3GPP TSG-RAN WG2 #113bis-e R2-21xxxxx

Electronic meeting, April 12th – 20th 2021

Agenda Item: 8.4.3

Source: CATT (Email discussion rapporteur)

Title: [Post113-e][057][ IAB17] CHO and DAPS for IAB (CATT)

Document for: Discussion

# Introduction

This document captures the outcome of the following email discussion [1]

* [Post113-e][057][IAB17] CHO and DAPS for IAB (CATT)

 Scope: Collect comments on the (potential) usage of CHO and DAPS, starting from agreements and previous input and discussions. Identify options / potential ways forward, easy agreements and discussion points. Detail level: Should focus on the next steps agreements.

 Intended outcome: Report

 Deadline: Long

This email discussion is divided in two phases:

* **Phase I** with the deadline on Tuesday March 23 1100 UTC (3am PST) for companies to provide their views.
* **Phase II** with deadline on Friday March 26 1100 UTC (3am PST) for companies to provide their views on the summary and suggested proposals.

As a reminder, the following agreements have been reached in previous meetings:

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| * **RAN2 Agreements**

**RAN2#112e*** CHO and potential IAB-specific enhancements of CHO is on the table.
* DAPS and potential IAB-specific enhancements of DAPS is not precluded for now (but as there is no PDCP it is not clear how to support DAPS).

**RAN3#113e*** Will indicate regarding P3 that R2 doesn’t understand what is asked by “DAPS-like”, Ask R3 to clarify what they want to achieve.
* RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration.
* R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed).
* R2 assumes that Rel-16 specification is the baseline for the configuration of default route, IP address(es) and target path for intra-donor CHO.
* **RAN3 Agreements**

**RAN3#111e****Discuss how to support simultaneous connectivity with 2 donors, to reduce service interruption; potential solutions may include dual-protocol-stack solutions (“DAPS-like”); FFS whether the same solution also applies to descendant nodes****The simultaneous connectivity dual-protocol-stack solutions (“DAPS-like”) of an IAB node should allow at least DL simultaneous transmission of BH traffic carried on BH RLC channels, on the paths to both donors.****Rel-16 CHO can be considered as baseline for the discussion of CHO for IAB; further analysis is expected****Rel-16 CHO is supported for INTRA-donor migration of IAB-MT****FFS whether the descendant nodes and UEs receive RRC reconfiguration messages before migrating IAB node connects to target path****RAN3 further studies “DAPS-like” solution after RAN2 has conclusions** |

Rapporteur encourages the participating delegates to provide your contact information in this table.

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| Company | Contact: Name (E-mail) |
| Kyocera | Masato Fujishiro (masato.fujishiro.fj@kyocera.jp) |
|  LG | SungHoon Jung (sunghoon.jung@lge.com) |
| Huawei | Yulong Shi (shiyulong5@huawei.com) |
| CATT | Sidong Li(lisidong@catt.cn) |
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# Discussion

## CHO

Rel-16 CHO is used for handover and RLF recovery for the purpose of service robustness. During Rel-17 eIAB discussion, both RAN2 and RAN3 agreed to take Rel-16 CHO as baseline for IAB-MT. At the first step, we can discuss if the use cases of Rel-16 CHO, i.e., handover and RLF recovery can be applicable to IAB-MT.

**Q1: Do you agree that the use cases for IAB-MT CHO should be handover and RLF recovery? If no,** **please provide the use case you suggested.**

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| **Company** | **Yes/No** | **Comments (if any)** |
| Kyocera | Yes | We think Rel-16 CHO was introduced for handover robustness improvements, so it’s still applicable to IAB.  |
| LG | Yes |  |
| Huawei | Generally fine | Not sure about the intention of this question. Which use case is excluded? If the intention to reuse the motivation from R16 CHO, it should be fine, as we already agreed to “R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT”.“Handover” should be “migration”. |
| CATT | Yes | This question is to clarify the details of use cases to make progress since we agreed “R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed)”.We have no strong preference for “handover” or “migration”. We think “migration” has no explicit definition and clear procedure, but we are OK for the terminology if all companies are fine with it. |
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In last meeting, RAN2 agreed to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration. Since inter-donor CHO has been postponed, we don’t discuss it in this email discussion. For intra-donor CHO, we find two potential cases: 1) intra-CU and intra-donor-DU CHO; and 2) intra-CU and inter-donor-DU CHO.

The possible differences between the two cases are:

* BAP address of migration IAB-node: In case 1, the BAP address of migration IAB-node can be unchanged during migration. In case 2, the destination DU can allocate another BAP address to the migration IAB-node. It may impact routing procedure.
* Migration IAB-node DU cell: In case 1, migration IAB-node DU cell for descendant IAB-nodes/UEs can be unchanged. In case 2, IAB-node DU cell could be reconfigured considering the resource pools in different donor-DUs. It may impact the mobility of descendant IAB-nodes/UEs, for example, whether the descendant IAB-nodes/UEs perform handover.

**Q2: Do you agree that we can discuss intra-CU/intra-DU CHO and intra-CU/inter-DU CHO separately? If yes, please identify potential issues you considered. If most companies answer no, we can consider common solution for the two cases.**

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| **Company** | **Yes/No** | **Comments (if any)** |
| Kyocera | Maybe No | We prefer a common solution for intra-/inter-DU CHO, even though we understand there’re some differences as the rapporteur pointed out. But we agree that it can avoid unnecessary confusion due to mixing the discussions for intra-/inter-DU CHOs We agree with the first analysis from the rapporteur, i.e., for BAP address. On the other hand, we’re wondering why the second analysis is the case, since the IAB-node is still connected with the same CU, i.e., the same donor.  |
| LG | No | Common aspect should be investigated first. Different aspects depending on intra/inter-DU cases can be discussed later, based on the discussion results of the common aspects.  |
| Huawei | No | There should be easy way to design common approach for intra-CU cases. Please note that R16 IAB already support the intra-CU migration regardless intra or inter donor-DU.Not fully agree that BAP address and resource pools of migration IAB-DU will change in the intra-CU inter-donor-DU case. |
| CATT |  | So a common solution for intra-/inter-DU CHO is preferred. |
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In last meetings, several open issues of CHO have been discussed in companies’ contributions. We list them as below.

**Open Issue 1: CHO execution condition**

CHO execution condition has been discussed in R2-2100226, R2-2101315, R2-2100359, R2-2100802, R2-2100903. The mentioned conditions are listed below.

* Condition 1: condEventA3;
* Condition 2: condEventA5;
* Condition 3: type-4 RLF indication;
* Condition 4: type-2 RLF indication;
* Condition 5: Event A4.

We think condition 1, 2, and 3 are supported in Rel-16 specification and the 3 conditions can be applied to IAB-MT CHO without specification revision. Other conditions need more discussion and verification.

**Q3: Do you agree that condEventA3, condEventA5 and type-4 RLF indication can be applied to IAB-MT CHO?**

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| **Company** | **Yes/No** | **Comments (if any)** |
| Kyocera | Yes, but… | Regarding Type 4 BH RLF indication, in Rel-16 we understand CHO is “executed” when the IAB-MT selects the CHO, as result of cell selection before RRC Reestablishment. However, I think Type 4 BH RLF indication is not the “trigger” of CHO. Also, the cell selection is up to IAB-MT implementation. So, we think Type 4 BH RLF Indication should “trigger” CHO in Rel-17.  |
| LG | Yes | Same as legacy (R16) |
| Huawei | Yes for A3, A5No for type4 indication  | We agree to reuse R16 basic solution. But type4 indication/detecting RLF is not the trigger condition for CHO.It means “type 4 indication” will be handled same as “detecting RLF”, and follows the rest R16 procedure (i.e. RLF->RRC re-establishment initiation->cell selection-> if CHO candidate cell selected, then CHO). |
| CATT |  | We agree HW’s clarification of Rel-16 procedure on type-4 RLF indication and CHO.So can we propose: 1) condEventA3 and condEventA5 are applied to IAB-MT as CHO execution conditions; 2) CHO configuration can be used in RRC re-establishment procedure which is triggered by type-4 RLF indication as Rel-16 specification? |
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**Q4: Please provide your suggestion on other CHO execution condition(s), such as condition 4 and condition 5 above, and provide your comments/explanations for further discussion.**

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| **Company**  | **Additional CHO execution condition** | **Comments/explanations to your suggested option if any** |
| **Kyocera** | 4 | Regarding Condition 4, i.e., “type-2 RLF indication”, we think it should be configurable by the donor, considering the same indication may be used for local rerouting. If Condition 4 is introduced, we wonder if RAN2 needs further discussion on how the IAB-MT determines the triggered cell for CHO, since Rel-16 CHO considers a cell fulfills Event A3/A5 as the triggered cell but it’s not the case in Condition 4. Regarding Condition 5, i.e., “Event A4”, we assume it was proposed for load balancing purpose, but we’re not sure if it’s aligned for the intention of CHO as in Q1 and/or Rel-16 baseline, i.e., it may not be an IAB-specific enhancement.  |
| **LG** | Only condition4 (reception of type-2 indication) | Condition 5 (event A4) may lead to triggering unnecessary CHOs |
| **Huawei** | None, at least not now | For 4): type2 indication, maybe it is not the best choice for IAB-MT to migrate to target cell, since the target cell does not becomes good enough at the time. Staying at the source cell to wait for the recovery may be the better choice for IAB-MT.For 5): A4. We see nothing new compared to R16 discussion. |
| **CATT** | Not now | Type 2 RLF indication does not instruct a steady state. It is possible for the parent IAB node to recovery successful. If CHO is performed upon receiving type-2 RLF indication, the descendant nodes and UEs may migrate and cause the network changed unnecessarily.But we can list the potential options on which most companies have interest for further discussion.  |
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**Open Issue 2:** **Impacts on descendant IAB-nodes/UEs**

The behaviors of descendant IAB-nodes/UEs were discussed in R2-2100359, R2-2100478, R2-2101283, R2-2100754, R2-2101766, and R2-2101071. Some issues are mentioned as following:

* CHO for descendant IAB-node(s) combined with CHO for migration IAB-node;
* Pre-reconfiguration for descendant IAB-node(s);
* Resource efficiency considering the reserved resources for descendant IAB-node(s)/UEs;
* Etc.

**Q5: Would you like to discuss the impacts on descendant IAB-nodes/UEs? If yes, please provide your comments/explanations for the potential issue(s).**

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| **Company** | **Potential Issues** | **Comments/explanations** |
| Kyocera | None | We wonder if the descendant IAB-nodes really need to perform handover during the intra-donor CHO at the parent, since the descendant nodes are still connected with the same serving cell, i.e., the same DU and CU, or the same parent and donor.  |
| LG | Migration of descendent IAB nodes and UEs | For intra-donor CHO, it is sufficient that intra-donor topology adaptation procedure as already specified in RAN3 spec applies for migration of descendent nodes and UEs.  |
| Huawei | Only one IAB-node is configured with the CHO trigger condition under this CU.Its descendant IAB-nodes/UEs should be (pre)configured with some candidate target configurations, according to the CHO configurations of top-level IAB node. | We got to specify/discuss the descendant IAB-MTs/UEs behavior anyway.The descendant nodes/UE needs to update the configuration accordingly (e.g. the routing table) due to the migration of top-level IAB nodes (applying new routing configuration in target cell).The issue is that source CU may not be aware of the CHO execution of the migration IAB-MT timely. |
| CATT | Migration of descendent IAB nodes and UEs | We are not sure if it is mandatory that IAB-DU cell should not be reconfigured when IAB-MT performing intra-donor/inter-donor migration.If the IAB-DU cell is not changed, descendant IAB-nodes may be reconfigured with new routing information.If the IAB-DU cell is changed, descendant IAB-nodes/UEs should perform RRC re-establishment if CHO is not configured. |
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**Q6: Do you see any other CHO issues, if not already discussed above?**

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| **Company** | **Other CHO issues** |
| **Huawei** | Do we allow multiple IAB nodes (e.g. one parent node and its child node) are configured with CHO at the same time? What if two IAB-MTs met the CHO trigger condition at the same time? |
| **CATT** | We propose to clarify if the IAB-DU cell should not be changed when IAB-MT performs migration before further discussion. |
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## DAPS-like

RAN3 considered the use cases of load balancing, robustness and reduction of service interruption for inter-donor topology adaptation in LS [R3-211326](file:///F%3A%5C%5C3GPP%5C%5CRAN3%5C%5C2021%5C%5CRAN3%23111-e%5C%5CChairmans_Notes%5C%5CInbox%5C%5CR3-211326.zip). However, RAN3 assumed that a DAPS-like solution for backhauling should be defined by RAN2. Then we can discuss the use cases for DAPS-like solution first.

**Q7: Which use case(s) do you prefer for DAPS-like solution, e.g., load balancing, robustness and reduction of service interruption?**

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| **Company** | **Answer** | **Comments** |
| Kyocera | Reduction of service interruption | We think Rel-16 DAPS was introduced for reduction in user data interruption during handover, so it’s still applicable to IAB.  |
| LG | None | RAN3 already consider DC as a baseline for simultaneous connectivity to two parents. Given this, we do not think DAPS-like solution is further needed. Whatever DAPS-like aims to achieve, we think DC based two parent connection can achieve the exactly same purpose.  |
| Huawei | None? | Not sure how to answer this, before we have the definition of “DAPS-like” solution.Please note the R3 LS mentioned “DAPS-like solution **for backhauling**” seems not reusing R16 DAPS to IAB-MT’s traffic. |
| CATT | Reduction of service interruption | We agree with Kyocera about the view of Rel-16 DAPs. But DAPs cannot directly be used in IAB, because IAB-node don’t have PDCP layer. RAN2 should discuss some enhancement on Rel-16 DAPS in order to apply it in IAB. Legacy DC can achieve the load-balance and robustness.So we propose DC is for load-balance and robustness, and DAPs-like is for reduction of service interruption. |
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In RAN2#112e, RAN2 deprioritized DAPS implicitly because it is not clear how to support DAPS of no PDCP in IAB-node. However, RAN3 agreed DAPS-like solution in RAN3#110e at the same time. Since it is not clear what the DAPS-like solution is, we need to confirm the basic understanding on DAPS-like solution.

Generally speaking, when the migration IAB-node performs inter-CU handover, the serviced UEs (including the UEs in subtree) have to perform handover with PDCP re-establishment. Similar to Rel-16 DAPS handover, dual-PDCP sublayers should be applied. In this case, other nodes (such as IAB-donor, UE’s accessed IAB-node and UE) will be impacted. If the migration IAB-node performs intra-CU migration, it is possible that PDCP sublayer is not involved. In this case, only the migration IAB-node is impacted. So we would like to confirm the involved sublayers and nodes for better understanding.

For clarification, potential DAPS-like architecture discussed in [3] is shown below. Note that during the discussion in [3], it was not decided there are one or two BAP entities in the migration IAB-node(IAB3) for DAPS-like. Our concern is, for inter-donor migration, the two parent IAB-nodes (IAB1 and IAB2) connects to two donor-CUs. If user data come from two donor-CUs and then from two PDCP entities (with independent ciphering, header compression), to reduce service interruption, more issues need to be considered except dual-protocol for the migration node.



Figure 1 Potential DAPS-like architecture for the migration IAB-node

**Q8: Should PDCP sublayer be involved in DAPS-like solution? (Do we need to consider the scenario that user data come from two donor-CUs when IAB-node performs migration?)**

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| **Company** | **Yes/No** | **Comments (if any)** |
| Kyocera | No for migrating IAB-node | The question is a bit unclear to us. We assume no PDCP involvement in the migrating IAB-node since it has no PDCP layer for user data relaying. We agree for inter-CU migration the PDCP entity in the UE needs to be re-established as the rapporteur pointed out, but it’s not in the migrating IAB-node.  |
| LG |  | If DAPS-like solution is merely to support simultaneous connectivity to two parents, PDCP does not have to be necessarily involved, but then DAPS-like solution is not really different from DC based dual-parent connection. For intra-CU migration with DAPS-like migration, descendent nodes and UEs should not be affected from PDCP point of view.  |
| Huawei |  | Not sure if all companies have the same understanding to interpret the “DAPS-like” solution as “PDCP layer involved DAPS”If we are talking about the UE’s E2E traffic, there should be no PDCP layer at any IAB-node. |
| CATT |  | This question is to clarify if we need to consider the scenario that user data come from two donor-CUs when IAB-node performs migration via dual-protocols connected to both source and target IAB-nodes. If yes, the migration node needs to deliver user data to UEs with corresponding PDCP configuration.We think this scenario is worth to be considered. |
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**Q9: Based on Q8, which node(s) should be impacted by DAPS-like solution?**

* **Option 1: migration IAB-node only;**
* **Option 2: migration IAB-node and other node/UE, such as the UE’s accessed IAB-node.**

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| **Company**  | **Preferred option** | **Comments if any** |
| **Kyocera** | Maybe Option 1 | It’s unclear to us what kind of DAPS-like solution is referred here, but we think RAN2 should aim to minimize the impacts in general.  |
| **LG** | Option1 | Given legacy UEs, UEs should not be impacted by DAPS-like migration.  |
| **Huawei** | ? | The question seems implying that DAPS-like solution only applies to migration procedure for the use case, which gives the answer to Q7. Some clarification is needed here.Not sure about the intention. Is this to ask whether to support intra-CU or inter-CU DAPS? |
| **CATT** |  | It’s too early to ask the question. We need to clarify Q8 first. |

RAN3 discussed NRDC and DAPS-like solution for inter-donor migration. NRDC has been taken as baseline. Currently, it is not clear the relationship between DC and DAPS-like solution. In Rel-16, only PCell is kept during DAPS handover for UE. We are not sure if this restriction is applied to DAPS-like solution for IAB-node, that is, only PCell is kept for IAB-node during DAPS-like procedure. Another explanation is that IAB-node can receive data from source path and a redundant path simultaneously. It looks like split data actually.

**Q10: Please provide your understanding on the relationship between DC and DAPS-like solution. For example, do you think only PCell is kept for IAB-node during DAPS-like procedure, or the DL simultaneous transmission comes from source path and a redundant path?**

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| **Company** | **Answer** | **Comments** |
| Kyocera |  | We have no strong view. We assume Rel-16 DAPS is the baseline for DAPS-like solution in general, but we see DL simultaneous reception from MCG and SCG during DAPS-like solution may reduce user data interruption during the migration although it may be complicated.  |
| LG |  | It is immature to discuss this until it is clear what DAPS-like solution really is.  |
| Huawei |  | We are also confused about the difference with NR-DC and DAPS-like. It seems DAPS-like does not provide any additional benefits in addition to NR-DC (please note NR-DC was already agreed by R3).Also, before we have the same understanding on “DAPS-like”, it is hard to clarify what’s the relationship with NR-DC. |
| CATT |  | Referring to Figure 1, we assume in DAPS-like solution, the migration IAB-node should connect to only one parent node before migration is started, and after migration is completed successfully. |
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**Q10a: Since it is difficult to discuss further before we know what DAPS-like is, can we agree to take below figure (consist of two independent protocol stacks “PHY/MAC/RLC” defined in the MT, 1 or two BAPs in the migration node is FFS) as the start of DAPS-like architecture discussion?**



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| **Company** | **Answer** | **Comments** |
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Except for above discussion, some other issues could be identified, such as one or two BAP entities for the migration IAB-node which had been discussed in last meeting.

**Q11: Would you like to discuss more detailed issues for DAPS-like solution? If yes, please provide your comments/explanations for the potential issue(s).**

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| **Company** | **Potential Issues** | **Comments/explanations** |
| LG |  | It is hard to discuss this until what DAPS-like solution really is.  |
| Huawei |  | Agree with LG. |
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# Conclusion

To be updated

# Reference

1. Draft RAN2#113-e Chairman Notes
2. RAN3\_111-e\_agenda\_with\_Tdocs20210204\_EOM
3. R2-2102288 Summary of [AT113-e][030][eIAB] Reply LS DAPS-like solution (Ericsson) Ericsson
4. R2-2102364 Reply LS on DAPS-like solution for service interruption reduction
5. [R3-211326](file:///F%3A%5C3GPP%5CRAN3%5C2021%5CRAN3%23111-e%5CChairmans_Notes%5CInbox%5CR3-211326.zip) LS on DAPS-like solution for IAB
6. R2-2102238 Report from email discussion [Post112-e][066][eIAB] Topology Adaptation Qualcomm Incorporated discussion Rel-17
7. R2-2101071 Consideration of topology adaptation enhancement for R17-IAB Huawei, HiSilicon discussion Rel-17 NR\_IAB\_enh-Core
8. R2-2100359 Discussion on Topology adaptation enhancements Intel Corporation discussion Rel-17 NR\_IAB\_enh-Core
9. R2-2100802 Further consideration of topology adaptation enhancements for eIAB Kyocera discussion Rel-17
10. R2-2100903 Topology adaptation enhancements in IAB Sony discussion Rel-17 NR\_IAB\_enh-Core
11. R2-2101261 Topology adaptation enhancements for IAB AT&T discussion
12. R2-2100886 Discussion on topology adaptation enhancements in eIAB Networks Apple discussion Rel-17 NR\_IAB\_enh-Core
13. R2-2101283 Considerations on topology adaptation enhancements in IAB ZTE, Sanechips discussion Rel-17
14. R2-2101315 On IAB Topology Adaptation InterDigital discussion Rel-17 NR\_IAB\_enh-Core
15. R2-2101798 RAN2 impacts of Rel.17 IAB topology adaptation enhancements Futurewei Technologies discussion R2-2010490
16. R2-2100360 Discussion on RAN3 LS of DAPS-like solution Intel Corporation discussion Rel-17 NR\_IAB\_enh-Core
17. R2-2101449 On IAB Inter-donor Topology Adaptation Ericsson discussion NR\_IAB\_enh-Core
18. R2-2100226 CHO and DAPS CATT discussion NR\_IAB\_enh-Core
19. R2-2101109 CHO in IAB system Lenovo, Motorola Mobility discussion Rel-17
20. R2-2101766 Discussion on Resource Reservation for CHO ETRI discussion Rel-17 NR\_IAB\_enh-Core
21. R2-2100478 On inter-CU Topology Adaptation Enhancements vivo discussion NR\_IAB-Core
22. R2-2101450 LS on DAPS-like solution for service interruption reduction Ericsson LS out Rel-17 NR\_IAB\_enh-Core To:RAN3