3GPP TSG-RAN WG3 #110-e R3-207165

Online, 2-12 November 2020

Agenda Item: 13.2.2

Source: Nokia (moderator)

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

Document for: Approval

# Introduction

**CB: # 13\_IABreducingSvcInterruption**

**KDDI 5961:**

**- liaise RAN2 asking to introduce an IAB-donor indicator in RRC messages for RLF recovery and Handover which possibly leads to inter donor-CU change**

**SS 6000:**

**- default configurations for F1-U traffic (i.e., default BH RLC CH, default BAP routing ID) can be configured to the UE via RRC message (i.e., HO Command) during migration procedure. Whether F1AP can be used or not needs further discussion.**

**- “DAPS”-like solution can be discussed after inter-CU migration procedure is determined**

**- delay transmission of RRCReconfiguration message can be applied to reduce the service interruption of the descendant nodes**

**SS 6001:**

**- existing schemes, e.g., DDDS reporting, PDCP status report, can be used to ensure the lossless DL packet transmission during migration.**

**- to resolve the UL packet loss during migration, the configurable UL DDS scheme can be used, i.e., the IAB node will be configured on whether UL DDS is enabled or not.**

**- to avoid the unnecessary transmission of DL packets, the IAB node can keep the old configurations at source path for a while till the final on-the-fly packet is received.**

**- to avoid the unnecessary transmission of UL packets, the operator input is needed on the source IP filtering function, e.g., either disabling source IP filtering or update source IP filtering.**

**Intel 6209:**

**- Donor-CU-CP sends a F1AP message to notify the access IAB node about a handover is about to take place at one of the migrating parents IAB node**

**QC 6257:**

**- revisit descendent-node reconfiguration before IAB-MT handover due to potential failure conditions.**

**- discuss viable procedures for descendant-node reconfiguration via source path.**

**- discuss procedures for concurrent TNL migration of all descendent nodes during intra-donor topology adaptation to reduce interruption time.**

**- discuss means to reduce the number of signaling handshakes for F1 migration.**

**- Extend the NR-UP protocol to support uplink data delivery status reports to enable recovery of packet loss during intra-donor migration.**

**Nok 6288:**

**- to reduce the interruption for F1-U, one optimization is to provide the UL mapping configuration to IAB node via RRC message. If agreed, RAN2 need to be informed.**

**- In inter-CU TA, consider routing the “old” F1-U/C (of the source Donor) over target path.**

**CATT 6296:**

**- RRC reconfiguration complete message is conveyed in UL RRC message transfer, which is sent by default BH RLC channel and default BAP routing ID to the target CU to reduce service interruption.**

**- F1 setup association signaling is sent by default BH RLC channel and default BAP routing ID to reduce service interruption.**

**- To reduce the service interruption, the following methods can be considered:**

**1) Migrating IAB node and its descendant node send RRC reconfiguration complete messages concurrently.**

**2) F1 setup procedure of migrating IAB node and its descendant node execute concurrently.**

**- UE context modification response message is sent by default BH RLC channel and default BAP routing ID to CU to reduce service interruption.**

**- Redirection of IAB node DU’s F1 association to new TNL address(es) via default BH RLC channel and default BAP routing ID.**

**- To reduce the service interruption in intra-CU migration, the following methods can be considered:**

**1) Descendant nodes send UE context modification response message to CU concurrently.**

**2) Descendant nodes send RRC reconfiguration complete message to CU concurrently.**

**3) CU redirect descendant nodes’ DU F1 association to new TNL address (es) concurrently.**

**4) CU configuration BH RLC channel, BAP route and mapping rules concurrently.**

**- Descendant nodes could migrate concurrently when top tier IAB nodes dual connections.**

**- Mitigation of packet loss can be further discussed in RAN3.**

**ZTE 6561:**

**- reconfiguration of descendant nodes are performed via source path before the reconfiguration of migrating IAB-MT in order to reduce service interruption time.**

**- Rel-16 re-routing mechanism is reused in intra-donor DU migration scenario.**

**- Considering the backward compatibility and architecture complexity, it is suggested that identical architecture is used in Rel-16 and Rel-17 IAB, i.e. hop-by-hop RLC ARQ is adopted in Rel-17 IAB.**

**- Rel-17 UE could be enhanced to perform re-transmission based on PDCP status report. However, this method is not applicable to legacy UE**

**- access IAB node performs re-transmission using the updated IP addresses and BAP address on the target path after migration.**

**- further study how the access IAB node could determine which packets need to be re-transmitted on the target path after migration.**

**E/// 6587:**

**- consider RLF recovery solutions based on connectivity to two donors.**

**- investigate solutions for minimizing the impact of RLF recovery, e.g. enhancement to existing RRC re-establishment procedure to reduce latency.**

**HW 6667:**

**- take the procedure shown as baseline for inter-CU BH RLF recovery.**

**- study the mechanism for IAB-DU recovery (e.g. F1 connection re-establishment, rather than setup) in inter-donor-CU RLF recovery case, to achieve:**

**1) Avoid signaling storm in F1 interface between IAB-DU and new IAB-donor-CU.**

**2) Avoid long term service interruption for connected UEs.**

**- discuss behaviors of the descendent IAB-nodes/UEs of the IAB-node recovering to a new IAB-donor-CU via new path, in the following two aspects:**

**1) How can descendent IAB-nodes and UEs be aware of the CU change?**

**2) Whether descendent IAB-nodes and UEs should re-establish to new IAB-donor-CU with the recovery IAB-node?**

**ZTE 6558:**

**- take the proposed procedure as baseline for inter-CU BH RLF recovery.**

**- discuss whether to enhance the UE Context Retrieve procedure or to introduce a new XnAP procedure, for retrieving the IAB-MT context, the collocated IAB-DU context, and the context of descendant IAB-nodes/UEs from the old IAB-donor-CU to the new IAB-donor-CU.**

**- mechanism should be used in both handover scenario and RLF scenario, where the mechanism is used for the new IAB-donor-CU and the migrating IAB-DU to re-establish/update the context of F1 interface and the F1AP UE context.**

**- discuss how to deal with the descendant IAB-MT/UEs of the recovery IAB-node. For example, how to update the AS security between the descendant IAB-MT/UEs of the recovery IAB-node and the new IAB-donor-CU, while avoiding the descendant IAB-MTs/UEs to be forced into RRC re-establishment.**

**Chair: suggest to start stabilizing general principles before putting signaling flows on the table**

(Nok - moderator)

Summary of offline disc R3-206856

The discussion has two phases:

Phase 1: Enhancements to IAB service interruption (and others) to be discussed in Rel-17

Phase 2: TBD

The deadline for Phase 1 is Thursday, November 5, 12:00 UTC. This allows us to have some further discussion based on the 1st round feedback and discuss intermediate stage in Monday online session. We might be able to already achieve some agreements at this stage.

The deadline for Phase 2 is the same as for all email discussions, i.e., Tuesday, November 10, 12:00 UTC.

# For the Chairman’s Notes

Propose the following:

**Agree following proposals:**

**[For intra-Donor case]**

Proposal 3-1: The RRCReconfiguration to the descendant IAB can be transferred via the source path, i.e. before the migrating IAB detach from source parent cell.

Proposal 6: RAN3 study the packet loss issue, e.g. further clarify the scenario for packet loss and possible solutions.

Proposal 7: RAN3 discuss “Avoidance of unnecessary transmissions” with focus on RAN3 impact.

**[For inter-Donor case]**

Proposal 1: RAN3 study the solution for the baseline RLF scenario that IAB connect with 1 Donor.

Proposal 2-1: RAN3 agree an RRC indication is provided to the migrating IAB node on whether it is connected to a new donor or not. FFS on the content of the indication. This indication also applies to RLF.

Proposal 8: The issue on Reduction of Service Interruption for inter-Donor case will be discussed after the basic migration procedure is determined.

**Continue discussion on following:**

* Whether need an indication to the descendant node of the migrating IAB, i.e. to indicate a handover is about to take place at the migrating IAB node, and whether this indication is provided via a F1AP message.
* How to enable transfer the RRCReconfiguration to the descendant IAB via the source path, e.g. buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met.
* Whether use RRC to provide the UL mapping to enable early F1-U setup
* concurrent transmission of the descendant IAB nodes

# Discussion

## Scenario to be considered for RLF

Contribution ([9]) propose to only consider RLF recovery solutions based on the simultaneous connectivity to two donors.

Contribution [12][10] propose to consider RLF scenario that the IAB node only connect with one donor.

**Q1: Please share your view on the RLF scenario (e.g. whether only consider an IAB simultaneously connect with two Donors, or only consider an IAB node connect with one Donor, or both).**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | We need analyze both scenariosAt this stage, it may be too early to rule out any scenarios since we didn’t have the whole picture of RLF recovery procedure for each scenario. |
| Qualcomm | The baseline RLF recovery scenario should use RRC reestablishment, and the IAB-node is only connected to one IAB-donor at a time. This would build on Rel-16 IAB. The question is if RLF can also be supported when the IAB-node is in NR-DC. This scenario implies that the IAB-MT stays connected to the MN solely via SCG path without having MCG path, and it won’t be able to every switch over. This could be supported as a corner case of inter-donor redundancy, and we could discuss this at a later stage.In any case, this scenario should be discussed under inter-donor redundancy.  |
| CATT | Consider RLF scenario that the IAB node only connect with one donor.We agree that using redundant connectivity in the network can avoid the migration of IAB-MT and UE context at RLF recovery. If adding the SCG path in RLF case, how to switch the SCG path to MCG path? Furthermore, RLF is a short-time case. How the donor CU/IAB node knows that link will suffer RLF and configure a redundant connection in advance? Each IAB node configures redundant cause resource waste. |
| Huawei | About the RLF recovery, we should start with the baseline scenario that an IAB node only connects with one donor. Whether to support the dual connection to two donors is still under discussion, so the RLF case in such dual connection scenario should not be considered until we have clear conclusion on how to support the inter-donor DC. |
| Nokia | Connecting with one IAB Donor is the basic scenario, but we are ok to study both.  |
| ZTE | Aree with QC, we prefer to consider RLF scenario that IAB node only connect with one donor first.  |
| KDDI | We think enhancement for the case where an IAB simultaneously connect with two Donors can be discussed in CB # 14\_IABtopoRed. So, in this CB#13 we propose to focus on the case where an IAB node connect with one Donor. |
| Fujitsu | RLF scenario that the IAB node only connect with one donor is the baseline. We should further evaluate the impact of simultaneous connectivity to two donors, i.e. inter-donor DC.  |
| Ericsson | There is an overlap with CB#11.First, we should absolutely work on scenarios where an IAB-MT is able to simultaneously connect to two donors. Second, we think that RLF is a rare event, and we should find the ways to avoid context migration whenever possible. The following needs to be considered:* The device will most likely reconnect to the same cell as before RLF, since this is generally the strongest cell. This reduces the need for dedicated signaling.
* We should strive to reuse load balancing mechanism, which is possible in case the IAB-MT of the migrating node can connect simultaneously to two donors.

In case RAN3 prefers to discuss RLF recovery for connectivity to only one donor, then **RRC reestablishment should not be adopted as baseline** – we should consider the alternatives as well. Fetching a large number of contexts at once will incur a large processing and signaling load, so we think that the solutions where the contexts are shared in advance. |
| Apple | Agree that we should not be ruling out any scenario at this early stage. We should look RLF with IAB node connecting to one donor as baseline.  |
| Intel | Simultaneous connection to two donor via NR-DC is a nice option but shouldn’t be the baseline solution for RLF.But should discuss under CB14 |
| AT&T | RLF scenario should be based on connectivity with only one donor. Agree with comments from Qualcomm. |
| Futurewei | For RLF, connectivity with only one donor can be taken as the baseline scenario.However, there is no harm in analyzing RLF in the DC scenario also. But perhaps that case can be covered by CB14, as proposed by KDDI and Intel. |
| Verizon | Agree with Samsung, both scenarios should be considered. One donor connectivity scenario can be taken as baseline.  |

**Summary:**

* 12 companies commented the baseline is IAB connect with 1 Donor.
	+ 1 company commented the RRC reestablishment should not be adopted as baseline. But this may be the next step to be discussed.
* There is no objection to also study the scenario for connecting with 2 Donors, and it can be part of the inter-Donor topology redundancy discussion.

**Potential Proposal:**

**Proposal 1: RAN3 study the solution for the baseline RLF scenario that IAB connect with 1 Donor.**

## Indication to the migrating IAB and descendant IAB

Contribution ([1]) propose “the IAB-DU needs an IAB-donor indication, so that the IAB-DU can understand whether it needs a new F1-C establishment or just maintain the existing F1-C association.”

Contribution ([4]) propose “Donor-CU-CP sends a F1AP message to notify the access IAB node about a handover is about to take place at one of the migrating parents IAB node.” So the child IAB node can stop to accept the UL data from the UE to avoid buffer overflow.

**Q2-1: Please share your view on the indication to the migrating IAB, i.e. to indicate whether it is inter-Donor or intra-Donor migration, and whether this indication is provided via RRC message.**

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| **Company** | **Comment** |
| Samsung  | We can further consider it since it can help the F1-C connection establishment. However, we would like to consider such indication as a general one rather than the one for migration only. The reason is that even for RLF recovery procedure, we may need such indication to speed up F1-C connection establishment. The RRC message can be used, e.g., RRCReconfiguration message for HO, RRCRe-establishment message for RLF recovery.In summary, our view:* A general indication on whether F1-C establishment is need or not can be considered, which can be applied for both migration and RLF recovery case.
* Such indication can be sent via RRC
 |
| Qualcomm | For donor-controlled migration (e.g. handover or NR-DC), the CU could explicitly inform the IAB-node if F1-C connectivity to a new IAB-donor is necessary. This indication could be sent earlier than the RRC reconfiguration that initiates the migration, so that the IAB-DU can preemptively establish F1-C with the new IAB-donor.For autonomous migration using RLF recovery, the IAB-node should be able to detect from SIB if the parent candidate belongs to the same or to a different IAB-donor. This could also be used for preemptive F1-C establishment. The solution is in RAN2 space. We therefore propose:**Proposal 1: For RLF recovery, the IAB-node can discover from broadcast if parent-node candidate belongs to same or different IAB-donor.****Proposal 2: LS to be sent to RAN to accommodate broadcast for discovery of IAB-donor ID.** |
| CATT | Migrating IAB node could know whether it should F1 setup or just maintain the existing F1-C association base on the CGI. The CGI of migrating IAB node in inter CU migration would be change while CGI of migrating IAB node in intra CU migration is not changed.Furthermore, migrating IAB node can distinguish whether the target cell in the same CU as itself or other CU. Because target cell will broadcast target cell ID.[Moderator]: Due to the variable length of gNB ID, it is not possible to derive the gNB ID from the cell ID. So it may be not possible for the migrating IAB node to know whether it is intra or inter via the CGI of target cell.  |
| Huawei  | The migrating IAB node need to be aware of whether the connected donor CU is a new one after its migration procedure, so as for the descendent IAB nodes. This can be achieved by some explicit indication in RRC or from SIB 1. How to enable the awareness of IAB node can be further discussed by RAN2.  |
| Nokia | This indication is needed for both HO and RLF. The indication may need to indicate the Donor, e.g. an Donor has one neighbor Donor in the east and another neighbor Donor in the west. The IAB node may need to know the specific Donor ID in order to ask OAM to configure the related info (e.g. CGI). This may be further discussed on the specific information to be provided via RRC.  |
| ZTE | Migrating IAB node could determine whether it is inter-Donor or intra-Donor migration based on the received *RRCreconfiguration* message, e.g. if new TNL address for F1-C and new PDCP security keys are configured, migrating IAB node determines that it needs to perform F1 connection establishment with new donor. [Moderator]: This may be difficult, since the IAB also change Donor-DU during the intra-Donor topology adaptation, and get a new IP address. Security key can also be updated during the intra-Donor.  |
| KDDI | Contribution [1]* We agree to have an RRC indication inter-Donor or intra-Donor migration

Contribution [2]A buffer over flow on uplink happens in other cases rather than handover. So, we may want to consider more generic solution which can be applied to other use cases. |
| Fujitsu | Agree there is a need of donor indication for the descendant nodes to understand whether it needs a new F1-C establishment or just maintain the existing F1-C association upon RLF or handover. Further study can be considered whether to introduce new mechanism or utilize existing signaling.  |
| Ericsson | Both **problem statements are relevant**. In the migration discussion there are proposals to withhold the HO commands for descendant nodes, in which case the migration would be performed in top-to-bottom manner. Now, even though downstream devices are going to be reconfigured later than the migrating node, it is beneficial at least to make them aware and let them prepare for an imminent handover (discussed in Q2-2, Q6 and Q7).So, a possible proposal is (pertains to Q7):**Proposal 3: RAN3 to discuss the migration type indication (e.g. inter-CU migration, intra-CU migration etc.) to migrating nodes and their descendants.** |
| Apple | Agree for a new RRC indication to clarify inter or intra donor migration to the migrating IAB node. |
| Intel | We are fine with the proposals from [1] |
| AT&T | We agree the indication is needed and explicit indication by RRC is a candidate solution. Similar to Samsung we thinking it could be useful to consider a general indication for both migration and RLF recovery.  |
| Futurewei | We can agree to proposals from [1]. |
| Verizon | Indication to the migrating IAB node is definitely needed as to whether it is an inter or intra donor migration. RRC based or other solution should be considered.  |

**Q2-2: Please share your view on the indication to the descendant node of the migrating IAB, i.e. to indicate a handover is about to take place at the migrating IAB node, and whether this indication is provided via a F1AP message.**

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| **Company** | **Comment** |
| Samsung | The benefit is unclear. If the intention is to avoid the overflow, the existing UL hop-by-hop flow control (i.e., UL scheduling as agreed in Rel16) can be used.  |
| Qualcomm | We are not convinced that turning off transmission before migration and turning it on after migration reduces the overall interruption time compared to identifying lost packets with retransmission. We believe that UDDS would be good enough.  |
| CATT | The benefit of indicating the descendant nodes stop transmit packets to parent nodes is not clear, if the intention is to avoid overflow/packet loss in migrating IAB nodes, the other questions or CB would discuss it. Maybe the buffer packets can re-route to CU or introducing UL DDS.However, migrating IAB node sends indication to child node to trigger F1 setup procedure of child node or indicates child node send RRC reconfiguration complete message to CU would be useful.Generally, the indication from migrating IAB node to descendant nodes could be further discussed. |
| Huawei | No strong view, we share the view that the indication may be beneficial for avoiding UL overflow. But such overflow may also be solved by some existing UL scheduling way, as suggested by Samsung.  |
| Nokia | Further analysis is needed, e.g. vs the existing mechanism.  |
| ZTE | We think it is not necessary. We prefer that *RRCreconfiguration* messages are delivered to child/descendant nodes/UEs before *RRCreconfiguration* message is delivered to migrating IAB node. In this situation, descendant node could stop UL scheduling after receiving *RRCreconfiguration* message to avoid the overflow.  |
| KDDI | We share the view with Samsung. |
| Fujitsu | Maybe the motivation to avoid buffer overflow is not clear enough. The UL overflow during handover can rely on the congestion control indication which is already supported. If there is RLF, the migrating node can indicate the descendant nodes with RLF indication of BAP layer. So not clear there is any other issue. |
| Ericsson | We support this, included this in our proposal in Q2-1.  |
| Apple | Agree with Samsung. |
| Intel | As our contribution [4] stated, the grandchild node doesn’t know there is a HO happing at the migrating IAB. Thus the grandchild node will continue allocate grant to the UEs. Furthermore, if RAN2 agrees to local rerouting, grandchild node can use this indication to reroute the data. |
| AT&T | We have a favorable view for providing an indication to the descendant node(s). Relying on flow control may not be responsive enough to avoid unnecessary scheduling and overflow, especially if there are multiple descendant nodes (even further down the topology from the migrating node). We also agree with CATT there may be even more benefits in triggering earlier F1 setup/RRC reconfiguration procedures and signaling.  |
| Futurewei | Agree with Samsung. The benefit is not clear. |

**Summary:**

**For Q2-1:**

* 12 out 14 companies commented the RRC indication is needed
	+ 4 companies commented that this indication is needed for both HO and RLF.
	+ 2 companies commented that the indication need to indicate the Donor, e.g. Donor ID.
* 2 companies commented that it may be solved by existing information (e.g. CGI), but it may have some issues as moderator commented above.

**Potential Proposals:**

**Proposal 2-1: RAN3 agree an RRC indication is provided to the migrating IAB node on whether it is intra-Donor or inter-Donor migration. FFS on the content of the indication.**

**In case Proposal 1 is agreed, this indication applies to both HO and RLF.**

**For Q-2:**

* 10 of 13 companies commented the benefit is unclear, or such overflow may also be solved by some existing UL scheduling way.
* 3 companies support the proposal.
* It is suggested to deprioritize this issue, or discussed later.
* **No agreement. Continue discussion on the benefit**

## When send the RRCReconfiguration message to the descendant IAB

Contribution ([5]) describe the interruption when the RRCReconfiguration to the descendant IAB is sent over the target path, i.e. after the migrating IAB has successfully connected to target parent (call flow is copied as below). Contribution ([5]) propose to revisit descendent-node reconfiguration before IAB-MT handover due to potential failure conditions.



Contribution ([2][5][8]) propose the RRCReconfiguration to the descendant IAB is sent over the source path, i.e. before the migrating IAB detach from the source parent cell. Contribution ([2][5]) propose the RRCReconfiguration to the descendant IAB is first buffered in the DU, and is only sent to the descendant IAB when a condition is met (example from [5] is copied as below). In ([2]), the migrated IAB node send the RRC message to the descendant node as long as its IAB-MT part receives its own RRC message.



Figure 4: Example for reconfiguration of the descendant nodes via source path *conditionally on* successful handover execution by the migrating IAB-node

**Q3-1: Please share your view on transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell.**

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| **Company** | **Comment** |
| Samsung | Agree “transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell”. This can be considered to send RRCReconfiguration in advance.  |
| Qualcomm | Please note that this relates to Int**RA**-donor migration. Indeed, this topic needs to be handled.We believe that sending the RRC Reconfiguration via the source path creates problems as discussed in [5] unless the solution in Figure 4 is applied. |
| CATT | It is suitable for both inter-CU and intra-CU migration. The parent node delay reconfigure itself when receive RRC reconfiguration message, until sending RRC reconfiguration messages to all descendant nodes. It may require CU send all RRC reconfiguration messages for descendant nodes to migrating IAB node concurrently.  |
| Huawei | For inter donor migration, agree the description “transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell” For the intra-donor migration case, the RRC reconfiguration to the descendent nodes can be send either via the source path, or the target path.  |
| Nokia | Does it have issue if sending the RRCReconfiguration via source path? For example, if the migration of the parent node fails. In this case are the RRCReconfigs of the child nodes executed anyway, or discarded? If discarded, they will anyway have consumed a PDCP SN on the child node’s SRB1, causing PDCP reordering delay for subsequent RRC messages. In fact, default PDCP reordering timer for SRB1 is infinity, in which case IAB MT PDCP will never skip a missing PDCP SN.Also, how to handle the scenario when there is a need for another RRC reconfiguration for the descendant IAB node while waiting for the condition to happen? |
| ZTE | We agree that RRCReconfiguration to the descendant IAB is transmitted via the source path, i.e. before the migrating IAB detach from source parent cell. |
| KDDI | Our preference is transferring the RRCReconfiguration via the source path.For inter-CU, this is discussed in CB: # 11\_IABinterDonorMigration 3.4 End-to-end migration sequence with IAB-MT handover. So, we should be careful to make intra-CU solution and inter-CU solution aligned |
| Fujitsu | Agree that transferring the RRCReconfiguration to the descendant nodes via the source path can be used to reduce the interruption time**.** In our view, transferring the RRCReconfiguration messages via the target path should not be excluded, while the inter-donor handover is performed sequentially, which is supposed as the *top-down* procedure in CB11.  |
| Ericsson | We are ok with \*transferring\* the configuration messages via source path, which is different than \*applying\* the configurations.Please look at our comment in Q3-2. |
| Apple | Agree |
| Intel | Agree, there is a need to send HO information to descendant IAB via the source path |
| AT&T | We are supportive of “transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell”  |
| Futurewei | “**transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell”** seems technically feasible. After all, CHO already send the RRC reconfiguration way in advance of the execution of the HO.How helpful this would be in terms of reducing service interruption time, probably needs to be evaluated. |

**Q3-2: If you agree to transfer the RRCReconfiguration to the descendant IAB via the source path, please share your view on “buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met”**

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| **Company** | **Comment** |
| Samsung | Agree “buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met”Meanwhile, we think the condition can be “receiving the RRCReconfiguration message by the collocated IAB-MT”. |
| Qualcomm | Agree, buffering and condition-based delivery is necessary to make delivery via source path a viable solution. |
| CATT | Agree “buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met”The condition could be. i.e., after migrating IAB node has send all RRC reconfiguration messages to descendant nodes. |
| Huawei | The buffering of RRC reconfiguration to the child node may be impossible to achieve, since the IAB-DU can only transmit the RRC message transparently to its child node without interpret the content of the RRC message, it will not know which RRC Reconfiguration need to be buffed. If the problem is the UL packets from descendent nodes need to be transmitted via the parent IAB node’s target path arrives the parent IAB node before the target path is ready, one possible way is that the parent IAB node can buffer such UL packets until the target path is ready, this can be achieved by parent node’s implementation. Or, the descendent nodes may not initiate the TNL migration procedure until it aware of that the target path of upstream migrating IAB node is ready.Alternatively, for R16 intra-donor migration case, sending the RRC reconfiguration via target path is also a feasible way.  |
| Nokia | It requires the parent DU to know this is RRCReconfiguration message for migration, rather other RRC message. It need further analysis, refer to our comments to Q3-1. |
| ZTE | If RRCReconfiguration is buffered in DU and then deliver to the descendant IAB when condition is met, there may be overflow issue and lead to packet loss.  |
| KDDI | Agree, buffering and condition-based delivery is necessary. |
| Fujitsu | We are fine with the proposal that “buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met” when the migrating node and descendant nodes are performing handover concurrently.However we think the condition should be after the IAB node has setup new F1 with the target donor, because the RRC configuration complete messages of the child nodes cannot be delivered to target donor unless the new F1 has been setup and the context of the child nodes has been setup within the IAB node.Otherwise, the IAB node should buffer the RRC configuration complete messages of the child nodes then deliver to the target donor when the new F1 has been setup with the target donor.  |
| Ericsson | We share the **concern** with Nokia and Huawei: the context of the story is withholding the RRC messages towards downstream devices. How can a parent DU know the content of an RRC message i.e. if it is related to HO reconfiguration or perhaps something else? |
| Apple | Agree |
| Intel | The concept of “buffering the RRCReconfiguration then deliver to the descendant IAB when condition is met” is fine. But the buffering and processing the conditional message need some discussion. RAN2 input on this is also recommended. |
| AT&T | We agree this is needed for the solution to work. To solve the issue raised by Huawei there may be a need for signaling to indicate to a parent node whether a certain RRC message needs to be buffered or not. |
| Futurewei | Agree with concerns expressed by E///, Nokia, and Huawei. This seems like an extremely complicated approach and would need to introduce capabilities that are likely not supported by DU today. Also, as mentioned by E/// RRC message is ciphered at CU-CP, and hence contents of the message are transparent to the DU. Overall, this approach does not seem that feasible to us.On the other hand, the idea that the TNL migrations in figure 4 can really be done concurrently seems very questionable to us. Therefore, we are not at all convinced that this complicated approach would actually result in a reduction of interruption time. |
| Verizon | Agree that transfer the RRCReconfiguration to the descendant IAB via the source path would be better. Concur with Qualcomm that buffering and condition-based delivery is necessary to make it a viable solution |

**Summary:**

**For Q3-1:**

* 10 out of 13 companies commented to support “transferring the RRCReconfiguration to the descendant IAB via the source path, i.e. before the migrating IAB detach from source parent cell.”
* 2 companies commented that it may have some problems.

**Potential Proposals:**

**Proposal 3-1: The RRCReconfiguration to the descendant IAB can be transferred via the source path, i.e. before the migrating IAB detach from source parent cell.**

**For Q3-2:**

* 8 of 14 companies commented to support “buffer the RRCReconfiguration in DU, then deliver to the descendant IAB when condition is met”.
* 1 company is fine, but would like the RAN2 input.
* 5 companies commented that there may have some issue, and further analysis may be needed.
* **No agreement. Continue the discussion.**

## UL Mapping configuration

In current topology adaptation, the F1-U is only resumed after the F1-C is ready on target path, and IAB get the new UL mapping configuration via F1-C. To enable the early setup of F1-U traffic, Contribution ([2]) proposes “the default configurations for F1-U traffic (i.e., default BH RLC CH, default BAP routing ID) can be configured to the UE via RRC message (i.e., HO Command) during migration procedure.” Contribution ([6]) proposes to use RRC to provide UL mapping for all F1-U traffic.

**Q4: Please share your view on using RRC to provide the UL mapping to enable early F1-U setup, and whether only consider default configuration or all configuration for F1-U (For Intra-Donor migration).**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | **We prefer to consider the default configuration for UL mapping for F1-U via RRC**. This default configuration is used only during the migration procedure, which is a temporary state. Such configuration can keep the F1-U transmission uninterrupted. Moreover, it can speed up the migration procedure. On the other hand, the method of using RRC to provide UL mapping for all F1-U traffic may bring some additional efforts:* **Significant signaling design effort in RRC**: the RRC message will include all UL F1-U tunnel information and the corresponding BH mapping information. Moreover, such method exposes the F1 interface configuration to the RRC message, which may cause inter-WG design coordination in the future (e.g., tunnel information enhancement results in RRC impact).
* **Delay the migration**: this method requires that before sending RRCReconfiguration message (Handover command) to IAB-MT, all UE contexts have to be transferred to the target in order to establish the UL F1-U tunnels. Thus, the execution of migration is delayed to the time when all UE contexts are transferred to the target.

  |
| Qualcomm | Again, please emphasize that this relates to Int**RA**-donor migration. We are fine with this proposal. To coordinate with RAN2, RRC should send a transparent F1AP container. We could use the same solution as discussed under CP/UP separation, i.e., where F1-C is sent in transparent container via RRC.  |
| CATT | The F1-U only work after MT migration complete in this proposal. Interruption still exit during MT migration procedure. The benefit is not significant. However, F1-U via target path during migration would be more efficient. |
| Huawei  | We can understand the motivation, but not convinced about the benefits, considering the potential specification impact to both RRC and BAP. To achieve early F1-U transmission, the IAB donor can provide the UL mapping configuration related to F1-U traffic immediately after the F1-C via target path is available. Thus, the gain of enabling the F1-U related UL mapping being configured by RRC is the F1-U transmission can be a litter earlier, e.g. at the same time with the F1-C migration. The time saving will not so significant, but the cost is both RRC specification and BAP specification need to be changed to allow the F1-U related UL mapping via RRC. |
| Nokia | Only using the default one may have issue. The default one is only used to transfer the initial F1-C traffic, which may not have much traffic. The BH RLC CH for the default one may not have enough bandwidth for F1-U traffic. Also, it may have QoS issue if using the same routing/BH for all F1-U traffic with different QoS. So we think it is better to transfer a F1AP container including all and not just the default one. |
| ZTE | We agree that UL mapping information could be provided via RRC. And we slightly prefer that sending default configuration via RRC in advance is enough. |
| KDDI | We are fine to reuse the default UL configuration which was already introduced in Rel-16 RRC. But we are negative to have enhancement on that. |
| Fujitsu | Agree with using RRC to provide the new F1-U mapping information to enable early F1-U with default configuration as well as additional UL configuration. The benefit to reducing service interruption is obvious. The IAB-MTs can apply the new UL mapping configuration as soon as the migrating node connects to the target parent cell no matter their collocated DUs have migrated the F1-C to the target donor or not. Otherwise, all the new F1-U mapping except the default one can only be configured when the new F1-C is setup. The service interruption time saving is significant.RAN3 can cooperate with RAN2 to consider the impact to RRC and the concrete solution should be made by RAN2, e.g. introduce new fields or a transparent F1AP container.  |
| Ericsson | We struggle to see the benefits, what is the time gain here? Also, if we configure default mapping for F1-U, soon we will need to reconfigure again, to the “business as usual” mapping. |
| Apple | Agree to consider default configuration for UL mapping for F1-U via RRC.  |
| Intel | We are fine with the proposal |
| AT&T | Agree with Qualcomm that a transparent container may be a better approach |
| Futurewei | Like E/// and Huawei, we are a bit skeptical that using default UL mapping for UP would provide significant reduction in service interruption time. |
| Verizon | We are fine with the proposal. Solution suggested by Qualcomm seems a good approach.  |

**Summary:**

* 9 out of 14 companies commented there is benefit to provide the UL mapping via RRC
* 4 out of 14 companies commented unclear benefit.
* 1 company commented to reuse Rel-16, and no enhancement.
* **No agreement. Continue the discussion.**

## How/when send the RRCReconfigurationComplete message for descendant IAB?

Contribution ([7]) proposes to use concurrent transmission for descendant nodes. (copied as below)

Proposal 6: To reduce the service interruption in intra-CU migration, the following methods can be considered:

1) Descendant nodes send UE context modification response message to CU concurrently.

2) Descendant nodes send RRC reconfiguration complete message to CU concurrently.

3) CU redirect descendant nodes’ DU F1 association to new TNL address (es) concurrently.

4) CU configuration BH RLC channel, BAP route and mapping rules concurrently.



Figure 3 Intra-CU migration via default configuration to reduce service interruption

**Q5: Please share your view on concurrent transmission of the descendant IAB nodes.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | We are not sure how the concurrent transmission of descendant IAB nodes can be achieve. Maybe further clarification is needed. Regarding to question “How/when send the RRCReconfigurationComplete message for descendant IAB”, we didn’t see the need of any enhancements.  |
| Qualcomm | This seems to be the same as the migration of descendant nodes via source path which has been discussed above. |
| CATT | Sorry for the misunderstanding, the above flow chart means RRC reconfiguration message for all IAB node and UE could be send by CU concurrently, as question 3-2, migrating IAB node not reconfigure itself until it sends all RRC reconfiguration messages to descendant nodes. There are two potions for the following step:Option 1: The descendant nodes send RRC reconfiguration complete messages to its parent nodes and further send to donor DU through BAP layer. Donor DU read the BAP packets, which are RRC messages, and sends these RRC messages to donor CU via F1AP.Option 2: The descendant nodes send RRC reconfiguration complete messages to CU via source path at the same time. After that, descendant nodes migrate F1-C to new TNL address concurrently.Actually, there are other solutions, which is out of the above flow chart, could reduce service interruption, i.e., all descendant nodes send the RRC reconfiguration messages to its parents node concurrently , their parent nodes further send these RRC reconfiguration messages to CU via new F1 association after F1 migrate finish. |
| Huawei | From our view, it is hard to reach the concurrent transmission of all the descendent nodes and UEs, since an IAB node and its parent node may not able to perform UL transmission at same time due to the duplexing constraint of an IAB node. Besides, we are also not sure how to guarantee such concurrent transmission from different descendent nodes and Ues. Maybe more clarification is necessary.While from CU point of view, it is possible for CU to provide configurations to different descendent nodes, but this should be up to CU implementation. |
| Nokia | For CATT’s comment, the migrating IAB node cannot know the RRC message encapsulated in a F1-C traffic to the descendant IAB (e.g. a grandchild IAB), so it cannot know when it has sent all RRC Reconfiguration message to descendant node. Option 1 is a significant change, since the Donor-DU does not have the F1AP UE context for the descendant IAB node. Option 2 need to be discussed. When the IAB-MT send the RRC Reconfiguration Complete, it means the IAB-MT start to use the new RRC configuration, but it is actually not in this case. Anyway, it is unclear on the issues to be addressed.  |
| ZTE | It is a little unclear. What concurrent transmission mean?In our opinion, RRCReconfigurationComplete message of the descendant node could be sent only after F1-C direction procedure of its parent IAB-DU.  |
| KDDI | Sorry we also still don’t understand “concurrent transmission”. But, proposed solution is related to Q3.1 above, and we can take this solution into consider when discussing the detail migration procedure. |
| Fujitsu | We understand the scenario is for the parallel migrating of the IAB nodes between two donors.However we think there is still some restriction. For example, the IAB node may need to buffer the RRC configuration messages of the child nodes until the IAB node has setup new F1 with the target donor, because the RRC configuration complete messages of the child nodes cannot be delivered to target donor unless the new F1 has been setup and the context of the child nodes has been setup within the IAB node.Otherwise, the IAB node should buffer the RRC configuration complete messages of the child nodes then deliver them to the target donor when the new F1 has been setup. |
| Ericsson | As pointed out by other companies, there are several technical challenges in the proposals, which outweigh the claimed benefits.  |
| Apple | We agree with Nokia that the IAB node cannot know the message encapsulated in a F1-C to the descendant IAB. However, the concept in general of being able to do concurrent transmission looks very interesting and should be further explored and agree with CATT that other solutions not in the picture are possible. |
| Intel | Maybe further explanation is needed. If concurrent transmission of RRCReconfigurationComplete of all descendant nodes, what happens if the one send by child node hits CU before its parent node? |
| AT&T | We see the need for doing some form of coordinated or “concurrent” transmission of the descendant nodes/Ues since in general it seems solutions in question 3-2 can also be applied here, albeit in the upstream direction. At this stage we are open to discuss different approaches to understand the tradeoffs and benefits better. |
| Futurewei | Like other companies, we were really confused about what [7] is trying to propose. Is this the same or different than the options that have already been covered by section 3.3? |
| Verizon | Concurrent transmissions to descendent nodes/UEs is beneficial from spectrum usage perspective. We are open to discuss issues and solutions.  |

**Summary:**

**For Q5,**

* Most companies are unclear about the proposal (either do not quite understand the proposal, or same as other issues discussed above).
* **No agreement. Continue the discussion.**
* …

## Packet loss

During inter-Donor-DU migration, some UL/DL packets may be lost. (copied from Contribution ([5]))



Figure 1:Packet loss during intra-donor migration: 4a: Packet loss in downlink, 4b: Packet loss in uplink

For DL, donor CU can discover the packet loss via current DDDS or PDCP status report, and recover the packet loss via retransmission. There may be no need for any enhancement.

For UL, contribution ([3][5]) propose to introduce an uplink version of the F1-U DDDS message. Contribution ([8]) proposes “the access IAB node performs the re-transmission using the updated IP addresses and BAP address on the target path after migration”

**Q6: Please share your view on how to address the UL packet loss, e.g. by introducing the UL DDS or any other solution. If a solution is needed, how to enable it, i.e. only enable it in case of a topology adaptation, or always enable it?**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | We agree to consider the solution based on UL DDS to address the UL packet loss. However, such UL DDS is enabled only during the migration procedure since the UL packet loss would not happen in non-migration case (note that, in legacy CU-DU, we don’t have UL DDS). As mentioned in our contribution, the basis of UL DDS is that the IAB-DU part of the migrated IAB node should buffer the UL packets. Since UL DDS is valuable for migration case only, it is better to allow the IAB donor CU to indicate the enabling of UL DDS so that the IAB-DU can start the UL packet buffering. In summary, our view is:* Configurable UL DDS: UL DDS + enabling indication for UL DDS
 |
| Qualcomm | We support UL DDS, where the access IAB-node buffers packets until it receives the UL DDS of successful delivery based on NR-UP SN. The UL DDS will certainly be configurable so that it is can be activated during topology adaptation, only. We are not certain if anything else is needed. |
| CATT | The UL packet loss mainly due to the packet buffered in migrating IAB node which may also include the descendant nodes’ packet. After migrating IAB node migrate to target DU, the buffer packet would be discard. There are two methods to address this problem, not preclude other solutions. One is UL DDS, the other is re-routing. For the first one, buffer all packets would cause large buffer size, and it may include some error packets. The second on should consider the source IP filter, and the migrating IAB node have not the ability to change packet header in current spec. Both of cases can be further discussed. |
| Huawei | As commented by CATT, the UL DDS requires that the access IAB node buffer a large number of UL packets, until receiving ACK from the donor CU. In topology adaptation case, based on the UL DDS solution, the access IAB node will re-transmit the PDCP PDUs which are not ACKed by the donor CU via the new path. However, for the inter-CU transmission case, the retransmitted PDCP PDUs cannot be deciphered correctly by the target CU, since these re-transmitted PDUs are ciphered by the UE use the old key related to the source CU. Thus the UL DDS based solution will not work well for the inter-donor topology adaptation case.We suggest to consider the inter-donor-DU re-routing, which will solve the inter-donor-DU packet loss problem for both intra-CU and inter-CU scenario. This will require the IAB node which perform re-routing change the BAP address of the packet. Such solution can be always enabled, but only will be used if necessary (e.g. inter-donor-DU topology adaptation occurs). The similar discussion of packet loss is also included in CB#16, based on our contribution R3-206670. |
| Nokia | Agree with CATT. |
| ZTE | UL DDS could be used to address UL packet loss in intra-donor migration scenario, it could be enabled in case of topology adaptation.  |
| KDDI | We are a little bit reluctant to introduce a new flow control mechanism. Since we think that proper buffer design/implementation and proper congestion/admission control can address the issues. |
| Ericsson | UDDS and UL flow control have been discussed several times in multiple WIs and it was always concluded that the mechanism is too complex. Please note the August RAN3 agreement stating that **UL flow control is deprioritized in Rel17.**Second, we believe that the August agreements have been misunderstood – they were taken (at least partly) on the basis of E/// contribution. Both the “packet loss” and “unnecessary transmissions” are a consequence of key change at inter-donor migration. Namely, at the time instant when the HO is executed, the old key is obsolete. However, at that same moment there may still be in-flight packets somewhere between the donor and the UE.So, **unnecessary transmissions** occur because packets encrypted with the key pertaining to the old donor association are in flight, while the destination device has migrated.**Packet loss** means that the abovementioned packets are lost since they will never be received by their intended destination. We propose to consider the **following enhancements**:* Enabling the old CU to indicate to intermediate nodes to discard in-flight packets whose destination/originating device has emigrated. This applies to both DL and UL packets.
* Enabling the CU to proactively poll the devices and nodes for buffered UL packets so that these can be delivered to the old donor before the key change is applied or before the devices (intermediate or end devices) buffering these packets emigrate.

Perhaps a meaningful first step would be to clarify what is meant by packet loss and unnecessary transmissions – our understanding is given above. |
| Apple | Agree to use UL DDS for addressing UL packet loss.  |
| Intel | Agree with CATT |
| Futurewei | We have similar concerns as expressed by CATT and others regarding requiring buffering at the IAB node. This is where is seems useful to support a dual stack (DAPS-like approach) at the migrating IAB node, so that packets can continue to be sent to/from the source DU until migration has been completed fully. |
| Verizon | Agree with CATT views. |

**Summary:**

**For Q6:**

* 5 out of 13 companies commented to consider the introduction of UL DDS.
* 6 companies commented to consider both UL DDS and inter-Donor rerouting.
* 2 companies commented no UL DDS, and need to clarify the meaning of packet loss.
* It is suggested to study the packet loss issue, e.g. further clarify scenario for packet loss and the possible solutions.

**Potential proposal:**

Proposal 6: RAN3 study the packet loss issue, e.g. further clarify the scenario for packet loss and possible solutions.

 …

## Avoidance of unnecessary transmissions

This is discussed in contribution ([3]). It is related to the “on-the-fly packets are buffered at the intermediated nodes towards the destination”.

* For DL, due to the change of the IP address in the migrating/descendant IAB node, the IAB node may discard the received DL packets using the old IP address.

Contribution ([3]) propose “the IAB node can keep the old configurations at source path for a while till the final on-the-fly packet is received”

* For UL, the new Donor-DU may discard the packet due to the source IP filtering.

The possible solution is to disable the source IP filtering, or donor CU informs Donor-DU for the “old IP address” so Donor-DU accept those UL packet.

**Q7: Please share your view on this issue (e.g. scenario, possible enhancements, etc)**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | During the migration procedure, the “on-the-fly” packets are evitable. The simplest way is to discard those packets as long as migration is triggered. However, this may be an efficient way since those packets are already on the way, especially when the volume of those packets are large. Thus, in our opinion, it is beneficial to design some schemes to continuously transmit those packets. **The scenario is:**During the migration procedure, the intermediate nodes transmit the on-the-fly packets received via source path **The possible enhancement:**The listed enhancements for DL and UL above can be considered as the starting points. Any additional enhancements can be discussed as well.  |
| Qualcomm | Note that this is primarily a RAN2 issue. Further, everything needed is already supported in Rel-16 BAP: 1. By implementation, the IAB-node can buffer packets on BAP layer in case they cannot be delivered because the egress link is not available. This allows the IAB-node to wait until a new routing entry with the same destination address is configured. When this happens the IAB-node can use local rerouting. This approach works for DL, and it also works for UL if the IAB-donor-DU does not change.
2. If the IAB-donor-DU *does* change, the BAP address will be different and the packets should not rerouted, since the packet’s source IP addresses don’t match the new IAB-donor-DU.

There is currently a Rel-16 CR to 38340 in RAN2 to add a Note that makes this procedure more explicit. |
| CATT | For intra-CU migration, the UL on flight packet can transfer to CU via source path eventually. DL on flight packet can use DDDS. For inter-CU migration. The on flight packet cannot be received by target donor DU. The simplest way is to discard them. |
| Huawei | We share similar view as Samsung. It looks beneficial to allow the on-fly packets being transmitted to the destination, this will also avoid some unnecessary re-transmission. |
| Nokia | For DL, it may be left to IAB’s implementation. If the IAB see the received packet using the old IP address, it uses the old configuration. For UL, ok to consider these options. |
| ZTE | For UL, the solution of “donor CU informs Donor-DU for the “old IP address” ” doesn’t work since routers between donor DU and donor CU may implement IP filtering. In our view, new F1-U TNL addresses which are configured by target donor CU need to be used by access IAB node when transmitting via target path.  |
| KDDI | Basically, we agree with QC, this is what RAN2 mainly discuss. |
| Ericsson | We agree with Samsung and Huawei that we should look for ways to either get in-flight packets to their destination to avoid packet loss or discard them to avoid unnecessary transmissions.As mentioned in Q6, we propose to consider the **following enhancements**:* **Unnecessary transmissions**: Enabling the old CU to indicate to intermediate nodes to discard in-flight packets whose destination/originating device has emigrated. This applies to both DL and UL packets.

**Packet loss**: Enabling the CU to proactively poll the devices and nodes for buffered UL packets so that these can be delivered to the old donor before the key change is applied or before the devices (intermediate or end devices) buffering these packets emigrate. |
| Apple | Agree with Qualcomm as well.  |
| Intel | This should discuss in RAN2 |
| Futurewei | Generally, agree with Samsung. The key issue that needs to be addressed is on-the-fly upstream packets. As mentioned by QCM, there are two fundamental issues for these upstream packets: packet BAP address and source IP address.BAP address is primarily within the scope of RAN2. However, IP address is not within the scope of RAN2. Also, we are a bit skeptical about Proposal 4 [3]. We think it would be extremely difficult for 3GPP to specify a solution to either disable source IP filtering or update source IP filtering, as this functionality would most likely be implemented by some middle boxes in the transport, rather than by 3GPP nodes such as the donor DU itself. |
| Verizon | Agree with Samsung and Ericsson that we should look for ways to either get in-flight packets to their destination to avoid packet loss or discard them to avoid unnecessary transmissions. |

**Summary:**

**For Q7:**

* 6 companies commented to study the solution to either get in-flight packets to their destination to avoid packet loss or discard them to avoid unnecessary transmissions.

+ 1 company commented the solution may not work.

+ 1 company commented this issue only need to be addressed in UL direction.

* 4 companies commented it is a RAN2 issue.
* 2 company commented either no issue for intra-Donor scenario, or just use new address when using target path.
* It is suggested to further discuss the issue with focusing on RAN3 impact.

**Potential Proposals:**

Proposal 7: RAN3 discuss “Avoidance of unnecessary transmissions” with focus on RAN3 impact.

## Context Transfer over Xn interface

For inter-Donor topology adaptation, the context for the IAB-MT and the context for each connected UE need to be transferred to target Donor. Current XnAP Retrieve UE Context procedure is performed per UE.

Contribution ([12]) propose to study how to more efficiently transfer the context, e.g. “enhance the UE Context Retrieve procedure or to introduce a new XnAP procedure, for retrieving the IAB-MT context, the collocated IAB-DU context, and the context of descendant IAB-nodes/UEs from the old IAB-donor-CU to the new IAB-donor-CU.”

Contribution ([9]) proposes “To reduce the signalling overhead and network latency, procedure enhancement can be introduced so that multiple UEs can be handled at the same time. For example, if the time needed by the target CU to fetch the context from the source is deemed too high, RAN3 could investigate how to reduce it, e.g., by allowing the source and target CU to exchange early information about the IAB node that could be subject to migration, without requiring the target CU to reserve resources and perform admission control in advance.”

**Q8: Please share your view on this issue (e.g. how to efficiently transfer the context to target Donor)**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | In our understanding, the efficient context transfer is an additional enhancement on top of the basic procedure. Thus, this issue can be discussed in two phases:* Phase I: design a baseline procedure which can reuse the existing signaling as much as possible.
* Phase II: think about further enhancements

For Phase I, we think we can use the legacy Handover procedure with some enhancements to gradually transfer UE context from the source to the target. Since the Phase I is still under discussion, we can consider the efficient context transfer at later stage. In summary, our view is:The efficient context transfer can be considered at later stage after the basic migration procedure is determined.  |
| Qualcomm | Let’s discuss enhancements such as message bundling at a later stage after we have converged on the baseline procedures.  |
| CATT | The context of IAB node could be sent to target CU in handover preparation when this IAB node would like to migrate. Similar, the UE context send to target CU only when UE triggers migration.The enhancement of efficient context transfer can discuss at later stage. i.e., sending UE context list which include all IAB and UE context to target CU. |
| Huawei | We think the context bundling will be beneficial for efficient context transfer, but also can agree with companies above, to consider the message bundling in later stage. |
| Nokia  | The Xn procedure need to be enhanced, but Ok to discuss it later.  |
| ZTE | Assuming that migration of IAB node and UEs are performed separately, i.e. no message bundling is used, identities of IAB nodes and UEs that are involved in the migration could to be indicated to target donor CU. |
| KDDI | We share the view with Contribution [9]. We should explore the enhancement based on the current XnAP procedure so that the multiple UEs can be handled at the same time. |
| Fujitsu | Agree to consider the efficient context transfer in later stage, i.e. after the baseline procedure of inter-donor migrating has been fixed. |
| Ericsson | Our views against dedicated solutions for RLF recover in another donor are given in CB#11, so let us first discuss if it makes sense to work on such a procedure at all. |
| Apple | Agree with Samsung’s and Qualcomm’s views for a later stage discussion. |
| Intel | Agree with Samsung |
| AT&T | We support introducing message bundling/efficient transfer enhancements once the basic signaling and procedures are finalized. |
| Futurewei | We are fine with Samsung’s suggestion to use a phased approach to address this. |
| Verizon | This seems like a low priority optimization that can be considered at a later stage. |

**Summary:**

**For Q8:**

* Most companies commented this issue can be discussed later after the basic migration procedure is determined.

**Potential proposals:**

Proposal 8: The issue on Reduction of Service Interruption for inter-Donor case will be discussed after the basic migration procedure is determined.

## F1AP signaling

For inter-Donor topology adaptation, the F1 interface need to be established with target Donor. There may be many UEs connected to the migrating IAB and descendant IAB, it may take some time to establish the F1AP context for all connected Ues. This is discussed in Contribution ([10] [12])

Contribution ([5]) propose to “reduce the number of ignaling handshakes needed for F1 migration.”

(NOTE: Contribution ([5]) is only for intra-Donor. Since the proposal is related to F1, it is listed here)

Contribution ([10]) propose “study the mechanism for IAB-DU recovery (e.g. F1 connection re-establishment, rather than setup) in inter-donor-CU RLF recovery case, to achieve:

1) Avoid signaling storm in F1 interface between IAB-DU and new IAB-donor-CU.

2) Avoid long term service interruption for connected Ues.”

Contribution ([12]) propose “A same mechanism should be used in both handover scenario and RLF scenario, where the mechanism is used for the new IAB-donor-CU and the migrating IAB-DU to re-establish/update the context of F1 interface and the F1AP UE context.”

**Q9-1: Please share your view on how to reduce the F1AP signaling**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | Since the basic procedure is unclear, we propose to delay this discussion.  |
| Qualcomm | Agree with Samsung, let’s get the baseline procedures down first and then discuss optimizations. |
| CATT | This could be discussed after baseline is approach.For reducing service interruption, maybe the F1 setup could execute earlier , i.e., before MT migration, via source CU. |
| Huawei | F1 connection re-establishment can be considered, instead of F1 setup. Fine to discuss it later after the basic procedure is clear. |
| Nokia | The enhancement is needed to avoid the signaling storm issue, but this may be discussed together (i.e. Xn, F1, E1, etc) later.  |
| ZTE | Agree with Samsung.  |
| KDDI | In general, we agree with the above directions, avoid signaling storm, avoid long interruption, commonality among handover scenario and RLF scenario. But we are not sure it is possible when it comes to details. |
| Fujitsu | The new F1 connection can be setup with all the child nodes context migrating from the old F1 connection directly, i.e. without context setup for the child nodes on the new F1AP, which can save the F1AP signaling significantly. Agree to consider this enhancement after the basic procedure is clear.  |
| Ericsson | It is too early for such details, but we are open to discuss the approaches for avoiding the F1 Setup from scratch |
| Apple | Agree with Samsung and Qualcomm to delay this item for later.  |
| Intel | Agree with Samsung |
| AT&T | Both the approaches from CATT and Huawei could be considered further |
| Futurewei | Fine to postpone this discussion until baseline procedures have been ironed out. |
| Verizon | Agree with Ericsson and Samsung |

Contribution ([12]) also propose to discuss “how to deal with the descendant IAB-MT/UEs of the recovery IAB-node. For example, how to update the AS security between the descendant IAB-MT/Ues of the recovery IAB-node and the new IAB-donor-CU, while avoiding the descendant IAB-MTs/Ues to be forced into RRC re-establishment.”

**Q9-2: Please share your view on this issue, e.g. how to update the AS security between the descendant IAB-MT/Ues of the recovery IAB-node and the new IAB-donor-CU, while avoiding the descendant IAB-MTs/Ues to be forced into RRC re-establishment**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung  | We agree that for inter-donor RLF recovery, AS security update is needed, and the RRC re-establishment of descendant IAB-MTs/Ues should be avoided. However, how to achieve it may need hold-on for a moment since we need the whole picture of inter-donor RLF recovery.  |
| Qualcomm | This topic is also discussed in CB11. We agree with Samsung that AS security update is needed. The details on how this is done (e.g. avoiding/replacing RA procedure) is in RAN2 realm. |
| CATT | We can discuss AS security update at later stage, if needed. |
| Huawei | Agree with companies above, to discuss how to solve the problem at later stage. |
| Nokia | This may be a RAN2 issue on how to update the AS security, but ok to discuss it later.  |
| ZTE | Agree with Nokia. |
| KDDI | We are not sure the motivation for this discussion, but the AS security should be discussed in RAN2 rather than RAN3. |
| Fujitsu | Agree the topic should be discussed in CB11. |
| Ericsson | AS security update is a must and it is a RAN2 issue. |
| Apple | Agree with Nokia |
| Intel | Agree with Ericsson |
| AT&T | Agree we need to address this, but details are FFS. |
| Futurewei | Agree with other companies. This is a RAN2 issue. |
| Verizon | This is an issue that needs to be addressed.  |

**Summary:**

**For Q9-1:**

* Most companies commented this issue can be discussed later after the basic migration procedure is determined.
* Can be covered by Proposal 8.

**For Q9-2:**

* Most companies commented this is a RAN2 issue, or to be discussed later.
* …

## Routing F1-U over a different Donor-DU

This is discussed in contribution ([6]). The F1-U over target path need to wait for the F1-C over target path is ready. The interruption is longer than the intra-CU topology adaptation, due to the establishment of the new F1-C interface between the migrating IAB node and target Donor. To minimize the interruption, one option is to route the “old” F1-U over target path, before the “new” F1-U is set up over target path. This enables the IAB node to continue the F1-C/U with source Donor over target path, while the migration of F1-C/U can be performed at the same time. Example is copied as below.



Fig. 3 F1-U/F1-C traffic by allowing to keep connection to both source and target

Contribution ([6]) propose “routing the “old” F1-U (of the source Donor) over target path can minimize service interruption”

**Q10: Please share your view on Routing the “old” F1-U (of the source Donor) over target path to minimize service interruption”**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Samsung | Agree. This can be considered as a part of inter-donor migration procedure.  |
| Qualcomm | Agree with Samsung. This is a procedural aspect which is discussed in CB11. |
| CATT | Agree with QC and SS. It could be discussed in CB11 |
| Huawei | Such way require a lot of standardization work on the BH configuration, only for a very short term F1-U transmission, since the migration procedure will not last long time. For example, to achieve such way, it will require a lot of negotiations among two different donor CUs, about the IP address, UL/DL F1-U information, QoS mapping information, BAP address, BAP path ID, etc, because the target path is consist of some IAB nodes and IAB donor DU which are controlled by the target donor CU, as well as some descendent IAB nodes and the migrating IAB node which are still controlled by the source CU. The discussion may also involve which donor CU will provide configurations to which nodes. These negotiation and configurations are inevitable and makes the whole solution very complicated.Considering the beneficial will be very limited but the solutions requires a lot of specification works, we suggest not consider such solution. |
| Nokia | Ok to discuss it in CB11.  |
| ZTE | The “old” F1-U packets which is routed via target path may be discarded by target donor DU if IP filtering is implemented.  |
| KDDI | We can discuss in CB11. |
| Fujitsu | Agree to discuss in CB11. |
| Ericsson | CB#11 |
| Intel | CB#11 |
| Futurewei | There are certainly technical challenges to be addressed (note comments from ZTE/Huawei).Having said that we are fine to continue discussing as part of CB11. |
| Verizon | Agree, this can be considered for inter-donor migration |

**Summary:**

**For Q10:**

* Most companies commented this issue can be discussed in CB#11.
* This issue can be closed in this CB.

## Other issues/enhancements

**Q11: Please list other issues/enhancements that should be considered for Rel-17 IAB? Please include assessment of expected benefit, impact on specification, implementation, other WGs.**

# Part II…[if needed]

If needed

# References

1. R3-205961, Considerations on IAB-donor indicator (KDDI Corporation)
2. R3-206000, Discussion on service interruption reduction for IAB (Samsung)
3. R3-206001, Discussion on mitigation on packet loss and unnecessary transmission (Samsung)
4. R3-206209, Mitigation of Packet Loss (Intel Deutschland GmbH)
5. R3-206257, Interruption time reduction for Intra-donor IAB-node migration (Qualcomm Incorporated)
6. R3-206288, discussion on Reduction of Service Interruption during Topology Adaptation (Nokia, Nokia Shanghai Bell)
7. R3-206296, Reducing the Service Interruption for IAB (CATT)
8. R3-206561, Discussion on reduction of service interruption in intra-donor IAB node migration (ZTE, Sanechips)
9. R3-206587, On RLF Recovery Support for IAB Nodes (Ericsson)
10. R3-206667, Inter-CU RLF recovery procedure (Huawei)
11. R3-206668, Inter-CU BH RLF recovery procedure for IAB node (Huawei)
12. R3-206558, Discussion on inter-CU BH RLF recovery (ZTE, Sanechips)