**3GPP TSG-RAN WG3 Meeting #114-eR3-215901**

**Online, November 1st - 11th 2021**

Agenda Item: 13.2.2

Source: Ericsson (moderator)

Title: Summary of Offline Discussion on the Reduction of Service Interruption

Document for: Approval

# Introduction

This is the SoD for the following comeback: **CB: # 1303\_IAB\_Red\_Serv\_Inter**

The deadline for providing replies to Phase 1 is **Thursday, November 4th at 23.59 UTC.**

Relevant papers:

1. R3-214689 Reply LS to RAN3 on reduction of service interruption during intra-donor IAB-node migration (RAN2)
2. R3-214823 Reduction of Service Interruption in IAB Migration (Ericsson)
3. R3-214874 Discussion on service interruption reduction for Rel-17 IAB (Samsung)
4. R3-214925 Further considerations on service interruption reduction (ZTE)
5. R3-214954 Reduction of service interruption during IAB migration (Qualcomm Incorporated)
6. R3-215014 Discussion on reduction of service interruption (CATT)
7. R3-215303 Service interruption reduction for IAB migration (Lenovo, Motorola Mobility)
8. R3-215345 (TP for BL CR for TS 38.401) Discussion on Reduction of Service Interruption (Nokia, Nokia Shanghai Bell)
9. R3-215612 Reduction of Service Interruption for IAB topology update (Huawei)

# For the Chairman’s Notes

**Proposal 1-1: WA: Neither Solution 1 nor Solution 2 should be supported together with the CHO of the migrating node.**

**Proposal 1-2: For Sol1, a descendant node of the migrating node can release the RRC Reconfiguration messages towards each of its child nodes after it has received an RRC Reconfiguration message for itself that does not contain a change of Pcell. Additional prerequisites are FFS**

**Proposal 1-3: For Sol2, a descendant node of the migrating node can transmit the L1/L2 signalling message to each of its child nodes after it has received the L1/L2 signalling message from its parent node and executed the buffered RRC Reconfiguration message. Additional prerequisites are FFS.**

**Proposal 1-4: For a migrating IAB-MT that successfully executed RLF recovery towards the same target Donor-DU as the originally planned one, the buffered RRC Reconfiguration can be reused, and the same conditions apply as in the case of migration success.**

**Proposal 1-5: WA: Solution 1 is agreed.**

**Proposal 2-1: RAN3 to discuss the solution for avoidance of descendant node reconfiguration (i.e., an IP tunnel between Donor-DUs) after the baseline solution for inter-donor migration (that implies reconfiguring of descendant nodes) has been settled.**

**Proposal 4-1: After the MOBIKE is successfully performed during intra-donor migration, the IAB-DU sends an F1AP GNB-DU CONFIGURATION UPDATE message to inform the IAB-donor-CU that the existing inner IP address can be reused i.e. that the MOBIKE is successfully performed. FFS if the indication is explicit or implicit.**

**NOTE:** the TP in Proposal 4-2 below is modified wrt Phase 1, assuming implicit indication.

**Proposal 4-2: Agree TP for IAB BL CR for TS 38.401 in R3-21xxxx (revision of R3-215345), introducing the following changes to the Intra-CU Topology Adaptation procedure in clause 8.2.3.1 of the TS 38.401 (changes in yellow):**

In case IPsec tunnel mode is used for TNL protection, the IAB-node may use MOBIKE to migrate the IPsec tunnel to the new outer IP addresses. After the completion of the MOBIKE procedure, the IAB-DU initiates a F1AP gNB-DU Configuration Update procedure from which the IAB-donor-CU can conclude whether the existing inner IP address(es) (e.g. for SCTP association) and the DL FTEID can be reused.

**Proposal 5: No further enhancements for the avoidance of unnecessary UL transmissions, other than local UL rerouting, are specified in Rel-17.**

# Phase 1

**Disclaimer:** The Moderator prioritized some issues wrt some other. Some proposals have been left out because they are either too detailed at this stage or because they are dependent on other proposals.

## RRC Reconfiguration delivery via the source path in intra-donor migration

RAN3 is discussing two solutions for reduction of service interruption in intra-donor migration, where the transfer of RRC Reconfiguration for TNL migration of a descendent IAB node occurs over the source path. The two candidate solutions are:

* Solution 1, where the RRC Reconfiguration 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.
* Solution 2, where the RRC Reconfiguration 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.

After the RAN3#113-e meeting, the LS reply from RAN2 in [1] has arrived.

### Interaction with the CHO of the migrating node

It was previously agreed that Rel16 CHO is supported for the migrating IAB-MT in intra-donor migration. Paper [5] proposes the following:

* Solution 1 and CHO should not be supported together.
* Solution 2 and CHO should not be supported together.

The reason is that the opposite would require that RRC Reconfiguration messages for the descendants contain multiple sets of IP addresses, each set pertaining to one candidate target cell of the migrating IAB-MT.

**Potential proposal 1-1: Neither Solution 1 nor Solution 2 should be supported together with the CHO of the migrating node.**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| **Ericsson** | Agree |
| QCOM | Agree |
| Samsung | Agree |
| CATT | Disagree, we do not preclude the CHO for descendant node based on the agreement i.e., agreement is focus on the migrating IAB MT. At least for Solution 2, it can be used for CHO case. Consider the limit mobility for IAB node in current spec., the candidate cell will not too much e.g., 1 or 2. It allows the descendant node perform RRC reconfiguration including new IP address as soon as possible.  We can assume that CHO for descendant node as an optimization of solution 2. The difference is when the descendant nodes receive RRC reconfiguration. |
| Nokia | Disagree.  In both solutions, it takes time to send all RRCReconfiguraiton. We believe the two solutions are useful when CHO is used for the migrating IAB, so the CU have time to send all RRCReconfiguration. If it is normal HO, we doubt that some RRCReconfigurations may not be able to be sent over source path.  In case CHO with multiple candidate cells, the RRCReconfiguration for the descendant IAB also need to be prepared for the candidate Donor-DUs. We do not think it is an issue for IP address. |
| Huawei | Agree |
| Lenovo | Agree |
| Fujitsu | Agree |
| ZTE | Disagree, we think solution 2 could be supported together with the CHO of the migrating node. There won’t be too much candidate cells for migrating MT. so the IP addresses reservation won’t be a big issue. |
| AT&T | Agree |

**Summary:**

Agree: 7 companies

Disagree: 3 companies

**Proposal 1-1: WA: Neither Solution 1 nor Solution 2 should be supported together with the CHO of the migrating node.**

### Prerequisites at the descendant nodes

In Moderator’s understanding, at the RAN3#113-e meeting, the prerequisites pertaining to the migrating node in Solution 1 and Solution 2 were agreed. However, the agreement did not capture that the action taken by the migrating node in Solution 2 when the prerequisite is fulfilled is to transmit the L1/L2 signaling message to each of its child nodes. This can be corrected if Solution 2 is been selected.

The **prerequisites pertaining to the descendant nodes** were addressed in several papers, as follows:

* [5]: For **Sol1**, the IAB-node releases RRC Reconfiguration messages when it receives an RRC Reconfiguration message for itself that does not contain a change of Pcell.
* [9]: The RRC Reconfiguration transfer in **Sol1** and RRC Reconfiguration execution in **Sol2** can take place as soon as the routing table has been updated to have one or more entries for the target path (i.e., no RACH).
* [5]: For **Sol2**, when the IAB-node receives the L1/L2 signalling message from its parent node, it transmits the L1/L2 signalling message to each of its child nodes and executes the buffered RRC Reconfiguration message, if available.
* [4]: In **Sol2**, for descendant nodes, RRC Reconfiguration execution could be triggered as soon as the routing table at the descendant IAB node has been updated to have one or more entries for the target path, and the L1/L2 indication to trigger the execution of RRC Reconfiguration is received.

**Potential proposal 1-2:**

**For Sol1, a descendant node of the migrating node can release the RRC Reconfiguration messages towards each of its child nodes after:**

* **It has received an RRC Reconfiguration message for itself that does not contain a change of Pcell, AND**
* **Its routing table has been updated to have one or more entries for the target path.**

**Potential proposal 1-3:**

**For Sol2, a descendant node of the migrating node can transmit the L1/L2 signalling message to each of its child nodes after:**

* **It has received the L1/L2 signalling message from its parent node and executed the buffered RRC Reconfiguration message, AND**
* **After its routing table has been updated to have one or more entries for the target path.**

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| --- | --- |
| **Company** | **Answer** |
| **Ericsson** | **Agree to both** |
| **QCOM** | **Agree to both** |
| Samsung | For each solution, the first condition can be agreed.  However, the second bullet may need some discussions. The descendant nodes do not have any routing entry for the target path since the target path is transparent to it. Moreover, the descendant node cannot be aware which routing entry aims at transmitting data over target path. Thus, **we suggest to remove second condition for each proposal**. |
| CATT | Agree with SS. Moreover, can we say that the default mapping/routing has been updated at a descendant node? |
| Nokia | This is related to the question in 3.1.1. for example, in case CHO with multiple candidate cells are prepared for the migrating IAB, the RRCReconfiguration to the descendant may also configure more than one set of reconfiguration, e.g. one set for each Donor-DU.  This proposal should be discussed after the decision on 3.1.1  For Sol1, Please clarify “**a change of Pcell**”. In intra-Donor migration, the IAB does not need to change PCI/NCGI. |
| Huawei | Agree |
| Lenovo | Agree to both |
| Fujitsu | For Sol1, we wonder how the descendant node judge an RRC Reconfiguration is for topology adaption just rely on that the reconfiguration does not contain a change of PCell.  We think the prerequisite for descendant node to release message should be that it has received an RRC Reconfiguration does not contain a change of PCell **and contains a BAP reconfiguration or a IAB IP configuration as well.** |
| ZTE | Agree |
| AT&T | Agree to both |

**Summary:**

Agree to both: 6 companies

Concerns related to the second condition: 4 companies:

**Proposal 1-2: For Sol1, a descendant node of the migrating node can release the RRC Reconfiguration messages towards each of its child nodes after it has received an RRC Reconfiguration message for itself that does not contain a change of Pcell. Additional prerequisites are FFS**

**Proposal 1-3: For Sol2, a descendant node of the migrating node can transmit the L1/L2 signalling message to each of its child nodes after it has received the L1/L2 signalling message from its parent node and executed the buffered RRC Reconfiguration message. Additional prerequisites are FFS.**

### Migration failure of migrating IAB-MT in Solution 1

The following issue related to Solution 1 was raised:

* How to handle the buffered RRC Reconfiguration message, in case the migration of the migrating IAB-MT fails?
  + Paper [5] Argues that, in case of **failure of intra-migration and RLF recovery**:
    - At the **same Donor-DU**: the buffered RRC Reconfiguration can be reused and same conditions as in the case of success case can be reused.
    - At a **different Donor-DU**: both new and old RRC Reconfiguration should be delivered to the child, and since they will be received in a short time span, there is no issue with delivering the old RRC Reconfiguration.
  + On the other hand, paper [4] expresses doubts with respect to the statement from [5] and argues that parent IAB-DU does not know the RRC message content and hence cannot know when to release the buffered RRC Reconfiguration message.
  + Paper [9] analyses three possible ways of handling:
    - If **migrating IAB-node still sends** the buffered RRC Reconfiguration message, it will make the child IAB node to trigger TNL migration incorrectly.
    - Else if the **migrating IAB-node discards** the buffered RRC reconfiguration message, it will cause the PDCP SN gap in PDCP layer and the delivery of subsequent RRC messages may not be possible.
    - Else if the **migrating IAB-node sends some dummy message** to the child IAB node, it will cause the child IAB node to perform RRC Reestablishment.
  + Paper [9] argues that, in case Donor-CU sends a new RRC Reconfiguration message to the child IAB node after the buffered RRC Reconfiguration message, the new RRC Reconfiguration message will be delivered to the child IAB-MT’s RRC layer once its PDCP reorder timer expires, while the previous RRC Reconfiguration message is still buffered at parent node. There will be RRC configuration mismatch between child IAB-MT and Donor-CU due to the missing of the buffered RRC Reconfiguration message.

As noticed in paper [5], upon migration failure, the migrating node will attempt RLF recovery. In Moderator’s view, **if the RLF recovery fails**, the migrating node should not forward the buffered RRC Reconfiguration to its child nodes, because, in that case, the parent-child relations cease to exist, and every node is “on its own”. In other words, the **failure of RLF recovery (after failed migration) should not be considered.**

Regarding **successful RLF recovery of the migrating IAB-MT**, two cases can be considered:

* Successful RLF recovery at the **same target Donor-DU as the originally planned one**. case can be reused.
* Successful RLF recovery at a **different target Donor-DU than the originally planned one**.

**Q1-1: Do you agree that, for a migrating IAB-MT that successfully executed RLF recovery towards the same target Donor-DU as the originally planned one, the buffered RRC Reconfiguration can be reused, and the same conditions apply as in the case of migration success?**

**Q1-2: Do you agree that, for a migrating IAB-MT that successfully executed RLF recovery towards a target Donor-DU different than the originally planned one, both new and old RRC Reconfiguration should be delivered to the child?**

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| --- | --- | --- |
| **Company** | **Answer** | **Motivation** |
| **Ericsson** | **Yes, to both.** | Regarding Q1-2, we think that the reception of two consecutive RRC Reconfiguration messages at a child node within a short time-window will not do any harm.  Regarding the concerns from [4], stating that the parent IAB-DU may not know whether the RRC message encapsulated within the UA F1AP message is RRC Reconfiguration, we think that this is easily solvable by introducing the flag in the F1AP message indicating to the parent IAB-DU to buffer the RRC message within. Please note that such a flag, pertaining only to RRC Reconfiguration messages, is needed anyway for Sol1, i.e., even for the general (i.e., non-failure) scenario. |
| **QCOM** | **Yes, to both** | We agree with Ericsson’s assessment |
| Samsung | Yes, to both | Share the same view as Ericsson. |
| CATT | Yes to Q1-1 | For Q1-2, it depends on RAN2 because it is about PDCP SN gap and RAN2 are working on it. RAN2 also consider setting the t-Reordering infinity. And may be other solutions, for example, the withheld RRCReconfiguration for TNL migration to descendant node can be discarded and the parent node sends a PDCP PDU without data (PDCP header only) to the child node |
| Nokia |  | Q1-1: yes  Q1-2: no. this is in RAN2 scope to analyze the impact to the child IAB-MT.  Disagree with the comments “since they will be received in a short time span, there is no issue with delivering the old RRC Reconfiguration.” The new RRCReconfiguration is sent via target path. Even the parent node keep the 1st RRCReconfiguraiton until the 2nd RRCReconfiguraiton is received, there may be some UL using the 1st RRCReconfiguration and they are not correct. Anyway, this should be studied by RAN2. |
| Huawei | Yes to Q1-1;  No to Q1-2 | For Q1-2, if RLF is recovered towards a different donor-DU, then a new RRC Reconfiguration including a different IP instead of the previously assigned one should be delivered to the child node.  If both the old RRC Reconfiguration is still delivered, the child node will perform the TNL migration based on the old-expired IP address first, no matter how short the time-window is. And this will lead to a failed TNL migration, which is not expected for the service continuity insurance. |
| Lenovo | Yes to Q1-1 | For Q1-2, agree with CATT and Nokia that this is the issue discussed within the scope of RAN2. And the time to release the old and new RRCReconfiguration need to be further studied. |
| Fujitsu | Yes, and | In case of successful RLF recovery at a different target Donor-DU than the originally planned one, we think IAB node can send a type-3 RLF indication to descendant node before sending the old Reconfiguration, for the descendant node to ignore the old (i.e., the first received) RRC Reconfiguration of topology adaptation. |
| ZTE | Yes to Q1-1 | For Q1-2, it should be discussed in RAN2. |
| AT&T | Yes to both |  |

**Summary:**

Q1-1: “Yes” - 10 companies.

Q1-2: “Yes” - 5 companies, “No” – 2 companies, “RAN2 business”: 4 companies (1 of which also answered “No”).

**Proposal 1-4: For a migrating IAB-MT that successfully executed RLF recovery towards the same target Donor-DU as the originally planned one, the buffered RRC Reconfiguration can be reused, and the same conditions apply as in the case of migration success.**

### Downselection between Solution 1 and Solution 2

In this meeting, we need to prioritize one of Sol1 and Sol2, and move forward with specification. Please indicate your preference.

**Q1-3: Which of Sol1 or Sol2 do you prefer? Are you fine with either solution?**

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| --- | --- | --- |
| **Company** | **Sol 1 or Sol 2** | **Comment** |
| QCOM | Sol 1 | We believe that both solutions work, and that the specification effort for of them is manageable.  We prefer Sol1 since it does NOT require additional L2 signalling |
| Samsung | Sol 1 |  |
| CATT | Solution 2 | 1) Solution 1 result in descendant node being unable to apply other RRC messages e.g., DRB reconfiguration only when the buffered RRC message is sent out. While this issue does not exist in Solution 2.  2) BAP message is faster than RRC message  3) Solution 1 still needs some discussion in RAN2 based on the RAN2’s LS, however, solution 2 is clear enough. RAN2 already identify the spec. impact and there is no RAN3 effort is needed for now. |
| Nokia | Sol 1 | We slightly prefer Sol 1. |
| Huawei | Sol 2 | We prefer Sol 2 since there should be no ambiguities left, but there still remain issues to be addressed for Sol 1 according to the LS. Technically we also agree that both solutions could work. |
| Lenovo | Sol 2 | There is no remaining issue for Sol 2. |
| Fujitsu | Sol 1 |  |
| ZTE | Solution 2 | Solution 2 is preferred since whether solution 1 can work is still under discussion in RAN2 while the specification impact in solution 2 is clear. |
| AT&T | Sol 1 |  |
| Ericsson | Solution 1 |  |

**Summary:**

Solution 1: 6 companies.

Solution 2: 3 companies.

**Proposal 1-5: WA: Solution 1 is agreed.**

## Avoidance of descendant node reconfiguration

The topic was addressed in papers [2, 3, 5, 6, 7].

### The solution for avoidance of descendant reconfiguration for inter-donor-DU routing

Papers [2, 5, 6, 7] propose base the discussion on IP tunnelling between source and target donor-DUs, similar to what has been agreed for UL inter-donor rerouting.

**Potential proposal 2-1: For avoidance of descendant-node reconfiguration, RAN3 considers IP tunnelling via one or more IP tunnels established between source and target Donor-DUs.**

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| **Company** | **Answer** | **Motivation** |
| **Ericsson** | **Agree** | This is compatible with the inter-Donor-DU tunnelling that will be used for inter-donor UL rerouting. |
| **QCOM** | **Disagree** | We submitted [5] but we do not recall “proposing” such a solution.  While inter-donor-DU tunnel is the only viable solution among all the options discussed, **we do not agree** that this is the same as UL inter-donor rerouting.  While for UL, a tunnel can be statically configured, for DL, the tunnel needs to be dynamically configured and the exact cut-over time between direct transport and tunnelling is very critical, i.e., must be perfectly matched to the MT migration since there is no packet buffering, e.g., like in packet forwarding during HO.  Further, inter-donor-DU tunneling creates a very **suboptimal** transport path. This if fine for short term, e.g., as for local rerouting, but it is not a long-term transport solution. This means that the descendant-node reconfiguration is still necessary. To improve migration performance, Sol 1 and Sol 2 are completely adequate. |
| Samsung | See comments. | For IP tunneling, if only one inter-donor-DU tunnel is established, we are concerning the QoS guarantee. It is because that in legacy case, each DRB is configured with one or multiple tunnels so as to transmit different traffic via different tunnels. If multiple inter-donor-DU tunnels are established, the specification impact would be large.  Moreover, without reconfiguration to descendant nodes, such IP tunneling scheme should exist for the whole period where inter-topology F1 transport exists. This is different from UL inter-donor rerouting, which is only used for a temporary cases (e.g., in-flight packet during migration). It may cause additional processing burden and data transmission delay, which may not be able to reduce the service interruption time.  Compared to IP tunneling, allowing descendant node reconfiguration does not introduce too much specification impact. The service interruption time can be evaluated after the baseline inter-donor migration procedure is determined. Then, we can determine a suitable solution to resolve it.  If we really want to have a solution at this moment, as QC comments, we can use the IP tunnel for re-routing as a temporary solution to resolve the service interruption due to reconfiguration of descendant node.  Thus, we suggest:  **Avoidance reconfiguration of descendant node is postponed till the baseline inter-donor migration is clear when considering reconfiguring descendant node.**   * **A temporary IP tunnel (as suggested for inter-donor-DU re-routing) can be used to reduce the service interruption due to descendant node reconfiguration.** |
| CATT | Agree | We consider avoiding descendant node reconfiguration can bring some benefits. It can be used in both intra-CU and inter-CU migration. At least for intra-CU migration, we already have a clear picture. To avoid involving in complex methods to increase our work load, the option 4 mentioned in local rerouting can be reused. And we are open to further discuss the details. |
| Nokia |  | Let’s start with intra-Donor first.  Using tunnel may be one possible option to be further studied.  But we have a question. In case RRCReconfiguration can be delivered via source path, what is the scenario for this proposal? It seems RAN3 are developing 2 options:   * Solution 1: RRCReconfiguration via Source path (per 3.1) * Solution 2: Avoidance reconfiguration. (per 3.2)   Just wondering why need 2 solutions. |
| Huawei | See comments | Technically, inter-DU tunneling is a way to decrease the reconfiguration of descendant nodes. However, as discussed before, it is only a temporary solution focusing on the in-flight packets with unchanged source IPs. And we think this kind of inter-DU tunneling should be left to the implementation.  Besides, the avoidance of descendant-node reconfiguration is in conflict with Sol 1/2. And the IP tunneling mechanism is still under discussion, far from being a mature solution.  Question to SS’s suggestion of temporary IP tunnel, does that mean we first assume a temporary IP tunnel, then we still need to discuss the reconfiguration of descendant?  Maybe the question is, are we on the same page that reconfiguration of descendant anyway could be avoided? |
| Lenovo | Agree | Updating all the IP addresses for all descendant nodes and redirection their F1 interface may cause signaling storm and increase the service interruption during migration. And diploid overhead will be introduced if the partial migration is revoked. Therefore, it’s necessary to avoid update the IP addresses for descendant nodes when perform partial migration. In addition, IP tunnel between donor-DUs has been agreed for inter-donor-DU rerouting can be reused for this scenario. |
| Fujitsu | Agree | The solution for avoidance of descendant reconfiguration is a very efficient way to reduce the service interruption in inter-donor topology adaption. We don’t understand why inter-donor-DU tunnel should only be used for on-the-fly packets. |
| ZTE | See comments | We think the avoidance of descendant reconfiguration should be discussed after the baseline procedure for inter-donor routing is determined. |
| AT&T | Disagree | We have concerns that this is only a temporary solution and that descendent node reconfiguration is eventually necessary. Maybe this needs to be clarified. |

**Summary:**

“Agree”: 4 companies

“To be discussed after the baseline has been settled”: 2 companies

“Can be further studied”: 1 company

“To be left to implementation”: 1 company

“Disagree”: 2 companies

**Proposal 2-1: RAN3 to discuss the solution for avoidance of descendant node reconfiguration (i.e., an IP tunnel between Donor-DUs) after the baseline solution for partial inter-donor migration (that implies reconfiguring of descendant nodes) has been agreed.**

### The scenarios to be considered

Paper [2] argues that avoidance of IP address reconfiguration applies to all the scenarios where inter-donor routing is used, i.e.:

* Partial migration.
* Topology redundancy.
* RLF recovery.

Paper [5] proposes to discuss the scenario for intra-donor migration first.

**Potential proposal 2-2: The avoidance of descendant reconfiguration is considered for the following scenarios:**

1. **Partial inter-donor migration.**
2. **Topology redundancy.**
3. **Inter-donor RLF recovery.**
4. **Intra-donor migration.**

**NOTE:** The proposal is **not about prioritization**, but rather about general relevance.

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| --- | --- | --- |
| **Company** | **Answer** | **Motivation** |
| **Ericsson** | **Agree** | **A, B and C:** all these scenarios use inter-donor routing, where descendant nodes of the boundary node remain anchored at CU1 and they should be able to keep using the IP addresses from CU1 domain. Changing their IP addresses introduces additional service interruption, since each descendant IAB node needs to receive the new IP addresses via RRC, then set up SCTP association(s) using the new IP address(es), in order to be able to deliver the RRC Reconfiguration to child IAB nodes. Moreover, the addresses would need to be updated for F1-U tunnels as well.  **D:** this case also includes IP address change, so the same benefits apply for this case as well. |
| **Qualcomm** | **Disagree** | Again, inter-donor-DU-routing creates a suboptimal transport path and should only be used as temporary relief. Descendent-node reconfiguration is therefore necessary. Sol1 and/or Sol2 are sufficient for temporary relief. |
| Samsung | Agree A/C/D if avoidance of descendant node reconfiguration is agreed in RAN3. | If avoiding reconfiguration to descendant node is agreed in RAN3, the above scenarios can be considered. However, we are not sure if scenario B has any service interruption since the paths under CU1 are always available. |
| CATT | Agree all | For all four cases, the descendant nodes have to reconfiguration i.e., allocated a new IP address current. And we try to avoid it which is not only for service interruption. |
| Nokia |  | This AI is for intra-Donor, so let’s start with intra-Donor scenarios. |
| Huawei |  | On one hand, we agree that descendant reconfiguration could apply to the aforementioned cases; on the other hand, we spent time on solution 1 and 2, are we going to discuss descendant reconfiguration avoidance. Maybe we firstly need a base line solution for migration? |
| Lenovo | Agree all | And we can start with scenario D since the baseline procedures for other scenarios are still pending. |
| Fujitsu | Agree | A, B, C and D |
| ZTE | Disagree | We think the avoidance of descendant reconfiguration should be discussed after the baseline procedure for inter-donor routing is determined. |
| AT&T | Disagree |  |

Paper [5] proposes that the avoidance of descendant node reconfiguration should be first discussed for intra-donor migration, until the solution for descendent-node migration in inter-donor partial migration has been defined.

In Moderator’s understanding, the solution for avoidance of descendant node reconfiguration in both intra- and inter-donor case roughly consists of:

1. **Setting up the inter-Donor-DU tunnels:**
   * The mechanism for setting up tunnels for inter-donor UL rerouting (AI 13.3.2) can be fully reused.
2. **Configuring the Donor-DUs** how to recognize and handle the packets to be tunnelled:
   * For **UL** traffic, the solution for inter-donor UL rerouting produced in AI 13.3.2 can be reused in full or with minor enhancements, depending on whether BAP or IP packets are to be tunnelled.
   * For **DL**, the signalling for configuring the Donor-Dus that is to be specified in AI 13.3.2 can be reused, with minor DL-specific enhancements.
3. **Setting up the target path** for inter-donor routing:
   * Target path setup is discussed in AI 13.2.1.1 and AI 13.2.3 and is needed for all inter-donor routing scenarios, not just for the sake of the present discussion. The mechanism for configuring the new ancestors of the boundary node can be reused in full. As mentioned in point 2), the Donor-DU reconfiguration needs separate handling.

**Summary:**

“Agree”: 4 companies

“Disagree”: 4 companies, out of which 1 company thinks this should be discussed after the baseline has been settled.

“To be discussed after the baseline has been settled”: 1 company

“Start with intra-donor case”: 1 company

No proposal.

**Potential proposal 2-3:**

**The solution for avoidance of descendant-node reconfiguration reuses, as baseline, the following mechanisms defined for UL inter-donor rerouting:**

* **Setting up inter-Donor-DU tunnels.**
* **Configuring the source and target Donor-Dus.**

**The necessary enhancements are FFS.**

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| --- | --- | --- |
| **Company** | **Answer** | **Motivation** |
| **Ericsson** | **Agree** | The bulk of the work will be done in 13.3.2, and the present use case can be served with minor enhancements. |
| **QCOM** | **Disagree** | **We disapprove of avoidance of descendent-node migration since it is not necessary. We should stop discussing this matter.**  **In this meeting, we wanted to down-select between Sol 1 and Sol 2. This hasn’t been addressed in this email discussion.** |
| Samsung | Disagree |  |
| CATT | See comments | For the second one, configuration on source and target donor DU for DL is not clear for me. UL local rerouting can be discussed in AI 13.3.2, and we should focus on DL in this AI. |
| Nokia | Agree |  |
| Huawei | Pending | Technically seems to us nothing wrong with the proposal.  Can I understand that now we are choosing between avoidance of descendant-node reconfiguration and solution 1&2? |
| Lenovo | Agree |  |
| Fujitsu | Agree | Source donor-DU should also be configured since it should determine the DL packet for IP tunnel transmission.  If inter-donor topology adaptation is performed without reconfiguration of descendant nodes, the DL traffic for descendant nodes will still be delivered to source donor-DU (since the destination IP address(es) is not changed). However, the descendant nodes are no longer reachable after the IAB node migration. These DL traffic can be transmitted through the IP tunnel by source donor-DU to target donor-DU and added BAP header then mapped to BH RLC channel by target donor-DU. In this way, DL traffic can be sent to descendant node without IP reconfiguration. |
| ZTE | Disagree |  |
| AT&T | Disagree |  |

**Summary:**

“Agree”: 5 companies, including one company that proposes to focus on DL in this AI.

“Disagree”: 4 companies, out of which 1 company thinks this should be discussed after the baseline has been settled.

“Are we choosing between Sol1/2 and avoidance of descendant node configuration?”: 1 company

No proposal.

## Inter-donor routing setup

Paper [3] argues that, in partial inter-donor migration, the steps related to context transfer between the source and target CU, and the target path configuration, are the biggest contributors to service interruption.

Two general methods, entailing five different options for reduction of service interruption during inter-donor topology adaptation were discussed.

* **Method 1:** **Proper timing** for executing inter-donor context transfer and target path setup:
* **Option 1:** Triggered before sending Handover Request message.
* **Option 2:** Triggered after receiving Handover Request ACK message.
* **Option 3:** Triggered by the non-F1-termination donor, i.e., non-F1-termination donor sends indication to F1-termination donor.
* **Option 4:** Triggered by the boundary IAB node, i.e., triggered by receiving the first message via new IP address of boundary node.
* **Method 2:** Introducing **default BH configuration for UP UL** traffic:
* **Option 5:** The RRC Reconfiguration message can include default UP mapping information, i.e., default BAP routing ID, default BH RLC CH, for all UL F1-U traffic.

**Q3-1: Please state your view on the above Options.**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| **Ericsson** | **Up to implementation.**  RAN3 should define the procedure for inter-donor routing setup (i.e., for transferring the contexts between donors) for all the scenarios of interest: partial migration, RLF recovery, topology redundancy. When the network triggers the execution of the procedure should be **up to implementation**.  For example, as noticed in [3], Option 1 can be used for planned load balancing, since in that case the source and target Donors may have enough time to prepare the target path before the migration.  For the case of abrupt change of conditions under the source donor, we think that the concern related to Options 1 and 2 expressed in [3] (i.e., unnecessary setup of target path in case boundary MT migration fails) can be resolved if the source CU transfers the context necessary for target path setup in parallel with the HANDOVER REQUEST for the boundary MT and the target CU builds the target path and responds to the source CU after the boundary MT has successfully connected to target CU.  In any case, when deciding whether to accept the handover or the RLF recovery of the boundary MT, the target CU should be able to take an educated decision, which is only possible if it knows to how much backhaul resources it needs to allocate for the target path for partial migration/RLF recovery. This is not ensured by Options 3-5. |
| **QCOM** | **We disapprove of avoidance of descendent-node migration since it is not necessary. We should stop discussing this matter.**  **In this meeting, we wanted to down-select between Sol 1 and Sol 2. This hasn’t been addressed in this email discussion.** |
| Samsung | This issue cannot be resolved by simply saying “up to implementation”.   * Case of load balancing   We need to identify whether the unnecessary setup of target path in case boundary MT migration fails is acceptable. This is different from the normal handover, such resource pre-reservation will consume a large amount of resource at the target path due to all the traffic under boundary node and descendant node(s). Thus, we need answer the following question:  **Can we accept the unnecessary setup of target path in case boundary MT migration fails?**  Assuming the answer is yes, we can discuss the case of load balancing, and the option 1&option 2 is applicable, i.e.,  Our 1st view: Option 1&2 can be applied if we can accept the unnecessary setup of target path in case of boundary MT migration fails for case of load balancing.   * Case of abrupt change of conditions   In this case, target path cannot be prepared in advance. E/// mentioned that “the source CU transfers the context necessary for target path setup in parallel with the HANDOVER REQUEST for the boundary MT and the target CU builds the target path and responds to the source CU after the boundary MT has successfully connected to target CU”. We have the following concern:   * **The current WA may not allow to send context in parallel with the HO REQ message.**   Our WA assumes that new IP addresses of boundary node is not provided to the CU1 via HO REQ ACK message. If this WA is finally agreed, it means that the CU2 will use the new IP address of boundary node only to configure the DL mapping at CU2’s donor DU, which is used to transmit IKE/SCTP related packets. To ensure the DL mapping based on IP address only, the CU2 cannot configure any other DL mappings based on IP + DSCP/Flow label since the IP packets from CU1, e.g., SCTP INIT ACK, may have a DSCP/Flow label conflict with DL mappings. In other words, the DL mapping for other traffic should be configured after CU1 knows the new IP address of boundary node (i.e., after receiving F1AP gNB-DU configuration update message).  **The current WA can only allow to start the context (QoS Info.) transfer after informing new IP addresses of boundary node.**  To resolve this concern, we can allow the CU1 knows new IP address and DSCP/FL for IKE/SCTP traffic via the HO REQ ACK message. If this is agreeable, context transfer in parallel with HO REQ message is possible.  Our 2nd view: for case of abrupt change of conditions, if HO REQ ACK message is used to inform new IP address and DSCP/FL for F1-C related traffic (e.g., IKE/SCTP traffic), the context transfer can be implemented in parallel with HO REQ message, and Option 3&4 is not needed.   * **Target path preparation is time-consuming compared to RACH procedure of boundary IAB-MT**   Even we have parallel message transmission, the target path preparation is still time-consuming. It is realized by configuring each IAB node in the target path, which is not implemented in parallel. Moreover, each IAB node configuration requires at least 6 signalings (4 for F1AP, and 2 for RRC). Thus, it is hard to assume that the target path preparation can be finished before RACH of boundary IAB-MT.  **We cannot simply assume that the target path preparation can be finished before RACH of the boundary IAB-MT**  The abrupt change of conditions requires to implement the boundary IAB-MT migration very quickly, while target path preparation is time-consuming. Thus, **the normal assumption is that the target path preparation is finished after RACH of the boundary IAB-MT**  With this assumption, Option 5 can be a choice to resolve the interruption during the time gap between success RACH of boundary IAB-MT and target path preparation.  Our 3rd view: Option 5 can be a choice to resolve the interruption during the time gap between success RACH of boundary IAB-MT and target path preparation.  In addition, E/// mentions that CU1 needs to know whether the CU2 can admit the traffic of boundary/descendant node. This can be achieved by responding to CU1 after finishing target path preparation. However, another way is that the CU1 can provide some rough load information of boundary/descendant nodes in HO REQ message to allow CU2 make a rough admission control. |
| CATT | Method 1: for option 1and option 2, they may meet MT handover failure but introduce less service interruption; option 3 and option 4 may meet F1-C/F1-U migration failure for boundary node. We think that even if the boundary node migration successful but target donor cannot accept the F1-C/F1-U terminated at descendant node, this load balance procedure is meaningful less. But for partial migration, they are more urgent cases, MT have to handover or re-established anyway. We can define some progress to reduce the service interruption during context transfer.  In general,  For load balance, we support option 1 or 2 to make sure all F1-U can route to target path before boundary MT reconfiguration.  For partial migration and RLF, we support option 4 or option 5 |
| Nokia | Method 1: This may be up to CU’s implementation. CU1 may initiate the context transfer before (or during, or after) the HO of the IAB-MT.  Method 2: this may overload an intermediate BH RLC CH, since the migrating/descendant IAB uses a default BH RLC CH that is mapped to one egress BH RLC CH. This egress BH RLC CH will likely be congested. |
| Huawei | For method 1, the timing for executing inter-donor context transfer and target path setup, it should be left to the network implementation.  For method 2, default BH configuration for UP UL traffic, it is beneficial for the reduction of service interruption. When a UL packet is transmitted to the parent node of the IAB node, if the parent node has not received the updated BAP layer configuration from the donor CU via the F1AP message, it can use the default BH configuration to deliver the packet to the next corresponding default node. |
| Lenovo | For Option 1-3 of method 1, the timing for executing inter-donor context transfer and target path setup is left to CU’s implementation. And for Option 4 of method 1, it seems a bit strange for boundary node to trigger inter-donor context transfer and target path setup since the boundary node even doesn’t know whether they have been already performed or not.  For method 2, default configuration for UP BH traffic is workable same as the default configuration for non-UP BH traffic. However, the QoS differentiation cannot be guaranteed when all the UL BH traffic are mapped to only one BH RLC CH. |
| Fujitsu | Option 5 can be considered.  Option 1-4 are not necessary. Context of IAB-node can be sent to target donor-CU by Handover Request message with CHO request, then the target path can be configured via source path to IAB-node as well as descendant nodes before IAB-node executing handover. |
| ZTE | For method 1, we think the context transfer can be performed before boundary MT’s migration so that CU2 could configure the routing and bearer mapping on the target path in advance to reduce service interruption, which is similar as in intra-donor migration case. |

**Summary:**

The answers vaguely indicate companies’ preference, given that the companies speak about when is which option applicable, instead of expressing preference for on option. This may be due to the way the Moderator has asked the question.

The way forward is discussed in Section 4.

## Support for MOBIKE in intra-donor migration

Paper [8] Argues that the donor CU is unaware of whether the MOBIKE is applied to intra-donor migration, and further, if it was successfully applied. It is hence proposed to use the GNB-DU CONFIGURATION UPDATE F1AP message to explicitly indicate such an outcome to the donor CU.

Moreover, a TP for IAB BL CR for TS 38.401 is submitted.

**Potential proposal 4-1: After the MOBIKE is successfully performed during intra-donor migration, the IAB-DU sends an F1AP GNB-DU CONFIGURATION UPDATE message to inform the IAB-donor-CU that the existing inner IP address can be reused i.e. that the MOBIKE is successfully performed.**

**Note**: the Proponent is invited to explain the difference between Proposals 3 and 4, which are, in the first version of this SoD, treated as identical.

**Potential proposal 4-2: The following update to the Intra-CU Topology Adaptation procedure in clause 8.2.3.1 of the TS 38.401 is agreed:**

In case IPsec tunnel mode is used for TNL protection, the IAB-node may use MOBIKE to migrate the IPsec tunnel to the new outer IP addresses. After the completion of the MOBIKE procedure, the IAB-DU initiates a F1AP gNB-DU Configuration Update procedure to inform the IAB-donor-CU that the existing inner IP address(es) (e.g. for SCTP association and the DL FTEID can be reused).

|  |  |
| --- | --- |
| **Company** | **Agree/disagree? Please motivate if you disagree** |
| **Ericsson** | Agree to both. |
| **QCOM** | Agree to both |
| Samsung | We are wondering if this new indication can be implicitly deduced via MOBIKE procedure. |
| CATT | Agree to both, informed source CU new inner IP address or reuse old inner IP address (MOBIKE) |
| Nokia | Agree to both.  Regarding to Samsung comments, MOBIKE is performed between IAB and the SeGW. The Donor cannot know whether the MOBIKE is performed. So it needs an indication to Donor. |
| Huawei | Agree to both |
| Lenovo | Agree to both. |
| Fujitsu | Agree to both |
| ZTE | Agree, but perhaps implicit indication could be used via existing signaling, i.e. there is no need to introduce explicit indication in the DU CONFIGURATION UPDATE message. For example, if new outer IP address is indicated with the same inner IP address as before, that means inner IP address is reused while outer IP address is updated. |

**Summary:**

Agree to both: 9 companies, out of which 2 companies think that the indication can be implicit.

Disagree: 0 companies

**Proposal 4-1: After the MOBIKE is successfully performed during intra-donor migration, the IAB-DU sends an F1AP GNB-DU CONFIGURATION UPDATE message to inform the IAB-donor-CU that the existing inner IP address can be reused i.e. that the MOBIKE is successfully performed. FFS if the indication is explicit or implicit.**

**NOTE:** the TP in Proposal 4-2 below is modified wrt Phase 1, assuming implicit indication.

**Proposal 4-2: Agree TP for IAB BL CR for TS 38.401 in R3-21xxxx (revision of R3-215345), introducing the following changes to the Intra-CU Topology Adaptation procedure in clause 8.2.3.1 of the TS 38.401 (changes in yellow):**

In case IPsec tunnel mode is used for TNL protection, the IAB-node may use MOBIKE to migrate the IPsec tunnel to the new outer IP addresses. After the completion of the MOBIKE procedure, the IAB-DU initiates a F1AP gNB-DU Configuration Update procedure from which the IAB-donor-CU can conclude whether the existing inner IP address(es) (e.g. for SCTP association) and the DL FTEID can be reused.

## Avoidance of unnecessary UL transmissions

Paper [9] argues that, given that UL inter-donor routing helps avoid unnecessary UL transmissions, no further enhancements are necessary.

**Potential proposal 5: No further enhancements for the avoidance of unnecessary UL transmissions, other than local UL rerouting, are specified in Rel-17.**

|  |  |
| --- | --- |
| **Company** | **Agree/disagree? Please motivate if you disagree** |
| **Ericsson** | Agree |
| **QCOM** | **Agree** |
| Samsung | Agree |
| CATT | Agree |
| Nokia | Agree |
| Huawei | Agree |
| Lenovo | Agree |
| Fujitsu | Agree |
| ZTE | Agree |

**Summary:**

Agree: 9 companies

Disagree: 0 companies

**Proposal 5: No further enhancements for the avoidance of unnecessary UL transmissions, other than local UL rerouting, are specified in Rel-17.**

# Phase 2

In [3], two general methods, entailing five different options for reduction of service interruption during inter-donor topology adaptation were discussed.

* **Method 1:** **Proper timing** for executing inter-donor context transfer and target path setup:
* **Option 1:** Triggered before sending Handover Request message.
* **Option 2:** Triggered after receiving Handover Request ACK message.
* **Option 3:** Triggered by the non-F1-termination donor, i.e., non-F1-termination donor sends indication to F1-termination donor.
* **Option 4:** Triggered by the boundary IAB node, i.e., triggered by receiving the first message via new IP address of boundary node.
* **Method 2:** Introducing **default BH configuration for UP UL** traffic:
* **Option 5:** The RRC Reconfiguration message can include default UP mapping information, i.e., default BAP routing ID, default BH RLC CH, for all UL F1-U traffic.

In Moderator’s understanding, for the case where load balancing is executed in a planned manner, Options 1 The proposed enhancement to accelerate context transfer between the source and target CU, and the target path configuration needs to be further discussed (Section 3.3). One company argue that partial migration caused by an abrupt change of channel conditions should also be considered.

**Q3-2: For partial migration caused by an abrupt change of channel conditions, should RAN3 discuss an enhancement allowing to accelerate the execution of inter-donor migration steps for context transfer between the source and target CU and the target path configuration?**

**Q3-3: If the answer to Q3-2 is “yes”, which of the above 5 options should be supported?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| **Ericsson** | Q3-2 – Q3-3: if this is to be discussed, this should be done at the next meeting. We are not sure that there is time to converge during this meeting. |
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