3GPP TSG-RAN WG3 Meeting #114-e R3-215899

E-meeting, November 1 – 11, 2021

Agenda Item: 13.2.1

Source: Qualcomm Incorporated

**Title:** **CB: # 1302\_IAB\_Inter\_Donor\_Mig**

Document for: Discussion

# Introduction

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| **CB: # 1302\_IAB\_Inter\_Donor\_Mig**  **-General advise: try to converge on the “low hanging fruit” that makes at least a basic solution work. If enhancements are possible, they can be added on top of the “basic” solution.**  **It is strongly recommended to focus the last 3 meetings discussions on topics that reached maturity and that can realistically be turned into full Stage 2 and Stage 3 specifications**  **- Inter-donor routing: can it be assumed that descendant nodes and UEs are not affected? How should it be setup?**  **- Full migration:**  **- Should the work on Full Migration be carried out in Rel17? Should it be moved to Rel18?**  **- Is it possible to conclude from the LSs received on full migration that Alt1 (the two logical DUs use separate physical cell resources) is the prioritized choice for RAN3? Or can Alt1 and Alt2 co-exist?**  **- Is full migration something that can be addressed in Rel17? If yes, what are the remaining essential issues to be solved?**  **- Partial migration:**  **- IPSec address knowledge: is IPSec address knowledge at the souce IAB-Donor-CU needed? If yes, is there a need for any specification enhancements**  **- Is there a need for any specification enhancements to support IP address addition, replacement, and release?**  **- Is there a need for any specification enhancements to support coupling of IP address (es) used in two CU’s networks?**  **- Should revocation of partial migration be supported with specific standard changes? If yes, which ones?**  **- Is there a need for any specification enhancements to support context transfer/QoS information?**  **- Procedure description over interfaces for support of inter-donor topology adaptation**  **- Should CHO be supported in Rel17?**  **- Should RLF Recovery be supported with specific standard changes? If yes, which ones?**  (Qualcomm - moderator)  Summary of offline disc [R3-215899](file:///C:\temporary\RAN3\RAN3%20November%2021\CB%20sessions\CB1302%20inter-donor%20migration\Inbox\R3-215899.zip) |

This CB#1302 discussion has two phases:

**Phase 1: Identify potentially achievable agreements for online discussion.**

**Phase 2: TBD**

The deadline for Phase 1 is Thursday, November 4, 23:59:59 UTC. This allows the moderator to prepare some proposals on Friday for Monday’s online session.

The deadline for Phase 2 is the same as for all email discussions, i.e., Tuesday, November 9, 12:00 UTC.

The discussion includes all contributions listed in the reference section.

# For the Chairman’s Notes

Propose the following:

### IP address allocation boundary node

**Proposal 1a1: RAN3 to discuss how CU1 sets IPv6 FL in DL packets of IKE/SCTP-INIT handshakes during migration if it doesn’t know with which IAB-DU it communicates at this stage (assume IPsec transport mode).**

**Proposal 1a2: RAN3 to discuss how CU informs SeGW about the IPv6 FL to use on outer IP header for IPsec tunnel mode with separate SeGW.**

**Proposal 1b: For IP address addition, non-F1-terminating CU to configure IP addresses on the boundary node via Rel-16 RRC signalling, and boundary node to report IP addresses it wants to use via Rel-16 F1AP signalling to the F1-terminating CU.**

**Proposal 1c: The non-F1-terminating CU to use Rel-16 RRC procedures for replacement and release of IP addresses at the boundary node.**

### Mapping configurations

**Proposal 2.2: The F1-terminating CU sends the IP addresses used by the boundary IAB-node together with other information, such as QoS info, to the non-F1-terminating CU so that the non-F1-terminating CU can configure the DL mapping in its Donor-DU.**

**Proposal 2.3: RAN3 assumes that F1AP is used for header-rewriting configuration on the boundary node.**

### Xn signaling for QoS info/L2 info transfer

**Proposal 3.1a: A separate Xn procedures is introduced for the exchange of QoS info/L2 info. FFS if UA or NUA Xn procedure.**

**Proposal 3.1b: The CUs retain the Xn AP IDs after the non-F1-terminating CU has sent the UE Context Release message to the F1-terminating CU.**

**Proposal 3.2: For IP address reconfiguration of descendent nodes:**

* **An Xn procedure between F1-terminating and non-F1-terminating CUs is used, and the F1-terminating CU adds, replaces or releases the IP addresses on the descendent node via RRC.**
* **The same Xn procedure is also used for the transfer of the descendent node’s QoS info/L2 info.**
* **The same Xn procedure is used for partial migration, inter-donor redundancy and RLF recovery.**
* **As the baseline, the reconfiguration of the descendent node occurs after the establishment of the target path. FFS on further details.**

**Proposal 3.4: The following information is exchanged between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for boundary node traffic:**

* **CU1->CU2**
  + **QoS info per traffic type for non-UP traffic and per one or bundle of F1-U tunnels for UP traffic; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **UL: UL boundary node configuration, e.g., UL BH mapping, for each QoS info; pending RAN2.**

**Proposal 3.5: The following information is exchanged between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for descendent node traffic:**

* **CU1->CU2**
  + **QoS info: granularity is FFS; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **DL: For each QoS info: routing information, e.g., BAP routing ID used in topology 2 and ingress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**
  + **UL: For each QoS info: routing information, e.g.,BAP routing ID used in topology 2 and egress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**

### Revocation of inter-donor topology adaptation, RLF recovery

**Proposal 4: The Xn HO procedure is used for revocation of partial migration. FFS if revocation is triggered by F1-terminating CU.**

**Proposal 5a: As a baseline, RLF recovery uses existing Xn procedures.**

**Proposal 5b: For IP address allocation during RLF recovery, same mechanisms to be used as for partial migration.**

### Inter-donor DU migration

Observation 6.1a: RAN2 has already answered its own question, which is: R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.

Observation 6.1b: RAN3 has no conclusive answer on RAN1’s question on how frequently the cell is switched between CU1 and CU2 for Alt2.

**Proposal 6.2: RAN3 to consider Alt 1 is baseline, where the UE can treat the separate resources as different cells on L1. How the UE differentiates the cells on L1, e.g., in frequency or in time domain, is out-of-scope for RAN3.**

**Proposal 6.3: The F1-terminating CU to receive an indication that the boundary node has established F1-C with the non-F1-terminating CU. FFS on the signaling for this indication.**

**Proposal 6.4: Inter-topology BAP routing with two logical IAB-DUs on boundary node is up to RAN2.**

**Proposal 6.5: The boundary node knows the non-F1-terminating CU’s IP address(es) based on OAM configuration.**

# PHASE I: Discussion

## Partial Migration

### IP address allocation boundary node

#### Issue: Explicit signaling of IAB-donor-DU2 IP addresses to CU1

Last meeting agreed:

WA: For no Ipsec/Ipsec transport mode, the source CU can be notified via F1AP Information about the network IP addresses assigned to the boundary node by CU2.

FFS if CU1 needs to know the outer IP addresses for IPSec tunnel mode

Contributions to this meeting discussed ***specific*** reasons why the IP addresses for IPsec tunnel mode ***must*** be explicitly provided via Xn to CU1:

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung claims that such explicit signaling is necessary so that CU1 can associated the SCTP INIT packet sent via the target path with the SCTP association it had via the source path. Otherwise, CU1 would not know that SCTP INIT is from boundary node. This would have the benefit that CU1 knows about the successful migration of IAB-MT rather early and start DL F1-U transmission. Otherwise, it would have to wait for the UE CONTEXT RELEASE message from CU2.

[R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Nokia claims that in case two of CU1’s IAB-nodes simultaneously migrate to different target CUs, CU1 would receive SCTP INIT from both of them and it would not be able to differentiate which is from whom. Consequently, it would not know how to set the IPv6 FL/DSCP for the SCPT INIT ACK appropriately for the DL mapping. This would imply that either all F1-C uses the same IPV6 FL/DSCP or CU1 is explicitly updated about the boundary node’s IP addresses.

[R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE believes that for CU1 needs to know the outer IP addresses to perform security check, i.e., that the inner packet has used the right outer IP addresses. However, gNB-DU CONFIG UPDATE presently only includes the outer IP addresses for F1-U, not for F1-C/non-F1 traffic. Therefore, gNB-DU CONFIG UPDATE might have to be extended to also include outer IP addresses of F1-C/non-F1 traffic.

[R3-215013](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) CATT believes there that explicit XnAP based signalling allows simultaneous F1-C and F1-U migration, which speeds up the F1-U resume procedure.

**Q1a: Please comment on the issues raised by Samsung, Nokia, ZTE and CATT why for IPsec tunnel mode the IP addresses need to be explicitly included in Xn to CU1 (reasons, no Likes/Dislikes)**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | **On Samsung’s concern:** CU1 can match the two SCTP associations after they have been established based on the gNB-DU ID contained in F1AP. SCTP matching is not necessary and hard to implement since SCTP is terminated on the OS rather than on application layer. Further, DL F1-U transmission can **NOT** start before boundary node has established IPsec to CU-UP, which cannot happen before F1AP gNB-DU CONFIG UPDATE has been exchanged.  **On Nokia’s concern:** This is a real problem. However, it already arises for IKE establishment which occurs before SCPT INIT and already uses an IPv6 FL/DSCP. Therefore, matching SCTP associations based on IP address wouldn’t help. Also, forcing all F1-C traffic to use same IPv6FL/DSCP is not a good idea. Finally, including F1-C IP addresses into Xn message does not help for IPsec tunnel mode, where the SeGW is outside the CU and the CU never needs to know the outer IP address. In fact, the CU would solely set IPv6 FL/DSCP on the inner packet and the SeGW would then copy it over to the outer header and add the IAB-DU’s IP address.  We propose the following solution to Nokia’s problem:  1. Only IPv6FL/DSCP is included in Xn from CU2 to CU1.  2. CU2 configures two DL mappings on donor-DU2, one containing only IP address for F1-C, and the other includes the IP address for F1-C + IPV6FL/DSCP.  3. The donor-DU2 applies precedence for full matches over partial matches. This implies that the IP-address-only DL mapping will be used for IKE and SCTP INIT, and the full match for F1-C afterwards.  **On ZTE’s concern:** For IPsec tunnel mode: The outer IP address of F1-C is terminated at SeGW, not at CU-CP. The SeGW knows the outer IP address from IKE handshake. The CU-CP doesn’t have to know it.  **On CATT’s comment:** The claim is that F1-U could be migrated without IAB UP CONFIG UPDATE message. We disagree since the IAB UP CONFIG UPDATE includes the UL mappings on topology 2, which the boundary node doesn’t know. |
| Samsung | **To QC’s concern on our proposal:**  We are not intended to associate two SCTP associations. Our essential intention is to ensure the CU1 can set the correct DSCP/FL for the SCTP INIT ACK message since we assume the DL mapping at the CU2’s donor DU is based on IP + FL/DSCP.  Companies may argue that the DL mapping at the CU2’s donor DU can be performed via IP address only. If this is the case, we agree that new IP address via new XnAP is not needed. However, this method brings the restriction. For example, we assume boundary node has one new IP address (IP#1) only. At the CU2’s donor DU, the DL mapping is configured based on IP#1. To ensure the correct transmission of IKE/SCTP packets, the CU2 cannot configure any other DL mappings since the CU2 cannot know which FL/DSCP can be set for IKE/SCTP packets. Among companies’ proposals, the HO REQ message is supposed to have QoS info., which intends to let CU2 configure DL mapping for the corresponding traffic. However, before finishing IKE/SCTP procedures, the DL mapping related to those QoS info. cannot be configured.  **To QC’s proposal for Nok’s concern**  If only FL/DSCP is provided to CU1, CU1 cannot know which packets should be applied those FL/DSCP setting since CU1 does not know the new IP address of the boundary node.  **To Nok’s concern:**  We acknowledge the issue mentioned by Nok. However, forcing all F1-C traffic to use same FL/DSCP is not a good idea since there are other F1-C traffic not belonging to boundary node.  Actually, the better way is to use XnAP to explicit include the new IP address. Meanwhile, the XnAP can be also used to inform CU1 the new IP address for descendant nodes.  So, we prefer to **use XnAP to explicitly indicate the new IP address of boundary node, and also include the FL/DSCP.** |
| **Ericsson** | **F1AP** should be used to indicate the new addresses to the CU1.  We think that QC’s workaround about full/partial matching at D-DU2 may work. For instance, wrt Samsung’s example, the initial IKE/SCTP traffic can be mapped to BH in the D-DU2 solely based on the IP address. Then, once everything is up and running, CU1 and CU2 can exchange the QoS info so that CU2 can update the mapping so that it becomes based on IP address + FL/DSCP. |
| Huawei | Here we are talking outer IP address. The outer IP address(es) of the IAB-node is useful for the DL IP-to-BAP mapping configuration at the target IAB-donor-DU, but such mapping configuration is managed by the target IAB-donor-CU, which is responsible for providing the new outer IP address(es) to the IAB-node via the source CU. In this case, the outer IP address(es) of the IAB-node will not even be seen by the source IAB-donor-CU. Consequently, it seems not necessary for the source IAB-donor-CU to know the updated outer IP address(es). |
| Nokia | The IPv6 FL may not work. According to RFC4301 “Security Architecture for the Internet Protocol”: “(8) See [RaCoCaDe04]. **Copying is acceptable only for end systems, not SGs.** If an SG copied flow labels from the inner header to the outer header, collisions might result.” “a security gateway (SG)”. So when SG is used, copying the FL from inner IP header to outer IP header is not possible.  On the other hand, CU2 know the outer IP address to be used for F1-C. For traffic mapping for DL F1-C, CU2 can directly configure its Donor-DU without the request from CU1. There is no need for CU1 to know the new outer IP address, e.g. via F1.  We propose to further discuss the IPv6 FL. If it is not an issue, CU1 does not need to know the new outer IP address. |
| CATT | The discussion is for no Ipsec/Ipsec transport mode hence the source CU needs to know the new IP address.  Before we go for F1AP, we should address how does the source CU knows the SCTP INIT ACK is for a specific IAB node. |
| ZTE | **On Samsung and Nokia’s concern:**  We agree with QC that DL mapping based on IP address(for F1-C) could be used for IKE and SCTP establishment. Meanwhile, DL mapping based on IP address(for F1-C/U)/DSCP/FL could be configured for target donor DU. After boundary node established new SCTP association and performed DU configuration update with source donor CU, source donor CU would be aware that the new SCTP association belongs to the boundary node. And then the source donor CU could use the DSCP/FL received from target donor CU.  **On QC’s comment for our proposal:**  For IPsec tunnel mode, if SeGW locates outside the CU-CP, it is true that CU-CP doesn’t have to know boundary node’s new F1-C outer IP address. However, if SeGW collocates with the CU, CU needs to know boundary node’s new outer IP addresses to perform security check. |
|  |  |

Summary:

The following issues have been identified and need further discussion:

**How should CU1 set IPv6 FL in DL packets of IKE/SCTP-INIT handshakes during migration if it doesn’t know with which IAB-DU it communicates at this stage (let’s assume IPsec transport mode)?**

* Option 1: All IKE/SCTP-INIT traffic uses same FL.
* Option 2: CU2 configures two DL mappings, one with IP address, the other with IP address + IPv6 FL, and it applies precedence to longer match. CU1 can set any FL6 for IKE/SCTP-INIT packets.
* Option 3: Initially, DL mapping is only configured based on IP address. QoS info is exchanged after CP has been established and then DL mapping is configured.

**Samsung**: Option 2 has problems if all traffic uses only 1 IP address since DL mapping with IP address only would not be able to differentiate packets, e.g., between CP and UP.

**Moderator**: Before any UP traffic is flowing, IAB-DU must have performed gNB-DU-CONFIG-UPDATE with CU where it discloses its IP address. At this point, CU1 can map the IPv6 FL obtained from CU2 for this IAB-node to the corresponding IP addresses.

**Rel-16/17 problem: For IPsec tunnel mode with SeGW outside of CU, how does CU inform SeGW about the IPv6 FL to use on outer IP header?**

* Option 1: CU sets IPv6 FL in inner header and SeGW copies from inner to outer header.
* Option 2: SeGW must always be collocated with CU.

**Nokia**: According to IETF RFC 4301, IPv6 FL copying should not be applied to SeGW due to IPv6 FL collision.

**Moderator**: RAN3 needs to discuss if the problem of IPv6 FL collision applies in an operator-managed backhaul network. Also, there is presently no other option.

The Moderator believes that more discussion is necessary to resolve these two issues. RAN3 should agree that both issues need to be resolved.

**Proposal 1a1: RAN3 to address how CU1 set IPv6 FL in DL packets of IKE/SCTP-INIT handshakes during migration if it doesn’t know with which IAB-DU it communicates at this stage (assume IPsec transport mode).**

**Proposal 1a2: RAN3 to address how CU informs SeGW about the IPv6 FL to use on outer IP header for IPsec tunnel mode with separate SeGW.**

#### Issue: IP address addition

CU2 can assign new IP addresses to the boundary node, e.g., for inter-donor redundancy. In this case, CU1 has to be informed which of these IP addresses are used for F1-U tunnel, F1-C, Non-F1 traffic. In case CU1 decides to migrate traffic any of these types to the target path, it needs to inform CU2 which of these IP addresses are used for which traffic to be migrated, so that CU2 can configure the DL mapping.

[R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm and [R3-215613](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Huawei propose that Rel-16 RRC signaling can be used by CU2 to configure the new IP addresses. [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm further proposes that Rel-16 is used by the IAB-DU to reports the IP addresses it wants to use to CU1 via F1AP.

**Q1b: For IP address addition: (1) Do you agree that Rel-16 RRC and F1AP signalling are used for CU2 to configure IP addresses on the boundary node, and for the boundary node to report IP addresses it wants to use to CU1, respectively?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Yes |
| Samsung | * **CU2 configures IP address on the boundary node**   We understand that here, the Rel-16 scheme means to use RRCReconfiguration message to configure IP address. If so, we agree.  This configuration can be sent to boundary node by CU2 directly via SRB3 or by CU2 indirectly through CU1   * **Boundary node reports IP addresses it wants to use to CU1**   Need clarification. What does “Rel-16” is referring to for IP address report by IAB-DU? In Rel-16, the IP address report is for the case of OAM configured IP address. |
| **Ericsson** | Yes.  Wrt Samsung comment on the second bullet: the indication of IP addresses from the boundary node to CU1 via F1AP is used even for network-based IP address assignment (not only for OAM). For example, if IAB node receives a prefix, it needs to communicate to CU1 via F1AP the individual addresses within this prefix that it wants to use. |
| Huawei | Yes |
| Nokia | Agree with Samsung.  In case IPv6 prefix is used, IAB may generate an IPv6 address. Current F1AP may be initiated to inform CU for the Transport layer Address Info, but that is only for F1-U. |
| CATT | Yes |
| Lenovo | Yes |
| Fujitsu | Yes |
| ZTE | Yes |
|  |  |

Summary:

The Moderator hopes that with Ericsson’s clarification of the question all doubts have been removed.

**Proposal 1b: For IP address addition: Rel-16 RRC signalling is used by CU2 to configure IP addresses on the boundary node, and Rel-16 F1AP signalling is used by the boundary node to report IP addresses it wants to use to CU1.**

#### Issue: IP address replacement/release

On IP address replacement and IP address release, contributions propose the following:

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung claims that IP address replacement/release by CU2 requires that old/new IP addresses are sent to CU1. The contributions further claims that both CUs can trigger IP address release.

[R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE believes that IP address replacement and release can be done by CU2 via RRC using Rel-16 signaling.

**Q1c: Should IP address replacement/release reuse Rel-16 procedure(s) (ZTE) or is a new signaling needed (Samsung)?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Rel-16 procedure should be used |
| Samsung | We understand this Rel-16 procedure is referring to the RRCReconfiguration procedure between CU and IAB node. If this is the intention, we agree to reuse Rel-16 procedure.  Note, in our proposal, we are referring to the enhancement over XnAP signaling. If the replacement is triggered by the CU2, this may need enhancement since Rel-16 does not define this. |
| **Ericsson** | We should reuse Rel-16 procedure. We do not understand why should CU1 be involved. After migration boundary node’s IP addresses are managed by CU2 (or OAM). |
| Huawei | Yes |
| Nokia | Need clarification for the replacement. Does it mean the migrating IAB further migrate to another Donor-DU of CU2?  Are we sure there is no enhancement to Xn? Rel-16 is only for intra-Donor. It may be better to change the proposal to:  **IP address replacement/release is based on Rel-16 procedure(s)** |
| CATT | Reuse R16 iab-IP-AddressToAddModList-r16 and iab-IP-AddressToReleaseList-r16 for boundary node.  RRC reconfiguration can be send to boundary node but how to handle the case of IP address replacement/release for descendant node e.g., Xn and F1 message is needed as IP address allocation. |
| Lenovo | Rel-16 procedures can be reused after migration. |
| Fujitsu | Rel-16 procedure should be used. |
| ZTE | Rel-16 RRC procedure should be used for IP address replacement/release.  Regarding proposals raised in R3-214873, it was agreed in RAN3#113e meeting that no dedicated signalling is needed to enable coupling of IP addresses in CU1 and CU2 networks. So no signaling enhancement is needed to send old/new IP addresses from CU2 to CU1. |

Summary:

There is agreement that IP address replacement and IP release by CU2 uses Rel-16 RRC procedures. Let’s include a little more detail to make sure everybody is on the same page.

**Proposal 1c: Rel-16 RRC procedures are used for replacement and release of IP addresses at boundary node by the non-F1-terminating CU.**

### Mapping configurations

#### Issue: UL Mapping configuration on boundary node

[R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm proposes that since UL mappings for both topologies are configured via CU1’s F1AP on the boundary node, each UL mapping information needs to incudes a topology identifier.

**Q2.1: Do you agree that the UL mapping configuration on the boundary node needs to include a topology identifier? If not, how does the boundary node differentiate UL mapping on topology 1 vs. topology 2?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Yes |
| Samsung | Yes. Detailed topology identifier design needs further discussion. |
| **Ericsson** | **No.** The proposal refers to the topology redundancy case? Why is it discussed in this CB?  “UL mapping” here refers to mapping of access traffic to backhaul link? If so, we don’t think this is necessary. In *BH Information* IE for one BAP routing ID, there can be up to two Next hop BAP Address + egress BH RLC CH ID configurations. The first item of the list can refer to Top1 and the second one to Top2. Moreover, from *Next hop BAP Address* IE entry in the list item it may also be clear for which topology is the entry, since the two parents in different topologies will likely have different BAP addresses. So, **implicit indication does the job.**  If this is about header rewriting, RAN2 has not still clarified Stage-3 details. |
| Huawei | Yes |
| Nokia | No. need to wait for RAN2 progress on the handling of the header re-writing. |
| CATT | Maybe no. UL mapping means BAP routing ID, ingress BH RLC channel, prior hop🡪 egress BH RLC. The UL mapping table for topology 2 does not have the descendant node i.e., there is no prior hop for boundary node for UL. However, boundary node has descendant node in top1. Boundary node can implicit tell different UL mapping for different topology by read the UL mapping table. |
| Lenovo | For partial migration scenario, the boundary IAB-MT has migrated to target parent node, there is no need to include a topology identifier in UL mapping configuration. |
| Fujitsu | Yes, we think the UL mapping configuration before and after migration need to be differentiated. |
| ZTE | For inter-donor migration scenario, the “topology identifier” is no need since there is only one egress link in the uplink at the boundary node. |

**Summary:**

There is no conclusive result.

4 companies agree.

1 company wants to wait for RAN2 decision on header rewriting. The moderator disagrees since boundary-node traffic does not require header rewriting.

1 company believes that implicit indication could be used.

2 companies believe that no indication is used at all.

The moderator believes that ultimately, the boundary node needs to know for every BH RLC CH and every BAP routing ID to which topology they belong. This might be communicated implicitly or explicitly. If this info is not available, things will not work.

No conclusion at this point.

#### Issue: DL Mapping configuration at target donor DU2

[R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm proposes that for IP address addition, CU1 to report to CU2 the IP addresses selected by the boundary IAB-node for the various traffic types so that CU2 can configure the DL mapping.

**Q2.2: Do you agree that for IP address addition, CU1 to report to CU2 the IP addresses selected by the boundary IAB-node for the various traffic types so that CU2 can configure the DL mapping?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Yes |
| Samsung | Partially yes.  There is no need to mention “for IP address addition”. IP addresses selected by boundary node should be sent to the CU2 during the procedure of QoS information transfer. |
| **Ericsson** | Samsung rewording is OK, this should be done also when boundary node receives its first addresses from CU2. |
| Huawei | Yes |
| Nokia | Agree with Samsung/Ericsson.  CU1 provide the selected IP address and other information (e.g. QoS) to CU2, so CU2 can configure DL mapping in its Donor-DU. |
| CATT | Yes. However, I am wondering how to convey IP addresses selected by boundary node in Xn handover request message? Because the new IP address is allocated by CU2 in Xn handover request ACK and QoS transfer may before this e.g., in Xn handover request. |
| Lenovo | Agree with Samsung. |
| Fujitsu | Yes. And after CU2 obtains the IP address used for DL mapping, CU2 should respond CU1 on the UL GTP addresses for the CU2 anchored bearers. |
| ZTE | We agree that CU1 needs to send DL IP address and corresponding Qos info to CU2. But we think it is applicable not only to IP address addition but also IP address replacement. And the wording ”selected by the boundary node” is a bit confusing. In our view, for IP address addition, it is true that IP addresses used for various traffic are selected by the boundary node. However, for IP address replacement, IP addresses used for various traffic are selected by CU2. |

**Summary:**

Samsung provided some rewording that seems to be acceptable to most. ZTE has concerns about the term “selected by the boundary node”, since for IP address replacement, it is CU2 that selects the addresses. The Moderator understands the concern even if one might dispute if it is CU2 or donor-DU2 that actually selects the addresses.

The Moderator proposes the following rewording to make everybody happy:

**Proposal 2.2:** The F1-terminating CU sends the IP addresses the IAB-node has reported to use together with other information, such as QoS info, to the non-F1-terminating CU so that the non-F1-terminating CU can configure the DL mapping in its Donor-DU.

#### Issue: Configuration of BAP header rewriting

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung proposes that the header rewriting configuration is provided to the boundary node together with routing and bearer mapping configurations via F1AP.

**Q2.3: Do you agree header-rewriting configuration is configured together with routing and bearer mapping configurations via F1AP?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Yes |
| Samsung | Yes |
| **Ericsson** | We prefer to discuss this once RAN2 determines the stage-3 details. They are already working on this. |
| Huawei | Partially Yes  “Together” should be clarified. If this is to discuss the stage3 signaling, it can be discussed later after RAN2 decision. |
| Nokia | Maybe yes, but need to wait for RAN2 |
| CATT | BAP header-rewriting configuration is configured by F1AP.  Maybe it can be performed during partial migration e.g., after negotiation between two donors. |
| Lenovo | “Together” should be clarified. And we agree with that header-rewriting configuration is configured via F1AP. |
| Fujitsu | Yes, we can enhance BAP Mapping Configuration procedure to include header-rewriting configuration. |
| ZTE | We agree that BAP header-rewriting configuration is configured via F1AP. The detailed signaling needs to be discussed after RAN2 decision. |

**Summary:**

All companies except Ericsson are in favor of using F1AP for BAP Mapping configuration. Ericsson believes that this is dependent on RAN2’s progress on St3 details. The Moderator disagrees since this is a St2 issue, which should precede st3, and it is in RAN3 scope. At present stage, RAN3 can assume that F1AP is used, and this will stay valid unless RAN2 explicitly decides that RRC needs to be used.

**Proposal 2.3: RAN3 assumes that F1AP is used for header-rewriting configuration on the boundary node.**

### Xn signaling for QoS info/L2 info transfer

#### Issue: Xn signaling for boundary node

[R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Nokia and [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm propose that the QoS info/L2 info can be included in the Xn HO preparation procedure.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung, [R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Nokia and [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm propose that a separate Xn procedure is introduced for QoS info/L2 info transfer for QoS info update, e.g., for new bearers, to modify bearers or in case the number QoS info/L2 info does not fit into the Xn HO Preparation message.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung further proposes that the QoS info transfer CU1->CU2 can be triggered by:

**Option 1**: explicit Xn indication from CU2 to CU1 upon reception of the boundary IAB-MT’s RRC Reconfiguration Complete message.

**Option 2**: implicit SCTP-based indication (SCTP INIT) or F1AP-based indication (gNB-DU CONFIG UPDATE) from descendent node to CU1 received after IAB-MT’s migration.

[R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcommand[R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE propose that CU1 and CU2 retain XnAP IDs after CU2 has sent the UE Context Release message (for the boundary IAB-MT) to CU1. [R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE further proposes that CU1 indicates to CU2 that the XnAP IDs should be kept.

**Q3.1: Please provide comments on:**

**a) QoS info/L2 info can be included in the Xn HO Preparation procedure.**

**b) QoS info/L2 info can also be exchanged via separate Xn procedure, which uses UA signaling.**

**c) If this separate procedure should be triggered by Option 1 or Option 2.**

**d) CU1 and CU2 retain the Xn AP IDs after CU2 has sent the UE Context release message.**

**e) CU1 indicates to CU2 to retain the Xn AP IDs.**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | a) yes  b) yes  c) Option 2, i.e., no new signaling needed.  d) yes  e) may not be necessary since CUs know that this is partial migration. |
| Samsung | 1. No.   We understand that the intention of this is to speed up the DL mapping configuration at CU2’s topology. However, during HO preparation procedure, the inter-topology transport cannot be carried out since the CU1 does not get F1-U tunnel switch information (current WA indicates F1-U tunnel switch can only happen after receiving GNB-DU Configuration Update message). Thus, we cannot identify clear benefit to include QoS info in HO REQ message.  In addition, we prefer to have a clean solution, i.e., HO REQ message is only used for boundary IAB-MT handover.   1. Partial Yes. We are ok for the first part. However, we are not OK for UA signaling. The reason is that, such signaling is used to transfer QoS info of traffic belonging to boundary IAB-DU, descendant IAB-MT, and descendant IAB-DUs. In some cases, CU1 may want to offload the traffic belonging to boundary node and descendant node(s) at the same time. If UA signaling is used, it means that several UA procedures should be triggered, each of which belongs to one node. However, if NUA signaling is used, CU1 can trigger one procedure to complete QoS info. transfer for all traffic. Thus, we propose:   **QoS info/L2 info can also be exchanged via separate Xn procedure, which uses NUA signaling.**   1. This relies on conclusion of Q1a. If new IP address is informed via HQ REQ ACK message, “ implicit SCTP-based indication (SCTP INIT)” is a good way since this is the first packet received by the CU1 after boundary IAB-MT migration. For descendant node, we may not need to have a trigger. As long as boundary node access is finished, the QoS info transfer can be triggered. Thus, we propose:   **The trigger for QoS info. transfer CU1->CU2 is needed. FFS on detailed trigger**   1. Yes with rewording, e.g., “ **CU1 and CU2 retain the Xn AP IDs of boundary IAB-MT after CU2 has sent the UE Context release message during partial migration**” 2. No. CU2 knows this is for migration. It can automatically keep the XnAP ID for boundary IAB-MT |
| **Ericsson** | 1. After some further thinking, our answer is: **probably no**. We proposed to use HO request, but we also tend to think that keeping all the QoS info in the new procedure is more elegant. We should avoid sending same info types in different procedures. 2. **OK.** On one side a UA procedure seems appropriate, since CU2 is building backhaul towards the boundary node (even though some of the traffic carried over the backhaul indeed pertains to the descendants). However, we are not sure that it is formally OK to run a UA procedure over Xn for an MT whose HO has been completed. 3. **Option 2.** 4. **Agree,** but we should **discuss this in more detail** in the revocation discussion.   e) Let us resolve d) first. |
| Huawei | a) yes  b) yes  c) Option 2  d) yes  e) no |
| Nokia | 1. Yes 2. Yes 3. No. This may be up to CU1’s implementation. For example, CU1 may first initiate the request to check whether CU2 can support the BH RLC CH, etc. 4. Yes. 5. No. both CU know this is a migration/HO for the IAB-MT, so they can do something related to IAB. |
| CATT | a) Yes for QoS of boundary node (F1 terminated at boundary node). The descendant node’s QoS ((F1 terminated at descendant node) should be sent after/during F1-C/U migration of boundary node for partial migration i.e., option 2 in c)  b) No, NUA for multiple QoS transmission  c) Option 2.  d) yes  e) agree with QC |
| Lenovo | a) yes  b) yes  c) Option 2  d) yes  e) no |
| Fujitsu | a) yes  b) yes  c) Option 2  d) yes  e) no. |
| ZTE | a) no, considering that new XnAP message must be defined to transfer QoS info, we prefer to transfer all QoS info related to boundary node and descendant nodes in the new XnAP message.  b) yes. UA signaling is referred since these QoS info/L2 info should be associated with the boundary node.  c) Neither. It can be performed before boundary MT’s migration (e.g. after receiving Handover Request ACK message) 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.  d) yes  e) yes, but we would like to clarify that our intention is that CU2 indicates to CU1 to retain the Xn AP IDs in the UE context release message. Otherwise, according to current specification TS38.423, the Xn association for the boundary MT may be released by CU1 after receiving UE context release message. We think it’s better to make it clear in the specification. |

**Summary:**

a) QoS info/L2 info can be included in the Xn HO Preparation procedure: **6 yes, 3 no.**

b1) QoS info/L2 info can also be exchanged via separate Xn procedure: **At least 8 yes, 1 not clear**.

b2) This is a UA procedure: **There seems some skepticism.** Let’s make this a RAN3 action item for the next meeting.

c) If this separate procedure should be triggered by Option 1 or Option 2.: **Mixed answers.** 6 companies for option 2, which means no new signaling needed. 1 company believes that no trigger is needed. 1 company believes that his is up to implementation. 1 company has a more complicated answer. At the moment, there doesn’t seem to be a lot of support for explicit trigger signaling.

d) CU1 and CU2 retain the Xn AP IDs after CU2 has sent the UE Context release message: **All yes**.

e) CU1 indicates to CU2 to retain the Xn AP IDs: **Mixed answers.** So let’s discuss this later.

**Proposal 3.1a: A separate Xn procedures is introduced for the exchange of QoS info/L2 info. FFS if UA or NUA Xn procedure.**

**Proposal 3.1b: The CUs retain the Xn AP IDs after the non-F1-terminating CU has sent the UE Context Release message to the F1-terminating CU.**

#### Issue: Xn signaling for descendent node

This section is about descendent-node reconfiguration. It is not about avoidance of descendent-node reconfiguration which, based on RAN3 agreement, will be discussed in 13.2.2.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung, [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcommand[R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Nokia propose that for IP address reconfiguration of descendent nodes, an Xn procedure between CU1 and CU2 is used, and CU1 then adds or replaces the IP addresses on the descendent node via RRC.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung further propose that the same Xn procedure used for IP address request/reply can also be used for transfer of the descendent node’s QoS info/L2 info.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung further proposes that this procedure is used for partial migration, inter-donor redundancy and RLF recovery.

[R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm proposes that a UA Xn message for the boundary node is used for this purpose so that CU2 returns IP addresses for the boundary-node’s donor-DU2. CU1’s UA Xn IP address request should further contain a “descendant-node indicator” so that CU2 know that this request is not for the boundary node.

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung proposes that as the baseline, the reconfiguration of the descendent node occurs after the successful migration of the boundary node.

**Q3.2: Do you agree that:**

**a) for IP address reconfiguration of descendent nodes, an Xn procedure between CU1 and CU2 is used, and CU1 then adds or replaces the IP addresses on the descendent node via RRC**

**b) the same Xn procedure can be used for transfer of the descendent node’s QoS info/L2 info**

**c) this procedure is used for partial migration, inter-donor redundancy and RLF recovery.**

**d) a UA Xn message for the boundary node is used for this purpose so that CU2 returns IP addresses for the boundary-node’s donor-DU2.**

**e) CU1’s UA Xn IP address request should further contain a “descendant-node indicator” so that CU2 know that this request is not for the boundary node.**

**f) the reconfiguration of the descendent node occurs after the successful migration of the boundary node.**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | a) yes  b) yes  c) yes  d) yes  e) yes  f) yes |
| Samsung | 1. Yes 2. Yes 3. Yes 4. Yes if the intention of this is to reuse XnAP HO Preparation procedure of boundary IAB-MT to derive new IP address of descendant node(s) 5. No. we are not sure why CU2 needs to know the IP address is for boundary node or descendant node. The CU1 only needs send the IP request based on the request from boundary node and descendant node, and the CU2 return the corresponding new IP address. How to allocate those IP addresses is CU1’s decision. 6. Yes as the baseline. |
| **Ericsson** | **Disagree to all a)-f).** The change of IP addresses to the descendants causes massive traffic and service interruption. If the descendant nodes would keep using their IP addresses from the Donor-CU1 network, at least the following actions could be avoided in partial migration, **per descendant node:**  1. Coordination between source and target donors about the new IP addresses for the descendants.  2. RRC signalling from source CU to assign the new IPs to the descendants.  3. Setting up the new IPsec tunnel to the SeGW of source donor.  4. If MOBIKE is not used, updating of inner address to the source donor, establishing new SCTP association/updating the F1-U tunnel.  5. If MOBIKE is used, informing the source donor that the inner address is reused.  6. Since the network below the boundary node may consist of several hops, the above actions, executed per each descendant node, need to be orchestrated layer by layer. For instance, the above should be first executed by the children of the boundary node, then by their children etc.  It should also be noted that, if descendants would be forced to change their IP addresses, when partial migration is revoked, all the above redundant actions would need to be done once again, by each descendant node.  Although we agreed to discuss the avoidance of descendant IP reconfiguration as an enhancement in AI 13.2.2, we think that in fact this should be **the baseline for partial migration.** |
| Huawei | a) yes  b) yes  c) yes  d) yes  e) no, CU1 knows the IP address assigned to the descendant nodes, which is sufficient to coordinate traffic mapping and BAP configuration with CU2.  f) yes |
| Nokia | 1. Yes 2. Yes 3. Yes 4. Yes 5. No. agree with Samsung. It is up to CU1 to assign an IP address to the boundary node or descendant node. 6. yes |
| CATT | a) Yes but how about release?  b) Is that means both QoS information of descendent node and IP address allocation via new XnAP message? If yes, then we can agree.  c) yes  d) yes it is Xn handover procedure. Didn't we agree to this before?  e) No, after boundary node migration, CU1 sends QoS information of boundary node and IP address request for boundary node to CU2. CU2 will know it is for boundary node.  f) Better to say “at least after CU1 establish new SCTP with new IP address”. Because the F1-C/F1-U migration and QoS information transfer for descendant node can be performed simultaneously based on Q3.1c |
| Lenovo | We’d better to avoid IP addresses update for descendant nodes. And this case can be discussed in full migration.  And for e), the “descendant-node indicator” is unnecessary since CU2 seems doesn’t need to know the requested IP address is for boundary node or descendant nodes. |
| Fujitsu | a) yes  b) yes  c) yes  d) yes  e) yes, but the exact format of “descendant node indicator” should be specified, e.g., the BAP address or anything else.  f) yes, the baseline is that the reconfiguration of the descendent node occurs after the successful migration of the boundary node, which is aligned with Rel-16. But note that there may be optimization on reconfiguring the descendent node and reconfiguring the boundary node concurrently as discussed for service interruption reduction in intra-CU scenario in 13.2.2. |
| ZTE | 1. Yes 2. Yes 3. Yes 4. Yes 5. Disagree, we are not sure about the motivation of including the “descendant-node indicator”. 6. Yes. |

**Summary:**

All except two companies agree at least on a), b), c) and f). The Moderator will therefore address the issues raised by these two companies:

* Ericsson’s lists 6 points why descendent-node reconfiguration would create massive service interruption. All of these points, except the first one, also apply for Rel-16 INTRA-donor migration, where they were never considered critical. The first point i.e., inter-donor coordination about the new IP addresses for the descendants, can be performed preemptively and should therefore not create *any* service interruption. For these reasons, the Moderator cannot follow Ericson’s reasoning.
* Lenovo claims that IP address reconfiguration should be avoided, and that this aspect should be handled together with full migration. The Moderator believes that descendant nodes’ traffic needs to be migrated to the target path also for partial migration.

On “avoidance of desc-node reconfiguration” proposed by Ericsson:

* Ericsson themselves proposed in the last meeting to consider this as an optimization rather than the baseline.
* Even if it was supported, it would create suboptimal routing (i.e., between donor-DUs). The Moderator believes that this would at best be a temporary solution. Therefore, descendent-node reconfiguration would still be necessary.
* Even if it was supported, Xn signaling would still be necessary for QoS info transfer between donors to support proper QoS on the target path.

On a): CATT pointed out that IP address release should be included.

On d): There was a lot of support for using a UA message referring to the boundary IAB-MT. However, two companies make this choice conditional on the use of the Xn HO preparation. Therefore, the explicit message may require further discussion.

On e): There were mixed views on the need for the descendent node indicator in this message.

On f): CATT discusses specific conditions for the “successful migration”. For the time being, we may want to keep this as FFS, and refer to the “establishment of the target path”. Fujitsu emphasizes that we want to consider f) as baseline since solutions discussed under AI13.2.2 may still be considered.

Based on the replies we can derive the following proposal:

**Proposal 3.2a: For IP address reconfiguration of descendent nodes:**

* **An Xn procedure between F1-terminating and non-F1-terminating CUs is used, and the F1-terminating CU adds, replaces or releases the IP addresses on the descendent node via RRC.**
* **The same Xn procedure can be used also for the transfer of the descendent node’s QoS info/L2 info.**
* **The same Xn procedure is used for partial migration, inter-donor redundancy and RLF recovery.**
* **As the baseline, the reconfiguration of the descendent node occurs after the establishment of the target path. FFS on further details.**

#### Issue: Xn QoS info/L2 info for boundary-node traffic

[R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Nokia and [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Qualcomm discuss QoS info/L2 transport info to be exchanged. The following information exchange can be derived for boundary node traffic.

CU1->CU2

* **QoS info per traffic type for non-UP traffic and per one or bundle of F1-U tunnels for UP traffic** (aligned with RAN3 agreements)

CU2->CU1

* **DL: IPv6 FL/DSCP value for each QoS info**
* **UL: UL BH mapping for each QoS info**

CU2 must forward the UL BH mapping for topology-2 traffic since it is configured on the boundary node by CU1 via F1AP.

**Q3.4: Do you agree with this information exchange?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | yes |
| Samsung | Yes with additional info.  CU1🡪 CU2: the DL IP address(es) corresponding to each QoS info. is also needed so that the CU2 can configure the DL mapping. |
| **Ericsson** | In principle OK, provided that we **discuss the content of QoS info separately.** |
| Huawei | Yes  The “UL: UL BH mapping for each QoS info” should be updated as more general description, like “UL: Boundary node configuration, e.g. UL BH mapping, for each QoS info” |
| Nokia | The QoS, IPv6 FL/DSCP are ok.  The CU1 -> CU2 information need to include the related IP header info  The info of the UL BH mapping need to wait for RAN2 decision |
| CATT | Yes |
| Lenovo | Yes |
| Fujitsu | yes |
| ZTE | It should be clarified what does “QoS info” mean. In our view, if UL BH mapping for each Qos info is transferred from CU2 to CU1, CU2 may configure UL packets with the same QoS info to different route for the sake of load balancing on the target path. In this case, it’s not clear how could CU1 determine the used UL BH mapping for each F1-U tunnel. |

**Summary:**

There was generally support for the handshake with the following comments:

* Ericsson: Content of QoS info is still FFS.
* Samsung: The DL IP address is also included so that CU2 can configure the DL mapping.
* Huawei: The “UL: UL BH mapping for each QoS info” should be updated as more general description, like “UL: Boundary node configuration, e.g. UL BH mapping, for each QoS info”
* Nokia: Details of UL mapping are pending RAN2.
* ZTE: QoS info needs further clarification.

The Moderator hopes that the following proposal includes the essence of this handshake together with the comments:

**Proposal 3.4: The following Xn information exchange is proposed between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for the boundary node:**

* **CU1->CU2**
  + **QoS info per traffic type for non-UP traffic and per one or bundle of F1-U tunnels for UP traffic; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **UL: UL boundary node configuration, e.g., UL BH mapping, for each QoS info; pending RAN2.**

#### Issue: Xn QoS info/L2 info for descendent-node traffic

This is based on the assumption that BAP header rewriting is configured by CU1’s F1AP

CU1->CU2

* **QoS info per traffic type for non-UP traffic and per one or bundle of F1-U tunnels for UP traffic**

CU2->CU1

* **DL: IPv6 FL/DSCP value for each QoS info**
* **DL: For each QoS info: BAP routing ID used in topology 2 and ingress BH RLC CH ID**
* **UL: For each QoS info: BAP routing ID used in topology 2 and egress BH RLC CH ID**

Note that CU1 does not have to send topology 1 info to CU2 if it performs the configuration via F1AP.

**Q3.4: Do you agree with this information exchange? Otherwise, what would you change?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | yes |
| Samsung | Yes with additional info.  CU1🡪 CU2: the DL IP address(es) corresponding to each QoS info. is also needed so that the CU2 can configure the DL mapping. |
| **Ericsson** | In principle OK, provided that we **discuss the content of QoS info separately.** |
| Huawei | Yes, but  We need to add below in the CU1->CU2. This is used for CU2 to guarantee the N:1 or 1:1 mapping.  CU1->CU2   * **DL: For each QoS info: BAP routing ID used in topology 1 and egress BH RLC CH ID** * **UL: For each QoS info: BAP routing ID used in topology 1 and ingress BH RLC CH ID** |
| Nokia | The QoS info, IPv6 FL/DSCP are ok.  The CU1 -> CU2 information need to include the related IP header info  The UL/DL routing ID/BH RLC CH need to wait for RAN2 decision |
| CATT | Yes. Maybe no IP address of boundary node is needed because the DL transfer is between target donor and boundary node. |
| Lenovo | For CU1 -> CU2:  The granularity for UP traffic has not been agreed yet. And we prefer to inform with the granularity of per BAP routing ID and per BH RLC CH |
| Fujitsu | yes |
| ZTE | Ok, however, it is under discussing in CB#1304. |

**Summary:**

There was generally support for the handshake with the following comments:

* Ericsson: Content of QoS info is still FFS.
* Samsung: The DL IP address is also included so that CU2 can configure the DL mapping.
* Huawei: Add that routing info is needed to ensure 1:1 or N:1 mapping
* Nokia: The DL IP address needs to be included. BAP routing IDs and BH RLC CHs for routing are pending RAN2.
* Lenovo granularity of UP traffic has not yet been addressed for descendent node traffic.
* ZTE: Also under discussion in CB1304.

The Moderator agrees with ZTE that there is overlap with CB1304, and proposes to see if we can make progress on this issue in CB1302, and otherwise pick up in CB1304.

Considering all the comments, the Moderator proposes:

**Proposal 3.5: The following Xn information exchange is proposed between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for the descendent node:**

* **CU1->CU2**
  + **QoS info: granularity is FFS; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **DL: For each QoS info: routing information, e.g., BAP routing ID used in topology 2 and ingress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**
  + **UL: For each QoS info: routing information, e.g.,BAP routing ID used in topology 2 and egress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**

### Revocation of inter-donor topology adaptation

R3-214822 Ericsson observes that presently, there is no way for a CU1 to request from CU2 to hand back the boundary IAB-MT. The contribution proposes the following two options:

* **Option 1:** A new XnAP procedure enabling CU1 to request revoking of partial migration from CU2.
* **Option 2:** An enhancement to an existing XnAP procedure.

The contribution further proposes to introduce a unified revocation procedure for single- and dual-connected boundary node scenarios.

[R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE and [R3-215613](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Huawei propose to use the existing Xn Handover procedure for revocation of partial migration.

[R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) ZTE proposes, that for this purpose, the XnAP IDs should be kept after initial handover. Further, CU1 should indicate to CU2 during the initial handover that the XnAP IDs should be kept. This aspect has already been discussed above under *Xn signaling for boundary node*.

[R3-215013](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) CATT proposes that after the revocation procedure, CU1 informs CU2 to release or suspend the configuration on the former target path (i.e., the path in topology 2).

**Q4.1: Please provide your views on:**

**a) the existing Xn HO procedure is used for revocation of partial migration, or a new procedure is introduced for revocation of topology adaptation of single and dual-connected boundary node.**

**b) CU1 can request revocation of partial migration from CU2**

**c) after revocation, CU1 informs CU2 to release or suspend the configuration on the path via top 2.**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | The main question is: **What event should trigger the revocation**? The partial migration was triggered by the boundary IAB-MT’s measurement report to CU1. However, the boundary IAB-MT does not send measurement reports to CU1 AFTER migration. **So how does CU1 or CU2 know that revocation would be beneficial?**  As a baseline, the existing Xn HO procedures should be used for revocation of partial migration. For dual connectively, there is no need for a revocation procedure. |
| Samsung | 1. For single-connected, existing HO procedure can be reused for revoke (no enhancement is needed)   For dual-connected, CU1 can trigger revoke due to, e.g., no need for offloading, and new procedure (e.g., reuse the procedure for QoS info transfer) can be used   1. No 2. No. We are not sure the intention of suspend the configuration after revoking. |
| **Ericsson** | Partial migration is not only triggered by link deterioration, but also by traffic load. Moreover, revocation is also relevant for partial migration due to inter-donor RLF recovery.  a) We prefer defining **a new XnAP procedure**. Even if we decide to reuse the existing procedures, the enhancements are needed.  **b) Yes.** In fact, **both CU1 and CU2** should be able to request revoking. CU1 needs to be able to request it once the **situation in CU1 network improves** (e.g., traffic load drops to an acceptable level). **CU2** should also be able to request revoking, for example if its **traffic load is too high**, i.e., such that it cannot serve the offloaded traffic anymore.  **c) Yes.** CU2 can release the backhaul resources only after the revocation has been successfully completed.  Revocation is **needed also in the case of DC** for the same reasons that hold for the single-connectivity case. Moreover, we should also discuss the need for partial revocation in the DC case.  As soon as the conditions that have led to partial migration disappear, the network topology should be returned into its “business as usual” state.  We invite the companies saying that not even an enhancement to existing procedures is needed to explain how revoking is to be done then. |
| Huawei | In general, we think the revocation of partial migration can be done by the already agreed procedures as reconfiguration, but maybe we should first discuss the question that why is revocation needed? |
| Nokia | Agree with QCOM/Huawei. We’d better clarify the issues first.  For example, If the revocation is based on the IAB-MT’s measurement report, then CU2 initiate a HO to CU1, the normal HO procedure is performed. CU1 can reconfigure the IABs to use the source path.  In TR, CU1 can request to modify the previous offload, e.g. move some traffic back to CU1’s topology.  Suggest clarify the issue, e.g. what is missing with current HO and reconfiguration? |
| CATT | The measurement report could send by boundary node MT to source CU via target path. Furthermore, revoke can be triggered if the load is not heavy on source path. It can be considered in combination with the measurement report but it is up to implementation.  We support both b) and c) |
| Lenovo | Since IAB-MT is connecting to CU2 after partial migration, the revocation (migration from CU2 to CU1) can be triggered by CU2 rather than CU1 via the legacy HO procedure. |
| Fujitsu | We generally support using the existing Xn HO procedure for revocation of partial migration and no new Xn procedure is needed. And we share the same concern with QCOM about revocation of partial migration. To QCOM’s question, we assume CU2 rather than CU1 can initiate the revocation when the boundary MT reports the measurement results to CU2.  For dual connectivity, we think there is need for revocation of part or all of the offloaded redundant paths. Note that in R16 we have the release of the redundant path for intra-CU topology redundancy. This may use a new XnAP procedure. This can be discussed together with CB#1304. |
| ZTE | 1. We prefer that existing Xn HO procedure is used for both single and dual connection scenario. 2. Assuming the revocation is triggered by link quality degradation, CU2 could initiate the revocation upon receiving the measurement report from boundary node. 3. Yes, and existing UE context release message could be used. |

**Summary:**

On a) All companies, except one, support using the Xn HO procedure for revocation of partial migration. The one company, Ericsson, prefers using a new Xn procedure, but does not seem to mind to also using the Xn HO procedure. Only few companies discussed DC, but generally, there was the feeling that no new procedure was needed since the boundary IAB-MT still has RRC connectivity to CU1. Any further enhancements to DC should probably be discussed in AI13.2.3.

On b) There were different views on the purpose of revocation trigger by CU1. Some companies believe that such a trigger is not needed if the reason of migration was deteriorating link quality. Some companies emphasize that migration might also be caused by overload in topology 1, and in this case a trigger by CU1 would be necessary. Two companies propose further discussion.

On c) Only 4 companies addressed this issue, and 3 of them was in favor of UE context release while 2 was opposed. The moderator believes that this issue will settle as soon as we have agreed on the Xn procedure(s) to be used.

**Proposal 4: The existing Xn HO procedure is used for revocation of partial migration. FFS if revocation is triggered by F1-terminating CU.**

### Inter-donor RLF recovery

R3-214822 Ericsson observes that the present RRC Reestablishment procedure is not sufficient for RLF recovery of the boundary node since CU2 cannot asses from the RRC Reestablishment Request, what resources are needed to take on the boundary node’s and subtree’s traffic. The XnAP Retrieve UE Context procedure then allows CU1 to pass information (e.g., QoS info) to the CU2, but it does not allow CU2 to confirm/reject the recovery request based on this information.

The contribution therefore proposes a new procedure containing the following 3-way handshake:

* Step 1: The target donor contacts the source donor, inquiring about the necessary resources to serve the node attempting RRC Reestablishment and its descendants.
* Step 2: The source donor replies.
* Step 3: The target donor confirms or rejects.

R3-215302 Motorola proposes that IP address addition can be applied for the inter-donor RLF recovery procedure.

[R3-215613](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Huawei proposes that information about IP addresses requested by the recovering IAB node is included in the RRC container and transferred for the Xn context fetch procedure.

**Q5.1: Please phrase your views:**

**a) How CU2 can confirm/reject RLF recovery attempt within the existing Xn procedures, or if a new procedure is necessary.**

**b) How IP address allocation for the recovering IAB-node (boundary node) is performed.**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | a) We don’t think that rejection of RLF Recovery of an IAB-node is a good idea in a properly managed network. A new procedure is therefore not needed. After context fetch, transfer of QoS info/L2 info can use the new Xn procedure introduced for Partial Migration above.  b) For IP address allocation: We can do IP address assignment as for partial migration. CU1 inserts the corresponding request in the Xn context transfer. |
| Samsung | 1. There is no need specific procedure to confirm/reject RLF recovery. The following-up QoS info transfer procedure can achieve this purpose if the further traffic transfer is not acceptable for CU2, it can reject the transfer. 2. Can reuse the procedure in the partial migration as much as possible. |
| **Ericsson** | a) A **new procedure** is necessary – we cannot freely assume that the target has enough resources to serve the recovering node and all its descendants. The stakes are much higher than for a normal UE.  b) The mechanism from partial migration should be reused. |
| Huawei | a) We think there is no need to introduce new procedure, update to existing procedure should be enough;  b) We think information about IP address(es) requested by the recovering IAB node is included in the RRC container and transferred via the Xn context fetch procedure from the initial donor CU to new donor CU |
| Nokia | 1. Why need confirm/reject RLF recovery? How is it different to normal UE RLF recovery, except the BH RLC CH and reconfiguration? 2. Agree with QCOM/Samsung.   Anyway, please clarify the issue for current procedure. |
| CATT | a) After XnAP Retrieve UE Context procedure (for boundary node MT) and F1 migration (or during), CU1can pass QoS info (for descendant node) to CU2 with the new XnAP in partial migration for QoS transfer. No new procedure is needed. Note that, this is RLF case, save boundary node MT is the most important thing rather than ensure all F1terminated at descendant node can accept by CU2.  b) similar as partial migration |
| Lenovo | a) There is no need to introduce confirmation/rejection for RLF recovery. Rejection for RLF recovery may trigger IAB node release which is undesired to us.  b) Reuse the mechanism for partial migration. |
| Fujitsu | 1. We think a new procedure may not be needed, e.g., the Context Fetch Request can trigger the Xn procedure for partial migration. 2. IP address allocation for inter-donor RLF recovery can reuse the procedure of partial migration. |
| ZTE | 1. Existing Xn procedure could be used.   b) IP address allocation for the recovering IAB-node could be reuse the mechanism similar as in migration case. |

**Summary:**

On a) 8 companies believe that RLF recovery should use existing XN procedure, potentially with updates. 1 company believes that a new Xn procedure is needed to support confirmation/rejection of recovery.

On b) All companies believe that the IP address allocation procedures from partial migration should be reused.

**Proposal 5a: As a baseline, RLF recovery uses the existing Xn procedure.**

**Proposal 5b: For IP address allocation during RLF recovery, same mechanisms to be used as for partial migration.**

## Inter-donor DU migration

This topic has been controversial in the past. RAN3 sent an LS to RAN1, 2, and 4 and received the reply LSs prior to this meeting. The reply LSs were also discussed in contributions to this meeting.

The reply LSs contained follow-up questions:

RAN1 asked for clarification on Alt2:

***Understanding 1****: The two DUs can be switched ON and OFF in a dynamic manner.*

***Understanding 2:*** *The two DUs can be switched between ON and OFF only once.*

RAN2 asked for clarification on the RAN3 terminology related to ‘physical cell resources’:

*What is the exact meaning of the separate vs. shared ‘physical cell resources’ concept in the assumed scenarios? For separate ‘physical cell resources’, does RAN3 consider the cells to use different frequencies or to perform time-multiplexing on the same frequency?*

For Alternative 1, the RAN WGs replied:

* RAN1: RAN1 has not identified any technical issues for Alt1.
* RAN4: Alternative 1 can be supported without impact to RAN4 specification TS 38.133.
* RAN2: RAN2 considers Alt1 to be a feasible solution, even though a technical analysis on the specification impact in RAN2 is needed for Rel-17 full migration scenario being considered by RAN3. The UE needs to perform the legacy handover procedures if Alt1 is adopted, and some companies in RAN2 foresee potential standardisation effort for RAN2 if Alt1 is adopted by RAN3.

For Alternative 2, all three WGs see significantly more issues.

Based at last in part on these reply LSs, contributions to this meeting propose the following related to Alt1 and Alt2:

[R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung, [R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214924.zip) ZTE, [R3-214953](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214953.zip) Qualcomm, [R3-215013](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215013.zip) CATT believe that Full Migration should be based on Alt1 (as the baseline).

[R3-214869](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214869.zip) Fujitsu also discusses solutions for Alt2.

[R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) Huawei believes that Alt2 should be down-scoped.

[R3-215495](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215495.zip) AT&T believes that selection between Alt1 and Alt2 is not necessary since they can co-exist by time-multiplexing same carrier on IAB-DU1 and IAB-DUs.

Contributions to this meeting further raise issues related to full migration:

R3-214869 Fujitsu , [R3-214873](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214873.zip) Samsung, [R3-214924](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-214924.zip) ZTE, [R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) Huawei raised the following issues:

Issue 1: Which node decides to initiate IAB-DU migration and how does this trigger the establishment IAB-DU2’s F1?

Issue 2: How is UE handover initiated after establishment of F1?

Issue 3: Which is the release of the old IAB-DU1 triggered?

Issue 4: How does BAP differentiate DL traffic to IAB-DU1 and IAB-DU2? How will BAP routing be performed on the boundary node in presence of two logical IAB-DUs?

Issue 5: Will both IAB-DUs use the same IP address(es)? How will IAB-DU2 know CU2’ IP address?

Issue 6: How to avoid a signaling storm due to handover of multiple UEs?

Another issue raised by [R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) was on how IAB-DU migration would be supported if some of the nodes were Rel-16 IAB-nodes. The moderator believes that this is a generic question which also applies to partial migration. For that reason, it should be discussed outside the IAB-DU-migration discussion.

Another issue raised by [R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) related to top-down, bottom-up and nested sequences. The moderator believes that IAB-DU migration following Partial Migration the understanding so far and that this sequence should be used as the baseline.

[R3-215344](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215344.zip) Nokia, [R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) Huawei believe that full migration should be done in Rel-18.

[R3-215749](file:///D:\会议硬盘\TSGR3_114-e\Docs\R3-215749.zip) Ericsson, Huawei, Nokia believe that full inter-donor migration in Rel-17 IAB should be down prioritized.

**The moderator proposes to pursue in the following manner:**

1. RAN3 should evaluate the reply LSs, considers which of Alt1 and/or Alt2 would qualify as a baseline for IAB-DU migration, and consider answering the WGs’ follow-up questions raised in their reply LSs.

2. RAN3 should discuss the issues on IAB-DU migration raised by contributions. This discussion should address the technical matter, i.e., it is not about Yes or No to the feasibility of IAB-DU migration in Rel-17. The outcome of this discussion can help identify the specification effort needed.

3. Based on the outcome of the discussion under bullet 2, RAN3 can discuss deprioritizing IAB-DU migration in Rel-17 and moving it to Rel-18. RAN3 should consider that Rel-18 IAB is still pending on approval by TSG RAN, and moving IAB-DU migration to Rel-18 would also require approval by TSG RAN. Further, TSG RAN would have to approve deprioritization of IAB-DU migration in Rel-17 since it would imply a change to the WID.

### RAN1/RAN2 questions

RAN1 considered the following two understandings:

***Understanding 1****: The two DUs can be switched ON and OFF in a dynamic manner.*

***Understanding 2:*** *The two DUs can be switched between ON and OFF only once.*

RAN2 had the following question:

*What is the exact meaning of the separate vs. shared ‘physical cell resources’ concept in the assumed scenarios? For separate ‘physical cell resources’, does RAN3 consider the cells to use different frequencies or to perform time-multiplexing on the same frequency?*

**Q6.1: Which of Understanding 1 or 2 was RAN3’s intention? What meaning of ‘physical cell resources’ does have RAN3 have in the context of Alt1 and Alt2?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | On RAN1’s issue: RAN3’s thinking for Alt2 was that of understanding 2, i.e., the two cells of the IAB-DUs were switched over once.  On RAN2’s issue: RAN3 considered the cells to use different frequencies. This was the reason why RAN3 considered Alt1 inefficient. RAN3 did not consider a TDM approach as proposed by AT&T in [R3-215495](file:///D:\\会议硬盘\\TSGR3_114-e\\Docs\\R3-215495.zip). |
| Samsung | Share the same understanding as QC |
| **Ericsson** | Similar understanding as the previous respondents.  Note that our view is that full migration should be postponed to Rel18. |
| Huawei | On RAN1’s question: Technically, for Alt2, the two DUs might be switched between ON and OFF more than once, since IAB-MT may need to measure the target DU, and then try to access to this target DU if migration is required;  On RAN2’s question: for the separate physical cell resource, we think that two logical IAB-DUs will use different set of (frequency and time domain) physical resources for radio access; we don’t think that time-multiplexing has to be used, yet detailed discussion has not been touched; for shared physical cell resources, we think that the two logical IAB-DUs will use same set of (frequency and time domain) physical resources for radio access. |
| Nokia | Agree with Huawei.  We prefer to finish the partial migration in Rel-17, and postponed the full migration to Rel-18. |
| CATT | 1. Understanding 1 is more align with RAN3.  2. different frequencies |
| Lenovo | Agree with Huawei.  And we prefer to postpone full migration to Rel-18. |
| Fujitsu | RAN1’s question:  Alt2. is understanding 2, i.e., the IAB-DUs are switched only once.  RAN2’s question:  The question has not reflected RAN2’s agreement in last meeting, with respect to the above description of Alt1 and the use of “separate” physical resources, RAN2 has reached the following understanding:   * R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.   We totally agree with RAN2’s assumption. Based on that, we think there is no need to discuss whether the cells of two DUs are using different frequencies/time resource or not, since different cells with the cell identity respectively can utilize the same L1 resource. Therefore, cells in Alt.1 can also share the same L1 resource.  Note that “the physical resource” should be understood as the cell resource rather than the L1 resource in the air interface. Alt.1 must cost two sets of cell resource that it is inefficient.  The approach proposed by AT&T is somehow the exact implementation of Alt.2. In Alt.2, the cells of 2 DUs share the same cell resource but they cannot use L1 resource simultaneously, so the result of Alt.2 must be TDM approach with switching once. |
| ZTE | On RAN1’s issue: understanding 2, i.e., the two cells of the IAB-DUs were switched over once.  On RAN2’s issue: in our view, separate physical cell resources used by the two logical DUs means different carriers, or orthogonal time and frequency resources of the same carrier which is also in line with RAN1 understanding. |
| AT&T | We agree with QC’s understanding. Our view is that RAN3 had not thought this through sufficiently to realize that Alt1 and Alt2 are not mutually exclusive and can coexist naturally on the same carrier frequency by leveraging existing NR features (e.g. full or partial TDM of the physical resources).  Also, the hybrid approach significantly alleviates the signaling storm issue faced by current alternatives by allowing gradual migration of UEs from one logical IAB-DU to another within the same carrier. Please also see response to Q6.6. |

**Summary:**

There is a wide spread of views. The Moderator believes that some companies state what they believe RAN3 had in mind when the initial LS was written while others contemplate the potential interpretations of RAN3’s LS.

On RAN2 question: As Fujitsu emphasized, RAN2 already provided a correct answer to their own question:

* R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.

This implies that the UE will treat same resources as one physical cell. How L1 assigns time/frequency resources to a cell is out-of-scope for RAN3.

On RAN1 question: Based on the answer to RAN2’s question, for Alt2, the UEs sees only one cell, which is switched between CU1 and CU2. Based on the replies to Q6.1, RAN3 has no conclusive answer on how often this cell is switched is between CU1 and CU2, i.e., if only once or if frequently.

**Observation 6.1a: RAN2 has already answered its own question, which is: R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.**

**Observation 6.1b: RAN3 has no conclusive answer on RAN1’s question on how frequently the cell is switched between CU1 and CU2 for Alt2.**

### Alt1 vs. Alt2

Based on RAN1, 2, 4 reply LSs and discussion in contributions, the moderator believes that Alt1 should be the baseline for further discussion on IAB-DU migration.

AT&T proposed a hybrid approach where IAB-DU1 and IAB-DU2 use the same carrier but time-multiplex the resources using Rel-16/17 HSNA TSM framework.

**Q6.2: Should Alt1 be considered as the baseline for IAB-DU migration? Should time-multiplexing between the two logical IAB-DUs be included into this baseline?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Moving forward, Alt1 should be considered as the baseline, where the IAB-DU cells use different frequencies. TDMing can be considered as on optimization. This would primarily involve RAN1. |
| Samsung | Agree Alt1 with IAB-DU cells of different frequencies as the baseline. |
| **Ericsson** | We should at least discuss the requirements for AT&T proposal. |
| Huawei | Between alt1 and alt2, our understanding is that alt1 is a preferred solution also by other groups, but still we see a lot of issues to be address in alt1, see our paper in R3-215613 |
| Nokia | No. We do agree with AT&T’s analysis “Alt1 is the poorer alternative for an operator”  Time-multiplexing may be technical possible, but it is a complicated implementation. Its complexity needs to be further analyzed in RAN1/2/4. |
| CATT | Alt 1as baseline; we can consider time-multiplex for shared resource after Alt1is supported |
| Lenovo | Alt1 can be considered as baseline. Time-multiplexing is more complicated and can be considered later. |
| Fujitsu | We think both Alt.1 and Alt.2 should be considered, since Alt.1 is not as efficient as Alt.2. The TDM approach proposed by AT&T is actually Alt.2. |
| ZTE | Agree that Alt1 be considered as the baseline for IAB-DU migration. And we think “separate physical cell resources” in Alt 1 means different carriers, or orthogonal time and frequency resources of the same carrier. |
| AT&T | Alt1 is the lowest common denominator that can always serve as a fallback. We strongly encourage not precluding the ability to multiplex between the two logical IAB-DUs. This hybrid approach significantly alleviates the signaling storm issue by allowing gradual migration of UEs from one logical IAB-DU to another within the same carrier. Please also see response to Q6.6. |

**Summary:**

8 (10) companies indicate that Alt 1 should be considered; 6 of these companies believe it should be the baseline.

7 (10) companies indicate interest in AT&T’s TDM solution; some of them would like to start out with this solution, while other would start out with this solution. There seems to be some uncertainty if this solution is referred to as Alt 1 or Alt 2.

One company does not indicate a clear preference.

Further, as stated above, RAN1, RAN2 and RAN4 anticipated substantially more issues with Alt2 than Alt1.

The Moderator believes that RAN3 should start with Alt1. The moderator further believes that using RAN2’s interpretation of “separate resources” allows Alt1 to subsume AT&T’s solution, i.e., the two cells can either use different frequencies or they can be time multiplexed within the same frequency. The handling of frequency vs. time multiplexing is RAN1 issue and out-of-scope for RAN3.

**Proposal 6.2: RAN3 to use Alt 1 is baseline, where the UE can treat the separate resources as different cells on L1. How the UE differentiates the cells on L1, e.g., in frequency or in time domain, is out-of-scope for RAN3.**

### Other issues raised

#### Issue: Procedural flow of IAB-DU migration

The following question identifies the principal signaling flow of IAB-DU migration assuming that Alt1 is used as baseline and that the two logical IAB-DUs use different carriers.

**Q6.3: Procedural flow:**

**a) Which node initiates the establishment of IAB-DU2’s F1 and how is it triggered?**

**b) How is CU1 informed that F1 has been established so that it can start UE handover?**

**c) How is IAB-DU1’ F1 release triggered?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | Up front: We think IAB-DU1’s F1AP should not be used to exchange information related to IAB-DU2.  a) F1 establishment could be initiated by any of CU1, CU2 or the boundary node itself.   * If initiated by boundary node: no signaling needed * If initiated by CU2: via RRC to boundary IAB-MT * If initiated by CU1: via XnAP request to CU2, then RRC to boundary IAB-MT   b) CU2 informs CU1 via XnAP that the boundary node 1 “is ready”, after F1AP has been established.  c) When CU1 is done handing over, it can simply release F1AP with IAB-DU1. No singaling needed. |
| Samsung | 1. The F1 establishment is always initiated by IAB-DU, which is legacy scheme. Either CU1 or CU2 can trigger it 2. The boundary node can send the indication to CU1 3. CU1 can trigger the release after transfer all UEs to CU2. |
| **Ericsson** | a) The boundary node or CU1. Should be discussed further.  b) Via Xn  c) By F1 removal from CU1 |
| Huawei | 1. It depends on whether the new F1 establishment is before or after the migration of the collocated boundary MT.  * If the F1 is to be established before the boundary MT migration, i.e., the MT is still connected to CU1. * Initiated by CU1: 1. CU1 to CU2 via XnAP Req; 2. CU1 to boundary MT via RRC * If the F1 is to be established after the boundary MT migration, i.e., the MT is connected to CU2. * Initiated by CU2: CU2 to boundary MT via RRC * Initiated by boundary node: no signalling  1. CU2 informs CU1 that the target logical DU is connected to the target CU2 2. It can be left to implementation |
| Nokia | First, we prefer to complete the partial migration, before the discussion on full migration.   1. F1 establishment is always initiated by IAB-DU. How is it triggered is up to the implementation, e.g. IAB2-DU2 may initiate the F1 setup well before the migration. 2. The boundary node can send the indication to CU1 3. This is up to implementation. For example, IAB-DU1’s F1 may not be released since the IAB may back to CU1 soon (in Rel-17 scenario) |
| CATT | a) source CU, it decides whether partial or full migration performed because it has measurement report and the load information on source path. The intention of trigger by boundary node is not clear for me e.g., not enough resource to perform local rerouting? But anyway it should inform source CU first.  b) CU2 sends XnAP to CU1 to request UE context.  c) by CU1’s implementation. |
| Lenovo | a) F1 setup for IAB-DU2 can be triggered by IAB-DU2 or CU2.  b) via Xn  c) left to implementation |
| Fujitsu | Agree with QCOM that IAB-DU1’s F1AP should not be used to exchange information related to IAB-DU2.   1. We think only CU1 has the motivation to initiate F1 setup. F1 setup with CU2 should be initiated by CU1 via XnAP request. 2. CU2 informs CU1 via XnAP after F1 establishment with CU2 then UE handover is started. 3. F1 release is initiated by the CU1 under one of following conditions: 4. The last RRC Reconfiguration message for UE or descendant IAB-MT migration is delivered. 5. The successful completion of the last UE or descendant IAB-MT migration. |
| ZTE | 1. CU1 could trigger the IAB-DU migration procedure by indicating IAB node to initiate F1 setup procedure with CU2. 2. an indication could be sent from the boundary node or CU2 to CU1 to trigger the migration of UEs/descendant MTs. 3. It could be up to implementation, e.g., after all served UEs/MTs are migrated to CU2 |

**Summary:**

**a) Which node initiates the establishment of IAB-DU2’s F1 and how is it triggered?**

As pointed out by Samsung, F1 establishment is always initiated by the IAB-DU. How is it triggered:

* IAB-DU: QC, E//, Nokia, Lenovo (4)
* CU1: QC, SS, E//, HW (before partial migration), CATT, Fujitsu, ZTE (7)
* CU2: QC, SS, HW (after partial migration), Lenovo (4)

There is no clear majority view. The Moderator believes that the IAB-DU can always proactively establish F1, which implies that triggering by CU1 or CU2 is technically not necessary for IAB-DU migration.

**b) How is CU1 informed that F1 has been established so that it can start UE handover?**

* **Via Xn: 7**
* **By IAB-DU: 2 (not clear which protocol)**
* **Both solutions acceptable: 1**

All companies agree that CU1 receives an indication that F1-C between logical IAB-DU2 and CU2 has been established. The Moderator is not certain via which protocol the IAB-DU2 on the boundary node would signal to CU1 that it has established F1-C with CU2, unless this signaling would use RRC to CU2 and then Xn from CU2 to CU1. This would need more discussion.

**Proposal 6.3: F1-terminating CU to receive an indication that boundary node has established F1-C with non-F1-terminating CU. Signaling of this indication are FFS.**

**c) How is IAB-DU1’ F1 release triggered?**

All companies agree that this can be left up to implementation.

#### Issue: BAP handling of simultaneous logical IAB-DUs

**Q6.4: How does BAP differentiate DL traffic to IAB-DU1 and IAB-DU2 and how is BAP routing and header rewriting be performed?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | The problem is the same as for UL traffic in case of inter-donor-redundancy. The packet’s BAP header is matched with a header-rewriting table. If there is a match, the packet crosses over to the other topology, otherwise it doesn’t. The egress topology determines the logical IAB-DU.  RAN2 will be eager to address this problem. |
| Samsung | This can be discussed after inter-topology routing discussion in RAN2 is clear. |
| **Ericsson** | RAN3 does not have enough info to start this discussion. |
| Nokia | RAN2 issue |
| CATT | In RAN2 scope |
| Lenovo | RAN2 scope. |
| Fujitsu | We don’t understand why BAP needs to differentiate DL traffic to IAB-DU1 and IAB-DU2. We think DL traffic to IAB-DU1 and IAB-DU2 are all from the target topology after the IAB-node completing inter-donor CU migration. |
| ZTE | It should be discussed in RAN2. |

**Summary:**

The majority view is that this issue is in RAN2 domain.

**Proposal 6.4: Inter-topology BAP routing with two logical IAB-DUs on boundary node is up to RAN2.**

#### Issue: IP address handling

Obviously, all traffic running via topology 2 need to use IP addresses allocated by donor-DU2. The boundary node already has such addresses assigned, and IAB-DU1 uses (a subset of) them for traffic with CU1. The question is which subset of IP addresses would IAB-DU2 use for traffic with CU2. Further, how would IAB-DU2 know CU2’s IP address.

**Q6.5:**

**a) Which of the boundary-node’s IP addresses assigned by donor-DU2 is used for IAB-DU2’s traffic with CU2?**

**b) How does IAB-DU2 know CU2’s IP address?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | a) To make life simple, IAB-DU2 should use the same IP address for the same traffic as IAB-DU1. In this manner, the same DL mappings on Donor-DU2 can be used.  b) Via OAM configuration as we already agreed. |
| Samsung | 1. Use the same address as assigned during partial migration 2. Via OAM |
| **Ericsson** | a) We are not sure if same IP addresses can be reused for the same purpose on both F1 instances. If such simplifications were feasible, we could have pursued them in our previous work.  b) OAM |
| Nokia | 1. This depends on whether the traffic is transferred via source path (then use the IP address from CU1), or via target path (then use the IP address from CU2). 2. OAM. Same as current gNB-DU/IAB-DU. |
| Fujitsu | 1. We think the IP address used for IAB-DU2 **should not be the same** as IAB-DU1. Otherwise, IAB-node cannot differentiate DL traffic to IAB-DU1 or IAB-DU2 for UEs. 2. Via OAM configuration. |
|  |  |

**Summary:**

There is no agreement if the logical IAB-DU uses the same or different IP addresses. However, there is agreement that the boundary node knows CU2’s IP address based on OAM configuration.

**Proposal 6.5: The boundary node knows the non-F1-terminating CU’s IP address(es) based on OAM configuration.**

#### Issue: Signaling storm

**Q6.6: How can a signaling storm be averted in case many UEs have to be handed over between the two logical IAB-DUs?**

|  |  |
| --- | --- |
| Company | Comment |
| QCOM | There is no signaling storm. Since both logical IAB-DUs can coexist at the air interface for an extended amount of time, the UE migration can occur gradually. |
| Samsung | The UE handover can be performed gradually. Signaling storm may not be a problem. |
| **Ericsson** | We need a proper discussion for this, when the time comes (sooner or later). |
| Nokia | XnAP procedure and F1AP procedure are needed for HO all UEs from Donor1 to Donor2, in a very short period. This causes the signaling storm. |
| CATT | It is about group handover, we can discuss it later. |
| Fujitsu | The signaling storm issue should be studied. There may be a lot of UEs should be handover, the signals will consume large amount of resource even though they do not occur concurrently. |
| ZTE | There is no signaling storm if Alt 1 is adopted since two logical DUs could be activated simultaneously and gradual migration is used. |
| AT&T | This is another benefit of a hybrid approach between Alt1 and Alt2 since, using TDM the resources needed for either DU during the gradual migration procedure can be proportionally adapted which also minimizes performance impact for the access and backhaul links. |

**Summary:**

While several companies feel that there is no signaling storm for Alt1, others believe that this should be analyzed later. The Moderator believes need for a proposal at this stage.

# PHASE II: Convergence of PH1

## Partial Migration

### IP address allocation boundary node

**Q1a: Please comment on the issues raised by Samsung, Nokia, ZTE and CATT why for IPsec tunnel mode the IP addresses need to be explicitly included in Xn to CU1 (reasons, no Likes/Dislikes)**

**Proposal 1a1: RAN3 to discuss how CU1 sets IPv6 FL in DL packets of IKE/SCTP-INIT handshakes during migration if it doesn’t know with which IAB-DU it communicates at this stage (assume IPsec transport mode).**

**Proposal 1a2: RAN3 to discuss how CU informs SeGW about the IPv6 FL to use on outer IP header for IPsec tunnel mode with separate SeGW.**

**Q1b: For IP address addition: (1) Do you agree that Rel-16 RRC and F1AP signalling are used for CU2 to configure IP addresses on the boundary node, and for the boundary node to report IP addresses it wants to use to CU1, respectively?**

**Proposal 1b: For IP address addition, non-F1-terminating CU to configure IP addresses on the boundary node via Rel-16 RRC signalling, and boundary node to report IP addresses it wants to use via Rel-16 F1AP signalling to the F1-terminating CU.**

**Q1c: Should IP address replacement/release reuse Rel-16 procedure(s) (ZTE) or is a new signaling needed (Samsung)?**

**Proposal 1c: The non-F1-terminating CU to use Rel-16 RRC procedures for replacement and release of IP addresses at the boundary node.**

### Mapping configurations

**Q2.1: Do you agree that the UL mapping configuration on the boundary node needs to include a topology identifier? If not, how does the boundary node differentiate UL mapping on topology 1 vs. topology 2?**

**-/-**

**Q2.2: Do you agree that for IP address addition, CU1 to report to CU2 the IP addresses selected by the boundary IAB-node for the various traffic types so that CU2 can configure the DL mapping?**

**Proposal 2.2: The F1-terminating CU sends the IP addresses used by the boundary IAB-node together with other information, such as QoS info, to the non-F1-terminating CU so that the non-F1-terminating CU can configure the DL mapping in its Donor-DU.**

**Q2.3: Do you agree header-rewriting configuration is configured together with routing and bearer mapping configurations via F1AP?**

**Proposal 2.3: RAN3 assumes that F1AP is used for header-rewriting configuration on the boundary node.**

### Xn signaling for QoS info/L2 info transfer

**Q3.1: Please provide comments on:**

**a) QoS info/L2 info can be included in the Xn HO Preparation procedure.**

**b) QoS info/L2 info can also be exchanged via separate Xn procedure, which uses UA signaling.**

**c) If this separate procedure should be triggered by Option 1 or Option 2.**

**d) CU1 and CU2 retain the Xn AP IDs after CU2 has sent the UE Context release message.**

**e) CU1 indicates to CU2 to retain the Xn AP IDs.**

**Proposal 3.1a: A separate Xn procedures is introduced for the exchange of QoS info/L2 info. FFS if UA or NUA Xn procedure.**

**Proposal 3.1b: The CUs retain the Xn AP IDs after the non-F1-terminating CU has sent the UE Context Release message to the F1-terminating CU.**

**Q3.2: Do you agree that:**

**a) for IP address reconfiguration of descendent nodes, an Xn procedure between CU1 and CU2 is used, and CU1 then adds or replaces the IP addresses on the descendent node via RRC**

**b) the same Xn procedure can be used for transfer of the descendent node’s QoS info/L2 info**

**c) this procedure is used for partial migration, inter-donor redundancy and RLF recovery.**

**d) a UA Xn message for the boundary node is used for this purpose so that CU2 returns IP addresses for the boundary-node’s donor-DU2.**

**e) CU1’s UA Xn IP address request should further contain a “descendant-node indicator” so that CU2 know that this request is not for the boundary node.**

**f) the reconfiguration of the descendent node occurs after the successful migration of the boundary node.**

**Proposal 3.2a: For IP address reconfiguration of descendent nodes:**

* **An Xn procedure between F1-terminating and non-F1-terminating CUs is used, and the F1-terminating CU adds, replaces or releases the IP addresses on the descendent node via RRC.**
* **The same Xn procedure is also used for the transfer of the descendent node’s QoS info/L2 info.**
* **The same Xn procedure is used for partial migration, inter-donor redundancy and RLF recovery.**
* **As the baseline, the reconfiguration of the descendent node occurs after the establishment of the target path. FFS on further details.**

**Issue: Xn QoS info/L2 info for boundary-node traffic**

**Proposal 3.4: The following information is exchanged between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for boundary node traffic:**

* **CU1->CU2**
  + **QoS info per traffic type for non-UP traffic and per one or bundle of F1-U tunnels for UP traffic; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **UL: UL boundary node configuration, e.g., UL BH mapping, for each QoS info; pending RAN2.**

**Issue: Xn QoS info/L2 info for descendent-node traffic**

**Proposal 3.5: The following information exchange is proposed between F1-terminating CU (CU1) and non-F1-terminating CU (CU2) for descendent node traffic:**

* **CU1->CU2**
  + **QoS info: granularity is FFS; content is FFS.**
  + **DL IP address info**
* **CU2->CU1**
  + **DL: IPv6 FL/DSCP value for each QoS info**
  + **DL: For each QoS info: routing information, e.g., BAP routing ID used in topology 2 and ingress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**
  + **UL: For each QoS info: routing information, e.g.,BAP routing ID used in topology 2 and egress BH RLC CH ID, to ensure N:1 or 1:1 mapping; details pending RAN2**

### Revocation of inter-donor topology adaptation

**Q4.1: Please provide your views on:**

**a) the existing Xn HO procedure is used for revocation of partial migration, or a new procedure is introduced for revocation of topology adaptation of single and dual-connected boundary node.**

**b) CU1 can request revocation of partial migration from CU2**

**c) after revocation, CU1 informs CU2 to release or suspend the configuration on the path via top 2.**

**Proposal 4: The Xn HO procedure is used for revocation of partial migration. FFS if revocation is triggered by F1-terminating CU.**

**Q5.1: Please phrase your views:**

**a) How CU2 can confirm/reject RLF recovery attempt within the existing Xn procedures, or if a new procedure is necessary.**

**b) How IP address allocation for the recovering IAB-node (boundary node) is performed.**

**Proposal 5a: As a baseline, RLF recovery uses existing Xn procedures.**

**Proposal 5b: For IP address allocation during RLF recovery, same mechanisms to be used as for partial migration.**

## Inter-donor DU migration

### RAN1/RAN2 questions

**Q6.1: Which of Understanding 1 or 2 was RAN3’s intention? What meaning of ‘physical cell resources’ does have RAN3 have in the context of Alt1 and Alt2?**

**Observation 6.1a: RAN2 has already answered its own question, which is: R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.**

**Observation 6.1b: RAN3 has no conclusive answer on RAN1’s question on how frequently the cell is switched between CU1 and CU2 for Alt2.**

### Alt1 vs. Alt2

**Q6.2: Should Alt1 be considered as the baseline for IAB-DU migration? Should time-multiplexing between the two logical IAB-DUs be included into this baseline?**

**Proposal 6.2: RAN3 to consider Alt 1 is baseline, where the UE can treat the separate resources as different cells on L1. How the UE differentiates the cells on L1, e.g., in frequency or in time domain, is out-of-scope for RAN3.**

### Other issues raised

**Q6.3: Procedural flow:**

**a) Which node initiates the establishment of IAB-DU2’s F1 and how is it triggered?**

**b) How is CU1 informed that F1 has been established so that it can start UE handover?**

**c) How is IAB-DU1’ F1 release triggered?**

**Proposal 6.3: The F1-terminating CU to receive an indication that the boundary node has established F1-C with the non-F1-terminating CU. FFS on the signaling for this indication.**

**Q6.4: How does BAP differentiate DL traffic to IAB-DU1 and IAB-DU2 and how is BAP routing and header rewriting be performed?**

**Proposal 6.4: Inter-topology BAP routing with two logical IAB-DUs on boundary node is up to RAN2.**

**Q6.5:**

**a) Which of the boundary-node’s IP addresses assigned by donor-DU2 is used for IAB-DU2’s traffic with CU2?**

**b) How does IAB-DU2 know CU2’s IP address?**

**Proposal 6.5: The boundary node knows the non-F1-terminating CU’s IP address(es) based on OAM configuration.**

**Q6.6: How can a signaling storm be averted in case many UEs have to be handed over between the two logical IAB-DUs?**

**-/-**

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