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 | ***Error: Reference source not found******Error: Reference source not found*** |
| 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.  |
| Vivo | Yes |  |
| Huawei | No | Case #6 and Case #7 timing are also applicable for dual panel when there is not sufficient isolation between MT and DU. In this case, timing alignment is still benefitial to mitigate the interference. In addition, we don't think the assumption on single/dual panel really matters here as long as the specification impact is same. For Case 4, Case #7 timing can be considered to mitigate the self-interference by adjust the UL Rx timing for IAB-DU. Note that there is no fundamental different from signalling point of view comparing with the Case #7 timing for Case 2.  |
| Ericsson | Yes for single panel Case 1 and Case 2, no for Case 3 and Case 4 | For Case 1 ad Case 2, dual panel can be viewed as an enhancement of the single panel case. For that reason, Case 6 timing and Case 7 timing can be used also for these if needed at all.Case 3 and Case 4 and multi-panel would need to take Case 1 timing requirements into consideration.We think that the multi-panel configuration should be defined so we share a common understanding of the capabilities of such nodes, e.g., w.r.t.* Antenna/RF isolation
* Interference cancellation
* Baseband timing
 |
| Intel | Yes | We also agree with Ericsson that multi-panel configuration should be defined as a common understanding.  |
| Lenovo, Motorola Mobility | Yes, but with comments for clarification | Since we have “Applicability / Benefit” in the description, we could distinguish between the cases where timing alignment Case 6 and Case 7 are not applicable (i.e., Case 3 and Case 4) versus where they may not seem immediately beneficial (i.e., Case 1 and Case 2 with multiple panels). This way:* We don’t rule out the applicability of Case 6 and Case 7 if the spec/implementation chooses to allow them for Case 1/2 with multiple panels.
* We keep open the possibility of introducing timing alignment beneficial for Case 3/4 at a later time.

Hence, for calrification, we suggest using an entry other than “N/A” for Case 1/2 with multiple panels.Side note: It would be helpful to call the scenarios something other than Case 1/2/3/4 so as to avoid confusion with timing alignment cases. |
| CEWiT | No | For case 3 and 4, timing alignment may or may not be required based on implementation. Besides that, isolation may not be enough even in multi panel case to avoid SI cancellation. Therefore timing alignment should be also studied in simultaneous MT-Rx/DU-Tx and simultaneous MT-Tx/DU-Rx cases.In general, there is no need to categorise timing alignment solutions for different cases based on single/dual panel. A timing alignment solution for any case should be applicable to both single or dual panel scenarios in the same way. |
| Nokia | Yes, for single panel. No for dual panel.  | To limit CLI in FDM, timing alignment will still be necessary in dual-panel implementation as well. Both case #6 and #7 may be still applicable for dual panel cases as highlighted by HW. Agree with Ericsson on case 3 and 4 where DL TX alignment may still need Case #1 timing. Case 3 and 4 cannot get any benefit out of timing modes mentioned as in the FL conclusion.  |
| AT&T | Not really | This categorization may be too simplistic. As some companies point out, there may be a need/benefit for Case 6/7 timing even with multi-panel operation in multiplexing Case 1/Case 2 and some form of timing alignment enhancements may also be beneficial for multiplexing Case 3 / 4. So this conclusion could be seen as a prioritization (e.g. identifying the limiting cases), but shouldn’t restrict implementation/specification impact. |

**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. [update on Aug 25]We are not convinced by Huawei’s comment that “Case 1 timing has nothing to do with Case 6 timing since they are essentially DL Tx timing for DU and UL Tx timing for IAB-MT respectively”. Case-6 timing needs to control, by its definition, the UL-Tx timing in a different way from case-1 timing. The different UL-Tx timing leads to different T\_delta. In the current spec, there is no mechanism on how to pair the TA and T\_delta (RAN1 even agrees this is implementation issue by allowing T\_delta filtering). To support case-6, the paring between TA and T\_delta has to be defined, or RAN1 needs to disable T\_delta when case-6 timing slot is in use, which seems another form to time-stamp a “disabling label” in case-1 timing. This “disabling T\_delta” also makes the definition of case-6 timing a bit different, because the original case-6 timing is defined as case-1 timing plus alignment of DU-Tx/MT-Tx, not the alignment of DU-Tx/MT-Tx at the moment without controllability of DL-Tx timing. Regarding to complexity in RAN4 to support case-6, 38.133 uses several sections to describe the timing requirements for UE’s UL-Tx. Two possibilities for IAB MT: * RAN4 does not specify anything additional for IAB (we see this reason for RAN4 not to include T\_delta value range and not to define new requirement for DL-Tx timing in RAN4 spec), i.e., there is no RAN4 timing requirement for case-6.
* RAN4 will generate another set of spec on UL-Tx adjustment under case-6 timing condition. The new requirement would depend on not only the UE hardware limitation (which is used as the basis to derive current RAN4 requirements for UL-Tx) but also the performance requirements coming from simultaneous Tx scheme. It does not seem an easy work for RAN4.
 |
| vivo | First bullet OK | It is beneficial to identify the enhancement aspects for both case 6 and case 7, it is too early to preclude either case. If the reason for deprioritization is large spec. effort, we can make decision few meetings later. |
| Huawei | Partially | Case #6 and Case #7 target different scenarios. There is no need to prioritize one over the other. Maybe one practical way is first agree on Case #7 timing. However, it should be noted that the feasibility of case #6 has already been proven and different detailed solutions on how to achive Tx timing alignment have already been capured in the Rel-16 TR. Case 1 timing has nothing to do with Case 6 timing since they are essentialy DL Tx timing for DU and UL Tx timing for IAB-MT repectively. The concern on RAN4 performance requirement is not valid since the RAN4 requirement is to define how accurate the UE shall set its UL Tx timing. Similar requirement can be defined once case #6 timing is agreed. |
| Ericsson | Yes for Case 7 timingNo for Case 6 timing if DL Tx | One should not be excluded over the other since a parent node may use Case 6 timing while a child node use Case 7 timing. Any concerns of UL Rx timing would be irrelevant if Case 6 timing is only applied in DL slots. |
| Intel | Not sure | We think this conclusion depends on the results of previous topic. If we have common understanding to operate on multi-pannel, then neither Case 6 nor Case 7 must be supported. It seems too soon to jump to the conclusion to support Case7.  |
| Lenovo, Motorola Mobility | Yes, but no need to deprioritize Case 6 | Case 6 timing alignment is expected to require less specification work in RAN1 than Case 7. We don’t think there is a need for deprioritizing Case 6. RAN1 can introduce Case 6 and Case 7 and introduce spec to deteremine when/where/how each one is applied. This way, the works on the two cases will be independent and can be done in parallel. |
| CEWiT | Yes, for first part Need further discussion for second point | Prioritization of Case 6 timing in Rel-17 depends on the discussion in 8.10.1 |
| Nokia | Partly, agree for case#7 timing, disagree for case#6 timing | A similar view as HW. Both timing modes plays essential roles when supporting MT RX/DU RX and MT TX/DU TX scenarios. It is not fully clear why there should be only Case #7, not Case #6. Also, please note that the agreement was reached during SI to support case#6 and case#7, and there is no clear motivation to support one case over the other, since both are relevant as agreed in FL conclusion 1. |
| AT&T | No | No need to deprioritize Case 6. The more important thing is to decide if there is a need to differentiate single-panel vs. multi-panel operation and whether the use of Case 6/7 timing is restricted to certain time resources (e.g. only backhaul resources or DL slots as proposed by Ericsson)  |