**3GPP TSG-RAN WG2 Meeting #116-bis-e R2-2202050**

**E-meeting, January 17 – 25, 2022**

**Agenda item:** 8.4.1

**Source:** Qualcomm Incorporated (Rapporteur)

**Title:** [Pre117-e][003][eIAB] eIAB Open Issues Input (Qualcomm)

**Document for:** Discussion

# Introduction

This document captures:

[Pre117-e][003][eIAB] eIAB Open Issues Input (Qualcomm)

The discussion is based on open issues identified in R2-2202050 [1].

**The deadline is February 14, 2021.**

# Discussion

## Update of ST2

The rapporteur will submit an updated running CR to TS 38300 to the meeting, which merges in RAN3 BL CR to TS 38300. This CR can be used as the baseline for further offline discussion during the meeting. Further refinements to the running CR to TS 37.340 related to the wording can be discussed in offline discussions during the meeting.

Editor notes in Running CR to TS 38.300:

Editor’s NOTE: The terms *BH RLF recovery failure indication* may be revised to BH RLF indication.

This issue is addressed in the section on RLF indication below.

Editor’s NOTE: FFS if more detail needs to be added on congestion-based rerouting.

The rapporteur believes that further details on congestion-based rerouting should be captured in 38.340, and they should be considered in offline discussion during the meeting. This Editor’s Note can therefore be removed.

Editor’s NOTE: The term topology needs to be defined (either in 38.300 or 38.401)

This term has been included in the CR to 38300 by RAN3. This Editor’s Note can therefore be removed.

Editor’s NOTE: FFS if different BAP header rewriting configurations are needed for inter-donor-DU local re-routing and inter-topology transport.

This issue will be discussed in AI 8.4.3.2. Based on the outcome of the discussion, the Editor’s Note can be addressed.

Editor’s NOTE: FFS how header rewriting for inter-donor-DU rerouting is combined with header rewriting for inter-topology transport.

This issue will be discussed in AI 8.4.3.2. Based on the outcome of the discussion, the Editor’s Note can be addressed.

Editor’s NOTE: FFS how the boundary node knows to which topology the ingress vs. egress BAP routing ID refers.

This issue has been addressed in an agreement of last meeting. The Editor’s Note can be removed.

Editor’s NOTE: FFS if any IAB-specific specifications are needed. FFS further details related to intra-/inter-donor migration/recovery.

RAN3-based section on intra-/inter-donor migration/recovery will be added. After that, the Editor’s Note can be removed.

Editor’s NOTE: FFS if dual-connected node triggers type 2 indication when the node detects BH RLF on any BH link

This has been discussed in RAN2. The next revision of the Running CR should capture the latest agreements. The Editor’s Note can be removed.

There are presently no Editor notes in Running CR to TS 37.340.

## MAC

Remaining MAC-related issues are discussed in thread [Pre117-e][014][eIAB] eIAB MAC Open Issues Input (Samsung).

## BAP

**Open issues identified in options *a* to *d* as well as BAP#1, 2, 3, 4 will be addressed in AI 8.4.3.2 as invited input.**

**Please provide contributions on this topic.**

Issue BAP#9 is addressed in section on RLF indication below.

Further refinements to TS 38.340 can be handled in offline discussion during the meeting.

## RRC

Open issues identified to RRC can be handled in offline discussion during the meeting. This includes ST3 issues related to CP-UP separation.

## RLF indication

**Issue:** Should type-2/3 RLF indication be propagated.

**Observation:** Email discussion [AT-116bis][048][eIAB] BH RLF indication (LGE) did not identify sufficient support for propagation of type-2 indication (only 6 to 10).

This implies that the following agreement applies: *If further propagation of type-2 indication is not supported, further propagation of type-3 indication is not supported.*

**Issue:** RAN2 agreed: *Not sufficient support that Type-2 indication triggered by a single-connected node includes routing information (such as unavailable routing IDs).* However, there is no agreement if Type-2 indication triggered by a dual-connected node can include routing information.

**Observation:** Email discussion [AT-116bis][048][eIAB] BH RLF indication (LGE) did not identify sufficient support for a type-2 indication triggered by a dual-connected node to carry routing information (only 5 to 10).

This implies that the following agreement applies: *If type-2 indication does not contain any routing information Type-3 indication does not include any routing information.*

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

**Observation:** 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.

**Issue:** Rel-17 terminology for type-4 RLF indication.

Email discussion [AT-116bis][048][eIAB] BH RLF indication (LGE) did indicate split views on renaming type-4 indication for Rel-17. The rapporteur understands that it is a little awkward if Rel-16 and Rel-17 use inconsistent terminology. To avoid this issue, the following two options can be considered:

* **Option 1:** The Rel-16 term “BH RLF indication” is used for type-4 indication in Rel-17.
* **Option 2:** Both Rel-16 and Rel-17 use the term “BH RLF recovery failure indication”. This would imply CRs for the affected Rel-16 documents.

**Q1: Do you prefer Option 1 or Option 2**

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| **Company** | **Option 1 or 2?** | **Comments** |
| Kyocera | Option 1 | We still prefer to keep the terminology as it is. We see in [AT-116bis][048] that there was almost equal number of proponents/opponents, so we assume it means there is nothing to be changed from Rel-16. Though, we don’t see any technical issue in both options, so we can accept Option 2 if majority wants. |
| Ericsson | Option 1 | We should avoid changing legacy definitions especially if related functionalities are not affected. Since the type-4 indication procedures/definitions are very clear from the legacy stage-2 and RRC specification, the terminology should be not be changed unnecessarily. |
| Samsung | 2 | We prefer intuitive specification, and think RLF indication cannot represent the RLF recovery failure indication even there is RLF detection indication for actual RLF detection. The cost of managing CR can be acceptable. |
| Fujitsu | Option 1 | Keeping the legacy term may be an easier way forward. |
| ZTE | Option 1 | We think both options works. So option 1 is preferred since no additional specification work is needed. |
| Lenovo | Slight prefer 1 | Because in the current specs, the “BH RLF indication” is explicitly defined for the case of BH RLF recovery failure, maybe no need to change the terminology and introduce CRs for the Rel-16 specs. |
| Huawei, HiSilicon | Option 1 | Prefer option 1.  If RAN2 deems to go with option 2, R16 CRs are needed. |
| Intel | Option 1 | Compared with option 2, this could reduce effort to generate new CRs to Rel-16. |
| LGE | Option 2 | No strong view. If majority wants the option 1, we can also accept the option 1. |
| Nokia, Nokia Shanghai Bell | Option 1 | For the sake of avoiding Rel-16 changes |

## 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. |

**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. |

**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. |

## UE capabilities

**Issue:** Whether to support UE capability for Rel-17 intra-donor-DU local-rerouting and inter-donor DU re-routing.

**Issue:** Whether need to differentiate the capability between “inter-donor CU partial migration” and “inter-donor CU routing for topology redundancy”.

**Issue:** Details on feature group.

Based on [AT116bis-e][051][eIAB] UE Caps, the views were split on these issues.

The rapporteur makes the following observations:

**Observation:** In Rel-16, BAP transport was considered mandatory and not supported with capabilities.

**Observation:** In Rel-16, RAN3 considered topology adaptation optional. No capabilities were supported since RAN3’s belief is that inter-RAN-node match up should be based on OAM and not based on capability signaling.

BAP header rewriting is certainly an Rel-17 enhancements of the Rel-16 functionality. If we wanted to depart from the mandatory support of BAP functionality for Rel-17 features, we would have to explicitly agree on it. Further, support for capabilities related to topology adaptation that are in RAN3 realm should be decided by RAN3.

**Q4: Do you believe that for Rel-17, BAP functionality should not be mandatory anymore as it is in Rel-16? Which aspects should not be mandatory anymore?**

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| **Company** | **Rel-17 BAP mandatory as in Rel-16?** | **Comments** |
| Kyocera | (No) | We have no strong view, but we assume the additional functions specified in Rel-17 are all optional in general. |
| Ericsson | No other capabilities besides BAP header rewriting. |  |
| Samsung | No | If the topology adaptation feature is optional, then BAP header rewriting needs to be optional since that is only necessary for some topological scenario. If we can split R17 BAP feature into BAP header rewriting and others, then only rewriting part can be optional with the remaining BAP feature to be mandatory as of R16. |
| Fujitsu | Maybe no. | We think most BAP-related capabilities discussed in the last meeting email discussion can be optional, such as BH RLF detection and recovery indication, BAP header rewriting, inter-donor-DU re-routing. No strong view. |
| ZTE | No | The BAP related feature group introduced in R16 is “Basic BAP procedures”, which consists of three components: 1) Routing; 2) Bearer mapping; 3) IP assignment over RRC. In our view, local rerouting is not included in the “Basic BAP procedures” feature group and is optional.  In RAN2#116bis-e meeting, it was agreed to define a new UE capability for BAP header rewriting based inter-donor CU routing as optional UE capability for IAB-MT. In our view, **the new UE capabilities for BAP header rewriting based inter-donor CU routing and BAP header rewriting based local rerouting should be optional**. It’s true that the procedures of inter-donor CU partial migration and inter-donor CU routing for topology redundancy are discussed in RAN3, BAP header rewriting in the two scenarios is definitely related to BAP which is in RAN2 scope. |
| Lenovo | No | The new BAP functions specified in R17 are optional, e.g., BAP header rewriting, BH RLF detection and recovery indication. |
| Huawei, HiSilicon | No | R17 feature is optional for IAB, since this is not the 1st release anymore. |
| Intel | No | First of all, we would like to clarify that for UE capabilities, that is mainly RAN2 domain and should be decided by RAN2.  Rel-17 enhances the topology scenario by extending intra-donor DU to inter-donor CU. However, for a fixed IAB-node, it’s not mandatory to support such expanded scenario, as the normal functionalities can be supported well within single IAB-donor DU, as in Rel-16. Therefore, we think Rel-17 BAP features, such as inter-donor DU re-routing, inter-donor CU routing and topology redundancy are **optional** features to IAB-node. Besides, it was already agreed in RAN2 #116bis-e meeting it is an optional UE capability:   * **[051] Define a new UE capability for BAP header rewriting based inter-donor CU routing as optional UE capability for IAB-MT.**   We don’t see a need to re-discuss this question. |
| LGE | No, this can be optional. | There may be a Rel-17 IAB node who does not support header rewriting functionality. |
| Nokia, Nokia Shanghai Bell |  | Rel-17 BAP extensions are subject to enhance BAP, thus if the node does not support Rel-17 BAP remains only Rel-16 |

## Other issues

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

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| **Company** | **Comments** |
| Intel | On UE capability, in [AT116bis-e][051][eIAB] UE caps, there are 7/13 companies support to define a new UE capability for Rel-17 local rerouting considering the newly agreed trigger conditions. 6/13 companies think it’s not needed. The views among companies are quite split. We think it is worth discussing such aspects in this meeting.  Besides, other FFS are also not discussed during this pre-meeting email discussion, for example, whether need to differentiate the capability between “inter-donor CU partial migration” and “inter-donor CU routing for topology redundancy, etc.  It was mentioned it will be discussed over this email discussion as summarized in R2-2202050, while it seems it is not included. We are wondering whether such aspects should be discussed based on companies’ contribution or not? |
| Nokia, Nokia Shanghai Bell | **Is local re-routing optional in Rel-16 BAP? We think no.**  The previous RAN2 meeting agreed:   * [048] Execution of local re-routing of all affected traffic among re-routable traffic upon BH RLF is not mandatory for a node capable of local re-routing. This can be revisited if there is a severe issue.   This agreement was justified by an understanding that local re-routing is optional in Rel-16 BAP. But as the spec quite clearly states as quoted below, it is not optional. Hence **the above agreement from last meeting should be reverted**.  *When the BAP entity has a BAP Data PDU to transmit, the transmitting part of the BAP entity shall:*  *- perform routing to determine the egress link in accordance with clause 5.2.1.3;* *5.2.1.3 Routing* *For a BAP Data PDU to be transmitted, BAP entity shall:*  *…*  *- else if there is at least one entry in the BH Routing Configuration whose BAP address matches the DESTINATION field, and whose egress link corresponding to the Next Hop BAP Address is available:*  *- select an entry from the BH Routing Configuration whose BAP address is the same as the DESTINATION field, and whose egress link corresponding to the Next Hop BAP Address is available;*  *- select the egress link corresponding to the Next Hop BAP Address of the entry selected above;* |
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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.