**3GPP TSG-RAN WG2 Meeting #103bis R2-18xxxxx**

**Chengdu, China, Oct 8th – 12th, 2018**

**Agenda item:** 11.1.2

**Source:** Qualcomm Incorporated (Rapporteur)

**Title:** Email discussion [103bis#32][NR - IAB] Unified Design

**Document for:** Discussion

# **1. Introduction**

This document contains email discussion:

**[103bis#32][NR - IAB] Unified design (Qualcomm)**

 **Intended outcome: attempt to extract a set of limited aspects to help reaching consensus on UP transport of unified design. No new architecture options should be considered.**

 **Intended outcome: Report to next meeting**

 **Deadline: Thursday 2018-11-01**

This email discussion is based on online discussion:

**F1-U termination**

[R2-1814369](file:///C%3A%5CUsers%5Cpanidx%5CDocuments%5CRAN%5CRAN2%5C103bis%20-%20Chengdu%5CDocs%5CR2-1814369.zip) Way forward on F1-U termination Ericsson, AT&T, KDDI discussion Rel-15 FS\_NR\_IAB

*Proposal 1. Further work on IAB for architecture group 1A should only consider solutions based on terminating GTP-U and NR user plane protocol in the IAB node.*

- Qualcomm thinks that we can put some of the GTP-U can be included in the adapt header. Ericsson indicates that we also have the flow control.

- Qualcomm thinks that we should consider this with the unified design and consider user plane transport as well.

- Huawei and Intel thought this is RAN3. Qualcomm explains that this is F1-U and adaptation layer design.

*Proposal 2 If the previous proposal is agreed, the remaining work on architecture group 1A should focus on alternatives d) and e) in figure 8.2.2 – 1 in TR 38.874.*

- Qualcomm thinks that this is a WI level decision

=> Placement of the adaptation layer and details of the adaptation layer should be analysed in view of the unified design

=> Noted

# **2. Discussion**

This discussion aims to identify design examples for the unified design. Each example specifies identifiers carried on F1\*-U, where these identifiers are carried in the L2-header-stack, and how they are processed.

The design examples illustrate how the unified design could be realized, identify potential constraints, and may serve as guide for WI stage. Since these designs are solely examples there won’t be any down selection.

Companies should feel free to propose their favorite design example. We should end up with at least one design example, which rapporteur has already provided below. We may end up with a few. In case there are too many design examples, some consolidation will be done, e.g. combine those that only differ with respect to stage-3 aspects.

The discussion contains two phases:

Phase 1: Collecting design examples for unified architecture

Phase 2: Discussion of design example(s) identified

The TP will contain the design examples proposed (and potentially consolidated) and the comparison among them.

Each design example should address the following points:

* Characteristics: A few points on which of the present TR design aspects are applied to design. This should include how N:1 and 1:1 bearer mapping is supported, LCID space shortage, etc.
* F1\*-U identifiers used and their placement on L2 header stack
* Downstream and upstream processing of F1-U and F1\*-U identifiers and access identifiers by IAB-donor-DU and IAB-node.

It is important to include the processing of F1-U and F1\*-U identifiers so that is becomes clear how the design works.

Please see example 1 below and use this template for further design proposals.

## **2.1 Phase 1: UP examples**

**Example 1 (Qualcomm)**

Characteristics:

* IP termination point can be on IAB-donor-DU or IAB-node
* UE-bearers are N:1-mapped to RLC-channels
* RLC-channels are 1:1-mapped to LCHs
* LCID-space extension necessary to support 1:1 bearer mapping

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID** above RLC
	+ Needs to be available on L2 for packet processing
* **IAB-node-address** above RLC
	+ Needs to be available on L2 for packet processing
	+ IAB-node may have multiple addresses, or the address may contain a route-Id for the support of multiple independent routes.
* **LCID** with extended space on MAC-sub-header

Downstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 1-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH-link, packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |
| **Packet****processing** | Node derives from packet header and lookup tables:* **UE-bearer-ID** from **UE-bearer-ID**
* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer based on **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping).
	+ **LCID** based on 1:1 mapping between RLC channel and LCH.
 | Node derives from packet headerand lookup tables:* Ingress RLC channel through 1:1 mapping from **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-node-address** (mapping between BH RLC channels)
	+ **LCID** via 1:1 mapping between RLC channel and LCH.
 |
| **Egress****packet** | On BH link, packet transmitted to child BH-link holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 | On BH link, packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 1-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress RLC-channel based on **LCID** using 1:1 mapping between RLC channel and LCH.
* Ingress link type (i.e. if access or BH link) based on ingress link and **LCID**.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child and **LCID** belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child and andLCID belongs to child’s BH channel.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
* If ingress = “BH”, derive:
	+ **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet header content and lookup tables:* Ingress RLC-channel based on **LCID** using 1:1 mapping between RLC channel and LCH.
* Ingress link type (i.e. if access or BH link) based on ingress link and **LCID**.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child and **LCID** belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child and LCID belongs to child’s BH channel.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
	+ **IAB-node-address** based on **UE-bearer-ID**
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping)
* If ingress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-node-address** (mapping between BH RLC channels)
* **LCID** via 1:1 mapping between RLC channel and LCH.
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |

**Example 2 (Huawei)**

Characteristics:

* UE-bearers can be either N:1 mapped to RLC-channels, or 1:1 mapped to RLC-channels
* Two flavors of LCH based on type of RLC-channel(s) mapped to LCH:
	+ N:1 mapped RLC-channels are 1:1 mapped to LCHs
	+ 1:1 mapped RLC-channels are K:1 mapped to LCHs (K ≥ 1)
* LCH type explicitly or implicitly indicated (e.g. a set of LCIDs may be configured for N:1 mapping)
* LCID-space extension not needed
* IP termination for F1 on IAB-donor-DU

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID**
	+ Needs to be available on L2 for packet processing
* **IAB-node-address**
	+ Needs to be available for routing
* **LCID** (reuse existing LCID space)

Processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

Downstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH-link, packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |
| **Packet****processing** | Node derives from packet header and lookup tables:* **UE-bearer-ID** from **UE-bearer-ID**
* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer based on **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID**
	+ If bearer mapping = N:1:
		- Egress **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress **LCID** based mapping between 1:1 mapped RLC channels and LCH
 | Node derives from packet headerand lookup tables:* If **LCD** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE-bearer-ID** + **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
	+ **LCID** based mapping between 1:1 mapped RLC channels and LCH.
 |
| **Egress****packet** | On BH link, packet transmitted to child BH-link holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 | On BH link, packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **Donor-DU-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress link type (i.e. if access or BH link) based on ingress link.
	+ “Access” if ingress link belongs to local UE.
	+ “Backhaul” if ingress link belongs to child and.

Note: Bearers terminating at child-MT may be treated either as “Access” links or “Backhaul” links depending on whether Adapt is implemented for such bearers (can be finalized in WI stage).* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
* If ingress = “BH”, derive:
* If **LCD** **type** = “N:1 bearer mapping”:
	+ RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ RLC channel based on combination of **UE-bearer-ID** + **LCID**
* **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet headerand lookup tables:* If **LCD** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE-bearer-ID** + **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
* **LCID** based mapping between 1:1 mapped RLC channels and LCH.
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |

**Example 3 (LG)**

Characteristics:

* Non-IP-based Adapt
* UE-bearers are N:1-mapped to RLC-channels
* No multiplexing between RLC-channels to LCHs same as legacy (i.e. one RLC channel is associated with only one LCH)
* LCID-space extension not needed (1:1 mapping is the special case of N:1 mapping. If IAB node can accommodate all UEs with 1:1 mapping, IAB node will provide 1:1 mapping. But if IAB node cannot support all UEs, IAB node would support N:1 mapping.)
* IP termination for F1 on IAB-donor-DU

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID** above RLC
* **IAB-node-address** above RLC

Downstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | F1\*-U packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
 |
| **Packet****processing** | Node derives from **F1-U-info** and lookup tables:* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ UE-bearer based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping).
 | Node derives from **F1\*-U info** and lookup tables:* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if this IAB node is destination of the address
	+ “BH” if this IAB node is not destination of the address
* If egress = “Access”, derive:
	+ UE-bearer from **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-node-address** (mapping between BH RLC channels)
 |
| **Egress****packet** | F1\*-U packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
 | F1\*-U packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **Donor-DU-address**
 | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress link type (i.e. if access or BH link) based on ingress link.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link
* If ingress = “BH”, derive:
	+ **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet header content and lookup tables:* Ingress link type (i.e. if access or BH link) based on ingress link.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child’s BH channel.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link
	+ **IAB-node-address** based on **UE-bearer-ID**
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping)
* If ingress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
 |

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**…**

**Example 4 (Samsung)**

Characteristics:

* Non-IP-based Adapt
* LCID-space extension necessary to support 1:1 bearer mapping
* To support N:1 mapping, UE-bearers are N:1-mapped to RLC-channels and RLC-channels are 1:1-mapped to LCHs; LCID space extension is required to support 1:1 mapping
	+ In one sub-option, the Adapt layer is always configured, even when not performing aggregation, to facilitate uniform packet processing for routing purposes;
	+ In another sub-option, the Adapt layer is only enabled when N:1 mapping is needed
* The design only supports hop-by-hop ARQ for N:1 mapping; both hop-by-hop and end-to-end can be supported for 1:1 mapping

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID** above RLC
* **Option A: IAB-node-address** above RLC (IAB-node-address explicitly included with UE bearer ID)
* **Option B: UE-bearer-ID** with a routing table (from which we get the next-hop information)
* **LCID** with extended space on MAC-sub-header

Processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 1: Processing for example 4 (Option A) (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | F1-U packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | F1\*-U packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |
| **Packet****processing** | Node derives from **F1-U-info** and lookup tables:* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ UE-bearer based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping).
	+ **LCID** based on 1:1 mapping between RLC channel and LCH.
 | Node derives from **F1\*-U info** and lookup tables:* Ingress RLC channel through 1:1 mapping from **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ UE-bearer from **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-node-address** (mapping between BH RLC channels)
	+ **LCID** via 1:1 mapping between RLC channel and LCH.
 |
| **Egress****packet** | F1\*-U packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 | F1\*-U packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |

**Example 5 (Nokia)**

Characteristics:

* IP termination for F1 on IAB-donor-DU
* Adaptation layer above MAC
* LCID space extension is not required
* UE-bearers can be either N:1 mapped to RLC-channels, or 1:1 mapped to RLC-channels
* GTP-U header is used for Multiplexing/De-multiplexing above RLC for N:1 mapping
* Adaptation header (UE-ID) together with LCID could be used for Multiplexing/De-multiplexing above MAC for 1:1

“F1\*-U” identifiers and their placement in L2 header stack:

* IAB node address as part of adaptation header above MAC (for routing)
* UE-Id as part of adaptation header above MAC (for multiplexing RLC channels to logical channels), only for 1:1 mapping
* GTP-U header is used for Multiplexing/De-multiplexing above RLC for N:1 mapping

Protocol stack:



Processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH-link, packet received from parent holds:* **UE-bearer-ID (=GTP-U TEID)**
* **IAB-node-address**
* **UE-ID (optional)**
* **LCID**
 |
| **Packet****processing** | Node derives from packet header and lookup tables:* **UE-bearer-ID** from **UE-bearer-ID**
* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ UE-bearer based on **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID**
	+ If bearer mapping = N:1:
		- Egress **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress **LCID** based mapping between 1:1 mapped RLC channels and LCH
 | Node derives from packet headerand lookup tables:* If **LCH** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCH** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE- ID** + **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
		- **UE-ID** and **LCID** based on mapping between 1:1 mapped RLC channels and LCH
 |
| **Egress****packet** | On BH link, packet transmitted to child BH-link holds:* **UE-bearer-ID (=GTP-U TEID)**
* **IAB-node-address**
* **UE-ID (optional)**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 | On BH link, packet transmitted to child holds:* **UE-bearer-ID (=GTP-U TEID)**
* **IAB-node-address**
* **UE-ID (optional)**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds:* **UE-bearer-ID (=GTP-U TEID)**
* **Donor-DU-address**
* **UE-ID (optional)**
* **LCID**

On access link, RLC packet received from UE holds:* **LCID**
 | On BH link, packet received from child holds:* **UE-bearer-ID (=GTP-U TEID)**
* **Donor-DU-address**
* **UE-ID (optional)**
* **LCID**

On access link, RLC packet received from UE holds:* **LCID**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress link type (i.e. if access or BH link) based on ingress link.
	+ “Access” if ingress link belongs to local UE.
	+ “Backhaul” if ingress link belongs to child and.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from C-RNTI and **LCID**
	+ **UE-ID** from C-RNTI
* If ingress = “BH”, derive:
* If **LCH** **type** = “N:1 bearer mapping”:
	+ RLC channel based on **LCID**
* If **LCH** **type** = “1:1 bearer mapping”:
	+ RLC channel based on combination of **UE-ID** + **LCID**
* **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet headerand lookup tables:* If **LCH** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCH** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE-ID** + **LCID**
* If egress = “BH”, derive:
	+ Egress **Donor-DU-address**= Ingress **Donor-DU-address**
	+ Egress link based on **Donor-DU-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
* **UE-ID** and **LCID** based mapping between 1:1 mapped RLC channels and LCH.
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
* **IAB-node-address**
* **UE-ID (optional)**
* **LCID**
 |

**…**

* 1. **Phase 2: Discussion**
1. Does the above design example meet the requirements of the unified design? If you believe it doesn’t please provide reasons.

|  |  |
| --- | --- |
| **Company** | **Answer** |
|  |  |
|  |  |

1. Is the above design example technically correct? Is something missing? Should something be changed? Is something unclear or not sufficiently well described?

|  |  |
| --- | --- |
| **Company** | **Answer** |
|  |  |
|  |  |

1. Do you have a different design example in mind which should be captured here? Please describe this scenario, or describe how it would differ from the design example above.

|  |  |
| --- | --- |
| **Company** | **Answer** |
|  |  |
|  |  |

1. Are there other aspects that should be considered for the discussion of the unified design? (Please note that this discussion only addresses UP and not CP)

|  |  |
| --- | --- |
| **Company** | **Answer** |
|  |  |
|  |  |

* 1. **Summary**

…

# **3. Text Proposal**

**\*\*\*\*\*\*\*\*\* Start of Change \*\*\*\*\*\*\*\*\*\***

# 8 Radio protocol aspects

…

### 8.x Examples of Unified Design for Architecture Group 1

Below, examples are provided for the unified design. Each example provides:

* Characteristics
* F1\*-U identifiers and their placement in L2 header stack
* Variants, options, optimizations
* Downstream and upstream processing steps for IAB-node and IAB-donor-DU

**Example 1**

Characteristics:

* UE-bearers are N:1-mapped to RLC-channels.
* RLC-channels are 1:1-mapped to LCHs.
* 1:1 bearer mapping is supported via setting N=1. This requires LCID-space extension.

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID** above RLC
	+ Needs to be available on L2 at the MAC scheduler for UE-bearer-specific QoS support
* **IAB-node-address/IAB-node-DU-address** above RLC
	+ Needs to be available on L2 for routing
* **LCID** with extended space on MAC-sub-header

Variants, options, optimizations:

* IAB-node/IAB-donor-DU may have multiple addresses, or the address may contain a route-Id for the support of multiple independent routes.
* MT-access link and BH link may be multiplexed onto common RLC channel. In this case, an access/backhaul multiplexing indicator is carried on the packet.
	+ In downstream direction, this indicator is set by the MT’s parent node to differentiate access and backhaul traffic and evaluated by the MT.
	+ In upstream direction, this indicator is set by the MT node to differentiate access and backhaul traffic and evaluated by the MT’s parent node.
* For 1:1 bearer mapping, end-to-end ARQ may be supported.

Downstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 1-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH-link, packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |
| **Packet****processing** | Node derives from packet header and lookup tables:* **UE-bearer-ID** from **UE-bearer-ID**
* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer based on **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping).
	+ **LCID** based on 1:1 mapping between RLC channel and LCH.
 | Node derives from packet headerand lookup tables:* Ingress RLC channel through 1:1 mapping from **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-node-address** (mapping between BH RLC channels)
	+ **LCID** via 1:1 mapping between RLC channel and LCH.
 |
| **Egress****packet** | On BH link, packet transmitted to child BH-link holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 | On BH link, packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 1-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-donor-DU-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-donor-DU-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress RLC-channel based on **LCID** using 1:1 mapping between RLC channel and LCH.
* Ingress link type (i.e. if access or BH link) based on ingress link and **LCID**.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child and **LCID** belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child and and LCID belongs to child’s BH channel.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
* If ingress = “BH”, derive:
	+ **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet header content and lookup tables:* Ingress RLC-channel based on **LCID** using 1:1 mapping between RLC channel and LCH.
* Ingress link type (i.e. if access or BH link) based on ingress link and **LCID**.
	+ “Access” if ingress link belongs to UE, or if ingress link belongs to child and **LCID** belongs to child-MT’s access channel.
	+ “Backhaul” if ingress link belongs to child and LCID belongs to child’s BH channel.
* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
	+ **IAB-donor-DU-address** based on **UE-bearer-ID**
	+ Egress link based on **IAB-donor-DU-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID** (N:1 bearer mapping)
* If ingress = “BH”, derive:
	+ Egress **IAB-donor-DU-address** = Ingress **IAB-donor-DU-address**
	+ Egress link based on **IAB-donor-DU-address**
	+ Egress RLC channel based on ingress RLC channel and **IAB-donor-DU-address** (mapping between BH RLC channels)
* **LCID** via 1:1 mapping between RLC channel and LCH.
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-donor-DU-address**
* **LCID**
 |

**Example 2**

Characteristics:

* UE-bearers can be either N:1 mapped to RLC-channels, or 1:1 mapped to RLC-channels
* Two flavors of LCH based on type of RLC-channel(s) mapped to LCH:
	+ N:1 mapped RLC-channels are 1:1 mapped to LCHs
	+ 1:1 mapped RLC-channels are K:1 mapped to LCHs (K ≥ 1)
* LCH type explicitly or implicitly indicated (e.g. a set of LCIDs may be configured for N:1 mapping)
* LCID-space extension not needed

F1\*-U identifiers and their placement in L2 header stack:

* **UE-bearer-ID**
	+ Needs to be available on L2 at the MAC scheduler for UE-bearer-specific QoS support
* **IAB-node-address/IAB-donor-DU-address**
	+ Needs to be available on L2 for routing
	+ IAB-node/IAB-donor-DU may have multiple addresses, or the address may contain a route-Id for the support of multiple independent routes.
* **LCID** on MAC header reusing existing LCID field (no LCID-space extension needed)

Variants, options, optimizations:

* IAB-node/IAB-donor-DU may have multiple addresses, or the address may contain a route-Id for the support of multiple independent routes.
* MT-access link and BH link may be multiplexed onto common RLC channel. In this case, an access/backhaul multiplexing indicator is carried on the packet.
	+ In downstream direction, this indicator is set by the MT’s parent node to differentiate access and backhaul traffic and evaluated by the MT.
	+ In upstream direction, this indicator is set by the MT node to differentiate access and backhaul traffic and evaluated by the MT’s parent node.
* For 1:1 bearer mapping, end-to-end ARQ may be supported.
* For 1:1 mapping, the UE-bearer-Id may be replaced by UE-Id + LCID. This implies that all RLC-channels supporting the UE-bearer use the same LCID.

Downstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-1: Downstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On wireline network, packet received from CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH-link, packet received from parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**
 |
| **Packet****processing** | Node derives from packet header and lookup tables:* **UE-bearer-ID** from **UE-bearer-ID**
* **IAB-node-address** based on **UE-bearer-ID**
* Egress link type (i.e. if access or BH link) based on **UE-bearer-ID**
	+ “Access” if UE of UE-bearer-ID is local
	+ “BH” if UE of UE-bearer-ID is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer based on **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress link based on **IAB-node-address** (routing)
	+ Egress RLC-channel based on **UE-bearer-ID**
	+ If bearer mapping = N:1:
		- Egress **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress **LCID** based mapping between 1:1 mapped RLC channels and LCH
 | Node derives from packet headerand lookup tables:* Determination of N:1 vs. 1:1 bearer mapping based on **LCID**.
* If **LCD** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE-bearer-ID** + **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-node-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-node-address** = Ingress **IAB-node-address**
	+ Egress link based on **IAB-node-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
	+ **LCID** based mapping between 1:1 mapped RLC channels and LCH.
 |
| **Egress****packet** | On BH link, packet transmitted to child BH-link holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 | On BH link, packet transmitted to child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet transmitted to UE or MT holds:* **LCID**
 |

Upstream processing of F1-U and F1\*-U identifiers by IAB-donor-DU and IAB-node

**Table 2-2: Upstream packet processing example 1 (red:** ingress parameters; **blue:** egress parameters)

|  |  |  |
| --- | --- | --- |
|  | **IAB-donor DU** | **IAB-node** |
| **Ingress****packet** | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **Donor-DU-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 | On BH link, packet received from child holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-node-address**
* **LCID**

On access link, RLC packet received from UE or MT holds:* **LCID**
 |
| **Packet****processing** | Node derives from packet header content and lookup tables:* Ingress link type (i.e. if access or BH link) based on ingress link.
	+ “Access” if ingress link belongs to local UE.
	+ “Backhaul” if ingress link belongs to child and.

Note: Bearers terminating at child-MT may be treated either as “Access” links or “Backhaul” links depending on whether Adapt is implemented for such bearers (can be finalized in WI stage).* If ingress = “Access”, derive:
	+ **UE-bearer-ID** from ingress link and **LCID**
* If ingress = “BH”, derive:
* If **LCD** **type** = “N:1 bearer mapping”:
	+ RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ RLC channel based on combination of **UE-bearer-ID** + **LCID**
* **UE-bearer-ID** from **UE-bearer-ID**
 | Node derives from packet headerand lookup tables:* Determination of N:1 vs. 1:1 bearer mapping based on **LCID**.
* If **LCD** **type** = “N:1 bearer mapping”:
	+ Ingress RLC channel based on **LCID**
* If **LCD** **type** = “1:1 bearer mapping”:
	+ Ingress RLC channel based on combination of **UE-bearer-ID** + **LCID**
* Egress link type (i.e. if access or BH link) based on **IAB-donor-DU-address**
	+ “Access” if address is local
	+ “BH” if address is remote
* If egress = “Access”, derive:
	+ Egress link and UE-bearer from **UE-bearer-ID**
	+ **LCID** based on **UE-bearer-ID**
* If egress = “BH”, derive:
	+ Egress **IAB-donor-DU-address** = Ingress **IAB-donor-DU-address**
	+ Egress link based on **IAB-donor-DU-address** (routing)
	+ On selected egress link RLC-channel and **LCID** are selected as follows:
	+ If bearer mapping = N:1:
		- Egress RLC-channel on **UE-bearer-ID**.
		- **LCID** based on mapping between N:1 mapped RLC channel and LCH.
	+ If bearer mapping = 1:1:
		- Egress RLC-channel based on ingress RLC-channel (mapping is implicit, since for 1:1 mapped bearers we can consider ingress and egress RLC channels to be the same RLC-channel)
* **LCID** based mapping between 1:1 mapped RLC channels and LCH.
 |
| **Egress****packet** | On wireline network, packet transmitted to CU holds **F1-U-info** with:* **UE-bearer-ID (=GTP-U TEID)**
 | On BH link, packet transmitted to parent holds **F1\*-U-info** with:* **UE-bearer-ID**
* **IAB-donor-DU-address**
* **LCID**
 |