * For inter-UE coordination information transmission in Scheme 1,
	+ Inter-UE coordination information can be multiplexed with other data only if the source/destination ID pair is the same
		- Retransmission of the TB carrying inter-UE coordination information is supported
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| **OPPO** | vivo’s suggestion is fine for us. |
| **Huawei, HiSilicon** | Considering we also have other MAC CEs, i.e., CSI MAC CE and DRX MAC CE, different cases for the LCP for IUC MAC CE can be listed and discussed as below. In addition, we need to discuss the HARQ attribute for different cases in the follow-up question. A: Standalone IUC MAC CEB: CSI MAC CE and/or DRX MAC CE + IUC MAC CEC: IUC MAC CE + MAC SDUD: CSI MAC CE and/or DRX MAC CE + IUC MAC CE+ MAC SDU |
| **ZTE** | We first agree with CATT’s comments.And we should also discuss whether more than one IUC MAC CE can be multiplexed into one MAC PDU. Since we do not have limitation on how many combinations are included in this MAC CE, then the IUC MAC CE may exhaust all SL grant, which cause SL-SCH can not be multiplexed into the MAC PDU. SL-BSR like mechanism can be used as shown in following:- MAC CE for SL-BSR prioritized according to clause 5.22.1.6;- MAC CE for BSR, with exception of BSR included for padding;- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;- MAC CE for the number of Desired Guard Symbols;- MAC CE for Pre-emptive BSR;- MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.22.1.6 and SL-BSR included for padding; |
| **Intel** | If we follow RAN1 discussion, it does seem like the question of whether the IUC MAC CE can be sent in a standalone way or not has been addressed therein. Therefore, the main question left is regarding the priority, for which we think we can follow CSI MAC CE design. |
| **Lenovo** | Follow RAN1’ conclusions, IUC MAC CE can be multiplexed with other MAC SDU. |
| **Qualcomm** | RAN1 supports both standalone (SCI 2C + MAC CE) and multiplexed with data.  |
| **Fraunhofer** | Same as Qualcomm, we propose to follow RAN1. |

## Issue 2. HARQ feedback option of inter-UE coordination MAC CE

RAN2 should determine the HARQ feedback option (i.e. enabled or disabled) for IUC MAC CE (reporting message). Also, HARQ feedback option for standalone MAC CE and HARQ feedback option for MAC CE multiplexed with MAC SDU should be discussed.

**Q2. If any, please comment if you have any missing issues or any suggestions for handling phase 2 discussion on this issue.**

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| **Company** | **Comments, if any (missing issues or suggestions for handling this issue)** |
| **Ericsson** | For standalone MAC CE, it is straightforward to use HARQ disabled mode. While in case IUC MAC CE is multiplexed with data, HARQ enabled mode may be used, i.e., depending on whether *sl-HARQ-FeedbackEnabled* is set to *enabled* or disabled for the highest priority logical channel . |
| **InterDigital** | Same comment for the previous question – can we use the same conclusions as for other MAC CEs? |
| **Xiaomi** | **Feedback disabled.** |
| **vivo** | See above comments for Issue 1. |
| **CATT** | RAN1 has agreed that IUC MAC CE supports retransmission.

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| * For inter-UE coordination information transmission in Scheme 1,
	+ Inter-UE coordination information can be multiplexed with other data only if the source/destination ID pair is the same
		- Retransmission of the TB carrying inter-UE coordination information is supported
 |

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| **Huawei, HiSilicon** | See comments above. We think we need to discuss the HARQ attribute for different cases listed as below. A: Standalone IUC MAC CEB: CSI MAC CE and/or DRX MAC CE + IUC MAC CEC: IUC MAC CE + MAC SDUD: CSI MAC CE and/or DRX MAC CE + IUC MAC CE+ MAC SDUIn addition, in Rel-16, there is no associated HARQ attribute for CSI MAC CE (reporting message), so not sure if we need to discuss the HARQ attribute for IUC MAC CE (reporting message). We are fine to follow the majority.  |
| **ZTE** | We can mimic CSI report MAC CE.  |
| **Intel** | Given the transitory nature of the IUC information, we do not think HARQ feedback for standalone IUC MAC CE is needed. Assuming we support multiplexing of IUC MAC CE with other SL data, we agree with Ericsson that it depends on the HARQ FB attribute for the associated logical channel. |
| **Lenovo** | Suggest to handling the IUC MAC CE as other SL MAC CE, e.g., CSI report MAC CE. |
| **Qualcomm** | RAN1 supports retransmission of the IUC MAC CE with data, e.g., with the same MAC CE content (same TB).**Agreement*** For inter-UE coordination information transmission in Scheme 1,
	+ Inter-UE coordination information can be multiplexed with other data only if the source/destination ID pair is the same
		- Retransmission of the TB carrying inter-UE coordination information is supported
* For explicit request transmission in Scheme 1,
	+ Explicit request can be multiplexed with other data only if the source/destination ID pair is the same
		- Retransmission of the TB carrying request is supported
 |
| **Fraunhofer** | We support the retransmission of IUC MAC CE with data. |

## Issue 3. Priority value/priority order of MAC CE for inter-UE coordination information

It has been decided to support MAC CE for IUC information report in RAN1. According to the RAN1 decision, RAN2 should determine the priority order/priority value of IUC MAC CE for logical channel prioritization and discuss this issue.

**Q3. If any, please comment if you have any missing issues or any suggestions for handling phase 2 discussion on this issue.**

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| **Company** | **Comments, if any (missing issues or suggestions for handling this issue)** |
| **Ericsson** | In our view, it is sufficient to let inter-UE coordination MAC CE to share the same priority order as CSI reporting MAC CE, since both MAC CEs are associated with latency bound. The UE can apply similar treatment for both MAC CEs without further differentiation between them in terms of priority order. |
| **Xiaomi** | **Priority could be higher than other SL MAC CE.** |
| vivo | No technical issue and is just about companies’ preference.Suggest to be ‘**Company input into Pre117-e-offline’**. |
| CATT | Some agreements on priority of IUC MAC CE were made in RAN1:

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| **Agreement**For inter-UE coordination information triggered by an explicit request in Scheme 1, the priority value of the inter-UE coordination information is (pre)configured priority value if it is provided by (pre)configuration. Otherwise, the priority value is the same as indicated by UE-B’s explicit request.* For the case when inter-UE coordination information is transmitted together with other data, the priority value of the multiplexed sidelink transmission is determined by the smallest priority value between the inter-UE coordination information and data

**Agreement**For inter-UE coordination information triggered by an explicit request in Scheme 1, the priority value of explicit request is (pre)configured priority value if it is provided by (pre)configuration. Otherwise, the priority value is the same as that of a TB to be transmitted by UE-B.* For the case when the explicit request is transmitted together with other data, the priority value of the multiplexed sidelink transmission is determined by the smallest priority value between the explicit request and data

**Agreement**For inter-UE coordination information triggered by a condition other than explicit request reception in Scheme 1, the priority value of the inter-UE coordination information is (pre)configured priority value if it is provided by (pre)configuration. * FFS: Otherwise, the priority value is determined by UE-A’s implementation.
* For the case when inter-UE coordination information is transmitted together with other data, the priority value of the multiplexed sidelink transmission is determined by the smallest priority value between the inter-UE coordination information and data
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RAN2 can discuss this issue based on above agreement. |
| OPPO | We don’t have strong view on the exact priority value, but our understanding is the **priority value of 2 different MAC CE can not be the same** unless there is no chance to transmit them in the same time. |
| **Huawei, HiSilicon** | As we commented during the online session, RAN1 has already discussed about this and achieved several agreements. See below. **Agreement**For inter-UE coordination information triggered by an explicit request in Scheme 1, the priority value of the inter-UE coordination information is (pre)configured priority value if it is provided by (pre)configuration. Otherwise, the priority value is the same as indicated by UE-B’s explicit request.* For the case when inter-UE coordination information is transmitted together with other data, the priority value of the multiplexed sidelink transmission is determined by the smallest priority value between the inter-UE coordination information and data

Based on our understanding, priority value and priority value is what indicated in SCI for the other UEs to monitor and refers to LCP priority value, priority value is the LCP priority value determined by RAN2.So the priority value marked with different color refers to the same one, i.e., LCP priority value. Actually this is also aligned with the Rel-16 logic, where the priority value indicated in SCI refers to the LCP priority value (smallest one). Therefore, in Rel-17, if we strictly follow RAN1 agreement, the LCP priority value should be (pre)configured or indicated by the explicit request. From RAN2 point, we can further discuss the detailed configuration (RRC CR issue) and the MAC CE design (MAC CR issue). In addition, since the CSI MAC CE and DRX MAC CE have a fixed priority value “1”, One remaining issue pending on RAN2 is the priority order among these MAC CEs if the IUC MAC CE is configured or indicated with a priority value “1”. Similarly if the IUC MAC CE is configured or indicated with the same priority value as data, how to handle the priority order between this MAC CE and data.  |
| **ZTE** | As comments in Q1, SL-BSR like priority order can be used as shown in following:- MAC CE for SL-BSR prioritized according to clause 5.22.1.6;- MAC CE for BSR, with exception of BSR included for padding;- Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;- MAC CE for the number of Desired Guard Symbols;- MAC CE for Pre-emptive BSR;- MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.22.1.6 and SL-BSR included for padding; |
| Lenovo | Agree with Huawei’s analysis, no strong view on the exact priority value of IUC MAC CE, but if IUC MAC CE shares the same priority value with CSI MAC CE, e.g., fixed priority value1, what should be discussed in RAN2 is the priority order handling between IUC MAC CE and CSI report MAC CE in the case that they cannot be transmitted at the same time. |
| Qualcomm | Similar to CSI MAC CE |
| Fraunhofer | We should follow the RAN1 agreements to prioritize the IUC MAC CE. |

## Issue 4. Timer to handle latency bound for inter-UE coordination

The need for a timer based approach for the transmission of IUC MAC CE has been mentioned in [4] and [5]. That is, the issue that could be discussed in RAN2 is how to ensure that the inter-UE coordination information can be transmitted to MAC layer in time since the inter-UE coordination information is time-sensitive.

**Q4. If any, please comment if you have any missing issues or any suggestions for handling phase 2 discussion on this issue.**

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| **Company** | **Comments, if any (missing issues or suggestions for handling this issue)** |
| **Ericsson** | In case MAC CE is used as the container for inter-UE coordination, it is beneficial to introduce latency bound for the MAC CE. In other words, the expected inter-UE coordination needs to be provided to UE-B within the latency bound, otherwise, the information would become invalid. Latency bound shall be defined for both inter-UE coordination request and inter-UE coordination information transmission.In case a UE-B triggers an explicit request message for intended UE-A, after UE-A has received the request message from UE-B, the expected coordination information needs to be provided to UE-B by UE-A in time so that UE-B can determine its resources for transmission considering the received coordination information. Otherwise, the coordination information becomes too late for UE-B to take this coordination information into account. Same as CSI reporting procedure defined in R16, UE-A can be configured with the inter-UE coordination latency bound by its peer UE via PC5-RRC signaling, **Issue 1: for explicit request procedure in scheme, what is the start/stop condition for the timer****Issue 2: for explicit request procedure in scheme, how to signal the timer value to UE-A?**In case of non-explicit request procedure in Scheme 1, as soon as a trigger condition is met, UE-A needs to transmit the coordination information within a latency bound so that UE-B can determine its resources for transmission considering the received coordination information. Otherwise, the coordination information becomes too late for UE-B to take this coordination information into account.**Issue 3**: **for non-explicit request procedure in scheme, what is the start/stop condition for the timer****Issue 4**: **for non-explicit request procedure in scheme, how to signal the timer value to UE-A?**In addition, RAN2 can further discuss if a common latency bound can be applied for both explicit request procedure and non-explicit request procedure in scheme 1. |
| **InterDigital** | This should use CSI report functionality (i.e. also timer-based) as a baseline, in which case, not much would need to be discussed other than whether we agree to support timer based or not. |
| **Xiaomi** | **Suggest to reuse similar mechanism as CSI report latency bound.** |
| **vivo** | Timer can be just one alternative, but this issue should be further considered whether we really need latency requirement for this MAC CE. And even if so, based on what information we can set the value of this timer. The latency aspects for CSI MAC CE was introduced by RAN1 actually, so the first question to answer for this aspect may be to ask companies in RAN2 to decide whether this latency bound can be directly concluded by RAN2. Considering the somewhat complicated situation, suggest to be ‘**Company tdocs invited’** |
| **CATT** | Agree with vivo. This issue related to the latency requirement for both IUC MAC CE and explicit request MAC CE. More analysis is needed. We also suggest change it to ‘**Company tdocs invited’.** |
| **OPPO** | Our understanding is this is a RAN2 issue and should be discussed in RAN2 since different from the CSI mechanism both the IUC report and the IUC request message are concluded as MAC CE (while CSI request is L1 signaling). We are fine to use the latency bound mechanism similar to CSI, including the timer length setting and start/stop/expiry condition discussion. |
| **Huawei, HiSilicon** | We think the following issues related to this aspect should be discussed.1. The applied scenario for the latency bound, i.e., explicit request procedure only or non-explicit request procedure only or both explicit and non-explicit request procedures.
2. How to configure this timer
3. When to start/stop this timer
4. When to cancel the IUC MAC CE
5. UE behaviour if transmission of a pending IUC MAC CE with the sidelink grant(s) cannot fulfil the latency requirement associated to the IUC reporting
 |
| **ZTE** | We can mimic the CSI report MAC CE procedure. |
| **Intel** | Agree with Xiaomi that we can consider CSI reporting mechanism as baseline and then check if companies have any additional enhancements/modifications in mind. |
| **Lenovo** | Share the view that taking the design of CSI report timer as baseline. Further, the timer-based approach can be applied for both non-explicit request scenario and explicit request scenario. For explicit request scenario, timer-based design should be considered not only for IUC MAC CE, but also for IUC request message. Agree the vivo s comments for change it to “Company tdocs invited”. |
| **Qualcomm** | For request based IUC , may be handled similarly to CSI MAC CE. For condition based IUC, what’s the time reference for the timer?  |
| **Fraunhofer** | Agree with Ericsson to further discuss the issues related to the IUC MAC CE timer. |

## Others

**Any essential RAN2 open issue is missing? Please provide input to the following table, if any.**

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| **Company** | **Other critical RAN2 open issues identified (if any)** |
| **Ericsson**  | **In case RAN1 agrees to introduce MAC CE for explicit request message, how to design the IUC request MAC CE?** |
| **CATT** | **Agree with Ericsson, MAC CE for explicit request should be discussed.** |
| **Huawei, HiSilicon** | **We think RAN1 has achieved the following WA.*** For Scheme 1,
	+ Following cast type(s) are supported for inter-UE coordination information transmission triggered by a condition other than explicit request reception
		- Groupcast/Broadcast for non-preferred resource set, FFS for preferred resource set
			* FFS: Under which conditions groupcast/broadcast can be supported
		- Unicast
			* FFS: Under which conditions unicast can be supported

**The conditions to support unicast/broadcast/groupcast are left to RAN2 for discussion. So we also need to discuss about this.** **In addition, RAN1 has finished the discussion on the content of IUC MAC CE and request MAC CE, we need to start the discussion on the design/MAC CE format of these two MAC CEs.** |
| **Intel** | As Huawei mentioned, the support cast types and associated conditions (if supported) need to be discussed. |
| **Lenovo** | Agree with Huawei, the conditions to support unicast/broadcast/groupcast need to be discussed. |
| **Qualcomm** | RAN1 agreed the following issues for RAN2 to decide.**Agreement**For determining preferred resource set in Scheme 1, when inter-UE coordination information transmission is triggered by a condition other than explicit request reception, * Values of following parameters are (pre)configured for a resource pool. If there is no (pre)configuration, UE-A determines by its implementation the values of the following parameters
	+ prio\_TX
	+ L\_subCH
	+ P\_rsvp\_TX
* UE-A determines by its implementation values of following parameters
	+ n+T\_1, n+T\_2
* FFS: Whether/how to support (pre)configuration of n+T\_1 and n+T\_2
* Note that it is up to RAN2 decision whether/how the values of these parameters are provided by PC5-RRC signaling from UE-B to UE-A and UE-A uses the received information to determine the preferred resource set

 **Agreement**For inter-UE coordination information is triggered by UE-B’s request, * A resource pool level (pre-)configuration can enable one of the following alternatives:
	+ Alt 1:
		- Resource set type to be provided by inter-UE coordination information transmission is determined by UE-A’s implementation and its information is indicated by UE-A’s inter-UE coordination information
			* UE-A’s inter-UE coordination information indicates either preferred resource set or non-preferred resource set
	+ Alt 2:
		- Resource set type to be provided by inter-UE coordination information transmission is indicated by UE-B’s request
			* UE-B’s request indicates either preferred resource set or non-preferred resource set
	+ Note that it is up to RAN2 decision whether/how UE-B provides its support of sensing/resource exclusion to UE-A via PC5-RRC signaling and UE-A uses the received information to determine the type of resource set to be transmitted to UE-B

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# Output Open Issue List and Recommendations

# References

1. R2-22xxxxx Coordinated Company Input For Rel-17 Open Issues Planning R2 117-e and impacts to R2 116bis-e RAN2 Chair
2. RAN2-116bis-e\_Rel17\_NR SL enh\_20220125\_1525R2-2201804
3. R2-2201804 Summary [AT116b-e][704][V2X/SL] Resource allocation enhancements LG Electronics Inc. (Rapporteur)
4. R2-2200375 Discussion on resource allocation enhancement OPPO
5. R2-2200939 Design of inter-UE coordination MAC CE Ericsson