3GPP TSG-RAN WG2 Meeting #115-e draftR2-2109107

Online, 16-27 August 2021

**Agenda item: 8.4.3**

**Source: AT&T**

**Title: Report from [AT115-e][040][eIAB] Reply LS on reduction of service interruption for intra-donor migration (AT&T)**

**Document for: Discussion and Decision**

# 1 Introduction

This document discusses companies’ views on reduction of service interruption for intra-donor migration, in attempting to achieve consensus on a draft Reply LS to RAN3:

* [AT115-e][040][eIAB] Reply LS on reduction of service interruption for intra-donor migration (AT&T)

 Scope: Reply to R2-2106948.

 Intended outcome: Approved LS out

 Deadline: Monday W2 (for CB if needed)

At RAN2#115, LS from RAN3 [1] was received asking RAN2 to provide views on following two solutions for reduction of service interruption during intra-donor IAB-node migration:

Solution 1:

The RRCReconfiguration message for TNL migration of a descendent node IAB-MT is withheld by this descendant node’s parent IAB-DU, and it is delivered only when a condition is satisfied. The indication of buffering and conditional delivery may be provided by the IAB-donor-CU to the parent IAB-DU via an F1AP message including the RRCReconfiguration message. The condition is set so that a sequential delivery and execution of RRCReconfigurations is created downstream.

Solution 2:

The RRCReconfiguration message for TNL migration of the descendant-node IAB-MT is buffered by the descendent-node’s IAB-MT itself, and it is executed only when an indication is received from the parent IAB-DU. The indication of buffering and conditional execution may be included in the RRCReconfiguration. The condition for initiation and propagation of this indication is set so that it causes a sequential execution of RRCReconfigurations downstream.

RAN2#115 received 9 contributions [2-10], providing views on this topic. In this discussion document, the moderator has attempted to develop initial draft content for Reply LS to RAN3 based on received company contributions. After companies provide feedback on this initial draft content, moderator will develop a draft Reply LS to RAN3 for final review. Companies are encouraged to provide constructive feedback to help progress the discussion.

Deadlines for initial feedback and final review are as follows:

Deadline for feedback on initial content for Reply LS to RAN3: Friday 2021-08-20 2300 UTC

Deadline for feedback on draft Reply LS to RAN3: Monday 2021-08-23 2000 UTC

# 2 Views on Solution 1

All company contributions provided views on Solution 1. Contributions [3], [5], [6], and [10] articulated that Solution 1 has no RAN2 impact. Specifically,

* Contribution [3] observed that the explicit indication in the F1AP message to the parent IAB-DU to withhold the RRC Reconfiguration message to the child IAB-MT, and the determination of target path available to release the child IAB-MT’s RRC Reconfiguration message are both in RAN3 scope and there is no RAN2 impact for Solution 1.
* Contribution [5] discussed further details of Solution 1, including condition for release of RRC Reconfiguration to child IAB-MT and proposed that existing procedures can be reused when the parent IAB-node receives another RRC Reconfiguration before the trigger condition is met. This contribution also concluded that Solution 1 has no RAN2 impact.
* Contribution [6] suggested a different solution other than Solutions 1 and 2 for reduction of service interruption but observed that Solution 1 has no RAN2 impact.
* Contribution [10] observed that Solution 1 requires no RAN2 specification work as it is transparent to RRC. The contribution also observed that in case of unsuccessful random access procedure, the withheld RRC Reconfiguration message can with withheld (in case of successful reestablishment) or it can be dropped/deleted by the IAB-node (in case of unsuccessful reestablishment)

Contributions [2] and [4] were not in favour of Solution 1 and pointed out several issues with this solution. Specifically,

* Contribution [2] articulated that Solution 1 has an impact on RAN2 because in Solution 1, the RRC-Container is no longer transparent to the IAB-DU. In the moderator’s view, this is an incorrect understanding of Solution 1. In Solution 1, the indication to withhold the child IAB-MT’s RRC Reconfiguration is provided in an F1-AP message that is visible to the IAB-DU. Therefore, Solution 1 does not require the IAB-DU to look into the RRC-Container. Hence, there should not be a RAN2 impact, at least from this perspective.
* Contribution [4] observed that the release of withheld RRC Reconfiguration message to child IAB-MT should happen after successful TNL migration and F1-based BAP routing table reconfiguration. The contribution also highlighted issues for Solution 1 in case the migrating IAB-MT’s handover fails, or in case the CU sends a new RRC Reconfiguration message to the child IAB-MT.

Contributions [7], [8] and [9] either showed no preference between Solution 1 or Solution 2 or preferred both solutions. However, all contributions discussed either some issues or proposed some enhancements for Solution 1. Specifically,

* Contribution [7] proposed that the trigger condition for release of withheld RRC Reconfiguration should be F1 migration execution by the IAB-node. The contribution also proposed that upon IAB-node migration failure, the descendent node can remove the withheld RRC Reconfiguration message based on type-4 RLF indication. Finally, the contribution proposed some enhancements to Solution 1.
* Contribution [8] observed that Solution 1 is a CHO command delivery procedure. The contribution observed that Solution 1 has no new impact on UE and that it requires larger buffer for upstream migrating IAB-nodes compared to Solution 2. Furthermore, this contribution observed that Solution 1 is applicable when CHO is not used.
* Contribution [9] proposed that the withheld RRC Reconfiguration message is delivered after routing table for target path is updated at IAB node. The contribution also proposed that the withheld RRC Reconfiguration message shall not be delivered to child IAB-MT if parent IAB-MT migration fails, but subsequent RRC Reconfiguration messages could be delivered after expiration of reordering time expiration.

Moderator’s view is that from the perspective of the Reply LS to RAN3, the focus of this offline discussion should be on identifying potential impact to RAN2 or any major show-stopper issues. Also, as observed in [3] since the determination of target path availability for release of withheld RRC Reconfiguration is within RAN3 scope, any discussion related to trigger conditions for release of withheld RRC Reconfiguration message can be postponed until details of the finalized solution are being worked out.

Finally, regarding enhancements to Solution 1 proposed by some of the contributions. Since details of the solutions are still FFS, it is not productive at this stage to have a detailed discussion on proposed enhancements. Those can be discussed at the appropriate time when either RAN2 or RAN3 is working on details of the finalized solution decided by RAN3. Having said that, it is still useful to review proposed enhancements from the contributions to determine if any of those have a major impact on RAN2. Upon reviewing proposed enhancements from the above contributions, no major RAN2 impact was observed.

Based on the above analysis, moderator asks companies for feedback on the following text proposals to be included in Reply LS to RAN3 with respect to Solution 1:

**Text Proposal 1: RAN2 observes that Solution 1 has no significant impact on RAN2.**

**Question 1: Please comment on Text Proposal 1 wrt Solution 1 for the Reply LS to RAN3.**

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| Company | Comment |
| Huawei, HiSilicon | We would suggest to first discuss the issues mentioned in Text proposal 3 below (also in our contribution R2-2107252), and then we can see if there are major impacts to RAN2. So far we see no good solutions for the identified issues for solution 1.It is true that withholding a RRC message at DU doesn’t have explicit impact to RAN2, but the problem is that the RRC message would consume a PDCP SN, and not sending the PDCP PDU (which contains the RRC message) may cause unexpected problems from RAN2’s perspective. Note that RAN2 design has never expected a network node along the route to withhold a packet intentionally. |
| CATT | Solution 1 has no impact on RAN2 specification.But it has impact on RAN2 regarding “**a subsequent RRC Reconfiguration message for that child IAB-MT**” in TP3. As stated in our contribution: “**If the PDCP SN corresponding to the suspended RRC message is out of PDCP window, the suspended RRC message will never be received by the child IAB node.”** Since it can incur RRC message transmission failure, we cannot consider it after RAN3 decision.For example, The PDCP count value of the withheld RRC message is COUNT1 = [HFN(20bit), SN(12bit)]=[0…01,0…01]. The count value of next RRC message is COUNT2 = [HFN, SN]=[0…01,0…10].When the first RRC message is withheld by the parent node and the next RRC message is transmitted, PDCP entity for SRB1 in IAB node will perform PDCP reordering and deliver the next RRC message to upper layer. After PDCP reordering, the lower edge of the PDCP receiving window (RX\_DELIV) is updated to COUNT2+1. Since COUNT1<(COUNT2 +1), the corresponding PDCP PDU will be discarded even if the withheld RRC message is transmitted to the IAB node later.

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| TS38.323- if RCVD\_COUNT < RX\_DELIV; or- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:- discard the PDCP Data PDU; |

**We propose RAN2 discuss this question first before hasty decision.**  |
| Sony | We agree with Huawei and CATT that RAN2 should addressed those issues before making any decision. |
| Interdigital | We agree with the comments above from Huawei, CATT and Sony that further discussion is required before we can answer that solution 1has no RAN2 impact (as that is likely to be the case only if everything succeeds) |
| Qualcomm | RAN2’s proposed reply on solution 1 should be: **Solution 1 has no RAN2 impact. RAN2 emphasizes that for solution 1, the PDCP SN order cannot be disrupted, i.e., it is not possible to discard a RRC Reconfiguration message.**The alleged problem in TS38.323 mentioned by Huawei, CATT, Sony and IDT can be easily addressed.**Solution to Huawei’s, CATT’s and Sony’s problem:****If a new RRC Reconfig arrives, while the buffered RRC Reconfig has not yet been delivered, the parent will deliver both messages to the child. This child will then perform two IP address changes in sequence, which is not issue at all.****NOTE: RAN2 does not have to make a decision right now. RAN2 has solely been asked to assess the situation.** |
| Kyocera | We agree with Qualcomm, and also with Text Proposal 1.  |
| LG | We are fine with the text proposal. |
| Lenovo | Agree with the comments from Huawei, CATT, Sony and Interdigital that further discussion is required before we make the decision. |
| Ericsson | We are fine with the text proposal. Regarding the issue raised by HW/CATT, it is not clear at the moment why it cannot be solved by implementation, e.g. as in the solution mentioned by QC. |
| Fujitsu | We think solution 1 may not have RAN2 impact. Since the default t-reordering value is infinity for SRBs, the PDCP receiving window will not move if the early PDU is not received. The problem CATT point out does not exist. The buffered RRC message should anyway be sent to the descendant nodes, otherwise the following RRC messages will never be received.  |
| Samsung  | In general, we agree that solution 1 has no RAN2 impact since IAB DU doesn’t care about RRC message which should be transferred to the target IAB MT. Regarding PDCP SN issue pointed by CATT/Huawei, we understand that if the later generated RRC msg is received first, then the updated COUNT value makes the withheld RRC msg (which is earlier generated RRC msg) discarded at target IAB MT when transmitted later. However, even though this is correct operation in PDCP, in the depicted scenario, we think later generated RRC msg should replace the earlier generated RRC message, and be transmitted immediately to the target IAB MT. Already donor CU knows that there is pending RRCReconfiguration msg in the parent node DU due to not receiving RRCReconfigurationComplete msg via target path, and if it wants some RRC command it will send the new RRC msg without buffering indication in F1AP msg, so that DU replaces the withheld RRCreconfiguration with the new received RRC msg, and immediately transmitted to the target IAB MT. Always donor CU knows the situation of pending RRCReconfiguration, i.e., released or not, and based on this, donor can command whatever and whenever it wants.  |
| Intel | We agree there’s no RAN2 impact when IAB-node migration is successful. However, there might be some **RAN2 impact when IAB-node migration is failed**.For a UE or IAB-MT, from RRC protocol point of view, RRC messages must be received in sequence, and PDCP reordering timer for SRB is set as “infinity”. This indicates that the PDCP in the IAB-MT will wait for each RRC message in sequence order to perform reordering and deliver to RRC. The rest of the RRC messages received after *RRCReconfiguration* message will be buffered by the PDCP in IAB-MT and will not be delivered to RRC. If the RRC message is discarded by the migrating IAB-node on HO failure, the IAB-MT will not receive this particular RRC message. There are two issues here to be addressed:1) The PDCP layer in the IAB-MT will stall as it will not receive this packet and will wait for this packet before it can deliver the next RRC message to the RRC layers. 2) The RRC layer in the CU is expecting a response message to this RRCReconfiguration message that is discarded. The consequences of that on RRC handling in the CU has to be discussed by RAN2.Hence we agree with QC’s observation that the RRC Reconfiguration message should not be discarded. There cannot be a gap in PDCP SN.On the other hand, if the RRCReconfiguration message is delivered and the IAB-MT processes it, it can result in wrong configuration at the IAB-MT at least until the next RRCReconfiguration message is received.Hence, we think “how to proceed the *RRCReconfiguration* message when migrating IAB-node HO failure” and “How to ensure IAB-MT configuration is not impacted” is a **RAN2 issue**, as it impacts *RRCReconfiguration* message handling. This need to be further discussed in RAN2 depending on solution details. Considering above analysis, we would like to propose to capture following text in the Reply LS to RAN3:“**RAN2 identifies Solution 1 has no significant impact on RAN2 when IAB-node migration is successful. RAN2 need to study how to proceed the RRCReconfiguration message and how to ensure IAB-MT configuration is not impacted when there is a migrating IAB-node HO failure”.** |
| AT&T | Solution 1 has no impact on RAN2. Conditions, such as IAB-node migration failure can be looked at more closely. But as pointed out by some companies these issues are solvable by proper implementation. |
| Nokia, Nokia Shanghai Bell | We see the TP1 contradicts with TP3.There are expected some impacts. Thus, we think it is too premature from RAN2 viewpoint to state that Solution 1 has “NO significant” impact. It would be good to understand more details of the Solution 1 and be able to identify the list of potential impacts (as for Solution 2).  There are identified impacts to RAN2 that may not be possible to be handled transparently (e.g. PDCP SN for withheld RRC message).   |
| Futurewei | We agree comments from Nokia and other companies. It is premature to state that solution 1 has no significant RAN2 impact. We think the issues raised should be further discussed before reaching any conclusion. |
| NEC | We checked the PDCP issue proposed by CATT, but lower edge of PDCP receiving window RX\_DELIV is only updated when the first COUNT VALUE of PDCP PDU equals with RX\_DELIV is received. - if RCVD\_COUNT = RX\_DELIV:- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV;- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers, with COUNT value > RX\_DELIV;But we identified another issue that the PDCP receiving window will be stalled by the withheld RRCReconfiguration, which also cause the new receiving PDCP PDU discarded due to the stalled receiving window. However this is a really corner case since compared to DRB, SRB doesn’t have so many PDCP PDU to send. If it withheld the RRCReconfiguration for a very long time, the RAN2 PDCP may need some enhancement or take care of this issue by some implementation based solution.  |
| ZTE | We need to discuss the issues mentioned in Text proposal 3 below first, and then we can discuss whether there’s any impact or identified issue from RAN2’s perspective. In addition, we are wondering how the parent IAB-DU know whether the RRC message contained in the F1AP message is a RRCreconfiguration message or not. As we know, the RRC-Container IE in the F1AP message should be transparent delivered via parent DU. As stated above, at least further discussion is needed on this issue before we rush into the conclusion that there is no RAN2 impact.  |

**Summary:**

In general, companies who are opposed to saying “no impact” are mostly concerned about either the migration failure case or the case where new RRCReconfiguration is received by parent IAB-DU for child IAB-MT when there is already one RRCReconfiguration withheld for same child IAB-MT at the parent IAB-DU. None of the company contributions or comments have identified RAN2 impact for the success case. TP1 was drafted more from the perspective of the success case, while TP3 had tried to capture concerns related to the failure case. The reply LS can say that RAN2 will continue to study the other cases to identify any potential impact to RAN2. However, the reply LS cannot wait until RAN2 finishes discussing and agreeing upon any potential solutions needed to address the other cases. Moderator believes that the current status of discussion needs to be conveyed accurately to RAN3. Per current status, no issues have been identified for success case. For other cases, some potential issues have been identified. Some companies believe that such issues can be addressed by implementation, while some companies believe that RAN2 needs to understand more details of Solution 1 before identifying further RAN2 impact. Therefore, RAN2 will continue to discuss these other cases.

**Text Proposal 2: RAN2 observes that trigger conditions for release of withheld RRC Reconfiguration at parent IAB-DU in Solution 1 may need further discussion. Such discussion is within the scope of RAN3.**

**Question 2: Please comment on Text Proposal 2 wrt Solution 1 for the Reply LS to RAN3.**

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| Company | Comment |
| Huawei, HiSilicon | Does “release of withheld RRC Reconfiguration” mean to forward the message or to discard the message? |
| CATT | Solution 1 will make the RRC Message receiving error. RAN2 don’t suggest Solution 1. |
| Sony | We think the trigger conditions should be within RAN3 scope. |
| Interdigital | We are also a bit confused with the definition of the “release of the configuration”. If it is referring to the forwarding the message to the concerned child IAB-MT, isn’t it the completion of the handover of the parent node that is the trigger or there is an additional trigger condition.If it is referring to the discarding of the message when the handover fails, then isn’t it the detection of a HOF of the parent node that is the trigger? |
| Qualcomm | We agree with Proposal 2.We don’t understand the confusion by other companies. The message cannot be discarded due to SN consistency of PDCP. |
| Kyocera | We agree with Text Proposal 2.  |
| LG | It would be good to give an example for trigger condition for release, i.e., “after routing table for target path is updated at IAB node”. |
| Lenovo | Agree with Proposal 2. |
| Ericsson | Agree with Proposal 2. Maybe to further clarify, the word “release” should be replaced with “forward”. |
| Fujitsu | Agree with Proposal 2.The trigger condition is under discussion in RAN3 now. We can consider this is RAN3 scope. |
| Samsung  | We think the condition to release of the withheld RRCReconfiguration is when the IAB MT collocated with DU withholding RRC Reconfiguration msg has successfully completed the migration to the target path. The motivation of the LS is to give the information of TNL configuration a priori. But still completion of migration could have multiple meaning, i.e., RRC complete or F1 configuration complete or just TNL migration completed etc. So we agree that further discussion is needed, and it needs to involve RAN3 (we are not sure the discussion needs only RAN3 though). |
| Intel | “release of withheld RRC Reconfiguration” is confusing. If this refers to parent IAB-node transfer the withheld *RRCReconfiguration* message to its child IAB-MT, we could use “forward/send” instead. |
| AT&T | Agree.  |
| Nokia, Nokia Shanghai Bell | We think instead of “release of withheld RRC Reconfig” it would be clearer to say “sending the withheld RRC Reconfig to child MT ”.  We have some trouble understanding why such triggers are within the scope of RAN3 according to this TP whereas according to TP5 they are within the scope of RAN2. We think the right trigger equally applies to both Solution 1 and 2. |
| Futurewei | Agree with Nokia. It is not clear why different triggers would be appropriate for the two solutions. |
| ZTE | We observed that the withhold RRCreconfiguration message should be released after the routing entries for target path is configured. Otherwise, subsequent packet from child node using the new default BAP routing ID would be discarded by the parent node. Since the routing functionality is in BAP sub-layer, it is suggested to mention the above consideration on the trigger for releasing the withhold RRCreconfiguration message in the reply LS. The suggested text is as below:**RAN2 observes that the withhold RRCreconfiguration message should be released after the routing entries for target path is configured.**  |

**Summary:**

Company comments indicate concern with the use of the word “release”. As suggested by some companies, it may be better to use the word “forward” instead of “release” to make it clearer. Regarding the part of TP related to trigger conditions for Solution 1 being within the scope of RAN3, moderator agrees that the TP about trigger conditions should be made more generic and applicable to both solutions because both solutions need some additional discussion about trigger conditions.

**Text Proposal 3: RAN2 further observes that there may be additional aspects of Solution 1 requiring further discussion, such as addressing the case of IAB-node migration failure, or the case where an IAB-node with a withheld RRC Reconfiguration message for its child IAB-MT receives a subsequent RRC Reconfiguration message for that child IAB-MT. Since further details of Solution 1 are FFS, it is not clear whether such discussions will identify any further RAN2 impact. However, this can be discussed in RAN2, if needed, once RAN3 has finalized the solution for reduction of service interruption for intra-donor migration.**

**Question 3: Please comment on Text Proposal 3 wrt Solution 1 for the Reply LS to RAN3.**

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| Company | Comment |
| Huawei, HiSilicon | Again, we should not conclude that there is no major impacts to RAN2 even before we discuss the issues.  |
| Sony | We are ok with this. |
| Interdigital | We prefer to have something succinct, for example:**RAN2 observes that there are additional aspects of Solution 1 requiring further discussion, such as addressing the case of IAB-node migration failure (e.g., how to handle the buffered reconfiguration message, how to handle subsequent reconfiguration messages the child IAB-MT may receive via another path, etc).**  |
| Qualcomm | We prepose rewording:**Solution 1 has no RAN2 impact. RAN2 emphasizes that for solution 1, the PDCP SN order cannot be disrupted, i.e., it is not possible to discard a RRC Reconfiguration message.**As we pointed out above: If a new RRC Reconfig arrives, while the buffered RRC Reconfig has not yet been delivered, the parent will deliver both messages to the child. This child will then perform two IP address changes in sequence, which is not issue at all.**What else is there that needs to be resolved by RAN2?** |
| Kyocera | We agree with Text Proposal 3.  |
| LG | We are fine with the text proposal. |
| Lenovo | Agree with Proposal 3. |
| Ericsson | Agree with Proposal 3. Even though in the final version we can make it shorter, and just say that RAN2 may further investigate this solution once RAN3 has finalized its work. |
| Fujitsu | Agree with QC’s rewording. But don’t understand the solution QC proposed that the parent node should deliver the buffered RRC reconfiguration immediately when it receives a new RRC message. |
| Samsung  | This additional aspects involve the RRC message, so the discussion on sol1 is anyway necessary to involve RAN2. But agree with that once RAN3 fianlized the solution. |
| Intel | We think there’s a RAN2 impact when IAB-node migration is failed, which we may need to indicate to RAN3. See our comment in Q1.  |
| AT&T | Agree.  |
| Nokia, Nokia Shanghai Bell | We think TP3 shouldn’t imply RAN2  to potential issues identified and encourage RAN3 to do the down-selection before reaching a conclusion in RAN2 on how significant the impacts are.”  contradicts with TP1. Without knowing what the potential additional aspects are, its either better to wait for RAN3 progress or let RAN2 to analyze.   ~~Since further details of Solution 1 are FFS, it is not clear whether such discussions will identify any further RAN2 impact. However, this can be discussed in RAN2, if needed, once RAN3 has finalized the solution for reduction of service interruption for intra-donor migration.~~ |
| Futurewei | We are not sure that it would be that useful for RAN3 to know every detail of what RAN2 needs to further discuss regarding Solution 1. If companies see a need to include further of these details, then we think it can be concise (along the lines of what Interdigital has proposed above). Perhaps we can limit our comments to something like:**RAN2 observes that there are ~~additional~~ aspects of Solution 1 requiring further discussion, such as addressing the case of IAB-node migration failure.** |
| NEC | We are fine with this.  |
| ZTE | Agree with Text Proposal 3.  |

**Summary:**

Please see summary for Question 1. As discussed there, any potential issues for Solution 1 may be mainly related to cases other than the success case. The reply LS can articulate this and state that RAN2 will continue to discuss and identify any potential RAN2 impact for such cases. Note that based on company contributions and comments in this discussion, currently there does not appear to be consensus within RAN2 about whether or not there is RAN2 impact for cases other than the success case.

# 2 Views on Solution 2

All company contributions provided views on Solution 2. Contributions [2], [3], [5], [6], [9], and [10] discussed RAN2 impact for Solution 2. Specifically,

* Contribution [2] identified the following RAN2 impact for Solution 2: i) In RRC specification, a deactivation indication should be added in RRCReconfiguration for TNL migration; ii) In BAP specification, the preconfigured RRCReconfiguration could be activated by BAP PDU from the parent IAB node.
* Contribution [3] identified the following RAN2 impact for Solution 2: i) A condition is required in the RRC Reconfiguration message to the child IAB-MT for the execution of this RRC message; ii) A L1/L2 indication message needs to be defined which is transmitted by the parent IAB-DU to the child IAB-MT to trigger the execution of the RRC Reconfiguration message.
* Contribution [5] identified the following RAN2 impact for Solution 2: i) Define a new message/indication to indicate the successful RACH procedure of the migrating IAB-node, so that the child IAB-node can execute the stored RRCReconfiguration message; ii) For IAB node configured with a CHO target, additional DL RRC MESSAGE TRANSFER messages carrying the corresponding conditional RRCReconfiguration along with ancestor CHO-configured IAB identity need to be sent to each descendant nodes’ parent node.
* Contribution [6] concluded that Solution 2 would impact RAN2 in terms of creating new indications for the RRC Reconfiguration messages.
* Contribution [9] identified the following RAN2 impact for Solution 2: BAP protocol needs to be enhanced, i.e. a new indication should be introduced to indicate child MT to execute the buffered RRCReconfiguration message and the detailed signaling design is FFS. Additionally, this contribution discussed trigger conditions and proposed that the parent IAB-DU shall send the trigger indication to child IAB-MT after routing table for target path is reconfigured at the parent IAB-DU.
* Contribution [10] identified the following RAN2 impact for Solution 2: i) Indication in RRCReconfiguration signal to store the received RRCReconfiguration, or introduction of a new dedicated message for it; ii) Introduction in TS 38.331 of a new variable where to store the received RRCReconfiguration; iii) Procedures for the child IAB node to discard the stored RRCReconfiguration in case the parent IAB node fails the migration (e.g., new action upon reception of BH RLF indication); iv) New BAP control PDU (sent by the migrated parent IAB-node DU to the descendant IAB-node MT) for the execution of the buffered RRCReconfiguration at the child IAB-node MT.

Contributions [4], [7] and [8] discussed issues related to Solution 2 but did not provide clear views on impact to RAN2. Specifically,

* Contribution [4] reiterated the issue of trigger condition for release of buffered RRC Reconfiguration being related to successful TNL migration and F1-based BAP routing table configuration. The contribution also observed that for Solution 2, in case CU sends a new RRCReconfiguration message to the child node after the buffered RRCReconfiguration message, the new RRCReconfiguration message will be delivered to the child IAB-MT’s RRC layer once its PDCP reorder timer expires. In terms of impact to RAN2, contribution [4] suggested very limited standardization effort related to introducing the L2 indication from parent node to child node, which can be carried through new BAP control PDU.
* Contribution [7] observed that for Solution 2, there may be several paths configured for descendant nodes corresponding to candidate cells of the migrating node, and proposed that the migrating node should inform descendent nodes with the target cell or target DU after it executes CHO and the RA to target cell is successful.
* Contribution [8] observed that Solution 2 is a CHO procedure for which handover is triggered upon an indication from parent IAB node. The contribution also observed that Solution 2 has no new impact on UE, and implied that it requires smaller buffer for upstream migrating IAB node for RRC Reconfiguration message buffering compared to Solution 1. Furthermore, this contribution proposed to use Solution 2 when CHO is supported.

As discussed in the previous section, the Reply LS to RAN3 should focus on impact of both solutions to RAN2 and identify any major issues (e.g. show-stoppers). Company contributions did not identify any major issues for Solution 2. However, a majority of companies did identify RAN2 impact for Solution 2. Based views expressed by companies in contributions, the moderator proposes the following summary of RAN2 impact for Solution 2 to be included in the Reply LS to RAN3 with respect to Solution 2.

**Text Proposal 4: RAN2 observes that Solution 2 is expected to have the following impact on RAN2:**

* **Impact to RRC specification (38.331):**
	+ **Buffering indication added to RRCReconfiguration message for TNL migration or new dedicated message for such indication**
	+ **Definition of new variable to buffer received RRCReconfiguration**
	+ **Procedures for the child IAB node to discard the buffered RRCReconfiguration in case the parent IAB-node fails the migration (e.g., new action upon reception of BH RLF indication)**
* **L1/L2 indication (potentially new BAP control PDU) sent by the migrated parent IAB-node DU to the descendant IAB-node MT for the execution of the buffered RRCReconfiguration at the child IAB-node MT.**

**Question 4: Please comment on Text Proposal 4 wrt Solution 2 for the Reply LS to RAN3.**

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| Company | Comment |
| Huawei, HiSilicon | Generally the impact analysis should be fine. Not sure if the “new variable to buffer received RRCReconfiguration” is essential. On the other hand, we believe the impacts to overall RAN2/RAN3 are similar for the two solutions. The difference is that solution 1 may require changes to both RAN2 and RAN3, and solution 2 is more like a RAN2-only solution. |
| CATT | Yes, above issues need to be considered in RAN2. |
| Sony | We suggest to delete “**potentially new BAP control PDU**” as RAN2 haven’t had enough discussion on how to indicate this. |
| Interdigital | We agree the above issues need to be considered.  |
| Qualcomm | We propose the following rewording:* **Impact to RRC specification (38.331):**
	+ **Buffering iIndication for conditional execution to be added to RRCReconfiguration message for TNL migration or new dedicated message for such indication**
	+ **Definition of new variable to buffer received RRCReconfiguration**
	+ **Procedures for the child IAB node to discard the buffered RRCReconfiguration, e.g., in case the parent IAB-node fails the migration (e.g., new action upon reception of BH RLF indication)**
* **L1/L2 indication (potentially new BAP control PDU) sent by the migrated parent IAB-node DU to the descendant IAB-node MT to trigger for the execution of the buffered RRCReconfiguration at the child IAB-node MT.**

We don’t see why a new variable needs to be added to the RRCReconfiguration apart from the indicator.  |
| Kyocera | Agree with Text Proposal 4, while the rewording by Qualcomm is fine.  |
| LG | We are fine with the text proposal. |
| Lenovo | Agree with Proposal, and we can only focus on the L2 indication for the execution of the buffered RRCReconfiguration at the child IAB-node MT |
| Ericsson | Agree with Proposal, but we should also include the RRC configuration/deconfiguration needed to enable/disable the L1/L2 indication transmission by the parent node.Regarding the comments on the RRC variable, that is needed because we need to store in the MT the received RRC configuration. That may be similar to the VarConditionalReconfig used in legacy to store the CHO configuration, but it cannot obviously be the same. So some ASN.1 work may be needed here. |
| Fujitsu | General fine with the proposal 4. Just propose a revision as follow:* **Impact to RRC specification (38.331):**
	+ **~~Buffering indication added to~~ Condition for execution of the RRCReconfiguration message for TNL migration ~~or new dedicated message for such indication~~**
 |
| Samsung  | We are generally fine with the TP4, except discarding behavior. We don’t think explicit discard is necessary, because whenever donor CU generates and transmitted the RRC msg,to the child node, that will replace the buffered RRCReconfiguration and immediately applied. If the parent node is failed on migration, there is no chance the parent node to send L1/L2 indication to the child node (assuming the condition for indication is parent node’s successful migration complete). So there is no risk that unintended indication triggers the application of RRCReconfiguration buffered. Actually donor always knows the situation of pending RRCReconfiguration msg, and based on this, it can command any RRC msg whenever it want and let UE apply this by giving without buffering indication. This is also the same as in solution 1, i.e., DU once buffered RRCmsg will replace this with new received RRC msg if this RRC msg is not configured with buffering indication in F1AP msg. And keeping earlier generated RRCReconfiguration may be useful when failure at the parent node is recovered, donor might want to configure the same content as earlier generated RRCReconfiguation.  |
| Intel | Agree |
| AT&T | Agree |
| Nokia, Nokia Shanghai Bell | New variable can be matter of detailed modelling. At this stage we can identify the change  more generally that ASN.1 amendment are needed for buffered RRC Reconfiguration.But we note additional point may be worth to mention:* Potential security issues related to RRC Reconfiguration execution based on (unprotected) BAP indication
 |
| Futurewei | We prefer Fujitsu’s wording. We don’t need to provide a detailed description of stage 3 details to RAN3, especially before we have finalized our discussion in the topic in RAN2. |
| NEC | RAN3 de-prioritized the discussion of inter-CU mobility, but both RAN2 and RAN3 should try to figure a common solution applies both inter-CU and intra-CU mobility. It seems that solution 1 applies to inter-CU mobility, since the access IAB node can withheld the RRCReconfiguration for the UE, but solution 2 doesn’t apply to inter-CU mobility scenario, since UE can’t wait for a new BAP message to execute the RRCReconfiguration. So we suggest to add this observation.* **Incompatibility with Inter-CU mobility. UE can’t wait for a new BAP message to execute the RRCReconfiguration. So we suggest to add this observation.**
 |
| ZTE | We are not sure why we need to define a new variable to buffer received RRCReconfiguration. QC’s rewording look fine.  |

**Summary:**

Draft reply LS will take into consideration company comments. Companies can comment further on the posted draft reply LS.

Furthermore, regarding trigger conditions for Solution 2 as discussed by some contributions.

**Text Proposal 5: RAN2 observes that trigger conditions for release of buffered RRC Reconfiguration at descendent IAB-MT in Solution 2 may need further discussion. This is within the scope of RAN2, and such discussion can be had once RAN3 decides on the solution for reduction of service interruption for intra-donor IAB-node migration.**

**Question 5: Please comment on Text Proposal 5 wrt Solution 2 for the Reply LS to RAN3.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | Not fully understand the case of “release of buffered RRC Reconfiguration at descendent IAB-MT”. May be better to further clarify. |
| CATT | OK for the TP |
| Sony | Ok with the text |
| Interdigital | Is this referring to the case until when the IAB-MT of the child keeps the buffered reconfiguration message (e.g., if the parent never sends any L2 message to apply it)  |
| Qualcomm | We don’t understand this proposal. The RRC Reconfiguration is buffered by the IAB-MT. The execution of this RRC Reconfiguration is triggered by the L1/L2 signaling messages. What is it that needs to be discussed? |
| Kyocera | We have similar question with Huawei, InterDigital and Qualcomm. We’re wondering whether “release of buffered RRC Reconfiguration” means “discard” or “apply”.  |
| LG | Need clarification: considering description of solution 2, ‘release’ would be replaced by ‘execution’ in the text proposal 5, i.e., “release of buffered RRC Reconfiguration”. |
| Lenovo | Further clarify is needed for this proposal with “release of buffered RRC Reconfiguration at descendent IAB-MT in Solution 2”. Anyway, we agree to discuss the trigger condition after RAN3 have further decision. |
| Ericsson | We agree with Qualcomm. This text proposal does not seem to be applicable to Solution 2? |
| Fujitsu | Not understand what “release” here mean. Does it mean “discard”? |
| Samsung  | Fine with the TP5. Regarding terminology, the terminology of “release” is suitable to solution 1 case where parent IAB node DU releases the buffered RRC msg to the child node. For solution2, the buffered RRC msg can be “applied” on the condition met. |
| Intel | Further clarification is needed for “release of buffered RRC Reconfiguration”, does it mean UE will discard the buffered RRC Reconfiguration message? |
| Nokia, Nokia Shanghai Bell | We think instead of “release of buffered RRC Reconfig at descendant MT” it would be clearer to say “sending of execution indication to child MT”. Contrary to this TP, we think the trigger condition needs to be discussed before selecting either of Solutions 1 and 2 since it determines whether, if any, reduction of service interruption is achievable.  |
| Futurewei | Agree with observations from QCM and others that this TP does not seem applicable to solution 2. |
| NEC | We are fine with the TP.  |
| ZTE | Similar view with most companies that in solution 2, there is no need to have trigger conditions for release of buffered RRC Reconfiguration to descendent IAB-MT.  |

**Summary:**

Moderator agrees that the term “execution” is probably more appropriate to use instead of “release” for Solution 2. Furthermore, as stated in summary for Question 2, trigger conditions need to be discussed for both Solutions 1 and 2. Draft reply LS will attempt to reflect this. Companies can comment on posted draft Reply LS.

**Text Proposal 6: RAN2 further observes that there may be additional aspects of Solution 2 requiring further discussion, such as applicability with or without CHO support, or the case of IAB-node migration failure. Since further details of Solution 2 are FFS, it is not clear whether such discussions will identify any further RAN2 impact. However, this can also be discussed in RAN2, once RAN3 has finalized the solution for reduction of service interruption for intra-donor migration.**

**Question 6: Please comment on Text Proposal 6 wrt Solution 2 for the Reply LS to RAN3.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | Similar to solution 1, we need to discuss these issues first, and see if there are real impacts to RAN2/RAN3. Not useful to just inform RAN3 that there may be additional impacts to be discussed |
| CATT | OK but not sure if we need to inform RAN3 such details. |
| Sony | Ok with the text. |
| Interdigital | We agree with Huawei that we need to discuss further regarding RAN2/3 issues.So maybe a best reply LS will be to have a short response that is common for both solution 1 and 2, saying that there are possible impacts on both solutions, e.g. in the case of the failure of the HO of the parent, that need further discussion. |
| Qualcomm | We are fine with the proposal. |
| Kyocera | We agree with Text Proposal 6. One thing we would like to be confirmed is that both solutions can support the legacy UEs, although the signalling sequences for both solutions in the LS from RAN3 [1] do not involve the UEs. We don’t have any concern for Solution 1, while we’re just wondering for Solution 2 if the UEs may or may not need to support the new functions that are identified in Text Proposal 4 above.  |
| LG | We are fine with the text proposal. |
| Lenovo | Agree with Proposal 6. |
| Ericsson | Agree with Proposal 6. Even though in the final version we can make it shorter, and just say that RAN2 will further investigate this solution once RAN3 has finalized its work. |
| Fujitsu | OK with the proposal. |
| Samsung  | We also have the similar view that such details are necessary on RAN3’s table. And we think this buffered RRCReconfiguration behavior is independent with the CHO. CHO has corresponding condition and that is associated to the measurement configuration, while this has dedicated indication from parent node. Because of this, as Ericsson said, buffered RRCReconfiguratoin and CHO will have different signaling structure, and different variable. |
| Intel | We think at least “the case of IAB-node migration failure” has RAN2 impact, as RAN2 need to define under which condition IAB-MT can ignore the configuration in the received *RRCReconfiguration* message. We propose to update Text Proposal 5 into:“**RAN2 observes that trigger conditions for processing RRC Reconfiguration at descendent IAB-MT and how to handle buffered *RRCReconfiguration* when IAB-node migration is failed in Solution 2 may need further discussion. This is within the scope of RAN2, and such discussion can be had once RAN3 decides on the solution for reduction of service interruption for intra-donor IAB-node migration** |
| Nokia, Nokia Shanghai Bell |  In any case, we think it shouldn’t be stated in the LS that RAN3 can finalize the solution before reaching a conclusion in RAN2 on how significant the impacts are. |
| Futurewei | Similar to Q3, we are not sure that it would be that useful for RAN3 to know every detail of what RAN2 needs to further discuss regarding Solution 2. If companies see a need to include further of these details, then we think it can be concise. Perhaps we can limit our comments to something like:**RAN2 observes that there are aspects of Solution 2 requiring further discussion, such as interaction with CHO (if any) and addressing the case of IAB-node migration failure.** |
| NEC | We are fine with the TP. |
| ZTE | These issues mentioned in Text Proposal 6 is mainly RAN2 issues, we could discuss them in RAN2 first and determine whether there is RAN2 impact or not before we reply the LS to RAN3. Otherwise, it would be no meaning for RAN3’s decision making. |

**Summary:**

Some companies questioned the need to inform RAN3 of such details and stated the need to continue discussion of issues. Moderator suggests at least stating succinctly that RAN2 is continuing to discuss to identify further RAN2 impact.

# 3 Conclusion

Company comments will be taken into consideration in the draft Reply LS. Companies are invited to comment on posted draft Reply LS.

# 4 Contributions

1. R2-2106948, LS to RAN2 on reduction of service interruption during intra-donor IAB-node migration (R3-212973; contact: AT&T), RAN3
2. R2-2107066, Reducing Service Interruption during Intra-donor IAB-node Migration, CATT
3. R2-2107171, Discussion of RAN3 LS on Interruption time reduction for Intra-donor IAB-node Migration Qualcomm Incorporated, Apple
4. R2-2107252, Discussion on two logical DUs and service interruption reduction for RAN3 LS, Huawei, HiSilicon
5. R2-2107291, Intra-donor CU topology migration, Intel Corporation
6. R2-2107636, Topology adaptation and RLF handling in eIAB networks, Apple
7. R2-2107650, Reduction of service interruption, Fujitsu
8. R2-2107862, Discussion on Migration and Service Interruption, vivo
9. R2-2108140, Discussion on inter-donor migration and service interruption reduction, ZTE, Sanechips
10. R2-2108423, On Intra-donor Migration: Reduction of service interruption and CHO, Ericsson