**3GPP TSG-RAN WG2 Meeting #102 R2-1809732**

**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.

# Summary of Discussion

The discussion focused on IAB architecture 1a.

A working document was generated and further refined during the email discussion.

From this working document, the following aspects and proposals have been derived for online discussion. Open question from the email discussion are included in red.

### 2.1 Identifier options considered for Adapt in Arch 1a

Adapt supports the following functions:

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,

For each function supported by Adapt, the following identifiers are considered:

1. Identification of UE-bearer for the PDU

Options:

1. UE-bearer-Id
2. UE-id + UE-specific bearer-Id

Uniqueness:

The UE-bearer-id is unique within the IAB topology.

The UE-Id is unique within the IAB topology and the UE-specific bearer-Id is unique for each UE.

***Nokia****: what is UE-bearer ID, how does it relates to UE-specific bearer ID? Do we envisage situations where bearer IDs have globally (e.g. within a single CU) unique identifiers?*

***Samsung****: Defining a “global” UE-bearer ID will bring a big impact to the current specification. The more likely option is the second one (a combination of UE ID and DRB ID). Even we do define a “global” bearer ID, the relationship between “global” bearer ID and the UE ID will have to be preserved (e.g. given in a routing table).The benefit of a new UE-bearer ID is therefore unclear to us.*

**Proposal 1: The above Adapt identifier options for the UE-bearer are included in the study.**

1. Routing across the wireless backhaul topology

Options:

1. UE-bearer-Id
2. UE-id
3. IAB-node Id (downstream)/IAB-donor Id (upstream)

Uniqueness: All these identifiers are unique within the IAB topology.

Comment: Routing of UP traffic for IAB-node-MTs (e.g. for OAM support) can use the same set of identifiers. There is no functional difference between these options.

**Proposal 2: The above Adapt identifier options for routing are included in the study.**

1. QoS enforcement by scheduler

Options:

1. UE-bearer-Id
2. UE-Id + UE-specific bearer-Id
3. QoS-Id

Uniqueness:

UE-bearer-Id, UE-Id and QoS-Id are unique within the IAB topology.

The UE-specific bearer-Id should be unique for the UE-Id.

* ***ZTE****: It is not clear why QoS-Id could be unique within IAB topology. Without QoS-Id, UE-brearer Id itself should be unique within IAB topology*

Tradeoff:

When adapt carries UE-bearer-Id or UE-id + UE-specific bearer-Id, the scheduler can enforce QoS with UE-bearer granularity. For this purpose, the scheduler has to be configured with the QoS policy for each UE-bearer.

QoS-id is used to mark the PDU as pertaining to a predefined QoS class. It allows to reduce the number of QoS-classes configured for the scheduler, i.e., the scheduler does not have to have explicit knowledge on the QoS-policy for each individual UE-bearer. QoS-Id may be based on 5QI used for the UE-bearer on the access link or on DSCP used for the UE-bearer on the F1-U fronthaul tunnel.

**Proposal 3: The above Adapt identifier options for QoS enforcement and the tradeoff are included in the study.**

1. Mapping of UE’s UP PDUs to backhaul LCID

Options:

1. Adapt above MAC: PDUs can use all the same BH LCID
2. Adapt above RLC: PDUs are mapped to BH LCID based identifier used for QoS enforcement

**Proposal 4: The above mapping of UE’s UP PDUs to backhaul LCIDs is included in the study.**

Resulting 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

### 2.2 Further considerations for Arch 1a

Assumptions

* The Adapt header 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.
* ***Nokia****: We think this depends on how the IDs are assigned (e.g. are they unique across the whole IAB network? UE ID could be e.g. unique only within a sub-tree of topology and be mapped in one of the intermediate nodes) and there may be some use cases for adapt layer when it needs to be modified. We would like to keep this open for now.*
* ***Qualcomm****: If**adapt identifiers are unique only over local areas, then nodes on the borders of these local areas must know how to map between the locally unique identifiers. For the expected sizes of IAB topologies, it is much easier to create unique identifiers than to manage local areas and identifier mapping at their borders.*

**Proposal 5: The above assumptions are included in the study.**

Overloading of LCID

It is possible to overload the LCID of the RLC-channel on the wireless backhaul with one of these identifiers. This identifier, consequently, does not have be carried separately on adapt.

Example: The BH-link LCID can be used as QoS-Id.

**Proposal 6: The above aspects of LCID overloading are included in the study.**

Configuring entity of adapt identifiers

* Adapt identifiers are deterministically mapped from other identifiers or configured by a centralized control function.
* The centralized control function is part of the CU-CP.

Protocols used for configuration of adapt identifiers

Since the configuring entity of adapt identifiers is part of the CU-CP, the following signaling protocols are used for configuration of adapt identifiers:

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

**Proposal 7: The above aspects of Adapt configuration are included in the study.**

### 2.3 Processing of Adapt for Arch 1a

Processing of identifiers to be considered:

* Generation of Adapt Id at initial node where Adapt header is inserted into PDU
* Processing of Adapt Id at final node where Adapt header is removed from PDU
* Processing of Adapt Id at intermediate node where Adapt header on PDU is inspected

Examples for generation of Adapt Id at initial node, where Adapt header is inserted into PDU:

* UE-bearer Id:
  + At access-IAB-node (UL), may be 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 (DL), may be deterministically mapped from F1-U GTP-U TEID of arriving fronthaul PDU.
* UE-Id:
  + At access-IAB-node (UL), may be deterministically mapped from gNB-CU UE F1AP ID, which is configured on UE-bearer’s DU based on native F1-AP procedures.
  + At IAB-donor DU (DL), may be mapped from F1-U GTP-U TEID; new procedure for configuration of mapping required since no information on UE contained in fronthaul F1-U.

***Samsung****: Unclear if UE generation (and especially propagation and use at intermediate nodes) is different for different positions of the adaptation layer in the stack.*

* UE-specific bearer-Id:
  + At access-IAB-node (UL), may be deterministically mapped from LCID of access link, where UL PDU arrives.
  + At IAB-donor DU (DL), may be mapped from F1-U GTP-U TEID. New procedure for configuration of mapping required since no information on UE-specific bearer contained in fronthaul F1-U.

***Nokia:*** *I think UE-bearer Id should be combined with UE UE-specific bearer Id. These are the same identifiers, but different options can be used in different architecture options.*

* IAB-node/donor-DU Id:
  + At access-IAB-node (UL), may be deterministically mapped from existing Ids, e.g. CGI or gNB-DU ID. In case a new identifier is introduced, a new configuration procedure is required.
  + At IAB-donor DU (DL), may be deterministically mapped from existing Ids, e.g. CGI or gNB-DU ID. In case a new identifier is introduced, a new configuration procedure is required.
* QoS-Id:
  + At access-IAB-node (UL), may be deterministically mapped from fronthaul DSCP to be used for the arriving PDU, which can be configured on DU for via native F1-AP procedure. For different mapping, a new configuration procedure is required.
  + At IAB-donor DU (DL), may be deterministically mapped from DSCP value or F1-U GTP-U TEID of arriving fronthaul PDU. For different mapping, a new configuration procedure is required.

**Proposal 8: The above aspects of Adapt Id generation are included in the study.**

Examples for processing of Adapt Id at final node, where Adapt header is removed from PDU:

* UE-bearer Id:
  + At access-IAB-node (DL), may be 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 (UL), may be deterministically mapped to F1-U GTP-U TEID of PDU forwarded on fronthaul.
* UE-Id:
  + At access-IAB-node (DL), may be deterministically mapped to gNB-CU UE F1AP ID, which is configured on UE-bearer’s DU based on native F1-AP procedures.
  + At IAB-donor DU (UL), may be mapped to F1-U GTP-U TEID; new procedure for configuration of mapping required since no information on UE contained in fronthaul F1-U.
* UE-specific bearer-Id:
  + At access-IAB-node (DL), may be deterministically mapped to LCID of access link, where UL PDU arrives.
  + At IAB-donor DU (UL), may be mapped to F1-U GTP-U TEID. New procedure for configuration of mapping required since no information on UE-specific bearer contained in fronthaul F1-U.
* IAB-node/donor-DU Id:
  + At access-IAB-node (DL), may be deterministically mapped to existing Ids, e.g. CGI or gNB-DU ID. In case a new identifier is introduced, a new configuration procedure is required.
  + Ad IAB-donor DU (UL), may be deterministically mapped to existing Ids, e.g. CGI or gNB-DU ID. In case a new identifier is introduced, a new configuration procedure is required.
* QoS-Id:
  + At access-IAB-node, not used.
  + At IAB-donor DU, it may be mapped to DSCP value of PDU forwarded on fronthaul.

***ZTE****: Since it is the processing at final node, the final node should be able to derive the specific UE and UE bearer from the GTP-U TEID. It is confusing for ”map to GTP-U TEID”. Shouldn’t it map to UE bearer id from GTP-U TEID?*

***ZTE****: In fact, the mapped to and mapped from are used extensively in the subsequent description. It is suggested to clarify when to use map from and when to use map to.*

**Proposal 9: The above aspects of Adapt Id processing at the adapt-terminating node are included in the study.**

Examples for processing of Adapt Id at intermediate nodes, where Adapt header on PDU is inspected

1. Identification of UE-bearer for the PDU: None
2. Routing across the wireless backhaul topology: The IAB-node matches the routing identifier on Adapt to an entry in the routing table. The matching entry holds information on 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 routing is 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 routing is 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: The 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 QoS-enforcement is done via UE-bearer Id, the policy table needs to be reconfigured when UE-bearer is established or released at access IAB-node.
* If QoS-enforcement is 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 QoS-enforcement is 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.

**Proposal 10: The above aspects of Adapt Id processing at intermediate nodes are included in the study.**

# References

[1] R3-182458: pCR for TR 38.874, 3GPP TSG-RAN WG3 #99bis Sanya, China, April 16-20, 2018

[2] R2-1806456: U-plane considerations for IAB architecture group 1, 3GPP TSG-RAN WG2 #101bis Sanya, China, April 16-20, 2018