**3GPP TSG-RAN WG2 Meeting #102 R2-1809100**

**Busan, South Korea, May 21 – 25, 2018**

**Agenda item:** 11.1.2

**Source:** Qualcomm Inc (Rapporteur)

**Title:** Report on configuration for routing and QoS support in arch group 1

**Document for:** Discussion and Decision

# Introduction

RAN3 #99bis agreed on two architecture groups for integrated access and backhaul (IAB) for NR [1]. Based on agreements by RAN2 #101bis, architecture group 1 uses RLC-channels with integrated adaptation layer for backhauling [2]. Further, RAN-2 agreed that the adaptation layer supports the following functions for architecture 1a [2]:

1. Identification of the UE-bearer for the PDU,
2. Routing across the wireless backhaul topology,
3. QoS-enforcement by the scheduler on DL and UL on the wireless backhaul link,
4. Mapping of UE user-plane PDUs to backhaul RLC channels,

and for architecture 1b:

1. Routing across the wireless backhaul topology,
2. QoS-enforcement by the scheduler on DL and UL on the wireless backhaul link,
3. Mapping of UE user-plane PDUs to backhaul RLC channels,

The goal of this email discussion was to identify:

- Configuration for routing and QoS support in arch group 1

- Information and identifiers to be carried on adaptation layer for this purpose

- Procedures and signaling for configuration of this information and these identifiers.

# Discussion

The following comments were made in the discussion:

**Qualcomm:**

* Proposes to define identifiers/information on adapt and to determine:
1. Purpose of the Id
2. Scope of Id (e.g. unique globally, per donor, per IAB-node, per UE, etc)
3. Managing node of Id
4. Procedures for (re)configuration of Id
5. Nodes that have to process the Id
6. Expected behavior when processing the Id
7. (Re)configuration necessary to achieve this behavior
8. Procedures used for this (re)configuration
9. Others

**Samsung:**

* Proposes to keep the discussion simple and to not emphasize on QoS support but on routing issues only.
* Proposes to extend the discussion to architecture group 2.

**Qualcomm:**

* Emphasizes that routing and QoS for architecture group 2 is more straightforward since standard protocols (i.e. IP and Ethernet) are used.
* Emphasizes that QoS discussion could be restricted to management of QoS identifiers rather than QoS policies.

**Nokia:**

* Proposes the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Identifier type / name | UE ID | Bearer ID | Route ID / IAB node ID | QoS ID |
| Purpose of the Id | To identify a UE. The only identifier required in case RLC channel aggregation is not used over the backhaul link. | When bearer aggregation is used, this ID is required to identify the bearer of the UE for proper QoS treatment and multiplexing on bearers on backhaul links. | To identify the next hop in the path (may be used to limit the size of routing tables in the intermediate nodes) | Same as bearer ID. On the path between Donor DU and Access UE there is no need to consider additional QoS parameters (e.g. QoS flows) as we should operate based on bearers, similarly as with wired backhaul. |
| Scope of Id (e.g. unique globally, per donor, per IAB-node, per UE, etc)  | Needs to be unique per Donor unless additional identifiers are used, e.g. route ID or IAB node ID. | Unique per Access UE. | Unique per single topology branch. |  |
| Managing node of Id | Should be assigned by the IAB node when new connection is established by the UE. To make it unique across the whole path, it should be combined with IAB node ID (or one could say that UE ID should have IAB node ID part in it). | Donor CU | Donor CU |  |
| Procedures for (re)configuration of Id | Once assigned it does not have to be reconfigured during an ongoing connection.  | UE CONTEXT SETUP REQUEST from CU to DU message could be used | ID needs to be assigned during IAB node setup |  |
| Nodes that have to process the Id  | In case only UE ID is used, all nodes on the transmission path need to process it. In case additional IAB node ID or route ID is used, then they only need to be processed in Donor DU and IAB node serving Access UE. | All nodes along the transmission path. | All nodes along the transmission path. |  |
| Expected behavior when processing the Id | Routing decision i.e. deciding whether packet is destined for the Access UE / MT part of IAB node / gNB/DU part of IAB node or destined for the next IAB node along the path | Input for scheduler, bearer aggregation function | Routing decision. |  |
| (Re)configuration necessary to achieve this behavior |  | IAB node needs to know QoS characteristics of the bearer to map it properly to aggregated bearers. | IAB node needs to be aware of its ID as well as IDs of other nodes it is connected to. |  |
| Procedures used for this (re)configuration | Association can be made by the DU internally when setting up the context of the UE. DU/MT/ next IAB node could have prespecified identifiers. | Each node along the path needs to be provided with bearer QoS characteristics for each Access UE | IDs can be passed during IAB node setup, need to be updated in case topology changes (node addition, node mobility etc.) |  |
| Others |  |  |  |  |

**Huawei:**

* Raises concerns that discussing the need for a QoS-Id in the adaptation layer is premature.
* Emphasizes that QoS for UE flows is dependent on a multitude of parameters such as (5QI, ARP, GFBR/MFBR, AMBR, Max packet loss rate, RQA, etc.).
* Proposes detailed discussion on issues to be addressed to achieve QoS for both GBR and non-GBR flows, and how corresponding QoS parameters need to be configured/treated in a multi-hop environment. Prefers to have this discussion during meeting rather than via email.
* Proposes to reduce the discussion to:

-              Identification of the UE-bearer for the PDU,

-              Routing across the wireless backhaul topology,

-              Mapping of UE user-plane PDUs to backhaul RLC channels.

**Huawei:**

* Raises concerns that architecture group 2 can support QoS only in a limited manner via DSCP.
* Emphasizes that routing and QoS is not that straightforward for architecture group 2.

**Qualcomm:**

* Recommends to primarily focus on architecture group 1
* Emphasizes that routing and QoS are well defined for both IP and Ethernet.

**Huawei:**

* Agrees with Qualcomm on routing and QoS for IP and Ethernet.
* Reiterates that QoS requirements have not be defined for backhaul links.

**Qualcomm:**

* Proposes “Adapt configuration and processing tasks” as an extension of table provided by Nokia. These tasks include further identifiers for routing and QoS enforcement that were not included in Nokia’s proposal.

**Oppo:**

* Requests clarification on UL vs. DL routing in the Qualcomm proposal: DL routing would use IAB-node address while UL routing would always end up at donor.
* Raises issue of Adapt placement for IAB-nodes own traffic.

**Qualcomm:**

* Clarifies UL vs. DL routing**.**
* Emphasizes that IAB-node’s own traffic handling has not been captured yet in TR.

**Oppo:**

* Proposes to include that QoS could be derived from LCID rather than Adapt header identifier.

**Qualcomm:**

* Includes Oppo’s proposal.
* Proposes centralized configuration with CU-CP as configuring node and F1-AP as configuring protocol.
* Asks question on QoS enforcement and routing for CP alternative 4

**Ericsson:**

* Clarifies QoS support for CP alternative 4: QoS will be based on DSCP on IP header on top of Adapt.
* Clarifies that IP could be used for routing on wireless backhaul. However, adapt layer may still be necessary for other purposes.

# Summary of Email Discussion

* The following list of “Adaptation layer configuration and processing tasks” (below) were established in the email discussion.
* Huawei emphasized they do not want to commit to a discussion on QoS-related configuration/processing tasks without having identified QoS requirements in online session.
* No objections were raised against this final list of tasks:

***Adaptation layer configuration and processing tasks***

***For arch 1a, TR section 8 defines four bullets for functional support of Adapt:***

1. *Identification of the UE-bearer for the PDU,*
2. *Routing across the wireless backhaul topology,*
3. *QoS-enforcement by the scheduler on DL and UL on the wireless backhaul link,*
4. *Mapping of UE user-plane PDUs to backhaul RLC channels,*

***These are the identifier options for each of these bullets:***

1. *Identification of UE-bearer for the PDU, based on (options):*
* *UE-bearer Id*
* *UE-id + UE-specific bearer Id*
1. *Routing across the wireless backhaul topology, based on (options):*
2. *UE-bearer Id*
3. *UE-id*
4. *IAB-node Id (downstream)/IAB-donor Id (upstream)*

*Routing of UP traffic for IAB-nodes (e.g. for OAM support) can use the same set of identifiers.*

*Routing of SRBs (CP alternatives 1-3) and F1-AP (CP alternative 4) can be based on an IAB-node-Id.*

1. *QoS enforcement by scheduler, based on (options):*
2. *UE-bearer Id*
3. *UE-specific bearer-Id*
4. *QoS-Id*
5. *Mapping of UE UP PDUs to backhaul RLC channels (options):*
6. *Adapt above MAC: They could use all the same RLC channel*
7. *Adapt above RLC: Mapping uses the same Id as QoS enforcement*

***This leads to the following set of identifiers to be considered for Adapt:***

* *UE-bearer Id*
* *UE-Id*
* *UE-specific bearer Id*
* *IAB-node Id/IAB-donor Id*
* *QoS-Id*

*The UE-specific bearer Id may be deterministically mapped to the LCID of the backhaul RLC channel. In this case, adapt would not have to separately carry a separate UE-specific bearer Id.*

***Further assumptions:***

* *Adapt is generated on access IAB-node for northbound PDUs and on IAB-donor DU for southbound PDUs.*
* *Adapt is not modified along the path across wireless backhaul.*

***We need to consider:***

* *Generation of Adapt Id at initial node where Adapt is generated*
* *Processing of Adapt Id at final node where Adapt is terminated*
* *Processing of Adapt Id at intermediate node*

***Generation of Adapt Id at initial node where Adapt is generated****:*

* *UE-bearer Id:*
	+ *At access-IAB-node, deterministically mapped from F1-U GTP-U TEID, which is configured on UE-bearer’s DU based on native F1-AP procedures.*
	+ *At IAB-donor DU, deterministically mapped from F1-U GTP-U TEID of arriving fronthaul PDU.*
* *UE-Id:*
	+ *At access-IAB-node, mapped from C-RNTI; mapping needs to be configured when UE-bearer is established.*
	+ *At IAB-donor DU, mapped from F1-U GTP-U TEID; mapping needs to be configured when UE-bearer is established.*
* *UE-specific bearer-Id:*
	+ *At access-IAB-node, deterministically mapped from LCID of arriving access PDU.*
	+ *At IAB-donor DU, mapped from F1-U GTP-U TEID; mapping needs to be configured when UE-bearer is established.*
* *IAB-node/donor-DU Id:*
	+ *At access-IAB-node, based on value configured on node; could be deterministically mapped from existing Id, e.g. CGI or PCI, or needs to be configurated when IAB-node attaches to topology.*
	+ *At IAB-donor DU, based on value configured on node; could be deterministically mapped from existing Id, e.g. CGI or PCI, or needs to be configured when IAB-donor is integrated.*
* *QoS-Id:*
	+ *At access-IAB-node, mapped from QoS class identifier configured for access bearer. Mapping may be semi-static, e.g. configured when IAB-node attaches to topology, or bearer-specific, e.g. configured when UE-bearer is established.*
	+ *At IAB-donor DU, mapped from DSCP value or F1-U GTP-U TEID of arriving fronthaul PDU. Mapping may be semi-static, e.g. configured when IAB-node attaches to topology, or bearer-specific, e.g. configured when UE-bearer is established.*

***Processing of Adapt Id at final node where Adapt is terminated***

* *UE-bearer Id:*
	+ *At access-IAB-node, deterministically mapped to F1-U GTP-U TEID, which is configured on UE-bearer’s DU based on native F1-AP procedures.*
	+ *At IAB-donor DU, deterministically mapped to F1-U GTP-U TEID of PDU forwarded on fronthaul.*
* *UE-Id:*
	+ *At access-IAB-node, mapped to C-RNTI; mapping needs to be configured when UE-bearer is established.*
	+ *At IAB-donor DU, mapped from F1-U GTP-U TEID; mapping need to be configured when UE-bearer is established.*
* *UE-specific bearer-Id:*
	+ *At access-IAB-node, deterministically mapped from LCID of arriving access PDU.*
	+ *At IAB-donor DU, mapped to F1-U GTP-U TEID; mapping needs to be configured when UE-bearer is established.*
* *IAB-node/donor-DU Id:*
	+ *At access-IAB-node, PDU is terminated when IAB-node-Id value on Adapt matches that configured for access-IAB-node.*
	+ *Ad IAB-donor DU, PDU is forwarded to fronthaul when IAB-donor Id value on Adapt matches that configured for IAB-donor DU.*
* *QoS-Id:*
	+ *At access-IAB-node, not used.*
	+ *At IAB-donor DU, it may be mapped to DSCP value of PDU forwarded on fronthaul.*

***Processing of Adapt Id at intermediate nodes***

1. *Identification of UE-bearer for the PDU: None*
2. *Routing across the wireless backhaul topology: The IAB-node matches the routing Id on Adapt to an entry in the routing table which determines the backhaul link where the PDU has to be forwarded. The routing table contains entries for routing in downstream direction. It holds separate entries for routing in upstream direction. For spanning tree topologies, upstream routing can be based on a default route entry.*
* *If done via UE-bearer Id, the routing table needs to be reconfigured when the UE-bearer is established or released at access IAB-node.*
* *If done via UE-Id, the routing table needs to be reconfigured when the UE connects to or leaves access IAB-node.*
* *If done via IAB-node/IAB-donor-Id, the routing table needs to be reconfigured when the topology changes.*
1. *QoS enforcement by scheduler: Scheduler matches the identifier used for QoS enforcement to an entry in a scheduling policy table, selects an RLC channel and applies corresponding scheduling policy when forwarding PDU.*
* *If done via UE-bearer Id, the policy table needs to be reconfigured when UE-bearer is established or released at access IAB-node.*
* *If done via UE-specific bearer Id, the mapping between UE-specific bearer-Id and RLC channel needs to be configured when backhaul link is established or, potentially, when new RLC-channels are added to the backhaul link. The UE-specific bearer-Id may also be deterministically mapped to the LCID of the RLC channel. .*
* *If done via QoS-Id, the mapping between QoS-Id and RLC channel needs to be configured when backhaul link is established or, potentially, when new RLC-channels are added to the backhaul link.*

***Configuring entity of adapt identifiers***

* *Adapt identifiers are configured by a centralized control function.*
* *The centralized control function is contained in the CU-CP.*

***Protocols used for configuration of adapt identifiers***

*Since the configuring entity of adapt identifiers is collocated with the CU-CP, the following protocols can be used for configuration of adapt identifiers:*

* *RRC for configuration via MT on IAB-node*
* *F1-AP for configuration via DU on IAB-node*

***For arch 1b, TR section 8 defines three bullets for functional support of Adapt:***

1. *Routing across the wireless backhaul topology,*
2. *QoS-enforcement by the scheduler on DL and UL on the wireless backhaul link,*
3. *Mapping of UE user-plane PDUs to backhaul RLC channels,*

*The same identifiers can be used to support these functions are for arch 1a. Also, the same identifier generation and processing is used as discussed for arch 1a.*

# Conclusion

The “Adaptation layer configuration and processing tasks” established in the email discussion will be converted into a TP for TR38.874 and submitted to RAN-2 AH-1807 for discussion.

# References

[1] R3-182334: pCR for TR38.9874, RAN-2 #99bis, Sanya, CHINA, April 16 – 20, 2018

[2] R2-1806456: IAB U-plane considerations for architecture group 1, RAN-2 #101bis, Sanya, CHINA, 16 – 20 April 2018