**3GPP TSG-RAN2 #116bis-e R2-220xxxx**

**Electronic meeting, January, 2022**

**Agenda item:** **8.4.2.1** (NR\_IAB\_enh-Core)

**Source:** LG Electronics Inc.

**Title:** Summary of AI 8.4.2.1 (BH RLF indication)

**Document for:** Discussion and Decision

# 1. Introduction

This contribution summarizes contributions submitted to AI 8.4.2.1 and compiles observations and proposals therein, and derives proposals.

# 2. Discussion

## 2.0 Agreements in RAN2#116

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| * 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. FFS whether to specify a detailed condition for success of re-establishment, e.g., successful transmission of RRC reestablishment complete. FFS whether to also include additional triggering condition such as successful transmission of ReconfigurationComplete, which is for the case the node initiates re-establishment and selects a CHO candidate cell and hence performs CHO successfully. * 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. * FFS if Type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic (if agreed see R2-2111539 for more details) * [032] 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. * [032]  Proposal 5\_alt: If option 2) is chosen in P1 (i.e. dual-connected node triggers type 2 indication when the node detects BH RLF on any BH link) and option 2 is chosen in P7 (i.e. Received type-2 indication is further propagated),  type-2 indication sent by a single-connected node includes routing ID information indicating which routing IDs are not available. FFS whether inclusion of routing ID can be omitted in some cases. Otherwise, type-2 indication sent by a single-connected node does not carry any further information related to BH RLF. * [032]  Conditional mobility is not triggered by reception of type-2 indication. * [032] For the need of further propagating received type-2 indication, FFS which option to take:   Option 1) Received type-2 indication is not propagated further (unless a normal type-2 triggering condition is met).  Option 2) Upon reception of type-2 indication, the node should further propagate type-2 indication to the child if it has no alternative path available.   * [032] 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. * [032] RAN2 does not specify that IAB-support indicator is toggled by reception of type-2 indication, i.e., when how to set IAB-support indicator it is up to implementation. FFS whether we need to add a Note in stage-2/3 CR. * [032] 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” |

## 2.1 Type-2 indication

### 2.1.1 Triggering of type-2 indication by dual-connected node.

#### Typical scenarios

It was agreed in the RAN2#116 that:

* 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.
* FFS if Type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic (if agreed see R2-2111539 for more details)

We need to resolve the FFS.

* **Option A: Do not support the FFS condition**
* **Option B: Support the FFS condition, i.e., Type-2 indication by a dual-connected node is triggered when the node detects BH RLF on any BH link and it cannot perform re-routing for affected traffic.**

There are proposals in [1]-[16] relating to this issue as excerpted in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Classification | Proposal |
| [1] | **Option A** | If a dual-connected node observes BH RLF on only one link, which is either the SCG link or it is the MCG link with fast MCG recovery supported, type-2 RLF indication should not be transmitted. |
| [2] | **Option A** | Type-2 RLF indication should not be triggered when one link is failed and the other is available with DC configuration. |
| [3] | **Option B** | Define unavailable BH link for local rerouting when any of the following conditions apply: 1) BH RLF; 2) receives type-4 RLF indication; 3) receive type-2 RLF indication; 4) receive flow-control feedback for congestion indication; 5) only available link is MCG link in EN-DC.  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 or alternative BH link for local rerouting is unavailable. |
| [4] | **Option B** | It should be supported that type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic. |
| [8] | **Option B** | Where type-2 indication by dual-connected node can be triggered when (1) the node detects BH RLF on any BH link and (2) it cannot perform re-routing for affected traffic Type-2 indication may carry information of the BAP routing ID |
| [10] | **Option B** | To cope with all RLF scenarios the IAB-node should send RLF indication when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic, as suggested with Option 2b.  In case MCG failure has been detected (i.e., for a node in DC when RRC sends the MCG failure to the MN and T316 is started) and not all possible traffic can be locally rerouted, the IAB-node shall transmit a BH RLF Type 2 indication to its child nodes.  In case SCG failure has been detected (i.e., for a node in DC when RRC sends the SCG failure to the MN) and not all possible traffic can be locally rerouted, the IAB-node shall transmit a BH RLF Type 2 indication – “Trying to recover” to its child nodes. |
| [11] | **Option B** | RAN2 should agree that Type 2 BH RLF Indication is sent when at least one route is unavailable upon BH RLF on any link, i.e., when local re-routing cannot be performed, regardless of whether the IAB-node is configured with single connection or dual connection, and also regardless of whether EN-DC or NR-DC. |
| [12] | **Option B** | IAB-node may trigger the Type-2 indication upon RLF on any CG.  For the dual connected IAB-node configured with CP-UP separation, the trigger condition to send type 2 indication on the BH link level should be upon RLF on the CG configured with “F1 over BAP” |
| [13] | **[Option B]** | RAN2 discuss and conclude the availability of the new routing ID written by header rewriting configuration when local rerouting is executed with this routing ID.  RAN2 discuss the solution and agree one of two: not executing the header rewriting (or fallback to the original routing ID) OR sending type 2 RLF indication to the child node(s).  *From the rapporteur understanding, the proposals above assume that type-2 indication can be triggered by RLF of one BH, not necessary both. So this [14] is classified into option B. If this understanding is incorrect, please clarify your preferred option.* |
| [14] | **Option B** | Type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic, so that local re-routing or other actions could be taken at its child/descendant nodes if possible. |
| [15] | **[Option B]** | Observation 2: To achieve preferential rerouting at an IAB node in response to receiving a BH RLF detection indication, it suffices for the indication to identify which of the parent IAB node’s UL BH links (MCG or SCG BH link) is not available. The IAB donor can configure the routing table of each child to trigger rerouting of specific routing IDs, if needed, in response to the BH RLF detection indication.  *From the rapporteur understanding, the observation2 assumes that type-2 indication can be triggered by RLF of one BH, not necessary both. So this [14] is classified into option B. If this understanding is incorrect, please clarify your preferred option.* |
| [16] | **Option B** | **A dual-connected node triggers type-2 indication when if both conditions are met: a) when the node detects BH RLF on any BH and b) it cannot perform re-routing for affected traffic** |
| [17] | **Option A** | **For a dual-connected parent IAB node, the type-2 RLF should be transmitted to the child IAB node only when both upstream links are unavailable due to BH RLF** |
| [18] | **Option B** | **A dual connected IAB node will send a type-2 RLF indication to a child node upon detecting an RLF on the MCG or SCG link, if any destination BAP routing ID that is mapped to the failed link can not be rerouted via the other functioning link** |

Counting preference yields:

* Option A: 3
* Option B: 15 (or 13)

The results indicate that a vast majority of companies prefer option B. Consequently, it is proposed to agree option B.

#### Proposal1: RAN2 attempt to agree option B, i.e., type-2 indication by a dual-connected node is triggered when the node detects BH RLF on any BH link and it cannot perform re-routing for affected traffic.

#### EN-DC scenarios and CP-UP split scenarios

In some contributions [10][12], there are proposals to introduce a new triggering condition or modify existing triggering condition for EN-DC scenarios and CP-UP separation scenarios, as shown below:

|  |  |  |
| --- | --- | --- |
| Company | Scneario | Proposal |
| [10] |  | To cover EN-DC scenarios and to have proper support for CP-UP split (Scenario 1), the RLF Type-2 indication is triggered also in case SCG fails and MCG cannot provide connection for BH data. |
| [12] |  | For the dual connected IAB-node configured with CP-UP separation, the trigger condition to send type 2 indication on the BH link level should be upon RLF on the CG configured with “F1 over BAP” |

#### Proposal 2: To further discuss if any further conditions should be specified to cover EN-DC and CP-UP split scenarios.

### 2.1.2 Content of type-2 indication

#### 2.1.2.1 Content of type-2 indication triggered by dual-connected node

There are two options

**Option1**: No routing information is included

**Option2**: To include some routing information that can be used for local routing by a receiving node

* This option assumes that, if a node receives this information, the node re-routes traffic identified to be affected, but not other traffic.
* **Option2a**: A list of Routing IDs that are not avaiable.
* **Option2b**: A list of BAP-destinations that are unreachable

Option1 can be taken if Option A in section 2.2.1 is agreed. Otherwise, Option2 can be considered.

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| --- | --- | --- |
| Company |  | Proposal |
| [4] | Option2a | BAP routing ID(s) of the traffic which needs to be re-routed is contained in the type 2 BH RLF indication. |
| [7] | Option2a | If RLF is detected on the link corresponding to the F1-terminating CU, or the inter-CU BAP Header Rewriting info for UL is not configured, the IAB-node determines the routing ID(s) affected and includes the routing ID(s) in the type-2 RLF indication to child node |
| [8] | Option2a | Type-2 indication may carry information of the BAP routing ID |
| [9] | Option2a | A BH RLF indication may convey a list of BAP path ID(s) or BAP Routing ID(s) impacted by the RLF. |
| [10] | Option2b | For the case that only part of the traffic cannot be rerouted, the type-2 RLF indication shall contain a list of BAP-destinations (from the indicating node’s routing configuration) that are unreachable due to the RLF. The absence of this list indicates that no upstream destination is reachable via the indicating node. |
| [11] | Option2a | RAN2 should agree that Type 2 BH RLF Indication indicates the Routing IDs that are unavailable due to BH RLF. |
| [12] | Option2a | The granularity of Type-2 indication can include per routing ID level. |
| [15] | Option 1 |  |
| [16] | Option 2 | Type-2 indication triggered by dual-connected node includes routing ID information indicating which routing IDs are not available. |
| [17] | Option 1 | The granularity of the type-2 RLF indication is per BH link, as the type-4 RLF |

Counting the preference yields:

* Option1: 2
* Option2: 8 (7 of 8 prefer option2a)

Based on the majority preference, if option B is agreed in section 2.1.1, it is proposed that RAN2 attempts to agree on option 2

#### Proposal 3: (In case P1 is agreed) To agree on option2a, i.e., type-2 indication triggered by dual-connected node includes a list of Routing IDs that are not available.

#### 2.1.2.2 Content of type-2 indication triggered by single-connected node

For type-2 indication triggered by single-connected node, there are two options to consider:

* Option1: No information
* Option2: Routing IDs that cannot be re-routed

Companies express their view as follows:

|  |  |  |
| --- | --- | --- |
| Company |  | Proposal |
|  |  |  |
| [14] | **Option2** | **BAP routing ID information needs to be included in the type2 indication sent by a single-connected node or a dual-connected node** |
| [16] | **Option1** | **Type-2 indication triggered by single-connected node does not include routing ID information.** |

We should note what RAN2 agreed in the RAN2#116:

|  |
| --- |
| * [032]  Proposal 5\_alt: If option 2) is chosen in P1 (i.e. dual-connected node triggers type 2 indication when the node detects BH RLF on any BH link) and option 2 is chosen in P7 (i.e. Received type-2 indication is further propagated),  type-2 indication sent by a single-connected node includes routing ID information indicating which routing IDs are not available. FFS whether inclusion of routing ID can be omitted in some cases. Otherwise, type-2 indication sent by a single-connected node does not carry any further information related to BH RLF. |

According to the agreement, routing ID is included only if option B is agreed and further propagation of type-2 is supported. However, RAN2 may need to consider the case where type-2 indication is triggered by a single connected node and sent to a dual-connected node, and the type-2 indication is further propagated to descendent nodes by the dual-connected node. In this case, if the type-2 indication constructed by the single connected node does not carry routing ID, it is not clear whether the propagated type-2 indication sent by the dual-connected node can include routing ID information.

#### Proposal 4: To discuss if routing information should be included in type-2 indication triggered by a single-connected node.

#### 2.1.2.3 Signaling details of type-2 indication

In [10], there is proposal to omit routing information in type-2 indication triggered by a failure of a BH link, in case all destinations are unreachable via the link (or all traffic via the link cannot be re-routed). Similarly, in [12], it is proposed that type-2 indication further indicates whether the failure is either “link-level” failure or “routing ID-level failure”. In [15].

|  |  |
| --- | --- |
| Company | Proposal |
| [10] | Destination/routing information can be omitted in the Type-2 indication if all destinations are unreachable via that link. |
| [12] | When constructing the Type-2 indication BAP control PDU:   * IAB-node includes the “BH link level” in the triggered Type-2 indication, in case of RRC re-establishment. * IAB-node includes the “routing ID level” in the triggered Type-2 indication, in case only some routing ID(s) is not be able to be routed to the next hop (e.g. not being able to be routed due to one CG RLF in NR-DC case). |
| [15] | Both the BH RLF detection indication and the BH RLF recovery indication transmitted by a dual-connected IAB node shall indicate the availability of its MCG and SCG BH links. The details of how this information is reported within the BH RLF indications, and how a child node is configured to react to this information is FFS. |
| [18] | Type-2 RLF indication may include information regarding the impacted destination BAP routing ID(s). If no such information is provided, child nodes will assume that all destination BAP routing IDs are not temporarily routable via the IAB node that sent the type-2 indication. |

#### Proposal 5: (In case of P1 agreed) RAN2 to discuss if the content of type-2 indication should indicate whether the failure is a link-level failure or whether it is a routing ID-level failure.

#### 2.1.3 Behaviour upon reception of type-2 indication

#### 2.1.3.1 Local re-routing upon reception of type-2 indication

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| --- | --- | --- |
| Company |  | Proposal |
| […] |  | Several proposals to support that a node receiving type-2 indication perform local re-routing for “affected traffic”, where “affected traffic” is determined based on information explicitly or implicitly conveyed by the type-2 indication |
| [11] |  | RAN2 should agree that the child node considers the Routing IDs to be unavailable, if these Routing IDs are indicated in received Type 2 BH RLF Indication |
| [12] |  | IAB-MT with NR-DC dual parent does not consider the BH link as available for the purpose of local re-routing, upon receiving Type-2 indication on BH link level.  AB-MT with NR-DC dual parent does not consider the BH link for the indicated routing ID as available for the purpose of local re-routing, upon receiving Type-2 indication on routing ID level on the BH link.  IAB-MT with single parent should suspend routing any data to its parent node, upon receiving Type-2 indication on BH link level  IAB-MT with single parent should suspend routing any data to its parent node, upon receiving Type-2 indication on BH link level |
| [16] |  | If the IAB node performs local routing upon reception of type-2 RLF or BH RLF, Rel-16 re-routing principles are used, i.e. the alternative link is selected among the entries in the routing table matching the BAP destination in the BAP header. |
| [17] |  | If the IAB node performs local routing upon reception of type-2 RLF or BH RLF, Rel-16 re-routing principles are used, i.e. the alternative link is selected among the entries in the routing table matching the BAP destination in the BAP header. |

Most of contributions seem to assume that upon reception of type-2 indication, the node performs local re-routing only for *affected* traffic, where “affected traffic” is determined based on information explicitly or implicitly conveyed by the type-2 indication. For example, if the type-2 indication includes routing ID information, this information should be taken into account by a receiving node’s decision on which traffic to re-route. If the rype-2 indication does not include any detailed information, the receiving node has no choice but to determining that all routing ID traversing the parent node are unavailable and has to be re-routed, if possible.

#### Proposal 6. If a node receives a type-2 indication, the node performs local re-routing, if possible, only for *affected* traffic as indicated by the type-2 indication. FFS re-routing principle (e.g., whether R16 principle or a new principle should be applied)

### 2.1.4 Further propagation of type-2 indication

#### 2.1.4.1 Whether to support further propagation of received type-2 indication

RAN2 made the following agreement:

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| * [032] For the need of further propagating received type-2 indication, FFS which option to take:   Option 1) Received type-2 indication is not propagated further (unless a normal type-2 triggering condition is met).  Option 2) Upon reception of type-2 indication, the node should further propagate type-2 indication to the child if it has no alternative path available. |

* Option1: No further propagation is supported
* Option2: Further propagation is supported

There are relevant proposals:

|  |  |  |
| --- | --- | --- |
| Ref | Classification | Proposal in Ref |
| [1] | Option 2 | A type-2 indication may be propagated by the receiving node if the node has no alternative path for local rerouting. |
| [2] | Option 1 | Propagation of type-2/type-3 RLF indication should not be supported. |
| [3] | Option 1 | IAB-node will not propagate type-2 RLF indication to its child IAB-node. |
| [4] | Option 1 | Propagation of type-2 indication should not be supported. |
| [8] | Option 1 | In case the IAB node cannot perform traffic re-routing on a configured link, the type-2 indication should not be propagated |
| [9] | Option 2 | Upon reception of a BH RLF indication from a parent IAB-node, an IAB node without any alternative path should forward the RLF indication to its own child IAB node(s) |
| [10] | Option 2 | RAN2 to select Opt.2 (Upon reception of type-2 indication, the node should further propagate type-2 indication to the child if it has no alternative path available) as the IAB-node behaviour when receiving Type-2 RLF indication. |
| [11] | Option2 | RAN2 should agree that the propagation of Type 2 Indication to descendant nodes is supported. FFS on detailed condition, e.g., forwarding only if the IAB-node does not perform any local rerouting. |
| [12] | Option 1 | **RAN2 does not support the propagation of Type-2 indication (i.e. child node can trigger type-2 indication based on its own radio condition).** |
| [14] | Option 2 | **Type 2/3 indication should be propagated to descendant nodes so that corresponding actions could be taken at descendant nodes, e.g., local rerouting** |
| [16] | Option 1 | **Upon reception of type-2 indication, the node does not propagate type-2 indication, regardless of whether the node has no alternative path available.** |
| [17] | Option 1 | **A received type-2 RLF is not propagated.** |
| [18] | Option 2 | **A node receiving a type-2 RLF indication may propagate the indication further to a child node, if it is not able to reroute packets via an alternate link/path.** |

Counting yields:

* Option1: 7
* Option2: 11

Since a majority of companies prefer to option2, it is attempted to agree on the option2:

#### Proposal 7: To attempt to agree on option2, i.e., further propagation of type-2 indication is supported.

#### 2.1.4.2 Simple forwarding vs Regenerative forwarding

In case further propagation of type-2 indication is supported, RAN2 needs to decide for fwarding:

* Option1: Received type-2 indication is simply forwarded without re-generation.
* Option2: A new type-2 indication is re-generated and then transmitted (forwarded).

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| Ref |  | Proposal in Ref |
| [10] | Option 2 | **Forwarded Type-2 indication is not changed in the intermediate IAB-node(s) forwarding the indication.** |

It seems that there is no explicit proposal to adopt option1 in [1]-[16] while there is an explicit proposal in [10] to adopt option2. Since there is no clear reason being identified to support regenerative type-2 indication, RAN2 consider option1 as baseline, until severe problem is identified.

#### Proposal 8: RAN2 to confirm that if further propagation of a tytpe-2 indication is supported, the propagation is based on a simple forwarding without re-generation of a type-2 indication.

## 2.2 Type-3 indication

### 2.2.1 Triggering of type-3 indication

Upon successful re-establishment, type-3 indication is triggered, as agreed in RAN2#116.

Note there is the case where a node initiates re-establishment but selects a CHO candidate cell during and performs CHO successful. For this case, [3] proposes to introduce successful CHO executed during re-establishment as another triggering condition of type-3 indication.

There is another case where a node initiates re-establishment but ends up with RRC setup, which is the case the

* Option1: To trigger type-3 upon successful CHO executed during re-establishment.
* Option2: To trigger type-3 upon successful RRC setup complete as a result of re-establishment

There are relevant proposals below:

|  |  |  |
| --- | --- | --- |
| Company |  | Proposal |
| [3] |  | Type-3 RLF indication is triggered upon successful transmission of RRCReconfigurationComplete message if the selected target cell during re-establishment is a CHO candidate cell. |
| [18] |  | A node that has sent a type-2 RLF indication will send a type-3 indication to child nodes upon sending one of the following messages to a target cell:   * RRCReestablishmentComplete * RRCSetupComplete * RRCReconfigurationComplete |

#### Proposal 9: To discuss if type-3 indication is triggered for the following cases:

* **upon successful transmission of RRCReconfigurationComplete message if the selected target cell during re-establishment is a CHO candidate cell.**
* **upon successful RRC setup complete initiated during re-establishment**

If option B is agreed, type-3 triggering conditions other than re-establishment success should be discussed. There are following proposals:

* Option1: Type-3 is triggered when the failed BH is recovered,
* Option2: Type-3 is triggered when at least one unavailable routing ID sent in type-2 indication becomes available.

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| Company |  | Proposal |
| FFS |  | **FFS** |
| [10] | Option1 | In case the MCG failure has been solved or is no longer relevant (e.g., after RRCReconfiguration with reconfigurationwithSync for the PCell or after MobilityFromNRCommand when all BAP destinations are reachable again) and the node has previously sent a BH RLF Type 2 indication, the IAB-node shall transmit a BH RLF Type 3 indication – “BH link recovered” to its child nodes.  In case the SCG failure has been solved or is no longer relevant (e.g., after Secondary Node Modification or Secondary Node Change or after a Secondary Node Release with a change of the BH routing configuration so that all BAP destinations are reachable) and the node has previously sent a BH RLF Type 2 indication, the IAB-node shall transmit a BH RLF Type 3 indication – “BH link recovered” to its child nodes. |
| [11] | Option2 | RAN2 should agree that Type 3 BH RLF Indication is sent when at least one route becomes re-available upon successful BH RLF recovery |
| [14] | Option 2 | BAP routing ID of path that has recovered needs to be included in type 3 RLF indication. |
| [15] | Option1 | Both the BH RLF detection indication and the BH RLF recovery indication transmitted by a dual-connected IAB node shall indicate the availability of its MCG and SCG BH links. The details of how this information is reported within the BH RLF indications, and how a child node is configured to react to this information is FFS.  From the rapporteur understanding, the above proposal assumes option1. |

Based on the observations and proposals in contribution in [1-16] , most contributions supporting option B in section 2.1.1 seem to take option1 as baseline. Then RAN2 needs to discuss if routing-ID level granularity of type-3 triggering is needed.

#### Proposal 10: (In case P1 is agreed), type-3 indication is triggered when the failed BH on MCG/SCG recovers.

#### Proposal 11: (In case P1 is agreed), discuss whether to support triggering type-3 indication when at least one unavailable routing ID previously contained in type-2 indication becomes available.

### 2.2.2 Content of type-3 indication

In case Option A is agreed in section 2.1.1, it is reasonable that type-3 indication does not include any information, and this seems to be assumed in contributions supporting option A in section 2.1.1.

In case Option B is agreed in section 2.1.1, RAN2 should decide whether/what information should be included in type-3 indication.

* **Option1: No routing related information**
* **Option2: Some routing related information (dependent of triggering of type-3 indication)**

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| --- | --- | --- |
| Company |  | Proposal |
| [8] | Option 2 | Type 3 BH RLF indication should indicate if the donor-DU has switched or not.  When Type 3 BH RLF indicating with no topology change (i.e. no donor-DU switch) has been received, an IAB node can perform data transmission/routing as before receiving the corresponding Type 2 BH RLF indication.  When Type 3 BH RLF indication indicating the donor-DU switch is received, the IAB node is allowed generate new BAP data PDU for UL transmission only after its BAP routing table is reconfigured. |
| [10] | Option 1 | Type-3 indication does not need to carry additional information for re-routing (CU sends routing re-configuration to the child/descendant nodes, if needed). |
| [11] | Option2 | RAN2 should agree that Type 3 BH RLF Indication is sent when at least one route becomes re-available upon successful BH RLF recovery |
| [14] | Option 2 | BAP routing ID of path that has recovered needs to be included in type 3 RLF indication. |
| [15] | Option 2 | Both the BH RLF detection indication and the BH RLF recovery indication transmitted by a dual-connected IAB node shall indicate the availability of its MCG and SCG BH links. The details of how this information is reported within the BH RLF indications, and how a child node is configured to react to this information is FFS. |

#### Proposal 12: (if Option A in section 2.1.1 is agreed), type-3 indication does not include any routing information.

#### Proposal 12Alt: (if Option B in section 2.1.1 is agreed) To discuss if type-3 indication should include routing information indicating recovered routing ID(s).

### 2.2.3 Further propagation of type-3 indication

In case further propagation of type-2 indication is supported (i.e., P7 is agreed), RAN2 needs to discuss whether to support propagation of type-3 indication accordingly

* **Option1: No further propagation of type-3 indication is supported**
* **Option2: Further propagation of type-3 indication is supported**

|  |  |  |
| --- | --- | --- |
| Company | Option | Proposal |
| [14] | **Option 2** | For descendant nodes, if type 2 RLF indication has been sent to child IAB-MT, type 3 RLF indication needs to be transmitted to child IAB-MT after reception of type 3 RLF indication which includes BAP routing ID. |

Since there is limited input on this, RAN2 needs to discuss this issue.

#### Proposal 13: (if P7 is agreed) To discuss whether to support propagation of type-3 indication.

### 2.2.4 Clarification of successful re-establishment

**Option1: there is no need to specify detailed conditions for success of re-establishment [2][4].**

**Option2: Detailed condition for successful of re-establishment refers to “upon successful transmission of RRCReestablishmentComplete message” [3][8][10]**

* **FFS whether the successful transmsission is declared by RLC or RRC (upon submission of the message)**

|  |  |  |
| --- | --- | --- |
| Company | Classification | Proposal |
| [2] | **Option 1** | The conditions of successful re-establishment are clear in RRC specification and there is no need to address extra details. |
| [3] | **Option 2** | Detailed condition for successful of re-establishment refers to “upon successful transmission of RRCReestablishmentComplete message”. |
| [4] | **Option 1** | RAN2 does not need to specify the detailed condition of successful re-establishment for transmitting Type-3 RLF indication |
| [10] | **Option 2** | The success of the re-establishment can be declared when RRC sends the RRCReestablishmentComplete -message to lower layers for transmission. |
| [14] | **Option 1** | There is no need to specify a detailed condition for success of re-establishment, i.e. it could be up to MT implementation |
| [16] | **Option 1** | Type-3 indication can be triggered no earlier than submission of RRCReestablishmentComplete from RRC to lower layers |

Based on the identified proposals, it seems that RAN2 can attempt to agree on option1,

#### Proposal 14: For type-3 indication, RAN2 does not specify detailed conditions for success of re-establishment.

## 2.3 Joint consideration of type-2 and type-3

### 2.3.1 CHO during re-establishment

[1] and [3] addresses the case that a node initiates re-establishment but selects a CHO candidate cell and hence executes CHO to the cell without further proceeding the re-establishment. This is the case the node has been configured with CHO candidate(s). The following shows the proposals in [1] and [3] for this case:

|  |  |  |
| --- | --- | --- |
| Company | Affected RLF indication type | Proposal |
| [1] | **Type-2** | **Type-2 RLF indication is not sent after RLF detection with subsequent CHO execution.** |
| [3] | **Type-3** | **Type-3 RLF indication is triggered upon successful transmission of RRCReconfigurationComplete message if the selected target cell during re-establishment is a CHO candidate cell.** |
| [16] | **Type-3** | **Type-3 indication can be triggered no earlier than a successful CHO to a cell during re-establishment procedure.** |

In [1], it is proposed that a node should not send type-2 indication if re-establishment has been initiated but CHO is executed during re-establishment.

In [3], it is proposed to introduce successful CHO executed during re-establishment as another triggering condition of type-3 indication.

From the rapporteur understanding, the proposal in [1] may change the triggering condition of type-2 indication in the sense that upon initiation of re-establishment, the node needs to *defer* triggering of type-2 indication until checking whether the selected cell during re-establishment is a CHO candidate cell or not, rather than immediately triggering type-2 indication. In contrast, [3] takes a different approach, where BH RLF is informed via type-2 indication to child(s) upon initiation of re-establishment as RAN2 agreed, but if CHO is executed during re-establishment and successful, recovery of BH RLF is informed to the child(s).

There are following options to address the case that CHO is triggered during re-establishment:

* Option 1: To trigger type-3 indication upon successful CHO executed during re-establishment.
* Option 2: To not trigger type-2 indication upon executing a CHO during re-establishment
* Option 3: Optoon1 and 2 are not needed.

#### Proposal 15: To discuss how to address the case CHO is executed during re-establishment:

* **Option 1: To trigger type-3 indication upon successful CHO executed during re-establishment (i.e., a new type-3 triggering condition is introduced).**
* **Option 2: To not trigger type-2 indication upon executing a CHO during re-establishment (i.e., type-2 triggering condition is modified)**
* **Option 3: FFS including none of option1 and 2.**

## 2.4 Terminology

The terminology of type-4 indication is FFS, i.e., we need to discuss to use either of:

* Option1: BH RLF recovery failure indication [1][4]
* Option2: BH RLF indication

|  |  |  |
| --- | --- | --- |
| Company | Classification | Proposal |
| [1] | **Option 1** |  |
| [4] | **Option 1** | **RAN2 use the new terms “BH RLF recovery failure indication” for Type-4 RLF indication.** |
| [12] | **Option 2** | **The terminology of Type-4 indication “BH RLF indication” should NOT be changed in R17**  **If RAN2 deems to use “BH RLF recovery failure indication” for type 4 indication, R16 CRs should also be agreed** |
| [16] | **Option 1** | **Type-4 indication is referred to as “BH RLF recovery failure indication” from Rel-17. No changes to Rel-16 specifications are needed** |

More companies prefer to use “BH RLF recovery failure indication” for type-4 indication at least from Rel-17. Since this is different from the name used in Rel-16, RAN2 should assess if there is any problem or action to resolve this misalignment across releases.

#### Proposal 16: To use “BH RLF recovery failure indication” for type-4 indication from Rel-17. RAN2 discuss if there is any serious issue due to misalignment between Rel-16 and Rel-17 on the name, and if there is any action to resolve the misalignment (e.g., having CRs from Rel-16)

## 2.5 Other

In [17], it is proposed that

*“Specify in the stage-2 and BAP specification that the type-3 indication is transmitted upon successful BH RLF recovery.”. The similar question/proposal can be applicable to type-2 triggering.*

Since there is limited input on this, it seems better to discuss this.

In [11], it is discusseds if RAN2 should introduce other condition for the IAB-node to revert the actions triggered by a previous Type 2 Indication other than reception of type-2 indication. [A possible condition in [11] may be

*“when the routing configuration on the IAB-node is updated by the donor, e.g., due to an update for load balancing, handover or RRC Reestablishment. After the configuration update, the parent node may no longer be able to send Type 3 Indication, or the child node cannot receive Type 3 Indication, due to the new configuration, e.g., since the parent node is no longer the parent of child”*

Since there is limited input on this, it seems better to discuss this.

In [2], it is proposed that

*“If IAB-node re-established to a different IAB-donor-CU, it should send type-4 RLF indication to its child IAB-node”*

Since there is limited input on this, RAN2 needs to discuss this.

In [17][18] it is proposed whether type-2 RLF can be transmitted or not by an IAB node is configurable by the CU. In the [AT116][32], this was discussed, and most companies think that network configuration for this is unnecessary. However, since no explicit agreement was made on this, it seems fine to ask this question again and conclude this.

In [1], it is proposed:

*“Add a note to stage-2 CR that a type-2 indication may trigger deactivation of IAB-supported in SIB and deactivation/reduction of SR and/or BSR transmissions at the receiving node.”*

Similarly in [2], it is proposed:

*“RAN2 should agree to add a Note in Stage-2/3 specifications that the IAB-MT deactivates or reduces SR and/or BSR transmissions when it receives Type 2 BH RLF Indication.”*

Since there is limited input on this, it seems better to discuss this.

#### Proposal 17: To discuss the following issue

* **If routing configuration update should be able to trigger the IAB-node to revert the actions triggered by a previous Type 2 BH RLF Indication [11]**
* **In case IAB-node is re-established to a different IAB-donor-CU, whether it should send type-4 RLF indication to its child IAB-node [2]**
* **in which specifications type-2 triggering and type-3 triggering are specified [17]**
* **whether to add a note to stage-2 CR that a type-2 indication may trigger deactivation of IAB-supported in SIB and deactivation/reduction of SR and/or BSR transmissions at the receiving node.”**

In [12], it is proposed that

*“IAB-MT with single parent should suspend routing any data to its parent node, upon receiving Type-2 indication on BH link level”*

*“IAB-MT with single parent should suspend routing any data to its parent node, upon receiving Type-2 indication on BH link level”*

However, these proposals seem to contradict the following agreement in the sense that the agreement does not prevent UL transmission upon type-2 indication:

|  |
| --- |
| * [032] 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. |

#### Proposal 18: Not to discuss the following issue

* **whether to suspend routing data to a parent node, upon receiving type-2 indication in [12]**

#### (Open) proposal 19: Specify issues proposed in contributions [1-16] but not addressed above:

* [To be filled]

# 3. Conclusion

This contribution summarizes contributions submitted to AI 8.4.2.1 and compiles observations and proposals therein, and derives proposals.

* Green-marked: proposals attempted for agreement

**Type-2 indication**

#### Proposal1: RAN2 attempts to agree on option B, i.e., type-2 indication by a dual-connected node is triggered when the node detects BH RLF on any BH link and it cannot perform re-routing for affected traffic.

#### Proposal 2: To discuss if any further conditions should be specified to cover EN-DC and CP-UP split scenarios.

#### Proposal 3: (In case P1 is agreed) To agree on option2a, i.e., type-2 indication triggered by dual-connected node includes a list of Routing IDs that are not available.

#### Proposal 4: To discuss if routing information should be included in type-2 indication triggered by a single-connected node.

#### Proposal 5: (In case of P1 agreed) RAN2 to discuss if the content of type-2 indication should indicate whether the failure is a link-level failure or whether it is a routing ID-level failure.

#### Proposal 6. If a node receives a type-2 indication, the node performs local re-routing, if possible, only for affected traffic as indicated by the type-2 indication. FFS re-routing principle (e.g., whether R16 principle or a new principle should be applied)

#### Proposal 7: To attempt to agree on option2, i.e., further propagation of type-2 indication is supported.

#### Proposal 8: RAN2 to confirm that if further propagation of a tytpe-2 indication is supported, the propagation is based on a simple forwarding without re-generation of a type-2 indication.

**Type-3 indication**

#### Proposal 9: To discuss if type-3 indication is triggered at the following cases:

* **upon successful transmission of RRCReconfigurationComplete message if the selected target cell during re-establishment is a CHO candidate cell.**
* **upon successful RRC setup complete initiated during re-establishment**

#### Proposal 10: (In case P1 is agreed), type-3 indication is triggered when the failed BH on MCG/SCG recovers.

#### Proposal 11: (In case P1 is agreed), discuss whether to support triggering type-3 indication when at least one unavailable routing ID previously contained in type-2 indication becomes available.

#### Proposal 12: (if Option A in section 2.1.1 is agreed, i.e. P1 is rejected), type-3 indication does not include any routing information.

#### Proposal 12Alt: (if P1 is agreed) To discuss if type-3 indication should include routing information indicating recovered routing ID(s).

#### Proposal 13: (if P7 is agreed) To discuss whether to support propagation of type-3 indication.

#### Proposal 14: For type-3 indication, RAN2 does not specify detailed conditions for success of re-establishment.

**Joint consideration of type-2 and type3 indication**

#### Proposal 15: To discuss how to address the case CHO is executed during re-establishment:

* **Option 1: To trigger type-3 indication upon successful CHO executed during re-establishment (i.e., a new type-3 triggering condition is introduced).**
* **Option 2: To not trigger type-2 indication upon executing a CHO during re-establishment (i.e., type-2 triggering condition is modified)**
* **Option 3: FFS including none of option1 and 2.**

**Terminology**

#### Proposal 16: Agree to use “BH RLF recovery failure indication” for type-4 indication from Rel-17. To discuss if there is any issue incurred by misalignment between Rel-16 and Rel-17 on the name, and if there is any action to resolve the misalignment (e.g., having CRs from Rel-16)

**Other issues**

#### Proposal 17: To discuss the following issues:

* **if routing configuration update should be able to trigger the IAB-node to revert the actions triggered by a previous Type 2 BH RLF Indication [11]**
* **in case IAB-node is re-established to a different IAB-donor-CU, whether it should send type-4 RLF indication to its child IAB-node [2]**
* **in which specifications type-2 triggering and type-3 triggering are specified [17]**
* **whether to add a note to stage-2 CR that a type-2 indication may trigger deactivation of IAB-supported in SIB and deactivation/reduction of SR and/or BSR transmissions at the receiving node.”[1]**

#### Proposal 18: Not to discuss the following issue

* **whether to suspend routing data to a parent node, upon receiving type-2 indication in [12]**

#### (Open) proposal 19: Specify issues proposed in contributions [1-16] but not addressed above:

* [To be filled]

# Reference and Proposals therein

### [1] [R2-2200196](../docs/R2-2200196.zip) QC

Open isuses on IAB RLF indications Qualcomm Incorporated discussion Rel-17 NR\_IAB\_enh

**Observation: Based on RAN3 agreement, inter-donor-DU local rerouting can always be configured via a static IP tunnel.**

**Proposal 1: If a dual-connected node observes BH RLF on only one link, which is either the SCG link or it is the MCG link with fast MCG recovery supported, type-2 RLF indication should not be transmitted.**

**Proposal 2: A type-2 indication may be propagated by the receiving node if the node has no alternative path for local rerouting.**

**Proposal 3: Add a note to stage-2 CR that a type-2 indication may trigger deactivation of IAB-supported in SIB and deactivation/reduction of SR and/or BSR transmissions at the receiving node.**

**Proposal 4: Type-2 RLF indication is not sent after RLF detection with subsequent CHO execution.**

**Proposal 5: Type-4 RLF indication is referred to as *BH RLF recovery-failure indication*.**

### [2] [R2-2200323](../docs/R2-2200323.zip) CATT

Discussion on RLF Indications CATT discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1: There is no obstacle of IAB capability for data rerouting in intra-CU inter-DU topological redundancy and inter-donor-CU topological redundancy.**

**Observation 2: Since NR DC is used to enable route redundancy in the BH, no reason for IAB-donor-CU to configure DC but not allow data rerouting.**

**Proposal 1: Type-2 RLF indication should not be triggered when one link is failed and the other is available with DC configuration.**

**Proposal 2: BAP control PDU format of type-4 RLF indication can be reused for type-2 and type-3 RLF indications, and 2 new PDU type values should be applied to indicate type-2 and type-3 RLF indication.**

**Observation3: The conditions of successful re-establishment are clear in RRC specification and there is no need to address extra details.**

**Proposal 3: For type-3 RLF indication triggered by successful re-establishment, there is no need to specify detailed conditions for success of re-establishment.**

**Observation 4: If IAB-node re-established to a different IAB-donor-CU, the sub-tree cannot be identified by the new IAB-donor-CU.**

**Proposal 4: If IAB-node re-established to a different IAB-donor-CU, it should send type-4 RLF indication to its child IAB-node.**

**Proposal 5: Propagation of type-2/type-3 RLF indication should not be supported.**

### [3] [R2-2200351](../docs/R2-2200351.zip) INTEL

Open issues on IAB-node RLF indication Intel Corporation discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1 If local rerouting is supported at dual-connected IAB-node which detects BH RLF on any BH link, local rerouting can be performed first without sending type-2 RLF indication. Triggering local rerouting at both IAB-node which detects BH RLF and its child IAB-node is not necessary.**

**Observation 2 Local rerouting at dual-connected IAB-node can always be supported via configuration/reconfiguration by IAB-donor CU.**

**Observation 3The alternative BH link for local rerouting is considered as unavailable if it is congested. A dual-connected IAB-node should also trigger type-2 RLF indication if alternative BH link is congested.**

**Observation 4MCG link in EN-DC is not available for local rerouting, as it’s a LTE link. A dual-connected IAB-node should also trigger type-2 RLF indication if alternative BH link is MCG link in EN-DC.**

**Observation 5 Define unavailable BH link for local rerouting when any of the following conditions apply:**

**1) BH RLF; 2) receives type-4 RLF indication; 3) receive type-2 RLF indication; 4) receive flow-control feedback for congestion indication; 5) only available link is MCG link in EN-DC.**

**Proposal 0: Define unavailable BH link for local rerouting when any of the following conditions apply:**

**1) BH RLF; 2) receives type-4 RLF indication; 3) receive type-2 RLF indication; 4) receive flow-control feedback for congestion indication; 5) only available link is MCG link in EN-DC.**

**Proposal 1 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 or alternative BH link for local rerouting is unavailable.**

**Proposal 2 For inter-donor DU re-routing, local rerouting at dual-connected IAB-node can only be configured by IAB-donor CU when IP tunnel between source and target IAB-donor DU is successfully established.**

**Observation 6 The IAB-node which receives the type-2 RLF indication will not generate a type-2 RLF indication to its child IAB-node, as BH RLF is not detected on both CGs or MCG with no fast MCG recovery.**

**Observation 7 UL congestion can be avoided by deactivation of iab-support in SIB or reduction of SR/BSR transmission. There’s no need to further propagate type-2 RLF indication for the same purpose.**

**Proposal 3 IAB-node will not propagate type-2 RLF indication to its child IAB-node.**

**Proposal 4 Detailed condition for successful of re-establishment refers to “upon successful transmission of RRCReestablishmentComplete message”.**

**Proposal 5 Type-3 RLF indication is triggered upon successful transmission of RRCReconfigurationComplete message if the selected target cell during re-establishment is a CHO candidate cell.**

### [4] [R2-2200405](../docs/R2-2200405.zip) NEC

Discussion on left issue of Type-2/3 RLF indication NEC discussion Rel-17 NR\_IAB\_enh-Core

**Proposal 1: It should be supported that type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic.**

**Proposal 2: BAP routing ID(s) of the traffic which needs to be re-routed is contained in the type 2 BH RLF indication.**

**Proposal 3: Propagation of type-2 indication should not be supported.**

**Proposal 4: RAN2 does not need to specify the detailed condition of successful re-establishment for transmitting Type-3 RLF indication.**

**Proposal 5：RAN2 use the new terms “BH RLF recovery failure indication” for Type-4 RLF indication.**

### [5] [R2-2200562](../docs/R2-2200562.zip) Fujitsu

Control plane behavior at receiving BH RLF detection indication Fujitsu discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1: Local re-routing cannot handle IAB-MT’s SRB.**

**Proposal 1: If a split SRB is configured, pdcp-Duplication of its PCDP entity is not configured, and the BH RLF detection indication is from MCG, then set the primaryPath to refer to SCG.**

**Proposal 2: ULInformationTransferMRDC is enhanced to carry the RRC messages which was intended to send on the link towards the parent who sends the BH RLF detection indication.**

**Proposal 3: F1-C can be enhanced to carry RRC messages.**

### [6] [R2-2200563](../docs/R2-2200563.zip) Fujitsu

A mechanism to avoid a storm of BH RLF indication Fujitsu discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1: There is no security protection for Type 2 BH RLF indication.**

**Observation 2: The trigger(s) to generate a Type 2 BH RLF indication should be restricted.**

**Proposal 1: A mechanism is introduced to avoid a storm of Type 2 BH RLF indications.**

**Proposal 2: RAN2 to select one from the following options to avoid a storm of Type 2 BH RLF indications:**

* **Option 1: only one type 2 BH RLF indication is triggered before a Type 3 BH RLF indication is generated**
* **Option 2: a prohibit timer-based mechanism**

### [7] [R2-2200564](../docs/R2-2200564.zip) Fujitsu

RLF indication and flow control feedback from boundary node Fujitsu discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1: The buffer for the previous routing ID and that for the corresponding new routing ID in the inter- -CU BAP Header Rewriting info should be shared.**

**Proposal 1: If the available buffer size of a routing ID among the new routing IDs in the inter-CU BAP Header Rewriting info for DL is low, the IAB node:**

* **Look up the previous routing ID of this routing ID in inter-CU BAP Header Rewriting info.**
* **Deliver the flow control BAP PDU containing the buffer size of this routing ID as well as the previous Routing ID to the egress link corresponding to the non-F1-terminating CU.**

**Proposal 2: If the available buffer of a routing ID is low and there is no inter-CU BAP Header Rewriting info for DL or the routing ID is not among the new routing IDs, the IAB-node delivers the flow control BAP PDU containing that routing ID to the egress link corresponding to the F1-terminating CU.**

**Proposal 3: If RLF is detected on the link corresponding to the non-F1-terminating CU, the boundary node:**

* **Determine the Routing ID(s) affected.**
* **Look up the previous routing ID(s) of the affected routing ID(s) in the inter-CU BAP Header Rewriting info for UL.**
* **Deliver the type-2 RLF indication including the previous routing ID(s) to child node.**

**Proposal 4: If RLF is detected on the link corresponding to the F1-terminating CU, or the inter-CU BAP Header Rewriting info for UL is not configured, the IAB-node determines the routing ID(s) affected and includes the routing ID(s) in the type-2 RLF indication to child node.**

### [8] [R2-2200806](../docs/R2-2200806.zip) vivo

Remaining Issues of BH RLF vivo discussion Rel-17 NR\_IAB-Core

**Proposal 1 Where type-2 indication by dual-connected node can be triggered when (1) the node detects BH RLF on any BH link and (2) it cannot perform re-routing for affected traffic Type-2 indication may carry information of the BAP routing ID**

**Proposal 2 Type-2 indication may carry information of the BAP routing ID**

**Proposal 3 In case the IAB node cannot perform traffic re-routing on a configured link, the type-2 indication should not be propagated**

**Proposal 4 If Type-2 indication is triggered and if no alternative path is available, the node may perform re-establishment.**

**Proposal 5Type 3 BH RLF indication can be triggered in case of successful ReconfigurationComplete message transmission.**

**Proposal 6Type 3 BH RLF indication should indicate if the donor-DU has switched or not.**

**Proposal 7 When Type 3 BH RLF indicating with no topology change (i.e. no donor-DU switch) has been received, an IAB node can perform data transmission/routing as before receiving the corresponding Type 2 BH RLF indication.**

**Proposal 8 When Type 3 BH RLF indication indicating the donor-DU switch is received, the IAB node is allowed generate new BAP data PDU for UL transmission only after its BAP routing table is reconfigured.**

### [9] [R2-2200837](../docs/R2-2200837.zip) CANON

Discussion on RLF indication enhancements CANON Research Centre France discussion Rel-17 NR\_IAB\_enh-Core

**Proposal 1: A BH RLF indication may convey a list of BAP path ID(s) or BAP Routing ID(s) impacted by the RLF.**

**Proposal 2: Upon reception of a BH RLF indication from a parent IAB-node, an IAB node without any alternative path should forward the RLF indication to its own child IAB node(s).**

### [10] [R2-2201051](../docs/R2-2201051.zip) Nokia

RLF indications and re-routingenhancements Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_IAB\_enh-Core

**Observation 1: If all possible traffic with MCG as the primary next hop can be rerouted via SCG, there is no need to send a BH RLF Type-2 indication provided that the fast MCG recovery is supported.**

**Observation 2: If all possible traffic with SCG as the primary next hop can be rerouted via MCG, there is no need to send a BH RLF Type-2 indication.**

**Observation 3: If an IAB node in DC, regardless of whether it detects MCG RLF or SCG RLF, indicates to its child nodes nothing more than that it is trying to recover from RLF, its child nodes may trigger local re-routing (and/or alter IAB-support indication in SIB, or reduce SR/BSR transmissions) unnecessarily.**

**Observation 4:Rel-16 IAB does not allow re-routing of downstream data having reached an IAB node with all downlink hops toward a given destination unavailable.**

**Observation 5: Local rerouting can be done at the IAB node if there is an alternative route to the same destination node.**

**Observation 6:In case of BH RLF, BH RLF indication may be sent to the child nodes. Rerouting may be possible at a child IAB node if an alternative path exists when the BH RLF indication is received.**

**Observation 7:Since the BAP entity may only reroute the BAP Data PDUs, which were not acknowledged by the lower layer, to an alternative path, it is not possible at the child IAB node to locally reroute the BAP PDUs which were successfully sent to the parent IAB node but not to the ancestor in case of a BH failure between the parent and ancestor nodes.**

**Proposal 1. Type-3 indication does not need to carry additional information for re-routing (CU sends routing re-configuration to the child/descendant nodes, if needed).**

**Proposal 2. The success of the re-establishment can be declared when RRC sends the RRCReestablishmentComplete -message to lower layers for transmission.**

**Proposal 3. To cover EN-DC scenarios and to have proper support for CP-UP split (Scenario 1), the RLF Type-2 indication is triggered also in case SCG fails and MCG cannot provide connection for BH data.**

**Proposal 4: In case MCG failure has been detected (i.e., for a node in DC when RRC sends the MCG failure to the MN and T316 is started) and not all possible traffic can be locally rerouted, the IAB-node shall transmit a BH RLF Type 2 indication to its child nodes.**

**Proposal 5: In case SCG failure has been detected (i.e., for a node in DC when RRC sends the SCG failure to the MN) and not all possible traffic can be locally rerouted, the IAB-node shall transmit a BH RLF Type 2 indication – “Trying to recover” to its child nodes.**

**Proposal 6: In case the SCG failure has been solved or is no longer relevant (e.g., after Secondary Node Modification or Secondary Node Change or after a Secondary Node Release with a change of the BH routing configuration so that all BAP destinations are reachable) and the node has previously sent a BH RLF Type 2 indication, the IAB-node shall transmit a BH RLF Type 3 indication – “BH link recovered” to its child nodes.**

**Proposal 7: To cope with all RLF scenarios the IAB-node should send RLF indication when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic, as suggested with Option 2b.**

**Proposal 8: For the case that only part of the traffic cannot be rerouted, the type-2 RLF indication shall contain a list of BAP-destinations (from the indicating node’s routing configuration) that are unreachable due to the RLF. The absence of this list indicates that no upstream destination is reachable via the indicating node.**

**Proposal 9: In case the MCG failure has been solved or is no longer relevant (e.g., after RRCReconfiguration with reconfigurationwithSync for the PCell or after MobilityFromNRCommand when all BAP destinations are reachable again) and the node has previously sent a BH RLF Type 2 indication, the IAB-node shall transmit a BH RLF Type 3 indication – “BH link recovered” to its child nodes.**

**Proposal 10: If a received Type-2 RLF indication contains a list of unreachable BAP destinations, local re-routing is allowed only for traffic addressed to the listed destinations.**

**Proposal 11. RAN2 to select Opt.2 (Upon reception of type-2 indication, the node should further propagate type-2 indication to the child if it has no alternative path available) as the IAB-node behaviour when receiving Type-2 RLF indication.**

**Proposal 12. Destination/routing information can be omitted in the Type-2 indication if all destinations are unreachable via that link.**

**Proposal 13. Forwarded Type-2 indication is not changed in the intermediate IAB-node(s) forwarding the indication.**

**Proposal 14: Re-routing of downstream data having reached an IAB node with all downlink hops toward a given destination unavailable is supported by:**

* **1) BAP-routing paths with a parent node as next hop, or**
* **2A) uplink indication (not accompanying data) that certain destinations are unreachable, or**
* **2B) undeliverable-indication in the header of a BAP PDU returned to parent node.**

**Proposal 15: BAP PDUs are not discarded by the BAP entity until the expiry of a BAP discard timer despite the received RLC ACKs. In case of a received type-2 or type-4 BH RLF indication, buffered PDUs are rerouted by the child IAB node via an alternative path.**

### [11] [R2-2201242](../docs/R2-2201242.zip) Kyocera

Remaining issues of BH RLF Indications for eIAB Kyocera discussion Rel-17

**Observation 1 In EN-DC, Type 2 BH RLF Indication needs to be sent upon SCG RLF (i.e., NR link), since local rerouting cannot be performed via MCG (i.e., LTE link), whereby this scenario does not experience BH RLF from both CGs (i.e., RRC Reestablishment is not initiated).**

**Observation 2 In NR-DC with CP/UP separation, e.g., MCG is only for CP while SCG is for UP, Type 2 BH RLF Indication needs to be sent upon SCG RLF (i.e., UP link) even if MCG is still good, similar to the EN-DC case in Observation 1.**

**Observation 3 The FFS solution “Type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic” is applicable to all the scenarios.**

**Proposal 1 RAN2 should agree that Type 2 BH RLF Indication is sent when at least one route is unavailable upon BH RLF on any link, i.e., when local re-routing cannot be performed, regardless of whether the IAB-node is configured with single connection or dual connection, and also regardless of whether EN-DC or NR-DC.**

**Observation 4 Upon reception of Type 2 BH RLF Indication, the child node can have the option if the “partial” local rerouting is performed for better load balancing (i.e., Option B).**

**Proposal 2 RAN2 should discuss whether the "partial” local rerouting is performed at the child node (i.e., Option B), when its parent in dual connectivity experiences BH RLF.**

**Proposal 3 RAN2 should agree that Type 2 BH RLF Indication indicates the Routing IDs that are unavailable due to BH RLF.**

**Proposal 4 RAN2 should agree that the child node considers the Routing IDs to be unavailable, if these Routing IDs are indicated in received Type 2 BH RLF Indication.**

**Proposal 5 RAN2 should agree that Type 3 BH RLF Indication is sent when at least one route becomes re-available upon successful BH RLF recovery.**

**Proposal 6 RAN2 should agree that Type e BH RLF Indication indicates the Routing IDs that are re-available due to successful BH RLF recovery.**

**Proposal 7 RAN2 should agree that the child node considers the Routing IDs to be available, if these Routing IDs are indicated in received Type 3 BH RLF Indication.**

**Proposal 8 RAN2 should discuss if there is any condition, other than Type 3 BH RLF Indication, for the IAB-node to revert the actions triggered by a previous Type 2 BH RLF Indication, e.g., when the routing configuration is updated.**

**Proposal 9 RAN2 should agree that the propagation of Type 2 Indication to descendant nodes is supported. FFS on detailed condition, e.g., forwarding only if the IAB-node does not perform any local rerouting.**

**Proposal 10 RAN2 should agree to add a Note in Stage-2/3 specifications that the IAB-MT deactivates or reduces SR and/or BSR transmissions when it receives Type 2 BH RLF Indication.**

**Observation 5 The handling of IAB-Support IE is up to IAB-DU implementation, as in Rel-16.**

### [12] [R2-2201301](../docs/R2-2201301.zip) Huawei

RLF indication and local re-routing based on flow control Huawei, HiSilicon discussion Rel-17 NR\_IAB\_enh-Core

**Proposal 1: The terminology of Type-4 indication “BH RLF indication” should NOT be changed in R17.**

**Proposal 2: If RAN2 deems to use “BH RLF recovery failure indication” for type 4 indication, R16 CRs should also be agreed.**

**Proposal 3: For the dual connected IAB-node configured with CP-UP separation, the trigger condition to send type 2 indication on the BH link level should be upon RLF on the CG configured with “F1 over BAP”.**

**Proposal 4: IAB-node may trigger the Type-2 indication upon RLF on any CG.**

**Proposal 5: The granularity of Type-2 indication can include per routing ID level.**

**Proposal 6: When constructing the Type-2 indication BAP control PDU:**

**IAB-node includes the “BH link level” in the triggered Type-2 indication, in case of RRC re-establishment.**

**IAB-node includes the “routing ID level” in the triggered Type-2 indication, in case only some routing ID(s) is not be able to be routed to the next hop (e.g. not being able to be routed due to one CG RLF in NR-DC case).**

**Proposal 7: As in R16, the trigger conditions for type 2/3 will be captured in BAP specification, rather than in RRC, with just some general descriptions.**

**Proposal 8a: IAB-MT with single parent should suspend routing any data to its parent node, upon receiving Type-2 indication on BH link level.**

**Proposal 8b: IAB-MT with single parent should suspend routing data with the indicated routing ID to its parent node, upon receiving Type-2 indication on routing ID level.**

**Proposal 9a: IAB-MT with NR-DC dual parent does not consider the BH link as available for the purpose of local re-routing, upon receiving Type-2 indication on BH link level.**

**Proposal 9b: IAB-MT with NR-DC dual parent does not consider the BH link for the indicated routing ID as available for the purpose of local re-routing, upon receiving Type-2 indication on routing ID level on the BH link.**

**Proposal 10: RAN2 does not support the propagation of Type-2 indication (i.e. child node can trigger type-2 indication based on its own radio condition).**

**Proposal 11: The granularity of flow control feedback triggered local re-routing is per routing ID.**

**Proposal 12: An egress link may be not considered to be available for a BAP routing ID, if it is determined as congested based on the received flow control feedback.**

### [13] [R2-2201306](../docs/R2-2201306.zip) Samsung

RLF indication related issues Samsung R&D Institute UK discussion

**Proposal 1. RAN2 agree that successful transmission of RRCReestablishmentComplete message can trigger type 3 indication to the former parent IAB node which sent type 2 indication.**

**Proposal 2. RAN2 agree that successful transmission of RRCReconfigurationComplete message can trigger type 3 indication to the former parent IAB node which sent type 2 indication when attemptCondReconfig was configured to this IAB node.**

**Observation 1. In the inter donor redundancy case, new routing ID written by header rewriting configuration cannot be understood by the source path topology since new routing ID is configured for the target path topology**

**Proposal 3. RAN2 discuss and conclude the availability of the new routing ID written by header rewriting configuration when local rerouting is executed with this routing ID.**

**Proposal 4. RAN2 discuss the solution and agree one of two: not executing the header rewriting (or fallback to the original routing ID) OR sending type 2 RLF indication to the child node(s).**

**Proposal 5. RAN2 discuss the pros and cons on propagation of type 2 indication, and decide the adoption of type 2 indication propagation feature.**

### [14] [R2-2201349](../docs/R2-2201349.zip) ZTE

Remaining issues on RLF indication ZTE, Sanechips discussion Rel-17

**Proposal 1: Type 2 indication by dual-connected node can be triggered when the node detects BH RLF on any BH and it cannot perform re-routing for affected traffic, so that local re-routing or other actions could be taken at its child/descendant nodes if possible.**

**Proposal 2: There is no need to specify a detailed condition for success of re-establishment, i.e. it could be up to MT implementation.**

**Proposal 3: Type 2/3 indication should be propagated to descendant nodes so that corresponding actions could be taken at descendant nodes, e.g., local rerouting.**

**Proposal 4: BAP routing ID information needs to be included in the type2 indication sent by a single-connected node or a dual-connected node.**

**Proposal 5: BAP routing ID of path that has recovered needs to be included in type 3 RLF indication.**

**Proposal 6: For descendant nodes, if type 2 RLF indication has been sent to child IAB-MT, type 3 RLF indication needs to be transmitted to child IAB-MT after reception of type 3 RLF indication which includes BAP routing ID.**

### [15] [R2-2201388](../docs/R2-2201388.zip) Futurewei

Open Issues for RLF indications for dual-connected IAB nodes Futurewei Technologies discussion

**Observation 1: A BH RLF detection indication (Type-2 BH RLF indication) warns descendant nodes of a transient condition which the IAB node is likely to recover from quickly.**

**Observation 2: To achieve preferential rerouting at an IAB node in response to receiving a BH RLF detection indication, it suffices for the indication to identify which of the parent IAB node’s UL BH links (MCG or SCG BH link) is not available. The IAB donor can configure the routing table of each child to trigger rerouting of specific routing IDs, if needed, in response to the BH RLF detection indication.**

**Proposal 1: RAN2 will minimize the complexity of the BH RLF detection indication solution.**

**Proposal 2: A dual-connected IAB node does not transmit a BH RLF detection indication if all the traffic routed via a backhaul link experiencing RLF can be rerouted via an alternate BH link.**

**Proposal 3: The BH RLF detection indication does not indicate routing ID information of traffic that can not be rerouted by an IAB node.**

**Proposal 4: Both the BH RLF detection indication and the BH RLF recovery indication transmitted by a dual-connected IAB node shall indicate the availability of its MCG and SCG BH links. The details of how this information is reported within the BH RLF indications, and how a child node is configured to react to this information is FFS.**

### [16] [R2-2201468](../docs/R2-2201468.zip) LGE

Resolving open issues on BH RLF indications LG Electronics discussion Rel-17

**Proposal 1: A dual-connected node triggers type-2 indication when if both conditions are met: a) when the node detects BH RLF on any BH and b) it cannot perform re-routing for affected traffic.**

**Proposal 2: Type-2 indication triggered by dual-connected node includes routing ID information indicating which routing IDs are not available.**

**Proposal 3: Type-2 indication triggered by single-connected node does not include routing ID information.**

**Proposal 4: Upon reception of type-2 indication, the node does not propagate type-2 indication, regardless of whether the node has no alternative path available.**

**Proposal 5: Type-3 indication can be triggered no earlier than submission of RRCReestablishmentComplete from RRC to lower layers.**

**Proposal 6: Type-3 indication can be triggered no earlier than a successful CHO to a cell during re-establishment procedure.**

**Proposal 7: Type-4 indication is referred to as “BH RLF recovery failure indication” from Rel-17. No changes to Rel-16 specifications are needed.**

### [17] [R2-2201607](../docs/R2-2201607.zip) Ericsson

On Local Routing and Type 2/3 RLF Handling Ericsson discussion NR\_IAB\_enh-Core

**Observation 1 If IAB Rel-16 mechanism for local re-routing (due to RLF) is adopted for link congestion scenario, then IAB-donor-CU does not need to configure specific alternative egress link to be used for local congestion mitigation.**

**Observation 2 When a dual-connected parent IAB node experiences an RLF in one of the two upstream links, it can perform local re-routing of the traffic from the problematic link to the other available link.**

**Proposal 1 RAN2 agree to adopt the IAB Rel-16 re-routing mechanism for local link congestion case, i.e. the alternative link is selected among the entries in the routing table matching the BAP destination in the BAP header.**

**Proposal 2 RAN2 to ask RAN3 to introduce a threshold on the available buffer size for the purpose of local re-routing, that may be provided by the CU to the IAB node DU.**

**Proposal 3 The IAB node may enable local re-routing if the available buffer size is below the configured threshold.**

**Proposal 4 How to deal with the case in which all links in the DL are congested is left to the IAB node DL scheduler implementation.**

**Proposal 5 Local routing can imply re-routing of congested BH RLC channel ID(s) or of congested BAP routing IDs.**

**Proposal 6 Whether type-2 RLF can be transmitted or not by an IAB node is configurable by the CU.**

**Proposal 7 For a dual-connected parent IAB node, the type-2 RLF should be transmitted to the child IAB node only when both upstream links are unavailable due to BH RLF.**

**Proposal 8 The granularity of the type-2 RLF indication is per BH link, as the type-4 RLF.**

**Proposal 9 If the IAB node performs local routing upon reception of type-2 RLF or BH RLF, Rel-16 re-routing principles are used, i.e. the alternative link is selected among the entries in the routing table matching the BAP destination in the BAP header.**

**Proposal 10 A received type-2 RLF is not propagated.**

**Proposal 11 Specify in the stage-2 and BAP specification that the type-3 indication is transmitted upon successful BH RLF recovery.**

### [18] [R2-2201644](../docs/R2-2201644.zip) InterDigital

On BH RLF indications in IAB InterDigital discussion Rel-17 NR\_IAB\_enh-Core Late

**Observation 1: Even if one of the backhaul links of a dual connected IAB node is functioning well, the IAB node may not be able to re-route the packets that were mapped originally mapped to the link being recovered.**

**Proposal 1: A dual connected IAB node will send a type-2 RLF indication to a child node upon detecting an RLF on the MCG or SCG link, if any destination BAP routing ID that is mapped to the failed link can not be rerouted via the other functioning link.**

**Proposal 2: Type-2 RLF indication may include information regarding the impacted destination BAP routing ID(s). If no such information is provided, child nodes will assume that all destination BAP routing IDs are not temporarily routable via the IAB node that sent the type-2 indication.**

**Proposal 3: A node receiving a type-2 RLF indication may propagate the indication further to a child node, if it is not able to reroute packets via an alternate link/path.**

**Proposal 4: The propagation of type-2 RLF indication is network configurable.**

**Proposal 5: A node that has sent a type-2 RLF indication will send a type-3 indication to child nodes upon sending one of the following messages to a target cell:**

* **RRCReestablishmentComplete**
* **RRCSetupComplete**
* **RRCReconfigurationComplete**