3GPP TSG-RAN WG3 #114-e R3-215905

Online, 1-11 Nov 2021

Agenda Item: 13.4.1

Source: Nokia (moderator)

Title: Summary of Offline Discussion on CB: # 1307\_IAB\_Res\_Multiplex

Document for: Approval

# Introduction

**CB: # 1307\_IAB\_Res\_Multiplex**

**- Can the WA agreed at RAN3-113e be confirmed?**

**- Can any down selection of Options 1, 2, 3 be done in light of the LS from RAN1?**

**- Any convergence on the information to be exchanged over Xn?**

**- Any need for information to be exchanged over F1?**

(Nok - moderator)

Summary of offline disc [R3-215905](https://ericsson-my.sharepoint.com/personal/filip_barac_ericsson_com/Documents/WORK/3GPP.exe/Meetings/RAN3%23114-e.exe/1.%20IAB/CBs.exe/CB%20%23%201307_IAB_Res_Multiplex/Inbox/R3-215905.zip)

The discussion has two phases:

**Phase 1: Identify potentially achievable agreements for online discussion.**

**Phase 2: TBD**

The deadline for Phase 1 is Thursday, Nov 4th, 23:59:59 UTC. This allows the moderator to prepare some proposals on Friday for Monday’s online session.

The deadline for Phase 2 is the same as for all email discussions, i.e., Tuesday, Nov 9th, 12:00:00 UTC.

# For the Chairman’s Notes

**Propose to capture the following Agreement:**

**…**

# Phase 1 Discussion

## Issue 1: non F1-terminating donor needs to be aware of boundary IAB-DU configuration

Last RAN3 meeting agreed following WA:

WA: The F1-terminating donor of the boundary node forwards the boundary IAB node’s multiplexing info and the boundary IAB-DU’s activated cell list to the non-F1-terminating donor, via following XnAP procedures:

- retrieve UE context procedure,

- handover preparation procedure,

- SN addition procedure,

- MN initiated SN modification procedure

- SN initiated SN modification procedure

Contribution ([2][3][4][6]) propose to confirm the WA.

**Q1-1: Do you agree to confirm the above WA as Agreement?**

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| **Company** | **Comment** |
| **Ericsson** | **Yes.** |
| Lenovo | Agree. |
| Samsung | Prefer to NUA message. However, we can follow majority view. |
| QCOM | Yes |
| Huawei | Yes |
| Nokia | Yes |
| AT&T | We agree to confirm the WA. |
| ZTE | Yes |
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Contribution ([2]) propose to enable XnAP signalling the exchange of the following information pertaining to boundary IAB node:

* Activated cell list.
* H/S/NA resource configurations.
* DL/UL resource configurations.
* Multiplexing info.
* Cell specific signal/channel configurations, including at least: SSB information, CORESET 0, and RACH configurations) from/for different parent nodes.

Contribution ([3]) propose XnAP signaling is enhanced to transfer boundary IAB-DU resource configuration, including TDD configuration, HSNA configuration, cell specific signal/channel configuration from F1-terminating donor to non-F1 terminating donor.

Contribution ([6]) propose XnAP TP to transfer the activated cell list and the multiplexing capabilities between the IAB-DU’s cell and the cells configured on the collocated IAB-MT.

**Q1-2: Please share your view on following information to be exchanged over Xn interface:**

* Activated cell list.
* H/S/NA resource configurations.
* DL/UL resource configurations.
* Multiplexing info.
* Cell specific signal/channel configurations, including at least: SSB information, CORESET 0, and RACH configurations) from/for different parent nodes.

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| **Company** | **Comment** |
| **Ericsson** | **Agree** |
| Lenovo | Agree with the information to be exchanged over Xn interface. All the information above is beneficial for non-F1 termination donor to avoid resource configuration conflict at boundary IAB node. |
| Samsung | Agree |
| QCOM | Agree |
| Huawei | Yes, we think these information should be exchanged. |
| Nokia | Agree |
| AT&T | We agree with this list and it aligns with RAN1 agreements as well. |
| ZTE | Agree |
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Contribution ([3][4]) propose to introduce New XnAP message to transfer updated IAB-DU configurations from the F1-terminating donor to the non F1-terminating donor in inter-donor migration/RLF recovery scenarios. FFS whether UE associated or non-UE associated message is introduced.

**Q1-3: Please share your view on whether need new XnAP procedure to transfer updated IAB-DU configurations from the F1-terminating donor to the non F1-terminating donor in inter-donor migration/RLF recovery scenarios.**

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| **Company** | **Comment** |
| **Ericsson** | **Disagree.** In our view, partial node migration due to load balancing and RLF recovery is a short-term scenario, where updates are unlikely.  Even if there would be a need for configuration update, the updates of descendant node configurations can be done via F1AP, but the updates should not deviate too much from the semi-matched configuration, since that would break the concept of semi-matched configuration. The new CU is responsible for resource allocation of the boundary MT, and any update should not deviate too much from the semi-matched configuration either. That means that, even in this case, **there would be no need to inform the non-F1-terminating donor.**  Note that configuration update in the scenarios of interest here always causes service interruption. |
| Lenovo | Agree with Ericsson that partial migration/RLF recovery is only a short-term case, and it may be revoked after source link has turnback to be available. In addition, source donor CU is unnecessary to update the configuration of boundary IAB-DU since the boundary IAB node does not have the connection to source parent node after migration and its configuration will not be affected by the change of source topology.  Therefore, no need to introduce new XnAP procedure to transfer updated IAB-DU configurations. |
| Samsung | We can discuss this later. |
| QCOM | Strongly AGREE that a new procedure is needed.  1) Partial migration is NOT of temporary nature if we do not have full migration.  2) Inter-donor redundancy is permanent and needs dynamic resource coordination.  If we do not support such Xn procedure, RAN1-based **resource multiplexing will not work at the boundary IAB-node.** This means that RAN3 essentially says good-bye to partial migration and inter-donor redundancy.  **RAN1 has clearly stated in their LS that we need support of such signaling before, during and after migration.**  **RAN1 writes:**  Additionally, reconfigurations of the parent and/or child resource configurations can align resource configurations **before** or **during** the inter-donor migration procedures and **after** to further align the migrating node(s) with its new parent node. |
| Huawei | Not needed. So far we have not identified any issues which could not be addressed by existing procedure. |
| Nokia | New XnAP procedure is needed. It does not matter whether it is short-term or long-term. |
| ZTE | New XnAP procedure is needed to transfer updated IAB-DU configurations especially in inter-donor migration/RLF recovery scenarios. Agree with QCOM that partial node migration is not a short-term scenario and update of IAB-DU resource needs to be supported after migration. |
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In case a new XnAP procedure is needed, contribution ([3]) discusses the further impact when this new XnAP procedure is a UE-associated procedure, or non-UE-associated procedure.

**Q1-4: In case a new XnAP procedure is needed, Please share your view on whether this is a UE-associated (UA) procedure or a non-UE-associated (NUA) procedure.**

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| **Company** | **Comment** |
| **Ericsson** | Support for **configuration update is not needed**, as explained above.  Moreover, the argumentation in [3] is based on releasing or not releasing the context after the release message. Since we cannot mandate node behavior (whether the node shall release the context or not), does it mean that both UA and NUA procedure should be defined for the configuration update? |
| **QCOM** | It needs to be UA procedure on behalf of the boundary node.  We already introduce such a procedure for QoS info transfer. We may use the same procedure to also carry this multiplexing info. |
| **Huawei** | See our comments above, also share E///’s view. |
| Nokia | No strong view. In case it is NUA, the message still need to include the ID of the IAB. |
| ZTE | UA procedure is preferred than NUA procedure since the updated DU resource configuration should be related to the boundary node. Regarding Ericsson’s concern, we suggest that CU2 could include a indication in UE context release message to inform CU1 to keep the corresponding Xn association after receiving UE context release message. |
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Contribution ([7]) proposes to send a LS to RAN1 to confirm RAN3 agreements:

*the F1-terminating donor needs to transfer the boundary IAB-DU’s cell configurations to the non-F1 terminating donor, which includes H/S/NA resource configurations, DL/UL resource configurations, the multiplexing info, and cell specific signal/channel configurations of boundary IAB-DU’s cells.*

**Q1-5: Please share your view on the reply LS to RAN1 on RAN3 agreement.**

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| **Company** | **Comment** |
| **Ericsson** | **Probably not needed**. We can liaise RAN1 if we need their input for something, but this is for info only. |
| Lenovo | Seems unnecessary. And it can be discussed later after we have made some conclusions on Q1-2. |
| Samsung | Not now. |
| QCOM | In case we do **NOT** support new Xn procedure, we need to tell RAN1 **that RAN3 is not inclined to provide proper support for resource multiplexing at the boundary node in the manner they recommended.** |
| Huawei | On one hand, an LS to RAN1 would not bring any harm; while on the other hand, I suppose we are not asking question to RAN1, and info exchange between nodes does not concern RAN1… |
| Nokia | No strong view. |
| AT&T | In our understanding this is already aligned with RAN1 agreements related to the Rel-17 multi-parent scenarios:  **Agreement**  To support extension of CA TDD prioritization rules to NR-DC, the following resource coordination mechanisms between parents/donors are supported:   * For intra-donor and inter-donor DC scenarios, in addition to coordination at the donor CU(s), a parent-node can be made aware of the DU resource configuration (UL/DL/FL, H/S/NA) of the other peer parent node that connects to the same IAB-node. * For intra-donor and inter-donor DC scenarios, coordinating the semi-static and/or cell-common higher layer configuration (e.g. SSB, CORESET 0, and RACH and configurations) from/for different parent nodes. |
| ZTE | If the information list in Q1-2 can be supported to be transferred via Xn procedure and new Xn message is introduced for IAB-DU resource configuration update, perhaps we don’t need to send an LS to RAN1 for confirmation.  For the RAN1 agreements copied above by AT&T, we would like to clarify that it is not about boundary DU’ s resource configuration, it is about peer parent node’s DU resource configuration. That means parent DU resource needs to be transferred via XnAP and F1AP.  Moreover, we noticed that the boundary DU resource configuration transfer via XnAP is not listed in the higher-layer parameter list for eIAB from RAN1 [R3-215793]. So perhaps it is necessary to send an LS to RAN1 to inform that boundary DU resource configuration also needs to be included in the higher-layer parameter list. |
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**Summary:**

Suggest following proposal:

**Proposal**

## Issue 2: parent node is aware of boundary IAB-DU cell configurations

Last RAN3 meeting agreed following WA:

WA: parent node is aware of boundary IAB-DU cell configurations via the F1AP GNB-DU RESOURCE CONFIGURATION message

Contribution ([2][3][4][5]) proposed to confirm the WA.

**Q2-1: Do you agree to confirm the above WA as Agreement?**

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| **Company** | **Comment** |
| **Ericsson** | Yes, this is our proposal as well. |
| Lenovo | Agree. |
| Samsung | Yes |
| QCOM | Agree |
| Huawei | Ok to turn this WA to agreement. |
| Nokia | Agree |
| AT&T | Yes we agree with the WA and it is also aligned with RAN1 agreements:  **Agreement**  To support extension of CA TDD prioritization rules to NR-DC, the following resource coordination mechanisms between parents/donors are supported:   * For intra-donor and inter-donor DC scenarios, in addition to coordination at the donor CU(s), a parent-node can be made aware of the DU resource configuration (UL/DL/FL, H/S/NA) of the other peer parent node that connects to the same IAB-node. * For intra-donor and inter-donor DC scenarios, coordinating the semi-static and/or cell-common higher layer configuration (e.g. SSB, CORESET 0, and RACH and configurations) from/for different parent nodes. |
| ZTE | Yes. |
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For RAN1 agreement “In DC scenarios, support per-child MT link-NA resource configuration.” Contribution ([2][4][5]) proposes F1AP signalling to be extended to support per-child MT configuration. Contribution ([5]) proposes Per-child MT link-NA resource configurations can be provided by the donor CU to a parent and child IAB-DU via delta signaling of the time domain configuration in the gNB-DU Cell Resource Configuration which also includes a list of associated child IAB-MT IDs (e.g. gNB-DU UE F1AP ID).

**Q2-2: Please share your view on enhancing F1AP signaling to support per-child MT link-NA resource configuration in DC scenario, and the detail of the enhancement, e.g. includes a list of associated child IAB-MT IDs (e.g. gNB-DU UE F1AP ID).**

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| **Company** | **Comment** |
| **Ericsson** | The proposal is generally OK, but we should discuss this alternative vs. the alternative of reusing the current signaling. Backwards compatibility should also be considered. |
| Lenovo | Since per-child MT link-NA resource configuration has been already agreed by RAN1, F1AP signaling should be enhanced to support it.  As for the detail signaling design, e.g. group signaling of multiple associated child IAB-MTs, can be discussed later after consolidated parameter sent from RAN1. |
| Samsung | Agree to enhance it. The details can be further discussed |
| QCOM | There are multiple issues here:  (1) Should per-child-link NA-configuration be supported: **YES**. This is a RAN1 feature that needs support.  (2) Should per-child-link NA-configuration as proposed by AT&T [5]: **This is a good idea that should be considered.**  We believe that the st3 signaling should be discussed together with RAN1 Rel-17 multiplexing enhancements they sent us in R3-215793.  This is not straightforward. We propose RAN3 to have an email discussion until next meeting. |
| Huawei | Maybe we should agree on a basic solution firstly, then we could consider further enhancements. |
| Nokia | Suggest first agree “enhancing F1AP signaling to support per-child MT link-NA resource configuration in DC scenario”, then we discuss the detail, e.g. a list of the child IAB-MT IDs. |
| AT&T | We agree the F1AP enhancement is needed to support the RAN1 agreement. Delta signaling and a list of IAB-MT IDs can be beneficial to reduce the signaling overhead since in practice the NA resource configuration will only be on a subset of the per-cell DU configuration and only applicable to a subset of a topology impacted by the DC scenario operation. |
| ZTE | Agree to support per-child MT link-NA resource configuration as agreed in RAN1. Detailed signaling design needs to wait for RAN1’s progress. Note that per-child MT link-NA resource configuration is not included in the higher-layer parameter list for eIAB from RAN1 [R3-215793] yet. |
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**Summary:**

Suggest following proposal:

**Proposal**

## Issue 3: support for FDM

Contribution ([2]) propose to wait for RAN1 conclusion.

Contribution ([4]) propose: F1AP signalling to be extended with H/S/NA configurations per RB set to support intra-carrier FDM.

Contribution ([5]) propose: The frequency-domain H/S/NA configuration of an IAB-DU provided by the donor CU can be updated via delta signalling for RB sets in a given slot which have a different H/S/NA resource type from the corresponding time domain H/S/NA configuration in the gNB-DU Cell Resource Configuration.

**Q3: Please share your view on support for FDM, e.g. wait for RAN1, or agree high level aspects, etc.**

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| **Company** | **Comment** |
| **Ericsson** | We proposed to wait for RAN1. For instance, one FDM-related FFS is about having a per-BWP H/S/NA configuration which can have impact on signal design. So, RAN3 is not ready not to start with F1AP discussion about how to signal one/many H/S/NA configuration.  For this meeting we can try to make some high-level agreements based on the RAN1 LS in R3-215793 that provides the higher layer parameters for RAN3 to support. Stage3 however, requires some further consideration. |
| Lenovo | It’s within the scope of RAN1. We need to wait for further inputs from RAN1. |
| Samsung | Wait for RAN1 |
| QCOM | As we learned from Rel-16, it is not so straight forward to understand RAN1’s agreements and get the signaling right. **As in Rel-16, RAN3 should have an email discussion until next meeting. The discussion has the goal to establish a CR based on RAN1 LS (R3-215793).** |
| Huawei | Wait for RAN1 |
| Nokia | The F1AP need to be enhanced, but the stage-3 detail may need to wait for RAN1. |
| AT&T | We believe the LS from RAN1 on Rel-17 higher-layer parameters ([R3-215793](file:///Users/novlan/OneDrive%20-%20AT&T%20Services,%20Inc/3GPP/RAN%203/RAN3_114%20E-Meeting/LSin/R3-215793.zip)) can be taken as a starting point. Extension of the F1AP signaling on a per RB-set basis can be the baseline. Delta signaling to only include RB sets which have updated H/S/NA configurations is beneficial to reduce signaling overhead, which can be substantial given the possibility to configure RB sets with only a few RBs within very large carrier bandwidths (e.g. in FR2 bands, typical for IAB deployments). |
| ZTE | The detailed signaling needs to wait for RAN1’s progress. |
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**Summary:**

Suggest following proposal:

**Proposal.**

## Issue 4: Resource compatibility between the two parents

In RAN3#112-e, RAN3 send a LS to RAN1 asking for RAN1 feedback on IAB resource multiplexing and 3 options:

For scenario 1 and 2, RAN3 considers the following solutions (other solutions are not precluded) for the resource coordination between the parent link and the child link:

* Option 1: The child node’s gNB-DU cell resource configuration is matched to the parent node’s gNB-DU’s resource configuration.
* Option 2: The parent node’s gNB-DU resource configuration is matched to the child node’s gNB-DU’s resource configuration.
* Option 3: A boundary node should connect only to a new parent with which it has a non-conflicting TDD and H/S/NA pattern beforehand.

For Scenario 2, RAN3 considers the following solutions (other solutions are not precluded) for the coordination between two parent links:

* Option 1: The gNB-DU cell resource configuration of the parent node controlled by the F1-terminating donor of the boundary node, is matched to another parent’s gNB-DU’s resource configuration.
* Option 2: The gNB-DU cell resource configuration of the parent node controlled by the non-F1-terminating donor of the boundary node, is matched to another parent’s gNB-DU’s resource configuration.
* Option 3: The secondary leg of a boundary node is established only towards a secondary parent whose H/S/NA configuration is compatible with the H/S/NA configuration of the master parent beforehand.

RAN1 reply LS ([1]) states:

RAN1 note that Option 1 and Option 2 may cause service interruption to child IAB nodes and associated UEs for network topologies without proper resource coordination and Option 3 is very restrictive.

RAN1 notes that all above options are feasible also for semi-matched configurations, where not all DL and UL slots match, albeit with a reduced performance. Additionally, reconfigurations of the parent and/or child resource configurations can align resource configurations before or during the inter-donor migration procedures and after to further align the migrating node(s) with its new parent node.

Contribution ([2]) proposes a modified version of Opt3, i.e., Option 4:

* For Scenario 1, the new parent has more or less compatible configuration with the one that the boundary node had prior to migration. Hence, Scenario 1 will unlikely require major reconfigurations at the boundary node and it descendants upon migration.
* For Scenario 2, the second parent link of the boundary node uses only a subset of resources assigned by the second parent, where this subset is compatible with the resource on the first parent link and the child link.

Contribution ([3][4]) propose option 1 and option 2 are both supported.

**Q4: Please share your view on which option(s) should be selected.**

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| **Company** | **Comment** |
| **Ericsson** | We prefer the abovementioned **Opt4.**  RAN1 LS indicates the **problems with service interruption** for Opt1 and Opt2, and these options should not be agreed because service interruption is a major issue in inter-donor topology adaptation.  Meanwhile, the agreed the semi-matched configuration in RAN1 has made Opt3 less restrictive, which is what we now call **Opt4.**  So, we propose (**Opt4**):   * For Scenario 1 (partial migration), the source and target can use **semi-matched configurations**, as indicated by RAN1 LS – note that in TDD networks the TDD patterns in the entire network are roughly aligned and small local deviations between individual network nodes are present. * For Scenario 2, the portion of resources on the second link that is incompatible with the first link is blanked, as per RAN1 agreement on per-child MT link-NA resource configuration. Please note that the boundary node will still have its first leg up and running and may not need all the resources that the new parent usually provides to its child nodes. |
| Lenovo | Based on the reply from RAN1, all above three options are technical feasible.  But for Option 3, since the time domain resource configuration is too flexible, it will be very difficult to find a target parent node or a second parent node which has a non-conflicting TDD and H/S/NA pattern.  And for Option 1 or Option 2 can be supported with further enhancements on service interruption reduction, if needed. |
| Samsung | Let’s start from option 1 or option 2. |
| QCOM | **Ericsson misinterprets Option1 and 2.** RAN1 LS says Options 1 and 2 cause service interruption **if there hasn’t been proper resource configuration before the migration**.  Further, RAN1describes **Option 3** as **very restrictive**  We do not see a major difference b/w Option 4 and Option 3 as they both rely on **semi-matched** configurations.  The **most important** message by RAN1 is that it should be possible to align child resource configuration **before**, **during** and **after** migration. It doesn’t matter so much if CU1 matches the config of CU2 or vs vica (i.e., option 1 or option 2). |
| Huawei | **Option1 or Option2** |
| Nokia | Option 1 or Option 2 |
| AT&T | We believe both Option 1 and Option 2 can be supported and it depends on the network deployment to determine which is appropriate. Also as pointed out in the RAN1 response, the entire configuration does not need to be updated at once, but subsets can be partially aligned to minimize disruption and either the parent or child node. |
| ZTE | Both option 1 and option 2 could be supported since the required signaling exchange can be supported already according to RAN1 agreements. |
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**Summary:**

Suggest following proposal:

**Proposal.**

## Issue 5: Synchronous application of the new configuration

Contribution ([2]) propose to discuss how to ensure that the configurations are applied at the same time, in case RAN3 agrees to go for a solution requiring reconfiguration of boundary node. To avoid resource conflict, the new configuration application should be done in a synchronized way.

**Q5: Please share your view on whether RAN3 need to ensure that the configurations are applied at the same time.**

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| **Company** | **Comment** |
| **Ericsson** | **Yes.**  If RAN3 lands at the decision that resource configurations are updated during inter-donor topology adaptation, we need to ensure that they are applied at the same time. Otherwise, we will have a solution with large service interruption. |
| Lenovo | This issue always exists in the cases of reconfiguration of any IAB-MT or IAB-DU. We need to avoid the issue, but it’s left to implementation. |
| Samsung | In general, we could see the benefit of apply the configuration at the same time. However, how to achieve it can be discussed further. Before discussing this, let’s focus on some basic things listed above. |
| QCOM | It is important that the resource configuration can be dynamically changed in compliance to channel and load conditions. Slight temporal mismatches are not very critical. |
| Huawei | yes |
| Nokia | The issue needs to be confirmed by RAN1, e.g. whether this is an issue (as commented by Lenovo), whether the “slight mismatch” (as commented by QCOM) is acceptable. |
| AT&T | We believe the issue of synchronized configurations can be somewhat mitigated by partially reconfiguring either the parent or child node before the migration event, and then completing the full reconfiguration (if needed) after the migration event. |
| ZTE | We share the same view with Nokia that this issue needs to be discussed in RAN1 first. |
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**Summary:**

Suggest following proposal:

**Proposal.**

## Any other issues

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# Phase 2 Discussion

# Conclusion, Recommendations

# References

1. R3-214672, Reply LS on IAB resource multiplexing (RAN1) LS in
2. R3-214827, Inter-Donor Resource Coordination in IAB Networks (Ericsson) discussion
3. R3-214928, Discussion on resource multiplexing in IAB (ZTE) discussion
4. R3-215348, Resource multiplexing (Nokia, Nokia Shanghai Bell) discussion
5. R3-215496, Enhancements for IAB resource multiplexing (AT&T) discussion
6. R3-215608, (TP for NR\_IAB\_enh BL CR for TS 38.423) IAB resource multiplexing (Huawei) other
7. R3-215614, [Draft] LS on IAB resource multiplexing (ZTE) LS out To: RAN1 CC: