**3GPP TSG-RAN WG2 Meeting #109e-bis R2-2003813**

**Electronic meeting, April 20 – April 30** *Revision of R2-2003775*

**Agenda item:** 6.1.6

**Source:** Qualcomm Incorporated (Rapporteur)

**Title:** Report email discussion [Post109e#36][IAB] RLF Handling Open Issues

**Document for:** Discussion

# Introduction

This document handles email discussion:

* [Post109e#36][IAB] RLF Handling Open Issues (Qualcomm)

Scope: Progress RLF handling Open Issues. See also Open Issue list distributed by WI rapporteur. In particular, RLF notification for IAB-node in ENDC, and Reestablishment at former descendant nodes (SA only).

Intended outcome: Solutions, agreeable CR//TP.

This email discussion has two phases:

**Phase 1: Discussion on behaviour and signalling**

**Deadline April 1 23:59 Pacific Time**

**Phase 2: Generation of CR/TP capturing potential agreements from Phase 1.**

**Deadline April 8 23:59 Pacific Time**

# Phase 1: Discussion on Behaviour and Signalling

Phase 1.1 RLF notification for IAB-node in ENDC

This was addressed in a few contributions to last meeting. The rapporteur believes that there is no need for RLF notification in ENDC scenario for the following reasons:

* RAN2 agreements:

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| * + *Current UE RLF detection and recovery is reused as baseline*   + *The IAB-donor CU controls IAB-node migration as baseline.* |

* Implications from these agreements:
  + In ENDC, the IAB-node has CP to the CU via LTE/X2 even if NR connectivity deteriorates. Therefore, in case BH RLF occurs on the IAB-nodes SCG link, it can be assumed that the CU is aware of the situation but not able to migrate the node to a different parent.
  + At this point, the descendant nodes still have CP connectivity to the CU, and therefore, based on the above agreement, the CU controls their migration to new parent nodes.
* For these reasons, RAN3 has defined the BH RLF recovery procedure only for SA (R3-201363).

**If you see a logical flaw in this analysis, please explain in detail why RLF notification is needed for ENDC and under what conditions it should be sent.**

***NOTE: This is not an opinion poll. Likes/Unlikes are appreciated but will not be considered without proper reasoning.***

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| **Company** | **Comments** |
| **Huawei** | cid:image001.jpg@01D600F8.5FF528C0  Scenario 1  **Scenario** is the EN-DC case where IAB node uses NSA mode. The example case is the RLF recovery failure between IAB1 and SN donor.  Followings descript the issue if we do not support the RLF notification from IAB1 to IAB2:   * After IAB1 SCG recovery failure, SgNB/donor is aware of this situation; * SgNB can identify the need of migrating IAB2 to a new parent, rather than MeNB; * SgNB could initiate the SCG changing procedure for IAB2. But, MeNB would not initiate the SCG changing procedure, since it is not aware of the need. * But, SgNB may not have the latest measurement result from IAB-2-MT, since no SCG failure report is triggered at IAB2. Without proper measurement result to find the target cell, SgNB is not able to migrate IAB2 to new parent via RRC. * Then, the only choice for SgNB is to directly release SCG for IAB2.   Please note above consequences, once not supporting RLF notification in NSA case. It is very illogical that we support the BH link recovery of child node in SA, but directly “give up” the BH link of child node in NSA. BTW, since we already supported the BH RLF notification in BAP, is there any essential issue to apply it to EN-DC?  Scenario 2  Also, in another scenario2, IAB-1 uses the NSA mode, but IAB-2 uses the SA mode without LTE link.  In this scenario, after IAB1 SCG recovery failure, the only connection between SgNB and IAB2 is lost. The only way to trigger IAB2 migrating to a new parent node is the RLF indication sent from IAB1. |
| **CATT** | **We do not see a critical issue in what the Rapporteur described. Our understanding is in the following**  **First of all, this is already very late stage of the WI, so we do not see a need to introduce new BH RLF notification type than ‘recovery failure’.**  **Then, to send ‘recovery failure’ to the decedent node upon RLF detection for NSA (i.e., option 1 in the discussions) just propagates the ‘recovery failure’ to all the decedent nodes (assuming they are all configured with ENDC or SA) , regardless of the likelihood of finding another IAB parent node quickly. As a result all the decedent nodes do re-establishment. This seems not very efficient.**  **And, in our understanding the main difference between option 1 and 2 is about a compromise between achieving lower recovery latency (option 1) and avoiding unnecessary reestablishment for the decedent nodes (option 2). Availability of measurement reports at the IAB-donor might not be an big issue here as periodic report can be configured.**  **Last but not least, in practice OAM configuration can be used to provide an IAB node a list of candidate in case of reestablishment. This means that the likelihood of not being able to find an alternative IAB donor in Scenario 1 is not very high.** |
| **Samsung** | Since IAB MT will follow the UE's operation as much as possible, once SCGFailureInformation procedure is triggered (i.e, by SCG RLF in the example), gNB (and finally MN) will command whatever it wants, i.e., Pscell change or SCG release.  If the topology is same as depicted in Huawei’s figure, i.e., there is no alternative parent nodes but IAB node 1, donor gNB knows this (by collected measurement result and topology information maintained) and it can command to both IAB-node 1 (release) and 2 (pscell change).  This can be done without BH RLF notification to the child node.  For the concern from Huawei on staleness of the measurement result seen at IAB node 2, there could be some delay since reception of SCGFailureInformation msg from IAB node 1 (gNB can know IAB node 2 needs migration) and obtaining new meas results from IAB node 2 will take some time (gNB will configure new meas config to IAB node 2 upon receiving SCGFailureInformaiton from IAB node 1). But I think this isn’t too long for the migration.  But MCG has failed, i.e., re-establishment failed, then there should be BH RLF failure notification down to the child node, which is agreement in SA case. This also could be applied in NSA. |
| **Lenovo&MM** | For Scenario1:  Once RLF on SCG link, SCGfailureinformation is reported by IAB1 to MN. According to 37.340 (7.7), ‘*In all SCG failure cases, the UE maintains the current measurement configurations from both the MN and the SN and the UE continues measurements based on configuration from the MN and the SN if possible. The SN measurements configured to be routed via the MN will continue to be reported after the SCG failure.*’ Therefore, SN still can get the latest measurement result if wants.  For Scenario2:  According to legacy specification, IAB2 will perform re-establishment after RLF happens on IAB1. If RLF notification is sent by IAB1 to IAB2 in time, it can reduce the latency to trigger re-establishment. But, we have not discussed this topology. I suggest that we can focus on the critical issue rather than optimized issue at the later stage. |
| **Nokia** | To us, the implications of the agreements are not captured properly. When BH RLF occurs, then there is CP connectivity (RRC) to Donor CU from both IAB node experiencing RLF and its descendant nodes. Furthermore, we cannot assume F1-C is using LTE leg, so there actually may be loss of F1-C connectivity. As long as there is RRC connectivity on LTE leg there seems to be no major issue. As agreed previously, in case BH link fails, IAB-MT would send SCG failure notification to the MeNB and MeNB would pass the information to SgNB (Donor), which would take the appropriate actions, e.g. configure a new SCG, move the descendant nodes to other parents if needed etc.  We do not think that the out of date measurement report is a real issue we need to address. Those are fixed nodes, so the measurements would not get outdated very often. The network may configure periodic reports if it wants to. Another way is to simply reconfigure the measurement configuration upon receiving SCG failure from the affected node.  We do not think we should address NSA/SA mixed scenarios at this stage as they are very unlikely to happen in any real deployment. |
| Futurewei | We agree that Huawei has raised a valid issue. However, similar to the views of Nokia and Samsung, we think this is unlikely to be a very serious issue for fixed IAB nodes, as the timeliness of measurements may not be so critical. Optimizations are of course possible, but we don’t view this issue as a showstopper.  As far as the agreements highlighted by the rapporteur, we don’t really see any problem to be addressed. There is no reason why RLF notification should not be sent in the ENDC case, as well as the SA case, whenever the appropriate triggering conditions are met. |
| **LG** | For the scenario1, we think that donor CU can take a proper action to migrate the IAB2 using LTE-tunneled RRC signaling, upon detecting the problem on the IAB1’s backhaul. If the donor wants to accelerate the migration, it can choose to a-priori configure the IAB2 to provide periodic measurements.  For the senario2, IAB1’s backhaul failure would be eventually detected by IAB node2 itself only after experiencing repetitive transmission failures. This outcome seems somehow unfortunate in that the bad new propagates too late. However, we do not see any a compelling reason to optimize RLF notification mechanism only for this particular deployment at least in R16. Rather, we would like to enhance RLF notification mechanisms targeting more generic scenarios in R17. |
| **ZTE** | Following the behaviour of UE in EN-DC, when an IAB node MT detects SCG RLF, it may report SCG failure to eNB and then eNB conducts SN change, PScell change without SN change or even SN release procedure for IAB node MT. It is not necessary for the IAB node MT to perform RRC re-establishment procedure, let alone the “RLF recovery failure (i.e., RRC re-establishment failed)” status. So it is not possible for the IAB node DU whose collocated EN-DC IAB node MT detects SCG RLF to send “RLF recovery failure” indication to its child IAB nodes. Instead, IAB node DU may only transmit the status of “RLF is detected” or other status indication to child IAB nodes.  Suppose the SN release is performed and IAB node is no longer connected with IAB capable SCG node, it shall no longer work as DU. The previously connected child IAB node anyway could detect this and then perform re-establishment correspondingly.  Based on the above observation, it is suggested not to consider the RLF notification for EN-DC scenario. |
| **Intel** | We are sympathetic to Huawei’s view. In addition to the issue of unavailability of timely measurements mentioned by Huawei, the scenario where different IAB nodes connect differently with respect to SA or NSA is important.  Some, but not all, IAB nodes may be operating in NSA mode (I assume there is nothing that precludes that). In fact, that may be an important deployment scenario – to enable IAB node placement deep indoors. If an SA IAB node is a child of an NSA IAB node, and the NSA IAB node experiences a backhaul failure, it is necessary to have the failure indication from the NSA IAB node to the SA IAB node.  While this is the technically correct approach to take, we recognize that it is late in the WI if this implies a significant change. We should asses the modifications required to support this; if the group feels that this is a large change, it can be postponed to Rel 17. |
| **vivo** | Agree with the comments from CATT, Samsung and Lenovo.  Some further comments regarding the measurement delay. As in Rel-16, the IAB nodes are assumed to be static and neighboring relationship does not change often. The CU can configure an IAB node to measure the neighboring IAB nodes at any time when the backhaul link is in good condition and base on these measurements to select to target donor node once *SCGfailureinformation* has been perceived.  In such sense, a good implementation can avoid measurement delay. |
| **Sony** | We also don’t see it as critical issue. For scenario 1, gNB CU is aware of the topology and if IAB1 link fails, SgNB can take action for IAB2 as well. We don’t understand why MeNB would ignore the SgNB request and even if it does then SgNB can release IAB2 which MeNB can not ignore. It’s a long procedure because IAB2 will go via IDLE but covers up a bad MeNB implementation.  For scenario 2, we think link keep alive messages are enough to detect the link failure |
| **Sharp** | Need of BH RLF notification depends on whether it is necessary for a descendant node to recover/maintain IAB functionality. For Scenario 1, since CP is still connected, CU can take whatever it should take (e.g. handover to another node) when receiving SCGFailureInformation. So, we do not think the BH RLF notification is absolutely necessary. For Scenario 2, we are not sure if this is under the current scope. |
| **AT&T** | As noted in the comments so far, the impact of not having the BH RLF notification can vary a lot depending on the assumed eNB/gNB implementations and network configurations and this applies for both SA and NSA scenarios. Therefore we think it is the safest option to keep BH RLF notification mechanism as a potential tool for both SA and NSA scenarios unless there is a significant technical hurdle to overcome and this also helps to keep the designs aligned as much as possible. In addition, the mixed NSA/SA scenario should not be precluded as this can be a viable deployment in certain cases as also pointed out by Intel. |
| Kyocera | We think there is the issue as Huawei described, but the major problem can be avoidable by implementation in Rel-16, i.e., assuming fixed IAB node.  On the other hand, RAN2 agreed that “*For DC case, the IAB-node considers the radio link is failed and uses RRC existing or Rel-16 Mechanism (e.g. MCG or SCG failure report, RRC reestablishment) if “Recovery Failure” notification is received from parent nodes on MCG-link or/and SCG-link.*” We think it can be simply applicable to NSA deployment and still work for e.g., failsafe in MCG link lost. As BH RLF Notification is the BAP functionality, we don’t see the reason to make the BAP to be aware of the deployments, i.e., NSA or SA, but the BAP just triggers the “recovery failure” notification when RLF recovery is failed. We think there is no significant issue to have the common solution for NSA and SA. |
| **Ericsson** | First, we agree with the comments from some of the companies above that the mixed SA/NSA scenario is a corner case.  Second, for the first scenario where the child node is also connected via EN-DC, the donor CU can still send F1-AP messages to the child node via the LTE leg, even if the NR leg of the parent is lost. For the second scenario where the child node is connected via SA NR, even though there is no F1-AP connectivity via LTE to it, the donor can still send an F1-AP message to IAB-1 that contains an RRC message to the MT of IAB-2, so the donor can still trigger HO of IAB-2. |
| **NEC** | As specified by CATT, we are in the late stage of the WI, it is not a wise idea to introduce more functions for IAB. And we have made decision that in the beginning of the WI, the SA scenario is prioritized, and the EN-DC scenario is de-prioritized. And since RAN3 has agreed that only RLF is considered for SA scenario, so RAN2 should not introduce more feature for EN-DC. |

Summary:

A few companies mentioned that based on RAN2 agreements, RLF notification can be sent in ENDC case if both MCG and SCG have RLF. Rapporteur acknowledges that this is the case and it does not need any further discussion.

Apart from this aspect, two scenarios were identified where issues may arise:

**Scenario 1:** IAB-node and child-node both use ENDC. In this case, companies feel that existing procedures are available that allow MeNB and CU to handle the procedure. However, the child-node’s measurement report may be stale when IAB-node has RLF.

**One** company believe that staleness of the measurement report justifies RLF notification.

**Eleven** companies believe that staleness of measurement reports is not an issue, not a showstopper, would not improve on latency in the migration of the child IAB-node, or does not need further discussion for other reaons.

**Two** companies do not address the measurement staleness issue.

**Rapporteur’s view:**

The vast majority of companies does not see measurement staleness is a sufficiently relevant issue for further discussion.

Even if measurement staleness was an issue, it is not obvious if the present RLF notification would be a remedy. Based on feedback by many companies, such potential measurement staleness could be addressed by configuration of measurement report or OAM configuration of alternative candidates.

* No further action is taken on Scenario 1 in Rel-16.

**[Note after closure of email discussion] Ericsson’s comments were not included in this summary by accident. NEC’s comments were not included in this summary since they arrived after the PH1 deadline. The rapporteur’s view above, however, is in line with both companies’ comments.**

**Scenario 2:** IAB-node uses ENDC and has RLF while child-node uses SA. In this case, the child node has no other means to learn about the parent’s RLF than through RLF notification.

**Three** companies believe that this scenario should at least be discussed in Rel-16.

**Four** companies have doubts or believe that mixed SA/ENDC is not in scope for Rel-16.

**Seven** companies do not even comment on scenario 2.

**Rapporteur’s view:**

Only a few companies believe that the mixed ENDC/SA scenario might be relevant. The vast majority of companies does not see this matter to be in scope for Rel-16, has doubts or is simply not interested.

* No further action is taken on Scenario 2 in Rel-16.

**[Note after closure of email discussion] Ericsson’s comments were not included in this summary by accident. NEC’s comments were not included in this summary since they arrived after the PH1 deadline. The rapporteur’s view above, however, is in line with both companies’ comments.**

Phase 1.2: Behaviour of IAB-DU after BH RLF declaration

We have not discussed the expected behavior of the IAB-DU after BH RLF declaration. At this point, the IAB-node MT starts BH RLF recovery procedure and has no BH connectivity. The IAB-DU must still be able to send DL RLF notification in case the BH RLF recovery procedure fails.

The following options may be considered:

**Option 1:** IAB-DU continues normal operation as possible (e.g. DL transmission of buffered data, sending UL grants until receive buffer is full). The details would be up to implementation.

**Option 2:** Certain restrictions are specified, e.g., blocking idle UEs/IAB-MTs from (re-)selecting this cell, blocking of connection attempts, others.

**Option 3:** Up the RAN3.

**Please provide your view on the behavior of the IAB-DU after BH RLF declaration.**

***NOTE: This is not an opinion poll. Likes/Unlikes are appreciated but will not be considered without proper reasoning.***

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| **Company** | **Comments** |
| **Huawei** | Both option 1 and option 2 can be left as IAB implementation. |
| **CATT** | **Option 1. We do not see a need for specified behavior.** |
| **Samsung** | **First, there could be possibly 3 stage in time, as below:**   |  |  |  |  | | --- | --- | --- | --- | | stage | 1 | 2 | 3 | | MT state | normal | MT RLF declaration & RRE execution | MT RRE failure(going IDLE) | | DU state | Normal DL/UL | Normal DL/UL | Shut down, i.e., no Tx |   **We think, the question is on stage 2, i.e., RLF is declared but RRE success/failure is not decided. In this case, we think option 1 and 2 all are possible. But if the question includes stage 3, then stage 3 will have shut down of DU (no Tx of any physical channel)** |
| **Lenovo&MM** | Option1, it can be left for implementation, e.g stop SI, stop DL/UL. |
| Nokia | We think it would be worth considering other types of RLF notifications to be sent, for example as proposed in R2-2001056 (i.e. BH RLF recovery ongoing and BH RLF recovery successful). These would require to be captured in BAP / RRC specifications. Other than that, we do not see any of the actions mentioned in option 1 or option 2 would require to be captured in specifications. It would be up to IAB node implementation whether to apply these or any other actions allowed by the standard currently. |
| Futurewei | Some actions, as proposed in Option 2, to restrict/limit the behavior of other nodes/UEs seem reasonable. However, we don’t see a strong need to define the actions of the DU in the specification. Such actions, if useful, can be left to implementation. Therefore, we believe that it is sufficient to leave IAB-DU actions in case of RLF up to IAB node implementation. |
| LG | We prefer option1 with the following clarification: IAB-DU *“may or may not”* continue its normal operation, i.e. purely up to implementation. |
| ZTE | Agree with Huawei and Nokia, actions in both Option 1 and Option 2 can be up to IAB node implementation. |
| Intel | We think option 2 is the desired behavior (i.e., UEs, other MTs don’t attach when a node has experienced backhaul failure recovery). To what extent this is specified can be discussed (e.g., we could simply have a note somewhere saying UE/MT access is blocked if BH link is broken at the IAB node). |
| **vivo** | **Option 1 and option 2 are both agreeable, but these IAB DU behaviors can be left for implementation.**  **Some further comments：**  **Further for Option.1, it can be understood that the IAB node which has detected the RLF failure to its parent IAB link can continue the DL transmission.** |
| Sony | We think option 1 is sufficient. |
| Sharp | Agree with Nokia. |
| AT&T | There can be different scenarios where either Option 1 or Option 2 may be the preferred mode of operation, so leaving the DU behavior up to implementation seems to be the best option for Rel-16. However as pointed out by Nokia, if additional BH RLF indication types are considered in a future release, there may be more motivation for specifying DU behavior in these scenarios. |
| Kyocera | We appreciate the three stages that Samsung provided for clarification and also assume the question discusses the stage 2 since RAN2#107bis already discussed the stage 3 aspects resulting in agreements with the “recovery failure” notification. We think the certain actions is needed to restrict the UE behaviour as Option 2 mentioned; In addition, for the UEs/IAB-MTs in RRC Connected, the UL transmissions (e.g., SR) should be suspended in order to avoid unnecessary interference and power consumption. To support these actions, we agree with Nokia that it’s worth considering the other types of BH RLF notification (such as BH RLF detected and BH RLF recovered) as also proposed in R2-2000516. On the other hand, the DU behaviour can be described with “may” as similar with the current statement in section 5.4.1 of TS 38.340. |
| Ericsson | We agree with Nokia that the other RLF notification types (e.g. Type2: trying to recover, Type 3: BH link recovered) that were discussed in previous meetings will help with that. What the IAB DU does (e.g. like option 2 where it can block idle UEs from camping, or not giving UL grants to connected child nodes/UE, etc.) could be left up to IAB implementation. |
| NEC | Option 2. Upon the reception of RLF notification, this IAB node should not serve both UE/IAB MT, as it doesn’t have valid UL path. So there should be some restrictions for DU, further details can be discussed by contribution. |

Summary:

While companies addressed the technical aspects (option 1 vs. option 2, other solution), the discussion was more about implementation vs. specification.

**Ten** companies believe that this issue should be left up to implementation and no specification would be required.

**One** company discusses potential implementation impact (stage 2 vs. stage 3)

**Two** companies do not address if specification is necessary.

**Rapporteur’s view:**

The vast majority of companies believes that this can be left up to implementation

**Proposal 1: IAB-DU behavior after RLF declaration is left up to implementation.**

**[Note after closure of email discussion] Ericsson’s comments were not included in this summary by accident. NEC’s comments were not included in this summary since they arrived after the PH1 deadline.**

**Two companies proposed to consider further signaling enhancements, e.g., “trying to recover”, “recovered”.**

Phase 1.3: Reestablishment at descendant nodes

The IAB-node, which has declared BH RLF, should *not* perform reestablishment attempts at its own descendant nodes *unless* they have an alternative path. However, since RLF notification is not sent to the child nodes before BH RLF recovery has failed, the descendant node does not know about the upstream RLF condition and appears to operate normally.

The following options should be considered to avoid reestablishment attempts at a descendant node

**Option 1:** Pre-configuration of potential recovery nodes, e.g., using CHO.

**Option 2:** Additional DL indications for declaration and revocation of BH RLF.

**Option 3:** Configuration of IAB-node with downstream topology.

**Option 4:** Nothing needed since RRC Reestablishment will fail if there is no BH connectivity.

**Please provide your view on the reestablishment at descendant nodes:**

***NOTE: This is not an opinion poll. Likes/Unlikes are appreciated but will not be considered without proper reasoning.***

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| **Company** | **Comments or other issues** |
| **Huawei** | We see no issue here. Only if the descendant node has the BH connection to CU, it will present the *iab-Support* indication in SI. Otherwise, the IAB will be barred by its descendant nodes. |
| **CATT** | **No critical issue here. If there is any issue with possible topology loop, we think it can be handled via OAM configuration, i.e., the IAB node is provided with a list of ‘proper’ candidate parent node.** |
| **Samsung** | **Option 1 is thought to be good way since CHO is already used for normal UE on HOF /RLF case. Since all the IAB nodes have the same CU as donor CU, there is even no inter node signaling between source cell and target cell. But need to discuss more detail.**  **Regarding Huawei’s comment, In our understanding, since SIB1 is made at DU even without CU’s signaling, once iab-support is broadcasted in SIB1, then there will be the same broadcasted. So parent node in RLF can select the child node.**  **For the CATT’s comment, this given list anyway need to be evaluated at cell selection phase (the first stage of re-establishment procedure) by checking PCI. However we wonder if the stored information for cell selection can include the specific PCI list ? As we know the stored information could be the frequency, and cell parameter like SMTC information used for measurement in normal case, or in detected cells previously. These information is not enough to exclude specific cells in descendant IAB nodes.** |
| **Lenovo&MM** | For option1:  The question is associated with ‘after RLF’. That means option1 is CHO based re-establishment. Namely, after RLF happens, IAB-MT starts T311 and performs cell selection. If the selected cell is CHO cell, perform CHO. Otherwise, IAB-MT performs re-establishment.  According to the legacy CHO, the candidate cell during cell selection is not limited to CHO cell. Therefore, if option1 is applied, the descendant node is still possible to be selected for re-establishment purpose.  We prefer to option4. If IAB with RLF performs reestablishment attempts at its own descendant nodes, the failure will happen anyway. |
| **Nokia** | **The IAB-MT of the failed node is performing cell selection and it could be provided with a list of eligible alternative parents with OAM. This could be left to UE implementation.**  **Also option 1 is possible according to the latest agreements in the Mobility WI (Agreement in RAN2#107bis)**  1. Confirm the working assumption as an optional feature:  At RLF/HO failure/CHO failure, the UE performs cell selection and if the selected cell is a CHO candidate then the UE attempts CHO execution, otherwise re-establishment is performed.  If the CHO performed during failure handling procedure fails, the UE will perform re-establishment, i.e. we do not allow multiple attempts of CHO during failure case.  **Solution described in option 2 is also interesting as we mentioned in our answer to the previous question. For example, it can be used as a guidance to the descendant nodes that they need to consider that the upstream node is not operational, at least temporarily. However, we are not sure how this helps in preventing the IAB node experiencing BH RLF to avoid reestablishing at its descendant nodes.** |
| Futurewei | Agree with the comments from Nokia and CATT, in that the IAB node should be provided with a “white list” of eligible alternative parent nodes to limit potential reestablishment candidates in case of BH RLF. This approach is both flexible and robust. Providing this list via OAM seems like a reasonable approach and would also have the advantage of avoiding the introduction of additional signaling at this late stage.  As far as using CHO for this purpose, this does not seem appropriate or sufficient, since as Lonovo/MM pointed out, this does not guarantee that a descendant node will not be selected if the CHO fails.  Option 2 does not appear to address the issue, and hence does not provide a solution. We can exclude this one.  Option 3 seems to be overkill. Also, it would seem that we would have to agree on how to represent and signal the topology to the IAB node, not to mention specifying how the IAB node uses this topology information to choose a candidate for reestablishment. Therefore, we do not prefer this approach. |
| **LG** | Introducing some autonomous but controlled topology adaptation mechanism, e.g., kind of CHO, may give some benefit, but this requires thoughtful analysis and intensive discussion. We believe we should focus on finalizing this WI and hence defer the discussion on topology adaptation optimization to R17. For this reason, we think option4 should be sufficient for R16. Option3 is always possible and can be considered as option4 category from RAN2 point of view. |
| **ZTE** | We think option 1 is feasible where the IAB node MT might be pre-configured with a cell list for potential re-establishment. The cell list should exclude the descendant node. The details can be further discussed. |
| **Intel** | The issue of potential attachment to a child node is not specific to the RLF scenario. It can happen even when an IAB node reselects. It is necessary to have means to avoid such invalid topologies. In such scenarios, a blacklist would make more sense (i.e., which nodes to not attach to).  However, given the late stage of the WI, we think this will need to be handled in Rel 17. For now, we may have to live with option 4. |
| **vivo** | **No critical issue. But, we think there should not be a hard restriction on whether an IAB node can access its previous child IAB node or not.** |
| **Sony** | A pre-configured cell list is needed so that IAB node does not select a downstream node after RLF. However, considering it is very late for Rel-16, we can rely on OAM based solution during IAB setup. |
| **Sharp** | We proposed Option 2 in our contribution R2-1915766. Option 2 should be combined with a recipient of the DL notification immediately changing the *iab-Support* status in SIB1.  Option 1 is also interesting. However, if we go with Option 1, we need to make sure that upon a topology change the pre-configuration gets updated at every affected IAB-node in a timely manner. In this case, Option 1 may become similar to Option 3 (if we understand Option 3 correctly).  As mentioned by other companies, CHO will not provide a complete solution as it involves a cell selection anyway when CHO fails. |
| **AT&T** | Leveraging the Rel-16 CHO solution would be ideal as it allows the CU to manage the topology adaptation without relying on a list of cells (re)configured by OAM. |
| Kyocera | Regarding Option 1, we also think it’s one promising way that OAM provides the “white list” as mentioned by CATT, Nokia and Futurewei. We also wonder if the IAB donor can provide a “black list” to avoid the descendant nodes in cell selection for RRC Reestablishment. For example, as similar with the Next-Hop BAP Address in BH Routing Configuration, the IAB donor may only provide a “next-hop Cell ID” together with the routing configuration which is adaptive for topology changes. We don’t think the way with CHO for this purpose can solve the issue as Lenovo pointed out.  Regarding Option 2, we assume it’s a kind of “other types of BH RLF Notification” but we’re not sure how such a DL indication can solve this issue.  Regarding Option 3, we assume it’s one of possibility to configure with the “black list” as we mentioned in Option 1 above.  Regarding Option 4, we think it’s true that the RRC Reestablishment to the descendant node is failed at the end, but it takes more time before the failure, e.g., from the preamble ramping to unsuccessful Msg4. |
| **Ericsson** | In our understanding, all options (i.e., 1, 2 and 3) are viable, but will all require further work we think RAN2 will not have time to finalize all the needed details within the Rel-16 time frame. |
| **NEC** | I think in this special scenario, we can leave it to IAB implementation. If the IAB node encounters RLF to its parent node, it should send RLF notification to its child node. And it can disconnect the connection to all its child nodes, and try to re-establish a new RRC connection at one of its child node, as the child node of its child node. |

Summary:

The following technical comments were made on options 1 to 4:

* **Option 1:** Pre-configuration of potential recovery nodes, e.g., using CHO.

It was pointed out, however, that cell selection was not limited to CHO candidates, and therefore, CHO would not completely solve the problem. Nevertheless, there was support for this option since it is off-the-shelf and at least alleviates the problem.

* **Option 2:** Additional DL indications for declaration and revocation of BH RLF.

Some companies had doubts that this option would solve the problem. One company pointed out that upon reception of the RLF indication, the child would have to remove IAB-support indicator in SIB so that the DU is not selected as parent.

* **Option 3:** Configuration of IAB-node with downstream topology.

There was little support for this option. Some companies pointed out that it had some similarity to option 1.

* **Option 4:** Nothing needed since RRC Reestablishment will fail if there is no BH connectivity.

There was support for this option especially since it does not require any further work.

Other options proposed

* **Option 5:** OAM-based solution

The rapporteur stresses that this is not a viable option when the CU manages the topology. In this case, the OAM has no clue about the IAB-node’s sub-topology. Therefore, this option will not be considered.

Several companies stressed the urgency for timely completion of the WI, and to move further topology adaptation issues to Rel-17.

**Rapporteur’s view:**

Many companies were in favor of options 1 and 4. These options do not require any specification effort. There was not enough support for any other option. The topic can be discussed again in Rel-17.

No further action is taken on this topic in Rel-16.

**[Note after closure of email discussion] Ericsson’s comments were not included in this summary by accident. NEC’s comments were not included in this summary since they arrived after the PH1 deadline. The rapporteur’s view is pretty much in line with these two companies’ views.**

Phase 1.4: Other aspects related to BH RLF

**Please provide comments if other BH-RLF-related aspects need to be considered which have not yet been discussed:**

|  |  |
| --- | --- |
| **Company** | **Comments or other issues** |
| **Samsung** | **We remember there was a discussion regarding cell selection restriction, i.e., after RLF (or any RLF specific recovery failure), MT will do RRC re-establishment including cell selection. Since Rel-16 IAB doesn’t have inter-donor gNB mobility as objective, we wonder how to restrict that the selected cell is under the same donor gNB.** |
| **Lenovo&MM** | The following has been agreed in RAN2#107bis meeting. We suggest RAN2 to confirm that fast MCG link recovery can be reused in IAB system.   * + - The following is agreed as working assumption: BH RLF recovery for DC case reuses UE’s MCG and SCG failure recovery procedures specified in Rel-16.   **The fast MCG link recovery procedure is as follows:**  If RLF is detected for MCG, and fast MCG link recovery is configured, the UE triggers fast MCG link recovery. Otherwise, the UE initiates the RRC connection re-establishment procedure.  During fast MCG link recovery, the UE suspends MCG transmissions for all radio bearers and reports the failure with *MCG Failure Information* message to the MN via the SCG, using the SCG leg of split SRB1 or SRB3.  If SRB3 is used, *MCG Failure Information* message is encapsulated in NR RRC message *ULInformationTransferMRDC,* which will be transferred from SN to MN.  Upon reception of the MCG Failure Indication, the MN can send *RRC reconfiguration* message or *RRC release* message to the UE, using the SCG leg of split SRB1 or SRB3.  If SRB3 is used, *RRC reconfiguration* message (or *RRC release* message) sent by MN is encapsulated in NR RRC message *DLInformationTransferMRDC,* which will be transferred from MN to SN using Xn interface.  It was agreed that split SRB is not supported in IAB system. Therefore, SRB3 should be configured for fast MCG link recovery. For Rel-16 IAB, IAB with DC is restricted to access to one IAB donor. That means both MN and SN share one CU in Rel-16 IAB.  Therefore, *MCG Failure Information* message sent by IAB node (SRB3) is unnecessary to be encapsulated in NR RRC message *ULInformationTransferMRDC since no Xn interaction is needed.* Similarly, *RRC reconfiguration* message (or *RRC release* message) sent by MN (SRB3) is unnecessary to be encapsulated in NR RRC message *DLInformationTransferMRDC.*  We need to discuss whether *MCG Failure Information* message (response message) should be encapsulated in *ULInformationTransferMRDC (DLInformationTransferMRDC)* or not if SRB3 is used in fast MCG link recovery. |
| **Nokia** | We think the problem mentioned by Samsung can be solved by implementation and OAM configuration of IAB-MT.  We agree with Lenovo fast MCG recovery can be reused by IAB, but we do not see any IAB specific issues to be solved. The details of the solution should be sorted out in DCCA WI. We also do not think we agreed that IAB-MT cannot support split SRB and there is nothing that would prevent this. |
| Futurewei | Agree with Nokia’s comment. The issue raised by Samsung can be addressed by configuration of the IAB-MT with a “white list” of eligible alternative parent nodes to limit potential reestablishment candidates in case of BH RLF. By simply not including cells of another donor gNB in this list, the issue of selecting to a cell of another donor can be avoided.  If we go with the OAM configuration proposed by CATT in their response to 1.1, this can be addressed completely by implementation. |
| ZTE | For DC scenarios, when the donor CU acquires the SCGFailureInformation from a IAB node, it can only know one of its parent IAB DU cannot provide service, but it cannot know whether the IAB node detects RLF or the parent IAB DU of the IAB node detects RLF. Then it is hard for the donor CU to re-configure or update the routing information via the other link. We need to discuss whether to enable the donor CU to know who initially detects RLF.  In addition, we think that it is necessary to discuss whether to support other types of RLF notifications. For example, Type 1 or Type 2 RLF indication(i.e., the status that RLF is detected and recovery is ongoing) is helpful for the child IAB node since the child IAB node can make preparation for potential RRC re-establishment, such as early measurement of neighboring cells when Type 1 or Type 2 RLF indication is received. |
| Kyocera | We think Samsung’s issue is valid, i.e., inter-CU mobility is not supported in Rel-16. On the other hand, we’re not sure if RAN2 should strictly restrict it or leave it to OAM. But at least, we wonder if the IAB node should notice whether it accidentally connects with different CU, e.g., for F1 re-setup.  We also think it’s worth considering the other types of BH RLF Notifications as ZTE pointed out and we commented on Phase 1.2 above.  As captured in TR 38.874 and some discussion above, we think CHO is configured with IAB nodes for more robustness of topology. In this case, we think CHO should be also executed if IAB node receives the BH RLF Notification (i.e., “recovery failure”) from its parent. We think it’s a kind of optimization, but simple and effective especially in case the parent still transmits SSB as proposed in R2-2000516. |
| Ericsson | About the issue raised by Samsung (how to ensure MT re-establishes only to the cells that are controlled by the same donor gNB), we agree with Nokia/Futurewei that it can be left to implementation/configuration.  With regard to the comment from Lenovo, our understanding is that split SRBs are still supported for the IAB-MT if it is connected in DC mode. What we agreed not to support is to have split bearer like operation at the backhaul channels, because there is no PDCP termination at the IAB nodes for those. However, for the IAB-MT, PDCPs of SRB1 is terminated at the IAB node, and as such spit SRB is can be supported.  As we mentioned in the comments to earlier questions, and also ZTE has pointed out, having type2/3 BH RLF notifications will greatly help in preparing the child nodes for finding an alternate path/node in a fast way and also prevent/minimize UL packet loss/delay (e.g. if the parent IAB node keeps giving grants to its children and receiving UL data while it is trying recovery, but then fails to find an alternate path). |

Summary:

The following aspects were identified:

* RLF recovery at same vs. different IAB-donor.

RAN3 agreed on BH RLF recovery procedure (TP in [R3-201363](file:///C:\temporary\RAN2\RAN2%20Feb%2020\CB%20email%20discussions\AT109e%20%5b013%5d%20IAB%20general%20(QC)\Inbox\R3-201363.zip)), which states:

NOTE: Determination of whether the recovery occurs at the same or a different IAB-donor-CU is up to implementation.

* Support for fast MCG link recovery

We may want to consider discussing this matter. MCG link recovery applies to ENDC and NRDC with different implications (for ENDC, MN is different from the donor, while for NRDC, it is not). We further need to recognize that this might affect RAN3. The rapporteur recommends the following proposals:

**Proposal 2a: Fast MCG link recovery is supported for NRDC.**

**Proposal 2b: Fast MCG link recovery is supported for ENDC.**

**We will use PH2 to discuss necessary RAN2 efforts for both proposals (some companies claimed that there was something to do while others said it was all off-the-shelf).**

* Limits of SCGFailureInformation

The CU receiving SCGFailureInformation does not know if it is the info is due to an SCG RLF by the reporting IAB-node or, if it is due to RLF recovery failure by the parent node on the IAB-node’s SCG link.

Rapporteur agrees that the SCGFailureInformation alone may not be sufficiently revealing about the reason for this message. However, the CU also receives notification via F1AP from the DU above the failed radio link. Taking both messages in unison, the CU should be able to draw a comprehensive picture.

[SAMSUNG] I wonder if there is any appropriate failure type for capturing the reception of RLF recovery failure in current failure type. If we want to reuse one of the legacy failure types by putting “reception of RLF recovery failure” into one of them, the RRC procedure to assign the failure type should be changed since each type has their own specific meaning. Moreover, this RLF recovery failure is not upon RLF detection at parent node, but failure of RRE after RLF detection. Since there could be several other cause to trigger RRE i.e., reconfiguration failure, IP check failure etc., even grand parent node cannot detect RLF at DU side and cannot report that to the CU via F1AP, there could be RLF recovery failure notification delivery to the child node. In this case, the CU will realize there was child node’s RLF not parent node’s failure. So if there is no the specific failure type in the SCGFailureInfomration report, it is not enough to envision the failure situation by CU in real.

* Supports for other types of RLF indications

We already discussed this matter and agreed to only go for notification in case of RLF recovery failure. There is no reason to reopen this discussion, especially at this late stage of the WI. We can certainly re-discuss in Rel-17.

* Execution of CHO in case of RLF notification

Since RAN2 agreed that RLF notification is interpreted as RLF declaration it should trigger CHO execution if CHO candidates are configured. I don’t believe we need further agreements. We could add this on stage-2 for clarification.

**[Note after closure of email discussion] Ericsson’s comments were not included in this summary by accident.**

# Phase 2: Proposals and further Discussion

Based on the detailed summary on each sub-section in Phase 1, the rapporteur proposes the following steps in phase 2.

RLF notification for IAB-node in ENDC

Scenario 1:

The vast majority of companies does not see measurement staleness is a sufficiently relevant issue for further discussion. Even if measurement staleness was an issue, it is not obvious if the present RLF notification would be a remedy. Based on feedback by many companies, such potential measurement staleness could be addressed by configuration of measurement report or OAM configuration of alternative candidates.

* **No further action is taken on Scenario 1 in Rel-16.**

Scenario 2:

Only a few companies believe that the mixed ENDC/SA scenario might be relevant. The vast majority of companies does not see this matter to be in scope for Rel-16, has doubts or is simply not interested.

* **No further action is taken on Scenario 2 in Rel-16.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Lenovo | Fine with the proposal |
| Nokia | We are OK with the proposals. |
| CATT | We agree with the WF. |
| Futurewei | We believe the mixed ENDC/SA scenario is valid. We are not opposed to addressing this in Rel-16, as long as any proposed solution can be done with minimal impact to the spec. (not introduce any new notifications, procedures, signaling, etc.) |
| vivo | Ok with the proposal. |
| Huawei | We are willing to compromise as the WF, even though not convinced. ☺  Based on the below feedback from Futurewei, Intel, AT&T, Apple, who are open for supporting to solve the issue. We provide the Text Proposal below, which has no impact to RRC and BAP. We only need to allow the IAB-DU’s implementation to send the existing BH RLF notification in stage 2 spec. The TP/CR to 38.300 is   |  | | --- | | Sec 9.2.7  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 using RRC reestablishment procedure.  For IAB-nodes operating in SA-mode, the IAB-node may transmit an RLF notification message to its child nodes in case the RRC reestablishment procedure to recover the BH link fails. For IAB-nodes operating in NSA-mode, the IAB-node may transmit the RLF notification message to its child nodes in case the SCG recovery procedure fails. The child node considers the BH link, on which it has received the RLF notification as failed (i.e. as if it has detected RLF on that BH link). The RLF notification message is transmitted on BAP layer. | |
| samsung | We are ok with the proposals. |
| Sharp | Fine with the proposal. |
| AT&T | We believe the scenario is indeed in Rel-16 scope, however similar to Futurewei it does not have to be optimized. If a simple extension of the existing solution can be proposed by companies we believe it should be considered. |
| Intel | We think it would be fine to support BH RLF indication in the EN-DC scenario and align it with the standalone case. We haven’t identified anything that needs to be different (RLF detection is supported anyway, and the BH RLF indication is generated by the IAB node). If it is indeed more complex than that, we would be ok to not consider this for Rel 16 (but so far we are not convinced). |
| Kyocera | We’re ok with the proposal. |
| Apple | Like AT&T we believe this is in Rel. 16 scope and believe it should be considered as well. |
| ZTE | We agree with the proposals. |
| Ericsson | Since the rapporteur missed to include our comment for Phase-I while summarizing the discussion, we have provided it here:  First, we agree with the comments from some of the companies above that the mixed SA/NSA scenario is a corner case.  Second, for the first scenario where the child node is also connected via EN-DC, the donor CU can still send F1-AP messages to the child node via the LTE leg, even if the NR leg of the parent is lost. For the second scenario where the child node is connected via SA NR, even though there is no F1-AP connectivity via LTE to it, the donor can still send an F1-AP message to IAB-1 that contains an RRC message to the MT of IAB-2, so the donor can still trigger HO of IAB-2.  So, we agree with the WF. |

Summary:

10 out of 14 companies agree with to not take further action. 4 out of 14 companies believe that RLF notification should be discussed for mixed SA/ENDC.

**Rapporteur’s view:**

1. There is not sufficient support to discuss RLF notification for mixed SA/ENDC deployment.

2. Mixed SA/ENDO deployment has not been discussed at all during Rel-16 WI and nobody seems to have missed it. Implications on other aspects of the work item would need to be discussed. Due to the late stage of the WI, this matter should be reconsidered during Rel-17.

We therefore stay with:

* **No further action is taken on Scenario 2 in Rel-16.**

**Post submission deadline:**

Some companies mentioned that RLF notification should also apply when RLF recovery fails for ENDC. RAN2’s agreements do support this claim.

|  |
| --- |
| * R2 assumes that RLF notification “recovery failure” would be triggered when RRC reestablishment has failed. FFS whether this need to be specified |

The present IAB CR to 38300 defines this behavior only for SA, not for ENDC:

*“For IAB-nodes operating in SA-mode, the IAB-node may transmit an RLF notification message to its child nodes in case the RRC reestablishment procedure to recover the BH link fails…”*

To properly capture RAN2’s agreement, IAB CR to 38300 should be revised and capture this behavior for also for IAB-node using ENDC.

**Observation 0: IAB CR to 38300 needs to capture that transmission of RLF notification applies to IAB-nodes using ENDC in the same manner as to IAB-nodes using SA.**

Behaviour of IAB-DU after BH RLF declaration

The vast majority of companies believes that this can be left up to implementation

**Proposal 1: IAB-DU behavior after RLF declaration is left up to implementation.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Lenovo | Fine with the proposal |
| Nokia | We agree this can be handled by the implementation and are OK with the proposal. |
| CATT | We agree with the proposal. |
| Futurewei | In general, we don’t have a problem with the proposal. However, as pointed out by the rapporteur, the IAB-DU must still be able to send DL RLF notification in case the BH RLF recovery procedure fails. At a minimum this means that the IAB-DU should not be released immediately after a RLF declaration.  IAB-DU behaviour is ultimately within the scope of RAN3 to decide. |
| Vivo | We agree that IAB DU behaviors are left for implementation. |
| Huawei | Fine with the proposal |
| Samsung | We agree with the proposal. |
| Sharp | Fine with the proposal. |
| AT&T | OK with the proposal |
| Intel | May be ok to leave it to DU implementation with the understanding that the IAB DU does not allow UEs to attach in this state, but still can transmit the BH RLF indication. |
| Kyocera | We agree with the proposal. We also share the comment provided by Futurewei, i.e., DU implementation should allow sending BH RLF Notification. |
| Apple | We are ok with this proposal. However, as mentioned by several companies the IAB-DU should be able to send the BH RLF notification in case the recovery procedure fails. |
| ZTE | We agree with the proposal. |
| Ericsson | Before commenting on the proposal, we have provided below our comment for Phase-I discussed that the rapporteur missed to include in the summary of Phase-I:  We agree with Nokia that the other RLF notification types (e.g. Type2: trying to recover, Type 3: BH link recovered) that were discussed in previous meetings will help with that. What the IAB DU does (e.g. like option 2 where it can block idle UEs from camping, or not giving UL grants to connected child nodes/UE, etc.) could be left up to IAB implementation.  So, we agree that IAB-DU behavior after RLF can be left to the implementation. However, in our view, having Type 2 notification will allow more flexibility for recovery as the child node can take some specific action while waiting for a subsequent Type 3 or 4 notification indicating the BH has been recovered or recovery has failed. With only one type of notification, all the child node can perform is re-establishment (or MCG/SCG failure recovery, if it was operating in DC mode).  Hence, we would like to have Type2 and Type3 notification. |

Summary:

All 14 companies agree that the IAB-DU behavior after RLF recovery failure should be left up to implementation. Several companies point out that the IAB-DU should be able to send RLF notification when RLF recovery fails. One company emphasizes on considering further signaling (type 2/3).

**Rapporteur’s view:**

Rapporteur stresses that the behavior of the IAB-node when IAB-MT goes to RRC\_IDLE needs to be handled in a separate discussion.

**Observation 1: The behavior of the IAB-node when IAB-MT goes to RRC\_IDLE needs to be handled in a separate discussion.**

For the time being, we keep proposal 1 and add that IAB-DU should still be able to send RLF notification in case BH RLF recovery fails.

**Proposal 1: IAB-DU behavior after RLF declaration is left up to implementation. IAB-DU should be able to send RLF notification when RLF recovery fails.**

While further signaling (type 2/3) might have benefits, this can be considered an optimization to RLF notification. Due to the late stage of the WI, such optimizations should be discussed in Rel-17.

Reestablishment at descendant nodes

Many companies were in favor of options 1 and 4. These options do not require any specification effort. There was not enough support for any other option. The topic can be discussed again in Rel-17.

* **No further action is taken on this topic in Rel-16.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Lenovo | Fine with the proposal |
| Nokia | We agree this can be handled by the implementation and are OK with the proposal. |
| CATT | We agree with the WF. |
| Futurewei | We are fine to go with the majority view. However, if we do not limit in some way which cell a descendent node can attempt a re-establishment, then a child node will almost certainly select the same parent node (the parent node that has suffered the RLF) and attempt to re-establish via this IAB node.  Furthermore, as discussed in response to the previous question, the parent’s IAB-DU can not be released immediately, as this would mean that the DL RLF notification could not be transmitted. Hence the parent node will still need to transmit DL signals, at least for some period of time.  Therefore, in order to prevent descendent nodes from attempting a re-establishment on the same parent node that suffered the RLF, we propose the following:  In case a BH RLF results in an RRC re-establishment, and this reestablishment fails, the IAB-DU transmits the DL RLF notification, and bars access attempts from MTs of other IAB nodes. |
| vivo | Agree. But, we’d like to further discuss this issue in R17 as optimization. |
| Huawei | Fine with the proposal. |
| Samsung | Find with the proposal. |
| Sharp | Fine with the proposal. We would like to further discuss this topic in Rel-17. |
| AT&T | We are OK to leave this for implementation in Rel-16. The scenario/solution proposed by Futurewei is valid but could be simply one of the mechanisms the IAB-DU can choose as part of its own implementation |
| Intel | Ok with proposal; this will need discussion in Rel 17. |
| Kyocera | We share the issue pointed out by Futurewei, although we thought the original intention in Phase 1.3 discussed the parent’s re-establishment towards its child (maybe we misunderstood).  So, for this issue, we wonder if it’s simple that the IAB MT should not select the IAB node which sent BH RLF Notification.  For the possible reestablishment to the descendant nodes, we’re fine with the proposal as it’s majority’s view for Rel-16, but we would like to discuss this issue in Rel-17 as the rapporteur and vivo pointed out. |
| Apple | Agree with the proposal. Needs discussion in Rel-17. |
| ZTE | We are OK with the proposal. |
| Ericsson | Again, we have provided below our input for phase-I that was missed by the rapporteur:  In our understanding, all options (i.e., 1, 2 and 3) are viable, but will all require further work we think RAN2 will not have time to finalize all the needed details within the Rel-16 time frame.  We are fine with the proposal; however, we suggest having Type2/Type3 BH notifications as we mentioned in the previous comment. |

Summary:

All companies seem to agree that for Rel-16, no further action needs to be taken. Many companies want to re-discuss the matter in Rel-17. One company emphasizes on considering further signaling (type 2/3).

**Rapporteur’s view:**

We won’t take any action now. Discussion of this topic is encouraged for Rel-17. Signaling of type 2/3 may be considered for this Rel-17 discussion.

We therefore stay with:

* **No further action is taken in Rel-16.**

Other aspects related to BH RLF

Support for fast MCG link recovery

We may want to consider discussing this matter. MCG link recovery applies to ENDC and NRDC with different implications (for ENDC, MN is different from the donor, while for NRDC, it is not). We further need to recognize that this might affect RAN3. The rapporteur recommends the following proposals:

**Proposal 2a: Fast MCG link recovery is supported for NRDC.**

**Proposal 2b: Fast MCG link recovery is supported for ENDC.**

Companies are asked to discuss necessary RAN2 efforts for both proposals (some companies claimed that there was something to do while others said it was all off-the-shelf).

|  |  |
| --- | --- |
| **Company** | **Fast MCG link recovery NRDC: Necessary RAN2 efforts or other comments** |
| Lenovo | **We support proposal 2a.**  If fast MCG link recovery is not supported, UE initiates re-establishment procedure and suspends all RBs (stop data transmission) upon RLF on MCG. That means IAB MT will stop data on MCG link and SCG link even RLF only happens on MCG.  If fast MCG link recovery is supported, the data transmission on SCG link will not be interrupted when MN fixes MCG link.  **One potential issue needs to be solved.**  If RLF is detected for MCG, UE transmits *MCG Failure Information* message to the MN via the SCG, using the SCG leg of split SRB1 or SRB3.  If SRB3 is used, *MCG Failure Information* message is encapsulated in NR RRC message *ULInformationTransferMRDC,* which will be transferred from SN to MN.  If SRB3 is used, the response (*RRC reconfiguration* or *RRC release* message) sent by MN is encapsulated in NR RRC message *DLInformationTransferMRDC,* which will be transferred from MN to SN using Xn interface.  We agree with the explanation from Ericsson. Split SRB1 can be configured in IAB DC. We don’t see the problem for split SRB1 case.  IAB via NR DC is restricted to access to one IAB donor. Namely, there is no Xn interaction in NR DC case.  Therefore, it is unnecessary for IAB node (if SRB3 is used) to encapsulate MCG Failure Information message in NR RRC message ULInformationTransferMRDC. Similarly, the response message (RRC reconfiguration or RRC release message) sent by MN (if SRB3 is used) is unnecessary to be encapsulated in NR RRC message DLInformationTransferMRDC. |
| Nokia | This is already agreed and can be reused directly for IAB. The issue mentioned by Lenovo is not specific to IAB (UE may also have NRDC which involves a single Donor CU). If that has to be solved, it should be raised in DCCA WI, not in IAB. |
| CATT | We agree with the Proposal, which confirms the previous working assumption in RAN2. We also do not see a need for further changes/optimizations at this stage. |
| Futurewei | We agree with the proposal. However, similar to the view from CATT, we don’t see any necessity of introducing further optimizations at this stage (and in particular IAB specific optimizations) |
| vivo | Agree, it seems to re-confirm the agreement made at #107bis. |
| Huawei | “unnecessary for IAB node (if SRB3 is used) to encapsulate MCG Failure Information message in NR RRC message ULInformationTransferMRDC” in NR-DC may be valid. But we are not the experts of DCCA WI to say if the change works. |
| Samsung | We agree with the proposal. However, at the same time, we also think lenovo’s issue is somewhat valid point. I think there obviously could be a point to be adapted specific for IAB even we use off-the-shelf solution.  Please find the comments in Rapporteur’s summary. |
| Sharp | We agree with the proposal, confirming the previous working assumption. |
| AT&T | Agree with Nokia. |
| Intel | This is not IAB specific. Agree with Nokia. |
| Kyocera | We agree with the proposal. |
| Apple | Agree with Nokia. |
| ZTE | We agree with Proposal 2a.  As we mentioned in Phase 1.4, when the donor CU acquires the SCGFailureInformation from a IAB node, it can only know one of its parent IAB DU cannot provide service, but it cannot know whether the IAB node detects RLF or the parent IAB DU of the IAB node detects RLF. Then it is hard for the donor CU to re-configure or update the routing information via the other link. We need to discuss whether to enable the donor CU to know who initially detects RLF. |
| Ericsson | Before commenting on the proposal, we have provided below our comment for Phase-I discussed that the rapporteur missed to include in the summary of Phase-I:  About the issue raised by Samsung (how to ensure MT re-establishes only to the cells that are controlled by the same donor gNB), we agree with Nokia/Futurewei that it can be left to implementation/configuration.  With regard to the comment from Lenovo, our understanding is that split SRBs are still supported for the IAB-MT if it is connected in DC mode. What we agreed not to support is to have split bearer like operation at the backhaul channels, because there is no PDCP termination at the IAB nodes for those. However, for the IAB-MT, PDCPs of SRB1 is terminated at the IAB node, and as such spit SRB is can be supported.  As we mentioned in the comments to earlier questions, and also ZTE has pointed out, having type2/3 BH RLF notifications will greatly help in preparing the child nodes for finding an alternate path/node in a fast way and also prevent/minimize UL packet loss/delay (e.g. if the parent IAB node keeps giving grants to its children and receiving UL data while it is trying recovery, but then fails to find an alternate path).  So, in our understanding, Rel-16 UE procedure is sufficient and do not see a need for further optimizations at this stage. |

|  |  |
| --- | --- |
| **Company** | **Fast MCG link recovery ENDC: Necessary RAN2 efforts or other comments** |
| Lenovo | We support 2b. |
| Nokia | This is already agreed and can be reused by IAB. |
| CATT | We agree with the Proposal, which confirms the previous working assumption in RAN2. |
|  | Agree with the proposal |
| vivo | Agree, see comment above. |
| Huawei | No particular issue and R2 IAB efforts for ENDC. |
| Samsung | Agree with the proposal. |
| Sharp | Fine with the proposal. |
| AT&T | We are OK with the proposal and do not see any need for IAB-specific changes to reuse the ENDC solution |
| Intel | This is not IAB specific. Agree with Nokia. |
| Kyocera | We agree with the proposal. |
| Apple | Agree with Nokia |
| ZTE | We agree with Proposal 2b. |
| Ericsson | Again, in our understanding, Rel-16 UE procedure is sufficient, and do not see a need for further optimizations at this stage. |

Summary:

All companies agree on proposals 2a and 2b.

**Rapporteur’s view:**

We combine P2a and P2b to:

**Proposal 2: Fast MCG link recovery is supported for NRDC and ENDC.**

One optimization proposed is to not encapsulate MCG Failure Information message in NR RRC message ULInformationTransferMRDC since the IAB-donor supports MN and SN functionality. The benefit of this optimization is minimal. It may further not be future-proof for the support of inter-donor topology adaptation in Rel-17.

Another concern raised is that SCG or MCG failure information does not reveal at which upstream BH link the failure occurred. As rapporteur pointed out above, such information could be obtained from F1-C. One company emphasizes that type-2/3 notification could improve on that matter. Rapporteur emphasizes that there are other options apart form type-2/3 signaling, such as adding more detailed information into the present RLF notification and feeding it back via the SCG/MCG failure information, enhancing F1 reporting by IAB-DU, etc. Therefore, a more comprehensive discussion is needed. This discussion should occur in Rel-17.

# Conclusion

On RLF notification for IAB-node in ENDC

10 out of 14 companies agree to not take further action. 4 out of 14 companies believe that RLF notification should be discussed for mixed SA/ENDC. Rapporteur concludes:

1. There is not sufficient support to discuss RLF notification for mixed SA/ENDC deployment.

2. Mixed SA/ENDO deployment has not been discussed at all during Rel-16 WI and nobody seems to have missed it. Implications on other aspects of the work item would need to be discussed. Due to the late stage of the WI, this matter should be reconsidered during Rel-17.

**No further action is taken on Scenario 2 in Rel-16**

Some companies mentioned that RLF notification should also apply when RLF recovery fails for ENDC. RAN2’s agreements do support this claim. To properly capture RAN2’s agreement, IAB CR to 38300 should be revised and capture this behavior for also for IAB-node using ENDC.

**Observation 0 (reminder): To be compliant with RAN2 agreements, IAB CR to 38300 needs to capture that transmission of RLF notification applies to IAB-nodes using ENDC in the same manner as to IAB-nodes using SA.**

On behavior of IAB-DU after BH RLF declaration

All 14 companies agree that the IAB-DU behavior after RLF recovery failure should be left up to implementation. Several companies point out that the IAB-DU should be able to send RLF notification when RLF recovery fails. One company emphasizes on considering further signaling (type 2/3).

Rapporteur stresses that the behavior of the IAB-node when IAB-MT goes to RRC\_IDLE needs to be handled in a separate discussion.

**Observation 1: The behavior of the IAB-node when IAB-MT goes to RRC\_IDLE needs to be handled in a separate discussion.**

**Proposal 1: IAB-DU behavior after RLF declaration is left up to implementation. IAB-DU should be able to send RLF notification when RLF recovery fails.**

On reestablishment at descendant nodes

All companies seem to agree that for Rel-16, no further action needs to be taken. Many companies want to re-discuss the matter in Rel-17. One company emphasizes on considering further signaling (type 2/3).

Rapporteur concludes that we won’t take any action now. Discussion of this topic is encouraged for Rel-17. Signaling of type 2/3 may be considered for this Rel-17 discussion.

**No further action is taken in Rel-16.**

Other aspects related to BH RLF

All companies agree to support fast MCG link recovery for NRDC and ENDC.

**Proposal 2: Fast MCG link recovery is supported for NRDC and ENDC.**