**3GPP TSG-RAN2 #116-e R2-211xxxx**

**Electronic meeting, November 1st – November 12th, 2021**

**Agenda item:**8.4.3 (NR\_IAB\_enh-Core)

**Source:** vivo (Rapporteur)

**Title:** [AT116-e][033][eIAB] CP-UP separation (vivo)

**Document for:** Discussion and Decision

# 1. Introduction

This offline discussion aims to progress on impact of CP-UP separation and attempt to close open issues based on the contributions submitted to AI 8.4.3:

* [AT116-e][033][eIAB] CP-UP separation (vivo)

Scope: Progress impact of CP-UP separation, based on contributions to this meeting. Identify agreements, discussion points, can also capture open issues. Attempt to close open issues.

Intended outcome: Report

Deadline: Tuesday W2 (online CB)

The document consists of Phase -1 and Phase -2, the deadline of each phase is outlined as follow:

Phase -1: to settle scope what is agreeable etc, deadline: Thursday W1 Nov 4 1200 UTC

Phase -2: to formulate agreeable proposals, deadline: Thuesday W2 Nov 9 10:00 UTC.

Please note that the **Phase-2 deadline is different from the normal deadline Schedule 1** set by the Chair (which is by Thursday W2 Nov 11), as this document is supposed to be discussed at the IAB CB (13:35-14:55 UTC) on Tuesday W2.

# 2 Contact Information

To make it easier to find the correct contact delegate in each company for potential follow-up questions, the rapporteur encourages the delegates who provide input to provide their contact information in this table:

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| --- | --- |
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# 3 Phase-1 Discussion

## 3.1 Common aspects for both scenario 1/2

3.1.1 Configuration on F1-C transfer (MCG, SCG, or both)

With regard to the configuration on F1-C transfer, it is proposed in [1][2][4] that a solution similar to the one adopted in LTE can be considered, in which the *f1c-TransferPath* was introduced indicating whether the LTE or NR or both legs should be used in EN-DC deployment. In particular, the introduction of a new field *f1C-TransferPath-r17* can be used to indicate whether the SCG or the MCG or both should be used by the IAB node.

Though [5] also agrees the F1-C traffic transfer path configuration can be “(MCG, SCG, both)”, this may not be a future-proof way if multi-connectivity is supported. Therefore [5] proposes that RAN2 can tentatively discuss if it is agreeable to consider a configuration of indicating the used cell group ID.

**Q1:** **Which option do you prefer to support the configuration of F1-C traffic on the indication of the the leg(s) used for transferring the F1-C traffic (i.e., via the MCG, or the SCG or both the MCG and SCG).**

* **Option 1: a new field, e.g., *f1c-TransferPath-r17* ENUMERATED {MCG, SCG, both}, is indicated to IAB-MT;**
* **Option 2: a specific cell group ID (to be used for F1-C transfer) is indicated to IAB-MT.**

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| Company | Option 1/2 | Detailed Comments |
| Huawei, HiSilicon | Option 1 | This is more like R16 manner for F1 over LTE.  Multi-connectivity should not be considered. |
| LG | option 1 | We can simply follow the LTE style and also it is not clear how option 2 indicate both option. |
| QC | Option 1 | Similar to ENDC |
| Samsung | Both options | As rapporteur’s comment, we prefer the cell group ID for the future proof, but also ok with legacy method. |
| Fujitsu | Option 1 | Similar to R16. |
| Apple | Option 1 | RAN2 can discuss option 2 to support potential multi-connectivity in the future. |
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Summary: TBD

3.1.2 Whether F1-C is transferred over BH or RRC

RAN2 achieved the following agreements:

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| * F1-C over RRC and F1-C over BAP should not be supported simultaneously on the same parent link. |

Both [4][5] discuss how to support such agreement by identifying the following two options:

* Option 1: F1-C-over-BAP is selected as long as BH RLC CH for F1-C is configured.
* Option 2: An explicit configuration is sent to the IAB-MT by indicating either F1-C-over-BAP or F1-C-over-RRC

Contribution [4] considers that from the cell group configuration, the IAB node knows whether the BAP configuration is configured or not configured over that cell group. The IAB node also knows whether F1-C transfer via RRC or via BH should be used over the CG selected to be used to transfer the F1-C, e.g., according to the the *f1c-TransferPath-r17* configuration.

**Q2: Which option do you prefer to make IAB node be aware of whether to use F1-C transferring over BH or F1-C transferring over RRC?**

* **Option 1: F1-C-over-BAP is selected as long as BH RLC CH for F1-C is configured**
* **Option 2: An explicit configuration is sent to the IAB-MT by indicating either F1-C-over-BAP or F1-C-over-RRC**

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| Company | Option 1/2 | Detailed Comments |
| Huawei, HiSilicon | Option 1, but | Option 1 should be clarified as “as long as the BH RLC CH for F1-C on the indicated CG is configured”, where the CG is indicated by Q1. |
| LG | Option 1 |  |
| QC | Option 1 | Agree with HW’s revision |
| Samsung | Both options | We are ok with any option, but have slightly more preference on option 1 since in SA architecture option, it was natural to use BAP layer to carry F1C traffic, and using RRC is regarded as additional feature to have CP reliability. |
| Fujitsu | Option 1 | Option 1 saves the signalling overhead. |
| Apple | Option 1 | An explicit config seems not absolutely needed for now, but we are ok with that option as an alternative. |
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Summary: TBD

3.1.3 Donor-capable node vs. non-donor-capable node during cell selection

The contribution [2] observes that the current mechanism cannot distinguish donor-capable node from non-donor-capable node during cell selection. Based on the current spec, both the donor-capable and the non-donor-capable gNB will broadcast the IAB-support indication, which may cause the IAB-MT to select a non-donor-capable M-gNB. In case that the non-donor-capable MN could not find a donor-capable SN for the IAB-node, the IAB-node will not work. Therefore, the IAB-node should be aware of the actual capability of the parent node, i.e., whether the gNB allows “F1 over BAP” or only allows “F1-C over RRC”. This gives the IAB-node the right to decide whether to select a non-donor-capable M-gNB.

**Q3: Do you think that IAB-node should be able to know whether the gNB allows “F1 over BAP” or only allows “F1-C over RRC” during cell selection, in case the gNB broadcasts *iab-Support*?**

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| Company | Yes/No | Detailed Comments |
| Huawei, HiSilicon | Yes | The “non-donor-capable” issue is discussed in R3. Regardless of that, the indication from gNB to tell IAB-MT whether gNB providing “F1 over BAP” or “F1 over RRC” like service will help IAB-MT’s cell selection. |
| LG | No | We think that IAB node does not need to know whether the gNB allows “F1 over BAP” or only allows “F1-C over RRC” during cell selection.  The IAB donor CU will determine whether an IAB node needs to be connected to a parent wihch allows “F1 over BAP” or “F1-C over RRC” based on the whole IAB network status after IAB node connected to a parent. If needed, handover, e.g., migration, can be performed. |
| QC | No | Support of F1-C over RRC should be a capability of the node (similar to f1c-OverEUTRA in ENDC). DUs do not normally broadcast capabilities for UEs/MTs. |
| Samsung | No | We don’t understand the problem. In our thought, IAB node can select any of gNB (regardless of non-donor- / donor- capability), and if selected one is non-donor-MN, then it should be able to add donor-SN. That should be guaranteed by the operator’s deployment. Even in some corner case where non-donor-MN cannot find the donor-SN, still this MN can hand over the IAB node to the other non-donor-MN which can find the donor-SN. So, basically finding donor/non-donor capable node, and applying which scenario seem not to be a problem in IAB node perspective. |
| Fujitsu | No | No need to introduce a third type of donor node. |
| Apple | Yes | We think this can speed up IAB-MT’s cell selection. |
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Summary: TBD

## 3.2 Scenario 1 specific issues

During RAN2#113bis-e, the following agreements were made for the CP-CU separation topic:

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| **From RAN2#113bis-e**   * SRB2 can be used for F1-C transport in CP/UP-separation scenario 1 (FFS other cases) * Split SRB2 can be used for F1-C transport in CP/UP-separation scenario 2 (FFS other cases) |

It is proposed in [3] that ‘Only SRB2 is used for F1-C transport in CP/UP-separation scenario 1’, thus the open issue can be closed by removing ‘FFS on other cases’, if this proposal can be acknowledged by the majority.

**Q4: Do you agree that for scenario 1 only SRB2 is used for F1-C transport in CP/UP-separation scenario 1?**

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| Company | Agree/Disagree | Detailed Comments |
| Huawei, HiSilicon | Agree | This is the agreement already. |
| LG | Agree |  |
| QC | Agree |  |
| Samsung | Agree |  |
| Fujitsu | Agree |  |
| Apple | Agree if SRB3 is not supported | If SRB3 is allowed for scenario 2 in certain cases (refer to Q5) then to rely only on SRB2 in scenario 1 can create a slight imbalance in because SRB3 has higher priority than SRB2. In this case the FFS may be justified even though F1-C does not require high priority transfer. |
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Summary: TBD

## 3.3 Scenario 2 specific issues

In this section, the overall structure is outlined as:

* first to confirm if other cases are needed (e.g., SRB3),
* then to discuss how to support split SRB2,
* other (miscellaneous) issues .

3.3.1 FFS on the need of SRB3

[1][3][4] propose that SRB3 is NOT used for F1-C transport in scenario 2 as such would require more specification work without any extra benefit compared to split SRB2 requirement, while [5][6] hold the opposite view towards this issue. The arguments for both sides are generalized as follows:

* Arguments for NOT supporting SRB3:
  + F1AP messages can be treated as lower priority compared with essential RRC messages, no need to transfer F1-C traffic via SRB3. [1]
  + Requires extra standardization efforts in RAN3. A new Xn procedure may be needed so that the MN can request the SN to establish the SRB3 (This procedure already exists in the RAN3 specification for the fast MCG link recovery, but not for IAB.). [3][4]
* Arguments for supporting SRB3:
  + Over Xn interface, the split SRB2 establishment may be refused by the SN. In this case, the SRB3 can be used for the F1-C traffic transfer. [5]
  + RRC messages from the IAB node can be delayed by RRC messages from UEs, if only split SRB2 is used in scenario 2. This is because the RRC messages (transmitted via SRB0/1) from descendant IAB/UEs are included into an RRC container (e.g., ULInformationTransfer), and then transferred to the SCG using split SRB2.[6]

Based on the above contributions, companies are invited to express their views on the support of SRB3 in scenario 2.

**Q5: Which option do you prefer to support F1-C transport in scenario 2?**

* **Option 1: Only Split SRB2 (i.e., SBR3 is NOT supported)**
* **Option 2: SRB3 (in addition to the already agreed split SRB2)**

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| Company | Option 1/2 | Detailed Comments |
| Huawei, HiSilicon | Option 1 | How to ensure the split SRB2 establishment in Xn is the R3 issue, based on the R2 agreement on supporting split SRB2.  Latency is not that critical requirement for F1-C over RRC. The key point is for reliability. |
| LG | Option 2 | The current spec already support to configure both split SRB and SRB3 simultaneously and extra work would be small although SRB3 is supported.  Our original concern is that if only split SRB2 is used for Fl-c transfer in scenario 2, RRC messages for IAB node should be mixed with RRC messages for UEs and the imporatant control messags for IAB node can be delayed by these RRC messages for UEs. This may generate a connection control problem at the IAB node which supports lots of UEs and finally all UEs connected to this IAB node also have trobles. |
| QC | Option 1 | Agree with HW that split SRB2 establishment is R3 issue.  The latency issue for UE RRC messages is not specific to scenario 2. It also applies to scenario 1 when SRB2 is used. |
| Samsung | Option 2 | Setting up split SRB2 is also up to SN, and if SN cannot ack to the request for split SRB2, SN should be able to setup SRB3. We think spec impact to RAN3 for setting up SRB3 at SN is not a big deal since already the similar procedure exists as rapporteur’s comment.  And, share the concern with [6] on the possible delayed F1-C packet for the access UE’s RRC msg but unclear on descendent IAB node’s . |
| Fujitsu | Option 1 | This makes spec simple (SRB2 is used for both scenario 1 and 2). |
| Apple | Option 2 | OK to have SRB3 in addition to cover the exceptional cases. |
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Summary: TBD

3.3.2 How to support Split SRB2

Currently, only if the PDCP&RLC data volume is greater than the threshold, the RRC message may have the chance to be transmitted via the secondary RLC entity, as described in the excerpt from TS 38.323. Therefore some enhancements may be needed for the support of split SRB2 in scenarios 2.

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| else (i.e. the PDCP duplication is deactivated for the RB or the RB is a DAPS bearer):  - if the split secondary RLC entity is configured; and  - if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the primary RLC entity and the split secondary RLC entity is equal to or larger than *ul-DataSplitThreshold*:  - submit the PDCP PDU to either the primary RLC entity or the split secondary RLC entity;  <unrelated part is omitted>  - else:  - submit the PDCP PDU to the primary RLC entity. |

[3][4][5] propose that the IAB-MT should be able to use SCG for the F1-C traffic transmission via split SRB2 in scenario 2, if configured. Specifically, [4][5] proposes that the prerequisite for the use of SCG should be that *f1C-TransferPath-r17* (as discussed in Section 3.1.1) is configured to ‘SCG’ or ‘both’.

Companies are invited to answer the following question that if the autonomous modification is agreeable or not.

**Q6: Do you agree that the IAB-MT can autonomously modify the *primaryPath* to SCG leg to support F1-C transport in scenario 2** **via split SRB2?**

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| Company | Agree/Disagree | Detailed Comments |
| Huawei, HiSilicon | See comments | Not sure about the meaning of “autonomously modify”.  Maybe the first proposal to be achieved is the intention as rapporteur’s summary “the IAB-MT should be able to use SCG for the F1-C traffic transmission via split SRB2 in scenario 2, if configured”  In our understanding, the path of split SRB2 is controlled by the paramters of “*primaryPath*” in 38.331. |
| LG | Disagree | First of all, we doubt whether the rapporteur’s description is correct, i.e., “only if the PDCP&RLC data volume is greater than the threshold, the RRC message may have the chance to be transmitted via the secondary RLC entity”.  According to the current spec, the case mentioned by the rapporteur would not happen. As shown below, all SRBs including split SRBs has set ul-DataSplitThreshold to infinity and primaryPath is set to only MCG. This means that there is no case that RRC message may have the chance to be transmitted via the secondary RLC entity due to large data volume for SRB.  ul-DataSplitThreshold UL-DataSplitThreshold OPTIONAL, -- Cond SplitBearer  ***ul-DataSplitThreshold***  Parameter specified in TS 38.323 [5]. Value *b0* corresponds to 0 bytes, value *b100* corresponds to 100 bytes, value *b200* corresponds to 200 bytes, and so on. The network sets this field to *infinity* for UEs not supporting *splitDRB-withUL-Both-MCG-SCG*. If the field is absent when the split bearer is configured for the radio bearer first time, then the default value *infinity* is applied.  *SplitBearer* : The field is absent for SRBs.  ***primaryPath***  Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 [5], clause 5.2.1 for UL data transmission when more than one RLC entity is associated with the PDCP entity. In this version of the specification, only cell group ID corresponding to MCG is supported for SRBs.  What RAN2 need to do is to release the restriction on primaryPath in the RRC spec for supporting F1-C transport in scenario 2, i.e., in IAB, primaryPath can be configured with cell group ID corresponding to SCG for split SRB2, not touching PDCP spec.  For the modify the primaryPath, the following is specified in the MCG failure information section of current 38.331.  1> if SRB1 is configured as split SRB and *pdcp-Duplication* is not configured:  2> if the *primaryPath* for the PDCP entity of SRB1 refers to the MCG:  3> set the *primaryPath* to refer to the SCG.  We think that same approach can be applied here for suppoting F1-C transport in scenario 2. So, changing primaryPath should be specified. Considering that modification of primaryPath may not happen frequently, it is not preferred to have autonomously modifying the *primaryPath*. |
| QC | See comments | For IAB-MT’s RRC that does not carry F1-C/F1-C-related traffic, the IAB-MT sticks to the primaryPath configuration.  For IAB-MT’s RRC that carries F1-C/F1-C related traffic, the IAB-MT may use split SRB2 via SCG in scenario 2 if f1c-TransferPath-r17 indicates SCG or both regardless of the primaryPath configuration. |
| Samsung | Agree | We agree with that changing *primaryPath* to refer to the SCG makes use of SCG leg of split SRB2 regardless of the pending data size and minimum spec impact. And this approach is already used in the MCG failure Information procedure as indicated by rapporteure. But at the same time, this UE’s autonomous change also needs to be conditional when donor node configures IAB node’s *f1c-transferPath-r17* as to SCG or both.  Regarding LG’s analysis, we agree that there is no case that traffic is transmitted via secondary path for SRB case. However this is even worse case than selectively transmitting case with non-infinity threshold value. Anyhow, conclusion is to change the primaryPath value to SCG for IAB.  Regarding HW’s question on autonomous, we think the problem is this ULInformationTransfer msg would be continuously used not only for IAB f1c traffic but for normal RRC msg for this IAB node MT. Even if we agree to change the primary path into SCG, still when to change is questionable due to above mixed traffic case. I think on every arrival of ULInformationTransfer msg including F1c MT should change the primaryPath to SCG, otherwise MT should fall back to the original configuration for the normal RRC traffic. This can be called autonomous. |
| Fujitsu | Agree with the intention | This is related to the following Q7. What should the IAB-MT do if the split SRB2 RRC message contains both F1-C traffic and other information unrelated to IAB. |
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Summary: TBD

3.3.3 Other (miscellaneous) issues

Contribution [5] proposes to discuss that what should the IAB-MT do if the split SRB2 RRC message contains both F1-C traffic and other information unrelated to IAB. Two potential candidate solutions are also proposed in the contribution: follow legacy split SRB2 method or follow the configuration of F1-C transfer path.

**Q7: Which option do you prefer if the split SRB2 RRC message contains both F1-C traffic and other information unrelated to IAB?**

* **Option 1: follow legacy split SRB2 method.**
* **Option 2: follow the configuration of F1-C transfer path.**
* **Option 3: please specify.**
* **…**

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| Company | Option 1/2/3… | Detailed Comments |
| Huawei, HiSilicon | Option 2 | If CU considers other information is more important to follow legacy split SRB2 method, then donor implementation will not configured the F1-C transfer path.  So, it the F1-C transfer path is configured, it is assumed that other information can also use the same path/method as F1-C, i.e. option 2, from CU implementation.  Maybe, option 2 should be“follow the configuration of F1-C transfer path, if configured.” |
| LG | none | We don’t understand what is an issue here?  In our understanding, it doesn’t matter split SRB2 RRC message contains both F1-C traffic and other information unrelated to IAB.  PDCP entity doesn’t know what information is included in the RRC message and just perform according to the configuration for Split SRB2. That is, if the IAB node has configuration of F1-C transfer path, the PDCP entity performs based on this configuration, but If the IAB node dosen’t have configuration of F1-C transfer path, PDCP entity performs based on legacy configuration. Thus, this is not an issue and nothing is needed. |
| QC | Option 2 | The IAB-node may choose to transmit F1-C/F1-C related traffic and other non-IAB traffic in separate RRC messages. |
| Samsung | Option 1/2 | We are ok with both 1 and 2. But slightly prefer to follow the f1c transfer path. Since this can simplify the MT’s autonomous change operation to be applied whenever f1c traffic is included in ULInformationTransfer msg. Otherwise there should be one more condition in MT’s operation to evaluate if the ULInformationTransfer msg only include f1c traffic or not, and accordingly apply the different behaviour. |
| Fujitsu |  | Slightly prefer opton 1. |
| Apple | Option 2 | The IAB-node can select to carry traffic in separate RRC messages in this case. But no strong view. |
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Summary: TBD

As also discussed in Section 3.3.1, [6] observes that because the RRC messages (transmitted via SRB0/1) from descendant IAB/UEs are included into an RRC container (e.g., ULInformationTransfer), and transferred to the SCG using split SRB2, therefore the RRC messages from the IAB node can be delayed by RRC messages from UEs, this will further delay the connection control of the IAB node and be problematic. In order to solve the issue observed in the contribution, [6] proposes that a SRB for transferring RRC messages for IAB nodes should be different from a split SRB 2 which is used for transferring RRC messages for UE.

**Q8: Do you agree that a SRB for transferring RRC messages for IAB nodes should be different from a split SRB 2 which is used for transferring RRC messages for UE** **in the CP/UP-separation scenario 2?**

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| Company | Agree/Disagree | Detailed Comments |
| Huawei, HiSilicon |  | We should trust donor configuration. BTW, the SRB to be used is specficied for each RRC message in current RRC. Does the proposal intend to make many modification on the spec? |
| LG | Agree | In the scenario 1, RRC messages for an IAB node supporting CP-UP separation are transferred to the MCG through SRB0 or SRB1, while F1-C traffic including RRC messages for all descendent UEs are transferred to the MCG through SRB2 after encapsulating F1-C traffic into RRC container. This means that RRC message for IAB node may not be mixed up RRC message for UEs.  However, it is different in scenario 2. Those two RRC messages can be transferred on the same split SRB2. Our concern is that if RRC messages for IAB node is mixed with RRC messages for UEs on one split SRB2, the imporatant control messags for IAB node can be delayed by these RRC messages for UEs. This may generate a connection control problem at the IAB node which supports lots of UEs and finally all UEs connected to this IAB node also have trobles. |
| QC | Disagree | The latency issue for UE RRC messages is not specific to scenario 2. It also applies to scenario 1 when SRB2 is used. |
| Samsung | Disagree | We cannot have clear view on the problem as indicated in the answer of Q5. The RRC msgs for access UEs of the IAB node 2 (in the figure) is F1c traffic, will be included in RRC ULInformationTRnasfer msg, and go via split SRB2 to SN, which is the same as the problem statement in [6]. However descendent IAB node’s RRC message will be transferred via SRB0/1 and using BH Link not SCG link. We are unclear with the problem. |
| Fujitsu | Disagree | This will break legacy RRC operation. |
| Apple | Maybe | We are not sure on the implications along similar lines mentioned by Samsung. In our view there is a link with Q4/5. |
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Summary: TBD

# 4 Phase-2 Discussion

TBD

# 5. Conclusions

TBD

# 6. References

1. R2-2109614 Inter-donor CU topology migration, topology redundancy and CP-UP separation Intel Corporation discussion Rel-17 NR\_IAB\_enh-Core
2. R2-2109786 F1 over NR access link and CHO Huawei, HiSilicon discussion Rel-17 NR\_IAB\_enh-Core
3. R2-2110293 Miscellaneous issues on CP-UP separation vivo discussion Rel-17 NR\_IAB\_enh-Core
4. R2-2110888 Remaining Issues Related to CP/UP Separation in IAB Network Ericsson discussion NR\_IAB\_enh-Core
5. R2-2111088 CP-UP separation and other topology adaptation issues Samsung Electronics discussion NR\_IAB\_enh-Core
6. R2-2111157 Remaining issues on enhancements of topology adaptation and congestion mitigation LG Electronics Inc. discussion Rel-17 NR\_IAB\_enh-Core