**3GPP TSG-RAN WG2 Meeting #117-e R2-22xxxxx**

**E-meeting, February 21 to March 3, 2022**

**Agenda item:** 8.4.3.1

**Source:** Qualcomm Incorporated (Rapporteur)

**Title:** [AT117-e][003][eIAB] Open Issues (Qualcomm)

**Document for:** Discussion

# Introduction

This document captures:

* [AT117-e][003][eIAB] Open Issues (Qualcomm)

      Scope: Based on R2-2202329, progress remaining proposals. Determine agreeable parts, points for discussion if needed, open issues if needed. Aim for offline agreement, if not possible then pave the way for efficient on-line.

      Intended outcome: Report

      Deadline: In time for on-line CB W2 Wednesday

**The deadline for this discussion is Monday Feb 28, end of day**. This leaves sufficient for the rapporteur to summarize the discussion for Wed’s online session.

# Discussion

## RLF indication

**Issue 1:** Whether execution of CHO should be captured in the spec as a triggering condition for type-3 indication.

Email discussion [AT-116bis][048][eIAB] BH RLF indication (LGE) did not identify sufficient support to capture CHO execution as a separate trigger condition for type-3 indication (only 8 to 6). The opponents believe that “..triggering upon recovery” implicitly includes recovery via CHO.

The rapporteur takes from this discussion:

* Opponents may have a point that “...triggering upon recovery” could be understood as implicitly including the execution of CHO.
* Proponents may have a point that not everybody may agree with tis implicit inference, and therefore, it would be better to capture it explicitly.

The rapporteur believes that it is better to include information, even if it is unnecessary, than to leave out information that might be necessary.

**Observation 1: It is better to include information, even if it is unnecessary, than to leave out information that might be necessary.**

**Proposal 1: St2 to explicitly capture CHO as a triggering condition for type-3 indication.**

**Q1: If you do not agree with the rapporteur’s observation 1, you have the opportunity to make a case.**

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| **Company** | **Comment** |
| LGE | Note that in 38.300 clause 9.2.7, CHO executed after RLF is clearly specified as a recovery mechanism from RLF. So we think that in general “upon recovery” in stage2 would be sufficient and there is no strong need to specify CHO after RLF as a separate type-3 triggering condition. If companies really want to specify something, we are fine with capturing CHO executed after RLF as an one possible mechanism of link recovery by referring to the section 9.2.7. <38.300>9.2.7 Radio Link FailureIn RRC\_CONNECTED, the UE performs Radio Link Monitoring (RLM) in the active BWP based on reference signals (SSB/CSI-RS) and signal quality thresholds configured by the network. SSB-based RLM is based on the SSB associated to the initial DL BWP and can only be configured for the initial DL BWP and for DL BWPs containing the SSB associated to the initial DL BWP. For other DL BWPs, RLM can only be performed based on CSI-RS. In case of DAPS handover, the UE continues the RLM at the source cell until the successful completion of the random access procedure to the target cell.<omitted>After RLF is declared, the UE:- <omitted>- in case of CHO, for RLF in the source cell:- selects a suitable cell and if the selected cell is a CHO candidate and if network configured the UE to try CHO after RLF then the UE attempts CHO execution once, otherwise re-establishment is performed;- enters RRC\_IDLE if a suitable cell was not found within a certain time after RLF was declared.- <omitted>When RLF occurs at the IAB BH link, the same mechanisms and procedures are applied as for the access link. This includes BH RLF detection and RLF recovery. |
| Huawei, HiSilicon | Stage2 is more than sufficient. Stage3 spec should not capture such details. Type2/3 indication is somehow NW node operation, which can be trusted by implementation. |
| Fujitsu | Agree with Proposal 1. |
| Apple | Agree with Proposal 1. |
| Ericsson | Agree with LG and Huawei. It is sufficient in the stage-2 to just mention that the type-3 indication is sent upon RLF recovery. |
| Lenovo | Agree with P1. And stage-2 description is enough. |
| Samsung  | Not only 38.300 but also 38.331 has the CHO as an optional sub-feature in RRCReestablishment procedure. Recovery from RLF means only successful RRCReestablishment procedure. We don’t think any explicit specification on this standalone CHO is needed. It’s totally imbalanced. |

## RAN3 efforts

**Issue:** RAN3 agreed to proceed with solution 1 for latency reduction of intra-donor topology adaptation. RAN3 informed RAN2 about this solution in LS in R2-2106948. RAN2 replied with potential concerns in LS in R2-2109108.

Here is a brief summary of RAN3’s agreements on this topic including the critical issues:

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| RAN3 working assumption to proceed with Solution 1:For intra-donor migration, the solution set to support transfer of RRCReconfiguration for descendent IAB node over source path is limited to solutions 1 and 2. Further down-selection is expected.WA: Solution 1 for delivery of RRCReconfiguration over the source path in intra-donor migration is agreed. This WA can be revisited if RAN2 raises objections/remarks. Agreement on the mechanism for an RRC Reconfiguration message to be withheld by the parent node:Agree to confirm solution 1: An IAB-DU buffers an RRC message for a child IAB-MT based on an indication in the F1AP message carrying this RRC message.For solution 1, the conditions that an RRC Reconfiguration message “buffered” (i.e., withheld) by a parent node is “transferred” or sent to its child node:The RRCReconfiguration transfer in Solution 1 and RRCReconfiguration execution in Solution 2 can take place as soon as the routing table at migrating IAB node has been updated to have one or more entries for the target path, and there is RACH success of IAB-MT of migrating IAB-node.The condition for the descendant node to send the buffered RRC message to its child node is: Upon a descendant IAB-MT receiving the RRC reconfiguration for its own intra-donor migration (e.g., including the new IP address(es) without PCI change).**Critical issue**: What should parent node “buffering” (i.e., withholding) an RRC Reconfiguration message for a child node do when a new RRC Reconfiguration message arrives for the child node (e.g., due to IAB-node migration failure with subsequent recovery at different target node). RAN2 had insisted that the SRB PDCP SN order cannot be changed. WA: Upon migration/HO failure case, the buffered RRC message is still transferred to child node.When a second RRC Reconfiguration arrives for the child-node before the buffered RRC Reconfiguration message has been released to the child node, the parent node sends both RRC messages in sequence immediately.**Critical issue:** Can solution 1 be used in case IAB-migration is based on CHO rather than HO?RAN3 believes the CHO combined with solution#1 is not feasible.CHO combined with solution#1 is not addressed by RAN3 unless requested by RAN2.  |

 **[Pre117-e][003][eIAB] (R2-2202329) had the following discussion:**

START PRIOR DISCUSSION

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| **Q2. Please provide comments on the RAN3’s working assumptions that “Upon migration/HO failure, the buffered RRC message is still transferred to child node.” Are there potential obstacles? If so, how to overcome them?**

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| **Company** | **Comments** |
| Kyocera | We assume the withheld RRC message is no longer useful in this case. From the child node’s perspective, we assume the outdated RRC Reconfiguration with sync still initiates the access to the target cell, which is no longer accepted. If it’s the case, we think the parent node should discard the outdated RRC message rather than transfer it. We think it’s up to RAN3 on what condition the parent node discards the withheld RRC message and how the donor knows the withheld RRC message is no longer transferred by the parent node. We also think it’s up to donor implementation how to align PDCP SN for the new (subsequent) RRC message from the child node’s perspective.  |
| Ericsson | We are ok with the RAN3 WA, that is one of the possible approaches. The parent IAB node will deliver both RRC message in sequence, and the child will apply the IP address change in sequence, which is ok. In general, the CU is aware that there is a message with a certain PDCP SN intended for the child node stored at the parent node, and it can get around this issue by implementation. For example, another approach is to generate a new message with the same PDCP SN and letting the IAB node discard the previously buffered message. |
| Samsung | We don’t think there is any problem. And it is also not the case that transferring two RRCReconfigurations (one buffered, and one via new parent path after recovery) together is always necessary. Migrating IAB node is still anchored to the same donor CU and there is no strict requirement to send new RRCReconfiguration msg immediately after the migrating node’s recovery done because using old IP address at the descendant node doesn’t make any drop in the relaying node due to the local rerouting.Regarding the condition to transfer the buffered one, it is possible to fail to apply the received RRC msg. So to align this situation, we think the condition for transferring the buffered RRCReconfiguation should be further refined not just receiving but successfully applying as below:The condition for the descendant node to send the buffered RRC message to its child node is: Upon a descendant IAB-MT receiving (successfully applying the received) the RRC reconfiguration for its own intra-donor migration (e.g., including the new IP address(es) without PCI change).  |
| Fujitsu | We think the working assumption is acceptable. |
| ZTE | If the buffered RRC message is still transferred to child node upon migration failure, incorrect reconfiguration would be implemented by the child MT. Moreover, the child node which receives the RRCreconfiguration for its own intra-donor migration would release the withheld RRC messages to descendant nodes consequently. In this situation, all child/descendant nodes would initiate IKE and SCTP handshake using the new TNL address and default BAP routing ID received in the RRCReconfiguration message. And these uplink packets would be discarded at the migrating node due to the migration failure. On the contrary, if the buffered RRC message is discarded at the migration node upon migration failure, there would be PDCP SN gap issue. In order to resolve the above issue, one potential solution is the migration failure is informed to the descendant nodes so that descendant nodes won’t implement corresponding RRCreconfiguarion, e.g. the migration failure could be sent from the migrating node to descendant node via BAP control PDU. Another potential solution is that the buffered RRC message is discarded at the migration node upon migration failure and the donor CU is informed that the corresponding RRC message is discarded.  |
| Lenovo | We agree with the solution in WA.The buffered RRC message cannot be discard in the parent node due to a PDCP SN gap, and it should be still transferred to child node. In addition, the buffered RRC message and the second RRC message will be sent to the child node in sequence and the second RRC message can be used to indicate the HO failure implicitly. |
| Intel | As RAN2 replied in R2-2109108, RRC message should be delivered to child IAB-node in sequence and it should not be dropped/discarded the parent IAB-node. Therefore, RAN2 can confirm RAN3’s working assumption that “Upon migration/HO failure, the buffered RRC message is still transferred to child node”.It should also be noted that the RRC message cannot be modified at the parent IAB-node, as the RRC message is encrypted at PDCP layer, which can only be decoded by child IAB-node. The child IAB-node will receive an “out-of-date” *RRCReconfiguration* message due to migration failure (e.g. the BAP configuration in *RRCReconfiguration* message is out-of-date), which includes bap configuration and may also include other RRC configurations. For other RRC configurations (if any), the child IAB-node should continue process them, however, for bap-config, the child IAB-node should ignore such information to avoid unnecessary bap configuration change. For example, if a wrong/invalid BAP address is used at the child IAB-node, it may lead packet drop in the downstream. It is possible that there are some packets are sent before boundary IAB-node’s migration and buffered at the boundary IAB-node or parent IAB-node (e.g. due to lack of scheduling). For those packets, the destination BAP address used in the downstream packets are still the BAP address of child/descendant IAB-node before migration happens. Therefore, if the buffered RRCReconfiguration message which carried an invalid BAP address (due to migration failure) is processed at the child/descendant IAB-node, the destination BAP address in the BAP header cannot match with BAP address of the child/descendant IAB-node. This will lead to packet drop at child/descendant IAB-nodes which is unexpected.Therefore, the child IAB-node should be able to identify whether it should ignore or continue process the bap configuration in received *RRCReconfiguration* message. One simple way is to send a failure indication to the child IAB-node before withheld *RRCReconfiguration* message is sent to it. By receiving such indication, the child IAB-node is aware of how to handle the upcoming *RRCReconfiguration* message (e.g. whether ignoring IAB-related configuration or treat it as normal).There’s no need to send a successful indication, as the child IAB-node can proceed the received RRC message as normal if migration is successful. |
| LGE | It depends on which configuration is included in the buffered RRC message. For example, if the buffered RRC message at the parent node has a configuration for frequency change, e.g., PCI, the child node may have a problem to maintain a connection with the parent node and RLF may occur while applying this buffered RRC message. RAN3’s WA may have some troubles in this scenario.One possible way to avoid this problem is that the CU guarantees the buffered RRC message for the child node should not include configurations which can cause a RLF problem when the buffered RRC message is received upon migration/HO failure at the parent node. If configurations which cause a RLF problem is actually needed at the child node, such configuration can be transmitted by another RRC message after successful of HO or successful recovery of HO failure at the parent node. This approach is sub-optimal and needs a network restriction/guidance, but transferring the buffered RRC message even after migration/HO failure at the parent node would not generate a problem at the child node.If this network guidance is not acceptable, the optimal way to handle this problem is to make the child node discard the buffered RRC message upon reception this RRC message after migration/HO failure at the parent node. For this, we think that an additional indicator would be introduced to indicate whether the buffered RRC message should be discarded at the child node after receiving this message upon migration/HO failure at the parent node. This indication can be transferred before or together with the buffered RRC message after migration/HO failure at the parent node. To indicate the buffered RRC message correctly at the child node, the transaction identifier of the buffered RRC message or sequence number can be used. |
| Nokia, Nokia Shanghai Bell | Several issues and potential solutions have been presented by several companies:- some companies propose to generate a new message with the same PDCP SN. This is strictly against the security requirements and thus not acceptable.- some companies propose a new BAP control PDU to indicate that subsequent RRC message should be discarded. This would have the same security issue as Solution 2 since BAP control PDUs are not encrypted, or integrity protected.- it is also proposed to discard the RRC message in the parent and inform the Donor-CU. This does not help since Donor-CU shall not send any new RRC message with the same PDCP SN as discussed above.**As indicated also by other companies there will be undesired behaviour while child MT is processing the second RRC reconfiguration**. The buffered RRC reconfiguration and the second one will be processed one after the other by the child MT. According to RRC processing-delay requirements (section 12 in 38.331), the child MT is allowed to spend 10ms processing the second RRC reconfiguration. During that time the MT will act according to the first – now outdated – reconfiguration, which is not the desired behaviour.For this reason, in our contribution R2-2201054 to last meeting we propose that the **withheld RRC message is delivered to the child MT over a newly defined SRB**. This way:* The new SRB can be configured with a finite PDCP reordering timer (and thereby lossy delivery), meaning that there is no need to deliver an outdated RRC message to the UE;

Because PDCP reordering of the new SRB is independent of SRB1/2, a new RRC message, delivered over SRB1/2 as before, can bypass the withheld message immediately. |
| Futurewei | Similar to other companies we have concerns about delivering an incorrect RRC Reconfiguration message to the descendent node. Therefore, we are open to discuss solutions which allow the buffered message to be cancelled in case of a HO failure by the migrating node. |

**Rapporteur Summary:**As pointed out by Intel, RAN2 already informed RAN3 in R2-2109108 that the RRC message buffered should be delivered to the As RAN2 replied in R2-2109108, RRC message should be delivered to child IAB-node in sequence, and it should not be dropped/discarded the parent IAB-node.**Observation 4: RAN3’s working assumption “*Upon migration/HO failure, the buffered RRC message is still transferred to child node.*” follow RAN2’s explicit recommendation.**Some companies propose discarding or cancelling the outdated RRC message. Other companies emphasize that discarding/cancelling the outdated RRC message would create a gap in the SN order, which is prohibited. The Rapporteur agrees with this view. This was the reason for RAN2’s prior decision to ask RAN3 to have RRC messages be delivered in sequence. The Rapporteur also agrees with Intel that the new RRC message cannot reuse the same SN as the prior one since the PDCP SNs are inserted on PDCP layer and not on RRC layer. The Rapporteur further believes that sending two different messages with same SN is commonly considered a security breach and would certainly require confirmation by SA3.Samsung proposes that the buffered RRC message should only be released if the RRC reconfiguration received by the collocated IAB-MT does not contain a PCI change. The Rapporteur believes that the conditions for the release of the RRC message are in RAN3 scope.Intel proposes that the receiving IAB node should not process an outdated BAP address configuration since this may lead to DL data delivery failure on BAP layer. The Rapporteur believes that the BAP address configuration is performed during network integration and not during IAB-node migration of an ancestor node. This problem therefore does not exist.ZTE, Intel and LGE propose that the descendent node could be informed about the migration failure so that it doesn’t apply the outdated RRC message. As pointed out by Lenovo, the subsequent new RRC reconfiguration does exactly that, i.e., it informs the descendent node about the new, correct RRC Reconfiguration which overwrites the prior RRC Reconfiguration.Nokia proposes to introduce a new SRB to bypass the outdated message. The Rapporteur emphasizes that the outdated message must still be released at some point in order to reuse the old SRB. Therefore, nothing has been gained.LGE emphasizes that the CU can limit the information carried in the to-be-buffered RRC Reconfiguration so that such an RRC Reconfiguration does not do any harm even if delivered when outdated. The Rapporteur agrees with this view.The Rapporteur would like to stress the following:* Some companies believe that there are issues if the buffered RRC message with outdated information is delivered before the new RRC message with updated information.
* In the context discussed, the RRC reconfiguration for the descendent node only needs to contain a new IP address configuration. The delivery of an outdated IP address configuration limits any potential issues to the IP layer which is in RAN3 scope.
* To overcome concerns RAN2 realm, RAN2 should limit the information carried in to-be-buffered RRC reconfigurations to IP reconfigurations.

**Observation 5: RAN2 should not be concerned about RAN3’s working assumption as long as it only includes IP reconfigurations, which are in RAN3 scope.** **Proposal 3: RAN2 to recommend that RRC message buffering to be restricted to RRC Reconfigurations that only contain IP address reconfigurations.** |

END PRIOR DISCUSSION

After this pre-117 discussion, some companies phrased concern about P3. To make further progress, the rapporteur clarifies the following:

* The outdated RRC message only contains a new IP address reconfiguration and a new default UL mapping configuration.
* If the outdated RRC message is delivered and executed, the updated RRC message will follow right after (i.e., typically less than a few milliseconds).
* The execution of the outdated RRC message will therefore lead to the UL transmission of ONE single UL IKE packet with an incorrect source IP address and UL mapping.
* The IAB-node will retransmit the IKE packet with correct IP address and UL mapping as soon as it receives the updated RRC message.

In all this discussion, the rapporteur has not heard any other damage the delivery of the outdated RRC message could do. With this premise, the rapporteur believes that RAN2 should not spend more time on this discussion.

**Q2: What other damage (as outlined by the rapporteur) can the execution of an outdated RRC message containing solely a new IP address configuration and new default mapping have for the time frame of a few milliseconds until the updated RRC Reconfiguration arrives? Does this damage justify any additional measures to be taken, including spending valuable time in the online session?**

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| **Company** | **Comment** |
| LGE | Agree with clarification above and we don’t see other critical damage from the rapporteur’s original proposal. |
| Huawei, HiSilicon | Agree with rapporteur to not spend time on this discussion. |
| NEC | RAN2 need clarify if the solution 1 means that as long as the parent node is configured with CHO, the child node cannot receive other RRC reconfiguration messages. For an example, the handover RRC reconfiguration message of child IAB node is buffered in the parent node. When there is another RRC message for child node need to be delivered, the CHO of parent node is not triggered and still buffer the handover RRC reconfiguration message of child IAB node, the UE cannot receive the RRC in time before the parent node triggering CHO. |
| Fujitsu | Agree with rapporteur. |
| Ericsson | Agree to stop discussing this. RAN2 can just confirm that RAN2 does not have specific concerns on the RAN3 WA on how to deliver the second RRC message.  |
| Lenovo | Agree with rapporteur. |
| Samsung  | We also agree with the rapporteur’s analysis, and we see no other critical harm on the operation. |

**[Pre117-e][003][eIAB] (R2-2202329) had the following discussion:**

START PRIOR DISCUSSION

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| **Q3. Do you believe that contrary to RAN3’s view, CHO combined with solution #1 is feasible? How? If yes, should it be supported?**

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| **Company** | **Comments** |
| Kyocera | No. We think RAN3’s agreement should be respected.  |
| Ericsson | No. We think RAN3 assumption is correct, it is not a critical requirement to support CHO and solution 1 together in Rel.17, especially since that may complicate the specification work.  |
| Samsung  | We also have the same view with RAN3. CHO has the arbitrary time to be executed. For CHO combined with solution 1, there could be more frequent RRCReconfigurations from donor to that IAB node for current configuration modification, not for CHO migration. Assuming same method as solution 1 is also applied for CHO, the buffered RRCReconfiguration msg is always transferred together with new RRCReconfiguration to the child IAB node whenever that RRCReconfiguration was given to that child IAB node, and donor continuously configures the IAB node the RRCreconfiguration for buffering whenever consumed. Therefore, unnecessary RRC configurations might happen frequently. We think this seems to give the bad predictability in the network. |
| Fujitsu | Agree with RAN3’s view. |
| ZTE | No, we share the same view that solution 1 shall not be applied when the migrating IAB-node is configured with CHO from RAN2’s perspective.  |
| Lenovo | No. We also agree with RAN3’s view.  |
| Huawei, HiSilicon | No. RAN3 believes the CHO combined with solution#1 is not feasible. |
| Intel | No. |
| LGE | No, we think it is infeasible.  |
| Nokia, Nokia Shanghai Bell | With a solution of new SRB (proposed in R2-2201054), even CHO could be supported more easily since with CHO new RRC messages for the child IAB-node will arrive more often. |
| Futurewei | We generally agree that it does not seem very beneficial to use CHO with solution 1 to trigger the HO of the migrating IAB-node. However, we also don’t see that it is necessary to specify any restrictions either, as the use of CHO is anyway subject to network implementation.  |

**Rapporteur Summary:**Some companies misunderstood the question. The question was not IF solution 1 and CHO could be combined but HOW they both would be combined. The problem is that the RRC Reconfiguration to be buffered can only contain the IP address configuration for one target donor-DU, while the CHO command can contain RRC Reconfigurations for multiple target nodes with different donor-DUs. The majority of companies agrees with RAN3’s view.**Proposal 4: Agrees with RAN3 that RAN3’s solution 1 for latency reduction should not be applied for CHO.** |

END PRIOR DISCUSSION

The rapporteur believes that we can move forward with P4.

**Proposal 4: Agrees with RAN3 that RAN3’s solution 1 for latency reduction should not be applied for CHO.**

**Q3: If you do NOT agree with P4, please provide a concrete solution on:**

* **How to include a separate IP address configuration in the to-be-buffered RRC Reconfiguration for the descendent node for each candidate target cell contained in the CHO command to the ancestor migrating IAB-node, and**
* **How to let the descendent node receiving the buffered RRC Reconfiguration know, which of these candidate target cells from the CHO command the ancestor migrating IAB-node has selected, so that the descendent node can select the right IP address configuration from all those contained in the RRC Reconfiguration.**

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| **Company** | **Comment** |
| LGE | Agree with proposal 4.  |
| Huawei, HiSilicon | Agree with P4. |
| NEC | Agree with proposal 4. |
| Fujitsu | Agree with proposal 4. |
| Nokia, Nokia Shanghai Bell | Disagree with proposal 4.From the above Rapporteur Summary: The problem is that the RRC Reconfiguration to be buffered can only contain the IP address configuration for one target donor-DU, while the CHO command can contain RRC Reconfigurations for multiple target nodes with different donor- DUs.Yes a CHO command can contain RRC Reconfigurations corresponding to different donor DUs, but it does not have to do so. So in the case of a **single target donor DU**, the sought “concrete solution” is trivial, and we still gain the attractive CHO property that the delivery of the mobility command is not at risk due to a deteriorating radio channel.In the case of **multiple target donor DUs**, the migrating node and its descendants buffer one RRC Reconfiguration per target donor DU. The delivery of each of them to the child node is conditional on:* for the migrating node: a configured set of target cells;
* for a descendant node: a matching index received in the RRC Reconfiguration that was buffered by the parent node.

Upon delivery of a given RRC Reconfiguration, the other ones can be discarded. All this is possible without PDCP-SN issues thanks to the new SRB that we propose, which can be configured with a finite PDCP reordering timer (and thereby lossy delivery). |
| Apple | Agree with proposal 4. |
| Ericsson | Agree with Proposal 4. Supporting CHO would require more discussion/specification work in RAN2/3, and there is not time for that.  |
| Lenovo | Agree with P4. |
| Samsung  | Agree with proposal 4. |

## UE capabilities

All issues related to UE capabilities are no handled in [AT117-e][022][eIAB] UE capabilities (Intel).

## Other issues

**Q5: Are there any other issues?**

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| **Company** | **Comment** |
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# 3 Conclusion

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# 4 References

[1] R2-2202050, [Post116bis-e][079][eIAB] Open Issues (Qualcomm), 3GPP RAN WG2 Meeting 116bis-e, January 2022.