**3GPP TSG-RAN WG2 Meeting #117-e R2-220xxxx**

**Online, 21st February– 3rd March 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** | **0389** | **rev** | **4** | **Current version:** | **16.8.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | | | UICC apps | | | |  | ME | **X** | Radio Access Network | | | | | **X** | Core Network |  |
|  | | | | | | | | | | | | | | | | | |
| ***Title:*** | Introduction of IAB enhancements | | | | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Source to WG:*** | Qualcomm (Rapporteur) | | | | | | | | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Work item code:*** | NR\_IAB\_enh-Core | | | | | | | | |  | ***Date:*** | | | 2022-3-10 | | | |
|  |  | | | | |  | | | | |  | | |  | | | |
| ***Category:*** | **B** |  | | | | | | | | | ***Release:*** | | | Rel-17 | | | |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | | | | |
|  |  | | | | | | | | | | | | | | | | |
| ***Reason for change:*** | | Capture RAN1, 2, 3 agreements NR\_IAB\_enh | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | |
| ***Summary of change:*** | | **RAN2-related agreements:** **RLF Indication**  * RAN2 to discuss enhancements to RLF indication/handling with the focus on the reduction of service interruption after BH RLF. * RAN2 to support type-2/3 RLF indication (FFS specified behavior(s) TS impact, FFS details). * Type-2 RLF indication may be used to trigger local rerouting * Type-2 RLF indication may be used to trigger deactivation of IAB-supported in SIB * Type-2 RLF indication may be used to trigger deactivation or reduction of SR and/or BSR transmissions * The trigger to generate a type 2 RLF indication is at RLF detection. FFS whether for both: single and dual connection cases. * The trigger for type 3 RLF indication transmission is successful recovery after BH RLF. FFS whether for both: single and dual connection cases. * Type 2 and Type 3 BH RLF Indications are transmitted via BAP Control PDU. * Upon reception of the type-2 indication, the IAB node does not initiate RRC re-establishment. * If an IAB node with dual parents (via DC) receives type-2 BH RLF indication from one parent, IAB-node may trigger a local re-routing to the other parent. The detail of local re-routing and whether/how the action on type-2 indication is configurable is FFS. * Type 2 indication by dual-connected node is triggered when the node initiates RRC re-establishment resulting from BH RLF on both CGs or BH RLF on MCG with no fast MCG recovery. * A node can transmit type-3 indication if re-establishment is successful. * A node can transmit type-3 indication only if it previously sent type-2 indication, i.e., type-3 indication cannot be triggered without triggering type-2 indication previously. * Upon reception of type-2 indication, the node should perform local re-routing if possible. * Upon reception of type-3 indication, the actions (e.g. local re-routing) triggered upon reception of a previous type-2 indication should be reversed, if possible. * For triggering condition of type-2 indication by a single-connected node, initiation of RRC re-establishment is a sufficient condition to trigger type-2 indication. * Conditional mobility is not triggered by reception of type-2 indication. * RAN2 does not specify UL transmission constraints (e.g. SR/BSR) to a node receiving the type-2 indication, i.e., whether the node can transmit uplink transmission is left to implementation of the node and also up to scheduling policy of a node transmitting the type-2 indication. FFS whether we need to add a Note in stage-2/3 CR. * To agree that the following terms are used:   Type-2: "BH RLF detection indication",  Type-3: "BH RLF recovery indication" , and  Type-4: FFS whether "BH RLF recovery failure indication" or existing name "BH RLF indication"   * Type-2 indication by a dual-connected node is triggered when the node detects BH RLF on a BH link and it cannot perform re-routing for any traffic, i.e. NR RLF for ENDC scenario, (FFS UP Link RLF for CPUP split scenario 1). * For these cases, the Type-2 indication is handled in the same way as for the case when both links goes down. * Execution of local re-routing of all affected traffic among re-routable traffic upon BH RLF is not mandatory for a node capable of local re-routing. This can be revisited if there is a severe issue. * For a dual-connected node, e.g., configured with CP-UP split/NR-DC/EN-DC, type-2 indication is triggered when all the CG(s) providing F1-over-BAP fail. * Type-3 indication is triggered upon successful CHO executed during re-establishment or upon successful RRC setup complete as a result of re-establishment. * Type-2/3 indication MAY be propagated, if the situation in the node doing the propagation is such that all BAP links are affected by the condition (e.g. single connected) (additional decision if to propagate or not can be left for implementation). * Type-2/3 indication is not propagated if the situation in the node doing the propagation is such that some BAP links are un-affected by the condition (e.g. dual connected). * The Rel-16 term “BH RLF indication” is used for type-4 indication in Rel-17. * Clarification: Successful CHO triggered by RLF is a triggering condition for type-3 indication (in addition to legacy reestablishment). This is already sufficiently covered by existing Stage-2 text.  **BAP routing enhancements**  * RAN2 to discuss local rerouting, including the benefits over central route determination, and on how topology-wide objectives can be addressed. * Local rerouting can be triggered by indication of hop-by-hop flow control. Further details, e.g., on trigger information, trigger conditions, role of CU configuration, are FFS. * RAN2 considers inter-donor-DU local rerouting to be in scope * Assume that the IAB-donor will configure (alternative) egress links that can be used at local re-routing (at least with same destination, FFS same routing ID) * Local re-routing based on flow control feedback is allowed based on certain value of available buffer size. FFS further details. (Current hbh fc is for DL traffic. * A configured threshold of available buffer size based on flow control feedback is used to determine the congestion, for the purpose of local re-routing. * For intra-CU cases, Support inter-donor-DU re-routing at least in the scenarios of NR-DC among donor-DUs, inter-donor-DU recovery and inter-donor-DU migration. * Support inter-CU re-routing, i.e. IAB-node re-routes the data to its original donor-CU via the alternative BAP path over the topology in target CU. * For inter-donor-DU re-routing, support the “previous routing ID to new routing ID” BAP header rewriting. * For Upstream, The pre-condition/criteria of “BAP header rewriting for re-routing” is that there is no available next hop found based on BAP routing ID and based on BAP address in the routing table (e.g. due to BH RLF, congestion or type2 indication, etc.), as in R16. * Will have rewriting mapping configuration(s) Old routing ID to New routing ID that limits the possible rewriting (for all cases of re-writing), * For each topology, the BAP address is configured to the boundary node by the CU of that topology via RRC (may need to check different scenarios). * In the Routing configuration: A BH link and the corresponding next-hop BAP address belong to the topology of the CU that provided the configuration of that BH link and next-hop BAP address. * The header rewriting configuration is provided via F1AP. * For inter-topology routing, the header rewriting configuration to include information that allows the boundary node to determine either the egress topology, or the ingress topology, or the traffic direction of a header-rewriting entry (selection of one of these expected). RAN3 to handle the St3-related aspects. * The BH RLC CH mapping configuration of the boundary node includes information for the boundary node to differentiate mappings based on ingress topology and egress topology. * The UL mapping configuration to include information for the boundary node to determine the egress topology of each UL mapping entry. * The routing configuration to include information that allows the boundary node to determine the topology each routing entry applies to. RAN3 to decide on St3-related aspects. * We go with Option c (if we find that some config is needed we include also Option b), where Option c = Rewriting mapping for inter-donor-DU re-routing is based on the BAP routing IDs included in the routing entries configured for each parent  **CHO**  * CHO and potential IAB-specific enhancements of CHO is on the table. * RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration. * R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed). * R2 assumes that Rel-16 specification is the baseline for the configuration of default route, IP address(es) and target path for intra-donor CHO. * The use cases for IAB-MT CHO should be migration and RLF recovery. * RAN2 should have a common solution for intra-CU/intra-DU CHO and intra-CU/inter-DU CHO. * condEventA3 and condEventA5 are applicable to IAB-MT * FFS if other CHO execution condition is needed (e.g. whether type 2 RLF indication can be used as trigger)   **RAN3 Draft CR: R2-2204164 / R3-221591**  **RAN1 Draft CR: R2-224110 / R1-2202884** | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-17 IAB is not supported. | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | |
| ***Clauses affected:*** | | 3.2 Definitions  4.4 Integrated Access and Backhaul  4.7.1 Architecture  4.7.3 User-plane Aspcets  4.7.3.1 Backhaul Transport  4.7.4 Signaling Procedures  4.7.4.2 IAB-node Migration  4.7.4.3 Topological Redundancy  4.7.4.4 Backhaul RLF Recovery  5.3.5.3 Uplink timing control  6.11 Backhaul Adaptation Protocol sublayer  6.11.1 Services and Functions  6.11.2 Traffic Mapping from Upper Layers to Layer-2  6.11.3 Routing and BH-RLC-channel mapping on BAP sublayer  9.2.3.4 Conditions Handover  9.2.7 Radio link failure  10.9 IAB Resource configuration | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | |
|  | | **Y** | | **N** |  | | | | | | |  | | | | | |
| ***Other specs*** | | **x** | |  | Other core specifications | | | | | | | TS 37.340 CR0296  TS 38.331 CR2811  TS 38.321 CR1171  TS 38.340 CR0020 | | | | | |
| ***affected:*** | |  | |  | Test specifications | | | | | | | TS/TR ... CR ... | | | | | |
| ***(show related CRs)*** | |  | |  | O&M Specifications | | | | | | | TS/TR ... CR ... | | | | | |
|  | |  | | | | | | | | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | | | | | | | | |

*First Modified Subclause*

## 3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

**BH RLC channel**: an RLC channel between two nodes, which is used to transport backhaul packets**.**

**Boundary IAB-node:** as defined in TS 38.401 [4].

**CAG Cell**:a PLMN cell broadcasting at least one Closed Access Group identity.

**CAG Member Cell**:for a UE, a CAG cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN.

**CAG-only cell**: a CAG cell that is only available for normal service for CAG UEs.

**Cell-Defining SSB**: an SSB with an RMSI associated.

**Child node**: IAB-DU's and IAB-donor-DU's next hop neighbour node; the child node is also an IAB-node.

**Conditional Handover (CHO**): a handover procedure that is executed only when execution condition(s) are met.

**CORESET#0**: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

**DAPS Handover**: a handover procedure that maintains the source gNB connection after reception of RRC message for handover and until releasing the source cell after successful random access to the target gNB.

**Downstream**: Direction toward child node or UE in IAB-topology.

**Early Data Forwarding**: data forwarding that is initiated before the UE executes the handover.

**gNB**: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**IAB-donor**:gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-donor-CU**: as defined in TS 38.401 [4].

**IAB-donor-DU**:as defined in TS 38.401 [4].

**IAB-DU**: gNB-DU functionality supported by the IAB-node to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor.

**IAB-MT**: IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise. IAB-MT function used in 38-series of 3GPP Specifications corresponds to IAB-UE function defined in TS 23.501 [3].

**IAB-node**: RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via LTE.

**IAB topology:** The unison of all IAB-nodes and IAB-donor-DUs that are interconnected via BH links and terminate F1 and/or RRC at the same IAB-donor-CU.

**Inter-donor partial migration:** Migration of an IAB-MT to a parent node underneath a different IAB-donor-CU while the collocated IAB-DU and descendant IAB-node(s), if any, are terminated at the initial IAB-donor-CU. The procedure renders the said IAB-node as a boundary IAB-node.

**Intra-system Handover**:Handover that does not involve a CN change (EPC or 5GC).

**Inter-system Handover**:Handover that involves a CN change (EPC or 5GC).

**Late Data Forwarding**: data forwarding that is initiated after the source NG-RAN node knows that the UE has successfully accessed a target NG-RAN node.

**MSG1**: preamble transmission of the random access procedure for 4-step random access (RA) type.

**MSG3**: first scheduled transmission of the random access procedure.

**MSGA**:preamble and payload transmissions of the random access procedure for 2-step RA type.

**MSGB**:response to MSGA in the 2-step random access procedure. MSGB may consist of response(s) for contention resolution, fallback indication(s), and backoff indication.

**Multi-hop backhauling**: Using a chain of NR backhaul links between an IAB-node and an IAB-donor.

**ng-eNB**: node providing E-UTRA user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

**NG-C**: control plane interface between NG-RAN and 5GC.

**NG-U**: user plane interface between NG-RAN and 5GC.

**NG-RAN node**: either a gNB or an ng-eNB.

**Non-CAG Cell**: a PLMN cell which does not broadcast any Closed Access Group identity.

**NR backhaul link**: NR link used for backhauling between an IAB-node and an IAB-donor, and between IAB-nodes in case of a multi-hop backhauling.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [40], between two or more nearby UEs, using NR technology but not traversing any network node.

**Numerology**: corresponds to one subcarrier spacing in the frequency domain. By scaling a reference subcarrier spacing by an integer *N*, different numerologies can be defined.

**Parent node**: IAB-MT's next hop neighbour node; the parent node can be IAB-node or IAB-donor-DU

**PLMN Cell**: a cell of the PLMN.

**SNPN Access Mode**: mode of operation whereby a UE only accesses SNPNs.

**SNPN-only cell**: a cell that is only available for normal service for SNPN subscribers.

**SNPN Identity:** the identity of Stand-alone NPN defined by the pair (PLMN ID, NID).

**Transmit/Receive Point:** Part of the gNB transmitting and receiving radio signals to/from UE according to physical layer properties and parameters inherent to that element.

**Upstream**: Direction toward parent node in IAB-topology.

**V2X sidelink communication**: AS functionality enabling V2X communication as defined in TS 23.285 [41], between nearby UEs, using E-UTRA technology but not traversing any network node.

**Xn**: network interface between NG-RAN nodes.

*Next Modification*

## 4.7 Integrated Access and Backhaul

### 4.7.1 Architecture

Integrated access and backhaul (IAB) enables wireless relaying in NG-RAN. The relaying node, referred to as *IAB-node*, supports access and backhauling via NR. The terminating node of NR backhauling on network side is referred to as the *IAB-donor*, which represents a gNB with additional functionality to support IAB. Backhauling can occur via a single or via multiple hops. The IAB architecture is shown in Figure 4.7.1-1.

The IAB-node supports the gNB-DU functionality, as defined in TS 38.401 [4], to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor. The gNB-DU functionality on the IAB-node is also referred to as *IAB-DU*.

In addition to the gNB-DU functionality, the IAB-node also supports a subset of the UE functionality referred to as *IAB-MT*, which includes, e.g., physical layer, layer-2, RRC and NAS functionality to connect to the gNB-DU of another IAB-node or the IAB-donor, to connect to the gNB-CU on the IAB-donor, and to the core network.

The IAB-node can access the network using either SA mode or EN-DC. In EN-DC, the IAB-node connects via E-UTRA to a MeNB, and the IAB-donor terminates X2-C as SgNB (TS 37.340 [21]).



Figure 4.7.1-1: IAB architecture; a) IAB-node using SA mode with NGC; b) IAB-node using EN-DC

All IAB-nodes that are connected to an IAB-donor via one or multiple backhaul hops and controlled by this IAB-donor via F1AP or RRC form an IAB topology with the IAB-donor as its root (Fig. 4.7.1-2). In this IAB topology, the neighbour node of the IAB-DU or the IAB-donor-DU is referred to as the *child* node and the neighbour node of the IAB-MT is referred to as the *parent* node. The direction toward the child node is referred to as *downstream* while the direction toward the parent node is referred to as *upstream*. The IAB-donor performs centralized resource, topology and route management for its IAB topology.



Figure 4.7.1-2: Parent- and child-node relationship for IAB-node

*Next Modification*

### 4.7.3 User-plane Aspects

#### 4.7.3.1 Backhaul transport

The IAB-DU's IP traffic is routed over the wireless backhaul via the BAP sublayer. The BAP sublayer is specified in TS 38.340 [31]. In downstream direction, upper layer packets are encapsulated by the BAP sublayer at the IAB-donor-DU and de-encapsulated at the destination IAB-node. In upstream direction, upper layer packets are encapsulated at the IAB-node and de-encapsulated at the IAB-donor-DU. IAB-specific transport between IAB-donor-CU and IAB-donor-DU is specified in TS 38.401 [4].

On the BAP sublayer, packets are routed based on the BAP routing ID, which is carried in the BAP header. The BAP header is added to the packet when it arrives from upper layers, and the BAP header is stripped off when the packet has reached its destination node. The selection of the packet's BAP routing ID is configured by the IAB-donor-CU. The BAP routing ID consists of BAP address and BAP path ID, where the BAP address indicates the destination node of the packet on the BAP sublayer, and the BAP path ID indicates the routing path the packet should follow to this destination. For the purpose of routing, each IAB-node and IAB-donor-DU is further configured with a designated BAP address.

On each hop of the packet's path, the IAB-node inspects the packet's BAP address in the BAP routing ID carried in the BAP header to determine if the packet has reached its destination, i.e., matches the IAB-node's BAP address. In case the packet has *not* reached the destination, the IAB-node determines the next hop backhaul link, referred to as *egress* link, based on the BAP routing ID carried in the BAP header and a routing configuration it received from the IAB-donor-CU.

For each packet, the IAB-node further determines the egress BH RLC channel on the designated egress link. For packets arriving from upper layers, the designated egress BH RLC channel is configured by the IAB-donor-CU, and it is based on upper layer traffic specifiers. Since each BH RLC channel is configured with QoS information or priority level, BH-RLC-channel selection facilitates traffic-specific prioritization and QoS enforcement on the BH. For F1-U traffic, it is possible to map each GTP-U tunnel to a dedicated BH RLC channel or to aggregate multiple GTP-U tunnels into one common BH RLC channel. For traffic other than F1-U traffic, it is possible to map UE-associated F1AP messages, non-UE-associated F1AP messages and non-F1 traffic onto the same or separate BH RLC channels.

When packets are routed from one BH link to another, the egress BH RLC channel on the egress BH link is determined based on the mapping configuration between ingress BH RLC channels and egress BH RLC channels provided by the IAB-donor-CU.

*Next Modification*

### 4.7.4 Signalling procedures

#### 4.7.4.1 IAB-node Integration

The IAB-node integration procedure is captured in TS 38.401 [4].

#### 4.7.4.2 IAB-node Migration

The IAB-node can migrate to a different parent node underneath the same IAB-donor-CU. The IAB-node continues providing access and backhaul service when migrating to a different parent node.

The IAB-MT can also migrate to a different parent node underneath another IAB-donor-CU. In this case, the collocated IAB-DU and the IAB-DU(s) of its descendant node(s) retain F1 connectivity with the initial IAB-donor-CU. This migration is referred to as *inter-donor partial migration*. The IAB-node, whose IAB-MT migrates to the new IAB-donor-CU, is referred to as a *boundary IAB-node*. After inter-donor partial migration, the F1 traffic of the IAB-DU and its descendant nodes is routed via the BAP layer of the IAB topology to which the IAB-MT has migrated.

Inter-donor partial migration is only supported for SA-mode.

The intra-donor IAB-node migration procedure and inter-donor partial migration procedures are captured in TS 38.401 [4].

#### 4.7.4.3 Topological Redundancy

The IAB-node may have redundant routes to the IAB-donor-CU(s).

For IAB-nodes operating in SA-mode, NR DC can be used to enable route redundancy in the BH by allowing the IAB-MT to have concurrent BH links with two parent nodes. The parent nodes may be connected to the same or to different IAB-donor-CUs, which controls the establishment and release of redundant routes via these two parent nodes. The parent nodes' gNB-DU functionality together with the respective IAB-donor-CU obtains the role of the IAB-MT's master node and/or secondary node. The NR DC framework (e.g., MCG/SCG-related procedures) is used to configure the dual radio links with the parent nodes (TS 37.340 [21]).

The procedures for establishment of topological redundancy for IAB-nodes operating in SA-mode is captured in TS 38.401 [4].

An IAB-node operating in NR-DC may also use one of its links for BH connectivity with an IAB-donor and the other link for access-only connectivity with a separate gNB that does not assume IAB-donor role. The IAB-donor can have the MN or the SN role. The IAB-node may exchange F1-C traffic with the IAB-donor via the backhaul link and/or via the access link with the gNB. In the latter case, the F1-C messages are carried over NR RRC between IAB-node and gNB, and via XnAP between gNB and IAB-donor

IAB-nodes operating in EN-DC can exchange F1-C traffic with the IAB-donor via the MeNB. The F1-C message is carried over LTE RRC using SRB2 between IAB-node and MeNB and via X2AP between MeNB and IAB-donor.

The procedures for establishment of redundant transport of F1-C for IAB-nodes using NR-DC and EN-DC are captured in TS 37.340 [21] and TS 38.401 [4].

#### 4.7.4.4 Backhaul RLF Recovery

When the IAB-node using SA-mode declares RLF on the backhaul link, it can perform RLF recovery at another parent node underneath the same or a different IAB-donor-CU. In the latter case, the collocated IAB-DU and the IAB-DU(s) of its descendant node(s) may retain the F1 connectivity with the initial IAB-donor-CU in the same manner as for *inter-donor partial migration*.

The BH RLF recovery procedures for IAB are captured in TS 38.401 [4]. BH RLF declaration for IAB and aspects of RLF recovery by the IAB-MT are handled in clause 9.2.7 of the present document.

*Next Modification*

**<**Unchanged text is omitted>

#### 5.3.5.3          Uplink timing control

The gNB determines the desired Timing Advance setting and provides that to the UE/IAB-MT. The UE/IAB-MT uses the provided TA to determine its uplink transmit timing relative to the UE's/IAB-MTs observed downlink receive timing.

An IAB-node may support additional modes for uplink timing:

* The IAB-MT uses the provided TA plus a provided an additional offset to determine its uplink transmission timing, to facilitate parent node’s IAB-MT Rx / IAB-DU Rx multiplexing.
* The IAB-MT aligns its uplink transmission timing to the IAB-DU downlink transmission timing, to facilitate IAB-MT Tx / IAB-DU Tx multiplexing.

The IAB-node uplink timing mode is indicated by the parent node via MAC-CE.

**<**Unchanged text is omitted>

*Next Modification*

### 6.11.1 Services and Functions

The main service and functions of the BAP sublayer include:

- Transfer of data;

- Routing of packets to next hop;

- Determination of BAP destination and BAP path for packets from upper layers;

- Determination of egress BH RLC channels for packets routed to next hop;

- Differentiating traffic to be delivered to upper layers from traffic to be delivered to egress link;

- Flow control feedback and polling signalling;

- BH RLF detection indication, BH RLF recovery indication, and BH RLF indication.

### 6.11.2 Traffic Mapping from Upper Layers to Layer-2

In upstream direction, the IAB-donor-CU configures the IAB-node with mappings between upstream F1 and non-F1 traffic originated at the IAB-node, and the appropriate BAP routing ID, next-hop BAP address and BH RLC channel. A specific mapping is configured:

- for each F1-U GTP-U tunnel;

- for non-UE associated F1AP messages;

- for UE-associated F1AP messages;

- for non-F1 traffic.

Multiple mappings can contain the same BH RLC channel and/or next-hop BAP address and/or BAP routing ID. In case the IAB-MT is NR-dual-connected (SA mode only), the mapping may include two separate BH RLC channels, where the two BH RLC channels are established toward different parent nodes.

In case the IAB-node is configured with multiple IP addresses for F1-C on the NR leg, multiple mappings can be configured for non-UE-associated F1AP messages or UE-associated F1AP messages. The appropriate mapping is selected based on the IAB node's implementation.

These traffic mapping configurations are performed via F1AP. For a boundary IAB-node, the traffic mapping configuration includes information that allows the boundary IAB-node to determine the IAB topology the mapping applies to.

During IAB-node integration, a default BH RLC channel and a default BAP routing ID may be configured via RRC, which can be used for non-F1-U traffic. These default configurations may be updated during topology adaptation scenarios as discussed in TS 38.401 [4].

In downstream direction, traffic mapping occurs internal to the IAB-donor. Transport for IAB-donors that use split-gNB architecture is handled in TS 38.401 [4].

### 6.11.3 Routing, BAP Header Rewriting and BH-RLC-channel Mapping on BAP sublayer



Figure 6.11.3-1: Routing and BH RLC channel selection on BAP sublayer

Routing on BAP sublayer uses the BAP routing ID, which is configured by the IAB-donor-CU. The BAP routing ID consists of BAP address and BAP path ID. The BAP address is used for the following purposes:

1. Determination if a packet has reached the destination node, i.e. IAB-node or IAB-donor-DU, on BAP sublayer. This is the case if the BAP address in the packet's BAP header matches the BAP address configured via RRC on the IAB-node, or via F1AP on the IAB-donor-DU. For a dual-connected boundary IAB-node that is configured with two BAP addresses, the BAP address in the packet’s BAP header is matched with the BAP address configured by the CU of the IAB topology, where the packet has been received.

2. Determination of the next-hop node for packets that have not reached their destination. This applies to packets arriving from a prior hop on BAP sublayer or that have been received from IP layer.

For packets arriving from a prior hop or from upper layers, the determination of the next-hop node is based on a routing configuration provided by the IAB-donor-CU via F1AP signalling or a default configuration provided by the IAB-donor-CU via RRC signalling. This F1AP configuration contains the mapping between the BAP routing ID carried in the packet's BAP header and the next-hop node's BAP address.

Table 6.11.3-1: Routing configuration

|  |  |
| --- | --- |
| BAP routing ID | Next-hop BAP address |
| Derived from BAP packet's BAP header | Egress link to forward packet |

The IAB-node resolves the next-hop BAP address to a physical backhaul link. For this purpose, the IAB-donor-CU provides the IAB-node/IAB-donor-DU with its child-node's BAP address via F1AP, and it provides the IAB-node with its parent-node's BAP address via RRC. For a boundary IAB-node, the routing configuration also indicates the IAB topology it applies to. The BH link to the next-hop node and the next-hop BAP address belong to the IAB topology of the CU that provided the RRC configuration of the BH link to that next-hop node.

The IAB-node can receive multiple routing configurations with the same destination BAP address but different BAP path IDs. These routing configurations may resolve to the same or different egress BH links.

In case the BH link resolved from the routing entry is considered *unavailable* for this packet, the IAB-node may perform local rerouting as defined in TS38.340 [31], i.e., select another BH link by considering only the packet’s BAP address and by disregarding the BAP path ID. In this manner, the packet can be delivered via an alternative path as defined in TS 38.340 [31].

A BH link may be considered *unavailable* in case the BH link has RLF. A parent link may be considered *unavailable* after a BH RLF detection indication has been received on this parent link and before a subsequent BH RLF recovery indication has been received on the same parent link. For DL traffic, a BH link may be considered *unavailable* due to congestion derived from flow-control feedback information, as defined in TS 38.340 [31].

For a boundary IAB-node, the routing configuration may carry information on the IAB topology the configuration applies to.

The IAB-node may rewrite the BAP routing ID in the packet’s BAP header under the following circumstances:

A packet is routed between two IAB topologies via a boundary IAB-node as defined in TS 38.401[31]. In this case, the BAP routing ID carried by the received BAP PDU is allocated by the IAB-donor-CU of the ingress IAB topology, while the BAP routing ID carried by the BAP PDU after header rewriting is allocated by the IAB-donor-CU of the egress IAB topology.

An upstream packet is locally re-routed to a different IAB-donor-DU than indicated by the BAP address in the BAP header of the received packet. The rewritten BAP header carries the BAP address of the alternative IAB-donor-DU and the BAP path ID for a path to this alternative IAB-donor-DU. BAP header rewriting for upstream inter-IAB-donor-DU local rerouting is only applied if neither routing nor local re-routing without header rewriting resolve to an available BH link.

For packets that are routed between two IAB topologies via a boundary node, the BAP header rewriting configuration is provided via F1AP, and it includes the ingress BAP routing ID, the egress BAP routing ID, and it indicates the egress IAB topology:

Table 6.11.3-2a: BAP header rewriting configuration

|  |  |  |
| --- | --- | --- |
| Ingress BAP routing ID | Egress BAP routing ID | Egress topology indicator |
| BAP routing ID carried in the BAP header of received BAP PDU | BAP routing ID carried in the BAP header of transmitted BAP PDU | Indicates the egress IAB topology. |

For upstream packets that are locally re-routed to a different IAB-donor-DU, the BAP header is rewritten with a BAP routing ID contained in the routing entry that was selected for re-routing.

Details of BAP header rewriting are defined in TS 38.340 [31]

When routing a packet from an ingress to an egress BH link, the IAB-node derives the egress BH RLC channel on the egress BH link through an F1AP-configured mapping from the BH RLC channel used on the ingress BH link. The BH RLC channel IDs used for ingress and egress BH RLC channels are generated by the IAB-donor-CU. Since the BH RLC channel ID only has link-local scope, the mapping configurations also include the BAP addresses of prior and next hop:

Table 6.11.3-2: BH RLC channel mapping configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Next-hop BAP address | Prior-hop BAP address | Ingress RLC channel ID | Egress RLC channel ID |
| Derived from routing configuration | Derived from packet's ingress link | Derived from packet's ingress BH RLC channel | BH RLC channel on egress link to forward packet |

For a boundary IAB-node, the BH RLC channel mapping configuration may also include indicators for the IAB topology of the ingress and of the egress link.

The IAB-node resolves the BH RLC channel IDs from logical channel IDs based on the configuration by the IAB-donor-CU. The IAB-MT obtains the BH RLC channel ID in the RRC configuration of the corresponding logical channel. The IAB-DU obtains the BH RLC channel ID in the F1AP configuration of the BH RLC channel.

*Next Modification*

#### 9.2.3.4 Conditional Handover

##### 9.2.3.4.1 General

A Conditional Handover (CHO) is defined as a handover that is executed by the UE when one or more handover execution conditions are met. The UE starts evaluating the execution condition(s) upon receiving the CHO configuration, and stops evaluating the execution condition(s) once a handover is executed.

The following principles apply to CHO:

- The CHO configuration contains the configuration of CHO candidate cell(s) generated by the candidate gNB(s) and execution condition(s) generated by the source gNB.

- An execution condition may consist of one or two trigger condition(s) (CHO events A3/A5, as defined in [12]). Only single RS type is supported and at most two different trigger quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously for the evalution of CHO execution condition of a single candidate cell.

- Before any CHO execution condition is satisfied, upon reception of HO command (without CHO configuration), the UE executes the HO procedure as described in clause 9.2.3.2, regardless of any previously received CHO configuration.

- While executing CHO, i.e. from the time when the UE starts synchronization with target cell, UE does not monitor source cell.

CHO is also supported for the IAB-MT in context of intra- and inter-donor IAB-node migration and BH RLF recovery.

CHO is not supported for NG-C based handover in this release of the specification.

*Next Modification*

### 9.2.7 Radio Link Failure

In RRC\_CONNECTED, the UE performs Radio Link Monitoring (RLM) in the active BWP based on reference signals (SSB/CSI-RS) and signal quality thresholds configured by the network. SSB-based RLM is based on the SSB associated to the initial DL BWP and can only be configured for the initial DL BWP and for DL BWPs containing the SSB associated to the initial DL BWP. For other DL BWPs, RLM can only be performed based on CSI-RS. In case of DAPS handover, the UE continues the detection of radio link failure at the source cell until the successful completion of the random access procedure to the target cell.

The UE declares Radio Link Failure (RLF) when one of the following criteria are met:

- Expiry of a radio problem timer started after indication of radio problems from the physical layer (if radio problems are recovered before the timer is expired, the UE stops the timer); or

- Expiry of a timer started upon triggering a measurement report for a measurement identity for which the timer has been configured while another radio problem timer is running; or

- Random access procedure failure; or

- RLC failure; or

- Detection of consistent uplink LBT failures for operation with shared spectrum channel access as described in 5.6.1; or

- For IAB-MT, the reception of a BH RLF indication received from its parent node.

After RLF is declared, the UE:

- stays in RRC\_CONNECTED;

- in case of DAPS handover, for RLF in the source cell:

- stops any data transmission or reception via the source link and releases the source link, but maintains the source RRC configuration;

- if handover failure is then declared at the target cell, the UE:

- selects a suitable cell and then initiates RRC re-establishment;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after handover failure was declared.

- in case of CHO, for RLF in the source cell:

- selects a suitable cell and if the selected cell is a CHO candidate and if network configured the UE to try CHO after RLF then the UE attempts CHO execution once, otherwise re-establishment is performed;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after RLF was declared.

- otherwise, for RLF in the serving cell or in case of DAPS handover, for RLF in the target cell before releasing the source cell:

- selects a suitable cell and then initiates RRC re-establishment;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after RLF was declared.

When RLF occurs at the IAB BH link, the same mechanisms and procedures are applied as for the access link. This includes BH RLF detection and RLF recovery.

The IAB-DU can transmit a BH RLF detection indication to its child nodes in the following cases:

- The collocated IAB-MT initiates RRC re-establishment;

- The collocated IAB-MT is dual-connected, detects BH RLF on a BH link, and cannot perform UL re-routing for any traffic. This includes the scenario of an IAB-node operating in EN-DC or NR-DC, which uses only one link for backhauling and has BH RLF on this BH link.

- The collocated IAB-MT has received a BH RLF detection indication from a parent node, and there is no remaining backhaul link that is unaffected by the BH RLF condition indicated.

Upon reception of the BH RLF detection indication, the child node may perform local rerouting for upstream traffic if possible.

If the IAB-DU has transmitted a BH RLF detection indication to a child node due to an RLF condition on the collocated IAB-MT’s parent link, and the collocated IAB-MT’s subsequent RLF recovery is successful, the IAB-DU may transmit a BH RLF recovery indication to this child node.

If the IAB-DU has transmitted a BH RLF detection indication to a child node due to the reception of a BH RLF detection indication by the collocated IAB-MT, and the collocated IAB-MT receives a BH RLF recovery indication, the IAB-DU may also transmit a BH RLF recovery indication to this child node.

Upon reception of the BH RLF recovery indication, the child node reverts the actions triggered by the reception of the previous BH RLF detection indication.

In case the RRC re-establishment procedure fails, the IAB-node may transmit a BH RLF indication to its child nodes. The BH RLF detection indication, BH RLF recovery indication and BH RLF indication are transmitted as BAP Control PDUs.

*Next Modification*

## 10.9   IAB Resource Configuration

If, the IAB-DU and the IAB-MT of an IAB-node are subject to a half-duplex constraint, as correct transmission/reception by one cannot be guaranteed during transmission/reception by the other and vice versa, e.g., when collocated and operating in the same frequency. If an IAB-node supports enhanced frequency or spatial multiplexing capabilities, additional multiplexing modes can be supported, i.e. IAB-MT Rx / IAB-DU Rx, IAB-MT Tx / IAB-DU Tx, IAB-MT Rx / IAB-DU Tx, IAB-MT Tx / IAB-DU Rx. An IAB-node can report its duplexing constraints between the IAB-MT and the IAB-DU via F1AP. An IAB-node can indicate via F1AP whether or not FDM is required for an enhanced multiplexing operation.

The scheduler on an IAB-DU or IAB-donor-DU complies with the gNB-DU resource configuration received via F1AP, which defines the usage of scheduling resources to account for the aforementioned duplexing constraint.

The resource configuration assigns an attribute of hard, soft or unavailable to each symbol of each DU cell. Transmission/reception can occur for symbols configured as hard, whereas scheduling cannot occur, except for some special cases, for symbols configures as unavailable. For symbols configured as soft, scheduling can occur conditionally on an explicit indication of availability by the parent node via DCI format 2\_5, or on an implicit determination of availability by the IAB-node. The implicit determination of availability is determined by the IAB-node depending on whether or not the operation of the IAB-DU would have an impact on the collocated IAB-MT.

The resource configuration can be shared among neighbouring IAB-nodes and IAB-donors to facilitate interference management, dual connectivity, and enhanced multiplexing.

To facilitate transitioning from IAB-MT to IAB-DU operation and vice versa, guard symbols can be used to overcome potentially misaligned symbol boundaries between the IAB-MT domain and the IAB-DU domain (e.g., IAB-MT Rx boundaries are not aligned with the IAB-DU Tx boundaries). Specifically, an IAB-node can indicate to a parent node a number of desired guard symbols, while the parent node can indicate to the IAB-node the number of actually provided guard symbols for specific transitions.

An IAB-node supporting enhanced multiplexing capabilities, i.e., IAB-MT Rx / IAB-DU Rx, IAB-MT Tx / IAB-DU Tx, IAB-MT Rx / IAB-DU Tx, IAB-MT Tx / IAB-DU Rx, can provide via MAC-CE to a parent node information to facilitate scheduling for enhanced multiplexing operation by the IAB-node, specifically:

* recommended IAB-MT’s Tx/Rx beams,
* desired IAB-MT Tx PSD range,
* desired parent node’s IAB-DU Tx power adjustment,
* required IAB-MT’s uplink transmission timing mode.

Correspondingly, the parent node can provide via MAC-CE information to the IAB-node to facilitate enhanced multiplexing at the IAB-node and/or at the parent node:

* restricted IAB-DU Tx beams,
* actual parent node’s IAB-DU Tx power adjustment,
* IAB-MT’s uplink transmission timing mode.

*End of Changes*