3GPP TSG RAN WG1 Meeting #102-e R1-2006826

17th Aug– 28th August 2020

Agenda Item: 8.10.2

Source: Moderator (Qualcomm Incorporated)

Title: Summary of [102-e-NR-eIAB-02]

Document for: Discussion and decision

### Introduction

This contribution provides a summary of the following email discussion:

[102-e-NR-eIAB-02] Email discussion on other enhancements for simultaneous operation of IAB-node’s child and parent links by 8/28– Luca (Qualcomm)

* Prioritize topics to be resolved in RAN1#102-e by 8/19

### Summary of discussion on prioritization of discussion topics

Based on the discussion on prioritization in the [102-e-NR-eIAB-02] email thread, it was generally agree to discuss the following topics according to the specified priority:

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| **Timing modes:**1. Discussion on which additional timing modes besides Case 1 (prioritizing Case 6 and Case 7 timing and leveraging the discussion that has already taken place in SI/Rel-16 on the same) are needed / useful for which duplexing scenario under which conditions. **HIGH PRIORITY**
2. Discussion on prioritization / focus in Rel-17 for additional timing modes –**MEDIUM PRIORITY**and conditional on agreement on high priority portion of proposed Topic 1 and Topic 2 of email thread [102-e-NR-eIAB-01]

**Interference mitigation:**1. Discussion on which interference scenarios apply to which duplexing scenario under which conditions. **HIGH PRIORITY**
2. Discussion on available solutions (e.g. Rel-16 CLI framework) and/or need and prioritization for Rel-17 IAB specific enhancements for handling the identified interference scenarios –**MEDIUM PRIORITY**and conditional on agreement on high priority portion of proposed Topic 1 and Topic 2 of email thread [102-e-NR-eIAB-01]

 **Power control:**1. Discussion on the need for power control for which duplexing scenario under which conditions –**HIGH PRIORITY**
2. Discussion on prioritization / focus in Rel-17 for power control enhancements –**MEDIUM PRIORITY**and conditional on agreement on high priority portion of proposed Topic 1 and Topic 2 of email thread [102-e-NR-eIAB-01]

 In the above, “conditions” is defined as the key attributes of the scenario which are relevant for RAN1 e.g. FR1 vs. FR2, in-band/out-of-band, TDD spectrum considerations such as RAN4 Scenarios 1/2, high-level antenna designs/RF architectures, deployment considerations etc.), as defined in the [102-e-NR-eIAB-01] email thread. |

### Discussion on timing modes

**Topic 1**

This topic relates to the discussion on which additional timing modes besides Case 1 (prioritizing Case 6 and Case 7 timing and leveraging the discussion that has already taken place in SI/Rel-16 on the same) are needed / useful for which duplexing scenario under which conditions.

Input from related contributions:

|  |  |
| --- | --- |
| Huawei, HiSiliconR1-2005261 | ***Observation 3****: Case #6 timing mode can achieve transmission timing alignment, which facilitates joint transmission of child and parent links of IAB node and mitigates the interference between MT and DU.****Observation 5****: Case #7 timing mode can achieve symbol-level timing alignment, which facilitates joint reception of child and parent links of IAB node.****Proposal 1:*** *Case #6 timing should be supported to mitigate interference in MT Tx/DU Tx scenario*.***Proposal 2:*** *Case #7 timing need to be supported for IAB to enabling better interference mitigation for simultaneous reception.****Proposal 3:*** *A Case #7-like timing mode can be adopted to enhance self-interference cancelation in UL full-duplex.* |
| VivoR1-2005400 | ***Proposal 1: To maintain simultaneous transmission between MT and DU, IAB node should support the Case #6 timing mode as defined in TR 38.874.******Proposal 2: To maintain simultaneous reception between MT and DU, IAB node should support the Case #7 timing mode as defined in TR 38.874.*** |
| AT&TR1-2005952 | **Proposal 4: New timing alignment mechanisms beyond Case 1 timing should be considered in Rel-17 for SDM/MPTR scenarios in resources which are orthogonal from those used by access or TDM-only backhaul links.** |
| LG ElectronicsR1-2006383 | ***Proposal 1:*** * Timing alignment mechanism for ‘case #6 (MT Tx / DU Tx)’ and ‘case #7 (MT Rx / DU Rx)’ of the IAB timing mode are considered as a starting point for specification work
* New cases of IAB timing mode for the other simultaneous scenarios (i.e., MT Tx / DU Rx and MT Rx / DU Tx) are identified.
	+ Case #8: Case#1 + The UL transmission timing of an IAB-node can be aligned with the IAB-node's UL reception timing.
	+ Case #9: Case#1 + The DL reception timing of an IAB-node can be aligned with the IAB-node's DL transmission timing.

***Proposal 2:*** * Simultaneous IAB-MT Tx and IAB-DU Tx can be operated by network configuration. Also, IAB timing mode case#6 can be operated by network configuration.
	+ When simultaneous IAB-MT Tx and IAB-DU Tx is configured, IAB timing mode case #6 (MT UL Tx time is aligned with DU DL Tx time) can be applied according to network configuration.
* When IAB timing mode case#6 is allowed, MT may apply timing advance value determined by DU DL Tx time.
* If network allows both TDM and simultaneous MT Tx/DU Tx, and IAB timing mode case#6 is allowed, MT may apply one of two timing advance values depending on IAB resource multiplexing.
 |
| NTT DOCOMOR1-2006745 | **Proposal 2: Case #6 and #7 timing modes should be considered for IAB node which has single transceiver/antenna panel.** |
| QualcommR1-2006826 | **Observation 3:****The benefits of Case 6 and Case 7 timing modes may be limited in a multi-panel implementation aimed at enhanced duplexing capabilities between the IAB-MT and the IAB-DU. Case 7 timing may have a higher benefit than Case 6 timing.** |
| EricssonR1-2006904 | **Observation 2 Simultaneous transmission and reception on child and parent links can be enabled by supporting Case-6 and Case-7 timing alignment configurations.****Proposal 3 Case-6 OTA timing alignment should be supported, if simultaneous transmission on parent and child links is supported for Rel-17 IAB.****Proposal 4 Case-7 OTA timing alignment should be supported, if simultaneous reception on parent and child links is supported for Rel-17 IAB.** |

There is a majority view that Case 6 and Case 7 timing modes can provide some benefit in at least some scenarios, e.g. SDM with single panel implementation.

For reference, the four main multiplexing scenarios from the Rel-17 WID are:

Case 1: Simultaneous MT-Tx/DU-Tx

Case 2: Simultaneous MT-Rx/DU-Rx

Case 3: Simultaneous MT-Rx/DU-Tx

Case 4: Simultaneous MT-Tx/DU-Rx

In reference to the above multiplexing scenarios the following conclusion is proposed:

**FL Conclusion 1:**

**The applicability of Case 6 and Case 7 timing to the defined multiplexing scenarios is summarized in the following table as a function of single panel vs. dual panel implementation:**

|  |  |
| --- | --- |
| **Applicability / Benefit of Case 6 and Case 7 timing**  | **IAB-Node implementation** |
| **Single Panel** | **Dual Panel** |
| **Multiplexing scenario** | **Case 1: Simultaneous MT-Tx/DU-Tx** | Case 6 | N/A |
| **Case 2: Simultaneous MT-Rx/DU-Rx** | Case 7 | N/A |
| **Case 3: Simultaneous MT-Rx/DU-Tx** | N/A | N/A |
| **Case 4: Simultaneous MT-Tx/DU-Rx** | N/A | N/A |

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with FL Conclusion 1?** | **Comments** |
| Qualcomm | Yes | None |
| LG Electronics | For Case 1 and Case2, Yes.But, For Case 3 and Case 4, No | For case 1 and case2 of multiplexing scenario, case 6 and case 7 can be considered. In addition, new timing alignment cases should be defined for case 3 and case 4 of multiplexing scenario if single panel based operation is assumed for the scenarios. |
| CMCC | Yes, for Case 1/2; No, for Case 3/4 | Regarding Case 4, with single panel, we believe that case 7 should be considered so that it is beneficial to self interference cancellation; regarding case 3, it seems that only case 1 can be supported for single panel. |
| NTT DOCOMO | Yes |  |
| ZTE, Sanechips | Yes | For case-3: if the target of timing alignment is to satisfying both of following conditions:* DL Tx of the IAB node and DL-Tx of its parent are time-aligned; 🡨 this is case-1 timing requirement which seems to be the basis for any inter-node resource coordination.
* DL-Tx of the IAB node and DL Rx of the same IAB node are time-aligned. 🡨 this is what simultaneous MT-Rx/DU-Tx targets.

Then the combination of above two leads to alignment between DL-Tx of the parent and the DL-Rx of the IAB node, which means the one-way propagation delay is zero --- infeasible to implement unless giving up case-1 timing. For case-4, I copy our comment from [eIAB-01] to here:In case 4, “timing alignment possible with parent timing advance” looks ok in theory but can have serious problem in practice: Any (controlled or autonomous) adjustment of UL-Tx timing of an IAB node on i-th hop may lead to adjustments of UL-Tx timing in IAB nodes that are on all follow-up hops. The worse is that these adjustments inside IAB nodes may not be able to well sync-up with each other and it is hard for IAB node and its parent to know when the sync-up is well-done. In addition, the case-4 timing requires the UL-Rx timing (or UL Tx timing) are strictly advanced to earlier time as IAB node’s hopping number increases, which could be a new restriction to deployment planning.  |

**Topic 2:**

This topic relates to the discussion on prioritization / focus in Rel-17 for additional timing modes.

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| ZTE, SanechipsR1-2005468 | Observation 1: To support case-6 timing in Rel-17 may cause following concerns.* Misalignment of UL-Rx timing at parent for child nodes and access UEs, for which all existing solutions (TDM-based, non-TDM-based) have deficiencies.
* RAN1 may need to revise or even re-design Rel-16 case-1 timing.
* It is unclear whether RAN4 should re-define the UL-Tx timing requirement once the UL-Tx timing is decoupled from TA process and aligned with DL-Tx timing, and, if yes, how complicated it is.

Proposal 1: To de-prioritize case-6 timing in Rel-17. |
| Lenovo, Motorola MobilityR1- 2005928 | **Proposal 1:** Support both transmission timing alignment (Case-6) and reception timing alignment (Case-7) for IAB Rel-17. |
| SamsungR1-2006166 | ***Proposal 1: Case #6 and Case #7 timing in the TR38.874 can be a starting point for timing discussion in Rel-17 IAB.*** |
| CMCCR1-2006229 | **Proposal 1:****The case #6 and case #7 could be a starting point for the discussion for the IAB timing mode under the simultaneous operation of IAB nodes. Case#7 is slightly preferred than case#6 to ensure both network synchronization, and symbol-level alignment.** |
| QualcommR1-2006826 | **Observation 1:****Operation in Case 6 timing mode of an IAB-node may cause uplink interference at the IAB-DU receiver of its parent node and/or may require special handling in the uplink scheduler of its parent node to TDM users to avoid such interference.****Observation 2:****Operation in Case 7 timing mode may require changes to the Rel-15 UL timing control for IAB nodes, which in turn may also impact the OTA timing mechanism defined in Rel-16 for IAB.****Proposal 1:****Downselect one of the following:*** **Alt 1: adopt Case 1 as the only timing mode.**
* **Alt 2: quantify the benefits of Case 7 timing mode to determine whether such benefits are sufficient to justify the additional complexity.**
* **Alt 3: quantify the benefits of Case 6 and Case 7 timing modes to determine whether such benefits are sufficient to justify the additional complexity.**
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| FujitsuR1-2005544 | **Proposal 1: Consider effective negative TA for supporting simultaneous operation of MT Rx/DU Rx in Rel-17.****Proposal 2: Further investigate the required control of the parent or the network for supporting simultaneous operation of MT Tx/Du Tx.** |

There are different views on the prioritization of Case 6 and Case 7 timing modes. However, there seems to be a preference of Case 7 timing vs. Case 6 timing. As a resul, the following is proposed:

**FL Proposal 1:**

**Case 7 timing is supported in Rel-17 for IAB-nodes operating in multiplexing scenario Case 2 (simultaneous MT-Rx/DU-Rx).**

**Case 6 timing is deprioritized in Rel-17 until the solutions for Case 7 timing are specified.**

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| --- | --- | --- |
| **Company** | **Do you agree with FL Proposal 1?** | **Comments** |
| Qualcomm | Yes | None |
| Fujitsu |  | We agree with that case-7 can have higher priority than case-6. But we are open to discuss them in parallel. |
| LG Electronics |  | It is good to discuss them in parallel. |
| CMCC | Need further discussion | We generally agree with the first sentence; for the second sentence, case 6 also has its suitable scenarios, which we think is somehow dependent on the discussion in 8.10.1.  |
| NTT DOCOMO | Yes for the 1st sentence | We prefer to define both case #6 and #7 at the same time. If IAB has a single panel, both case #6 and #7 are necessary for the simultanouse MT and DU operation as in FL conclusion 1. Thus, if we agree to discuss the multiplexing scenarios of case1 and case2, both case #6 and #7 are necessary. |
| ZTE, Sanechips | Yes | The Rel-16 SI already showed some issues within case-6 timing (e.g., “require maintenance of separate Rx timings at the parent node for Case 6 UL transmissions from different child nodes”). In addition, we also concern about following issues: * The back-and-forth change of UL-Tx timing between aligning to DL-Tx (when in case-6 timing mode) and aligning to DL-Rx less TA (when in legacy TA mode) may cause RAN1 to revisit case-1 timing mechanism, such as adding time-stamp information to TA and/or T\_delta. This could be time consuming.
* It is also uncertain how RAN4 can handle the requirement for case-6 timing: Among the two aligned timings, DL-Tx timing has no IAB-specific accuracy requirement, and UL-Tx timing has a quite loose accuracy requirement including even the autonomous adjustment component, which results in the timing drift that is larger than what DL-Tx timing usually endures, especially in multi-hop scenario. It could be also time-consuming in RAN4 if RAN4 needs to generate another set of spec for UL-Tx timing under case-6 timing condition.

Given the performance concern upon case-6 timing, we just do not feel it deserves the expected efforts.  |