**3GPP TSG-RAN WG3 Meeting #112-eR3-212677**

**Online, May 17th- 27th 2021**

Agenda Item: 13.2.1.2

Source: Ericsson (moderator)

Title: Summary of Offline Discussion on IAB CHO and DAPS

Document for: Approval

# Introduction

This is the SoD for the following comeback: **CB: # 37bis\_IAB\_CHO-DAPS**

The deadline for providing replies to Phase 1 is **Thursday, May 20th at 23.59 UTC.**

Relevant papers:

1. R3-211725 On the Use of Conditional Handover and Dual IAB Protocol Stack in IAB Networks (Ericsson)
2. R3-211799 IAB topology adaptation (CHO&DAPS-like and Procedure Details) (CATT)
3. R3-212083 Considerations on intra-CU CHO (KDDI Corporation)
4. R3-212413 IAB topology update procedure (Huawei)
5. R3-211891 discussion on Inter-Donor IAB Node Migration (Nokia, Nokia Shanghai Bell)
6. R3-212046 Discussion on inter-donor IAB migration (Fujitsu)
7. R3-212038 Discussion on reduction of service interruption, intra-donor CHO and RLF (ZTE)
8. R3-211424 Reply LS on DAPS-like solution for service interruption reduction (RAN2)

NOTE: some of the above papers were submitted to other AIs, such as 13.2.1.1 and 13.2.2. However, they are considered in this CB since they contain relevant proposals.

# For the Chairman’s Notes

TBW

# Discussion

## CHO for IAB node migration

The main topic discussed in the papers is how to inform the descendant nodes of the top-level IAB node and served UEs about the configurations to be applied after the top-level node has migrated by means of CHO.

Paper [4] proposes that the target configurations in intra-donor migration (e.g. TNL address, new default BAP configuration) are preconfigured at the descendant nodes and UEs, and these configurations will be activated once the top-level (TL) node has executed the CHO.

Paper [6] discusses the use of CHO for inter-donor load balancing and RLF recovery, and the ways to update the configuration at descendant nodes and UEs. The following 4 options are proposed to be discussed:

* Option 1: The CHO/recovery IAB-node indicates the descendent nodes and UEs to initiate RLF recovery or RRC re-establishment procedure.
* Option 2: The descendent nodes and UEs are configured with CHO, and the CHO/recovery IAB-node indicates the descendent nodes and UEs to apply the conditional configuration.
* Option 3: The target/new donor CU transmits RRC re-establishment or RRC reconfiguration message to the descendent nodes and UEs to update their configuration.
* Option 4: The target/new donor CU transmits the configuration for the descendant nodes and UEs in an F1AP message to the CHO/recovery IAB-DU. The CHO/recovery IAB-DU then forwards the configuration to the descendent IAB-nodes or UEs.

Paper [7] proposes a call flow for the intra-donor CHO procedure.

Paper [2] discusses inter-donor CHO with respect to whether the DU cell of migrating IAB node is changed or unchanged after IAB-MT migration:

* When the DU cells served by the migrating node are unchanged, it is proposed that RRC reconfiguration to the descendant IAB-node can be pre-configured by source CU and activated certain RRC reconfiguration message by the top-level node after a successful CHO. Herein, the reconfigurations refer to e.g. routing parameters.
* For the case when the DU cells served by the migrating node are changed, it is proposed that RAN3 discusses whether source IAB-donor CU can get new DU cell information of the migration node beforehand.

***Q1-1: Please state your view on the above.***

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| **Company** | **Answer and motivation** |
| **Ericsson** | Our view can be summarized as follows:   * As of today, we can discuss the inter-CU case **only in the sense of proxy-based solution for inter-donor topology adaptation,** because IAB-DU migration still needs to be analysed and discussed. In that respect, for the **proxy-based** solution, there is **no need to reconfigure or inform the descendants about CHO execution** by the top-level node because the descendants will not migrate (they remain connected to the old donor). * Since, RAN3 agreed that Rel16 CHO is supported for **intra-CU** migration, there is nothing more to be done in that context. * Even if CHO would be studied for full inter-CU migration, it **makes no sense to reserve resources at multiple candidate cells for both the top-level node and the descendants**. Even in full migration, it is the top-level MT that migrates first, after which the descendants are reconfigured to access the new cells served by their current parent. Not only that these new cell parameters are unknown in advance (i.e. before the top-level MT migrates), but it is also that configuring the CHO to the descendants once the potential new cell parameters are known would slow down the full migration and prolong service interruption. * Regarding the **configuration of CHO to the descendants and UEs**, and notification about which configuration to apply, there is an obvious UE impact, which is against the principles of the IAB WI of avoiding the UE impact. Also, we wonder what is the point with IAB-specific CHO enhancements that can be applied to child nodes, but not to UEs?   Based on the above, we propose the following:  **Proposal 1: For IAB topology adaptation, the Rel16 CHO is applied to as is, and it is applied only to the top-level IAB node.** |
| Samsung | In general, we agree the analysis given by Ericsson.  We would like to see a scheme to reduce the impact to the descendant nodes as little as possible since multiple cell preparation is the resource consumption. Based on this intention, we can say CHO can be applied to top-level IAB-MT at least. For other descendant nodes, whether the impact can be avoided or not need further discussion. So, we propose to re-phrase Ericsson’s proposal as:  **Proposal 1: For IAB topology adaptation, the Rel16 CHO is applied to as is, and it is applied to the top-level IAB node at least. FFS on descendant nodes.** |
| Qualcomm | There seems to be consensus that off-the-shelf Rel-16 CHO can be used for IAB-MT migration.  **Proposal: Rel-16 CHO can be used for IAB-MT migration.**  For INTRA-donor IAB-node migration, the descendant nodes do NOT perform handover and therefore they do NOT need to perform CHO either.  For INTER-donor IAB-node migration, UEs and child MTs ONLY have to perform handover during IAB-DU migration, but not during the IAB-MT migration.  R3-211739 proposes to use Rel-16 CHO for UEs and child MTs during IAB-DU migration. Again, this would have nothing to do with the migration of the top level IAB-MT.  **We do not agree with Ericsson’s and Samsung’s proposal since CHO could be used by a descendant IAB-MT during migration of the parent DU.** |
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Paper [3] discusses CHO for intra-donor migration and argues that descendant nodes should be able to decide whether to change their serving parent after the top-level node has migrated.

***Q1-2: Should the descendant nodes of the top-level node be able to decide whether to change their serving parent after the top-level node has migrated?***

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| **Company** | **Answer and motivation** |
| **Ericsson** | No, for the following reasons:   * We believe that allowing this degree of freedom to descendants will not only complexify network management, but also cause a lot of signalling and prolong service interruption. * The proposal for the IAB-DU to send CHO notifications to descendants mandates the IAB-DU behaviour, which we should avoid. Also, it is unclear how to inform the UEs, which shall not be impacted. * The above implies that old CU cannot exactly tell the new CU about the necessary resources, since it is unclear whether some of the devices will remain being served by the top-level node. |
| Samsung | FFS for now because the following aspects are unclear :   * Whether the information to descendant node is needed or not * How to react when descendant node receives information, e.g., perform re-establishment, keep connection with parent, etc. * The inter-donor migration procedure   The first two aspects may need RAN2 input. |
| Qualcomm | No. There seems to be a misunderstanding.  During INTRA-donor migration, the descendant node has a perfectly good link to its parent node DU, the parent node DU does NOT change, and therefore, the descendant node should NOT change parent node. |
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## Dual IAB Protocol Stack (DIPS) and DAPS-like solution

The RAN2 LS reply on DAPS-like solution [8] calls for clarifications and further consultations with other RAN groups, implying that the discussion is to be first continued in RAN3.

Paper [1] proposes one understanding of the DAPS-like solution therein referred to as the **Dual IAB Protocol Stack (DIPS)**. Paper [1] further argues that the DAPS-like solution is not an enhancement of DAPS and proposes that no enhancements of Rel-16 DAPS are introduced in IAB Rel-17.

Paper [5] proposes that the DAPS-like solution is not further discussed in Rel17, questioning the benefits compared to NR DC.

***Q2-1: Please state your view of DAPS-like solution/Dual IAB Protocol Stack.***

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| **Company** | **Answer and motivation** |
| **Ericsson** | We propose that RAN3 agrees **Dual IAB Protocol Stack (DIPS)** as a solution for **load balancing**. Note that DIPS is **not an enhancement of Rel-16 DAPS.**  **What is DIPS?**   * The DIPS comprises two protocol stacks in the boundary IAB-MT, including the PHY, MAC, RLC and BAP layers. Each protocol stack is then controlled by one CU. DIPS supports both simultaneous UL and simultaneous DL transmissions from/to two donors.     What is **the advantage of DIPS over NR DC?**   * RAN3 has previous agreed that “***The boundary IAB node belongs to two topologies of two donor CUs”***. This means that the IAB node will have two BAP addresses, one for each topology, where each address will be managed by its respective CU. Applying NR DC, where IAB node has one BAP entity, would effectively mean that this **one BAP entity is being controlled by two different CUs**, which is **an example of bad design**. Therefore, the **boundary node should have two BAP entities, each controlled by one and only one CU.** * In relation to the above, it may be the case that **some BAP features configured by one donor are not supported or configured by the other donor**. Having independent BAP entities allows that each CU configures the BAP layer according to the capabilities of the IAB-MT and the configuration in the respective network. * In general, since **minimal coordination between CUs is preferred**, there may be cases in which the source and the target network assigns identical IDs e.g. BAP Path IDs and BAP addresses for the migrating node. If there are two independent BAP entities and each CU configures its BAP, **there will never be a conflict even if they would use same IDs**.   What is the **use case for DIPS?**   * A congested IAB node sets up two legs towards two donors. This **dual-leg establishment could be active until the congestion is alleviated,** where some or all the traffic traversing/terminating at the top-level node is offloaded via the leg towards the new donor. The traffic is still controlled by the old donor, and the new donor DU shares the load. * The above setup can also be applied **for network robustness i.e. inter-donor RLF recovery**, where the traffic pertaining to the leg subject to RLF can be moved to the leg that works fine. |
| Samsung | The original intention of raising DAPS-like solution is to resolve the service interruption during the migration procedure. Specifically, when the top-level IAB-MT is performing the migration procedure, the service may be interrupted during the following periods:   * Period 1: the top-level IAB-MT performs RACH towards the target parent node * Period 2: the migration of F1 transport path in case of IAB-MT migration method, or the migration of IAB-DU in case of full migration method   DAPS-like solution can resolve the service interruption in above two periods. This solution requires that the IAB-MT has the capability of connecting two parent nodes during the migration procedure. In Rel-16 DAPS, UE has such capability only for DL, that’s why we need ask RAN2 advice on UL.  For DIPS solution, we still didn’t see clear difference between DIPS and NR-DC. It seems Ericsson’s focus is on the protocol stack at the boundary IAB node. However, in our understanding, NR-DC also requires the boundary node have two BAP layers. Since NR-DC is already agreed, we may not need to take further discussion on DIPS unless DIPS can introduce big benefit on top of NR-DC.  In summary,   * **DAPS-like solution: it aims at service interruption reduction during migration procedure. Such solution can be considered as the extension of Rel-16 DAPS to BH link so that the top-level migrating IAB node can keep DL reception at both source and target links at BH RLC CH level. FFS on simultaneous UL transmission.** * **DIPS is only discussed if additional clear benefit is identified on top of NR-DC.** |
| WI Rapporteur | This topic is in RAN2 scope. We passed it over to them. Let’s please not spend time on this in RAN3. |
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Before proceeding, it is important to establish a RAN3 common understanding of the concepts under discussion. Given that no concepts other than DIPS have been proposed in the “DAPS-like” discussion, it would be reasonable to acknowledge the equivalency between the DAPS-like solution and DIPS. Hence, the proposal is:

**Proposal 2-1: RAN3 to confirm the understanding that the DAPS-like solution currently under discussion is equivalent to the Dual IAB Protocol Stack (DIPS), as defined in R3-211725.**

Moreover, as argued in paper [1] (i.e. R3-211725), DIPS is not an enhancement of DAPS.

**Proposal 2-2: RAN3 to confirm the understanding that the DAPS-like solution is not an enhancement of DAPS.**

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| **Company** | **Agree/disagree + motivation** |
| **Ericsson** | Agree to both proposals. |
| Samsung | Disagree.  The target scenario for DAPS-like solution is different from DIPS.  DAPS-like solution is an enhancement of Rel-16 DAPS. |
| WI Rapporteur | This topic is in RAN2 scope. We passed it over to them. Let’s please not spend time on this in RAN3. |
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Paper [2] proposes to apply the DAPS-like concept for reduction of service interruption in the scenario where the top-level IAB-MT is connected to only one donor before, and only one donor after the topology adaptation (i.e. to the old donor before and the new donor after). Meanwhile, the assumption in paper [1] is that DIPS is a solution for enabling simultaneous connectivity of the boundary node to two donors.

***Q2-2: In scenarios under discussion, is the DAPS-like solution/Dual IAB Protocol Stack applicable for IAB nodes capable of simultaneous connectivity to two donors or for IAB nodes capable of connecting to only one donor at a time?***

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| **Company** | **Answer** |
| **Ericsson** | DIPS is a solution for enabling **simultaneous connectivity** of the boundary node **to two donors.** |
| Samsung | At this moment, we can only say DAPS-like solution is considering **the IAB node capable of simultaneous DL connectivity to two parent nodes, FFS for UL**. |
| WI Rapporteur | This topic is in RAN2 scope. We passed it over to them. Let’s please not spend time on this in RAN3. |
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Given that a clarification to the DIPS-related expressed in paper [5] was provided in the answer to Q2-1, the Moderator would like to set forth the following proposal for discussion:

**Proposal 2-3: RAN3 to introduce Dual IAB protocol stack (DIPS) for load balancing.**

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| **Company** | **Agree/disagree + motivation** |
| **Ericsson** | Agree, as explained above. |
| Samsung | Disagree since the difference between DIPS and NR-DC is unclear. |
| WI Rapporteur | This topic is in RAN2 scope. We passed it over to them. Let’s please not spend time on this in RAN3. |
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During earlier RAN3 discussions, concerns were expressed about simultaneous UL transmissions, and RAN2 was liaised accordingly. The LS reply from RAN2 on DAPS-like solution in [8] states the following:

*“RAN2 also believe that RAN1 should be consulted as to whether simultaneous UL transmissions can be supported in Rel-17 from their point of view.*

*RAN2 respectfully asks RAN3 to clarify what is intended for DAPS-like solution and what should be achieved with that. RAN2 also recommends consulting RAN1 as to whether simultaneous UL transmissions can be supported in Rel-17 from their point of view.”*

In case the RAN3 companies do not have a common view about support for simultaneous UL for the DAPS-like solution, RAN1 can be invoked, as suggested by the LS reply from RAN2.

**Proposal 2-4: RAN3 to liaise RAN1, asking whether simultaneous UL transmissions from an IAB-MT can be supported in Rel-17.**

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| **Company** | **Agree/disagree + motivation** |
| **Ericsson** | Agree, **RAN3 should liaise RAN1** and ask whether simultaneous UL transmissions can be supported in Rel-17. |
| Samsung | Agree. However, we need have a clear concept of DAPS-link solution before sending LS. |
| WI Rapporteur | This topic is in RAN2 scope. We passed it over to them. Let’s please not spend time on this in RAN3. |
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