**3GPP TSG RAN WG1 #102-e R1-20xxxxx**

**e-Meeting, August 17th – 28th, 2020**

**Agenda Item:** **7.2.3**

**Source: Moderator (AT&T)**

**Title: Summary of [102-e-NR-IAB-01]**

**Document for:** **Discussion/Approval**

# Introduction

This contribution provides a summary of the following email discussion:

[102-e-NR-IAB-01] Clarify starting slot within DCI 2\_5 indication – Thomas (AT&T)

* Discussion and agreements by 8/19, TPs by 8/21.

# Starting slot within DCI 2\_5 indication

**Source**: R1-2005316

**Background:** The current TS 38.213 states the following:

*An AI index field value in a DCI format 2\_5 indicates to an IAB-node DU a soft symbol availability in each slot for a number of slots starting from a slot where the IAB-node detects the DCI format 2\_5.*

The specification text “from **a** slot” does not specifically mention whether the slot is defined based on the DU or MT resource configuration/timing and configured SCS for the AI index file value in DCI Format 2\_5. If the SCS is different for the IAB-DU and IAB-MT, different slots may be identified for that reference slot as shown by Figures 1 and 2 below by R1-2005316:



Figure 1: SCS configured by *availabilityCombinations* is higher than MT SCS for DCI format 2\_5



Figure 2: SCS configured by *availabilityCombinations* is lower than MT SCS for DCI format 2\_5

Given the soft resources are only defined for slots within the resource configuration of an IAB-DU, it seems straightforward that the starting slot is relative to the IAB-DU, however since DCI Format 2\_5 is received by an IAB-MT, there appears to be a need to define the starting slot also relative to the slot where the IAB-MT detected DCI Format 2\_5.

The first goal should be to clarify the common understanding and then whether any specification update is needed.

**FL Conclusion 1: Clarify the common understanding as the following:**

**An AI index field value in a DCI format 2\_5 indicates to an IAB-node DU a soft symbol availability in each slot for a number of slots starting from the earliest slot of the IAB-DU which overlaps in time with the slot of the IAB-MT where the IAB node detects the DCI format 2\_5.**

**Discussion:**

|  |  |  |
| --- | --- | --- |
| **Company** | **Do you agree with FL Conclusion 1? Is an update to 38.213 needed?** | **Comments** |
| ZTE, Sanechips | Agree. The update to 38.213 is needed. | As mentioned by FL, the “starting” behavior happens to DU slot and the “DCI 2\_5 detection” happens in MT slot. The mapping connection between the two types of slots has to be built, especially for the case where DU and MT have different numerologies. |
| Qualcomm | Agree that there is a problem and that an update to 38.213 is needed.  We also agree with the intent of the conclusion but some refinement may be needed. | Agree with ZTE. Moreover, given that the IAB-DU has two different timings for Tx and Rx there is still some potential ambiguity with the identification of the “earliest slot of the IAB-DU which overlaps in time with the slot of the IAB-MT where the IAB node detects the DCI format 2\_5”. Since the IAB-DU Rx timing is not precisely known at the parent, the reference should probably be the IAB-DU Tx timing. |
| Ericsson | Agree there is a problem, but more discussion may be needed to find a solution. | The problem may be a bit more complex than what is presented in ZTE’s figure. A DU slot overlapping with an MT slot may both start and end earlier than the MT slot. In that case, there is a problem of causality. To capture that case in a desirable way, we propose a small addition to the above formulation: “**starting from the earliest slot of the IAB-DU which overlaps in time with the slot of the IAB-MT where the IAB node detects the DCI format 2\_5 and does not start before the slot of the IAB-MT.**” |
| Nokia | Agree an update is needed | This may not be a critical issue now as whatever we do here does not fully solve the problem.  RAN1 discussed processing timeline of soft resource availability for some extent in Rel-16.  However, RAN1 understood that the implementation could handle such processing delays (MT receiving DCI 2\_5 and DU using the soft resource). Therefore, even though we define that the earliest slot that DU can use the soft resource, that will not be known to the parent and be able to use the resource efficiently until child DU start using it. In summary, as we have not defined processing delay for the IAB DU to prepare a schedule the first slot, there seems a waste of concurrent resources.  Anyways, we are fine with clarifying the spec text to reflect the wording refer DU slot. |
| Intel | Agree there is a problem, but more discussion and text refinement needed | We have some concern on the FL description of “the earliest slot of the IAB-DU which overlaps in time …. where the IAB node detects the DCI format 2\_5”.  In Figure 2 shows above, does this description means the first red rectangle, which is even before the IAB MT detects DCI 2\_5?  We propose “starting from the earliest slot of the IAB-DU that after the IAB-MT slot that carries the DCI format 2\_5”. |
| LG | Agree, further discussion is needed. | We agree there might be some ambiguity on starting symbol especially for the case where DU and MT have different numerology. As Qualcomm and Ericsson pointed out, there are still some ambiguities on statement of “… overlaps in time with the slot of the IAB-MT… ” to be further clarified.  Regarding update of specification, our preference is making a conclusion as a RAN1’s common understanding based on the discussion and leaving specification as it is. |
| ZTE, Sanechips (further comments) |  | @Qualcomm: there seems no ambiguity with the identification of “the earliest slot”. This is because that, according to case-1 timing principle, the DU Tx timing is always ahead of MT Rx timing and the difference in between is the one-way propagation delay that is always positive (we have such agreement that case-1 timing only deals with positive estimated one-way delay). So there could be only one single choice of DU Tx slot that is “the first overlapping slot”, as shown in figure below. Of course, the ambiguity does exist if the IAB node does not follow case-1 timing. However, if the IAB node does not follow a way (e.g., case-1 timing) to allow the parent node knowing the timing relationship between the two, there seems no way for both IAB node and its parent to work together properly.    @Ericsson,@Intel : we wonder whether the causality issue is indeed an issue. The current logic of DCI 2\_5 interpretation comes from the existing text for DCI 2\_0, which is copied below.  “A SFI-index field value in a DCI format 2\_0 indicates to a UE a slot format for each slot in a number of slots for each  DL BWP or each UL BWP starting from a slot where the UE detects the DCI format 2\_0”.  Please note people could virtually have a corresponding relation mapping as following between two DCIs:   * DL slot where DCI 2\_0 is detected 🡺 MT Rx slot where DCI 2\_5 is detected; * UL slot for which DCI 2\_0 indicates SFI 🡪 DU Tx slot for which DCI 2\_5 indicates the soft resource availability.   So if the causality issue is indeed a concern here, the same concern may also go for DCI 2\_0 that has been stable for quite a while. We prefer to keep the same logic between DCI 2\_0 and DCI 2\_5, which is also a RAN1-agreed method to define DCI 2\_5 framework. |
| Intel |  | We can design DCI 2\_5 with DCI 2\_0 as a baseline, but they are still different in some ways. DCI 2\_0 indicates resources for MT itself, while DCI 2\_5 indicates resource availability for the co-located DU. Hence, after receiving DCI 2\_0, even the specification describes as “starting from a slot where the UE detects the DCI format 2\_0”, the MT itself can handle when to start next slot as indicated by DCI 2\_0 with processing delay.  However, for DCI 2\_5, MT is receiving the indication for the co-located DU resource availability. There is a possible issue of MT/DU resource collision. Hence, we want to guarantee that the starting DU slot will not collide with the current MT slot.  That’s why we propose: “starting from the earliest slot of the IAB-DU that after the IAB-MT slot that carries the DCI format 2\_5”. |
| LG2 |  | According to the ZTE’s proposal, “the earliest slot of the IAB-DU which overlaps in time with the slot of the IAB-MT where the IAB node detects the DCI format 2\_5” can be the slot with blue color in the figure below. Is it correct understanding? However, even though we follow the above proposal, there may be an error between parent node and child node for applying DCI 2\_5 as shown below figures due to some timing estimation error at parent node and child node. Thus, we propose to further refine ZTE’s proposal  An AI index field value in a DCI format 2\_5 indicates to an IAB-node DU a soft symbol availability in each slot for a number of slots starting from a DU slot floor(n\*(SCS\_MT/SCS\_DU)) where the IAB-node detects the DCI format 2\_5 in slot n.  Note that this proposal can be equivalent to ZTE’s proposal, if the timing difference is less than DU slot duration.  cid:image001.jpg@01D67633.8A8E2770  cid:image002.jpg@01D67633.8A8E2770 |
| Ericsson |  | With respect to the figure provided by ZTE, our intention was in fact to refer to the second DU slot for the sake of clarity, in case the slot beginnings are not aligned. As long it is clear from which slot the signaled AI is valid, we would be fine to also refer the first DU slot in ZTE’s figure. We would like to remark that, practically, neither of both can be used in case of TDM, since the MT would be receiving during both DU slots anyway and the parent would need to signal them as unavailable (in terms of not yet available), in either case.  We can agree to a proposal either including or excluding IAB-DU slots starting prior to the start of the IAB-MT slot where the IAB node detects the DCI format 2\_5. |
| ZTE, Sanechips (3rd round comment) |  | For LG’s comment, it seems to us that the timing estimation error would not be an issue here. The error in one-way propagation delay estimation can be small or large, but cannot go from positive to negative. So in LG’s two figures, the DU Tx slot can only shift left-ward but not right-ward. So there is no ambiguity when it comes to determine the “earliest overlapping DU slot”. It is also our understanding that in general the one-way propagation delay would not be larger than one slot (regardless DU slot or MT slot). The violation to this assumption may impact quite many aspects such as T\_delta value range in RAN4, guard symbols in RAN1, CP length and etc.  For comments from Intel and Ericsson, we agree the soft resource availability indication for the DU slot that overlaps with MT Rx slot where DCI 2\_5 is detected should not turn the soft symbol into available. But this should be a separate issue that is not limited to the soft DU resource but also Hard ones (The RAN1 agreements in 96bis and 98bis seem to say such conflict is solved per UE implementation). |

# Summary

**Proposed conclusion:**

* **Clarify the RAN1 common understanding of the starting slot for the AI index field value in DCI Format 2\_5 as the following:**

**“An AI index field value in a DCI format 2\_5 indicates to an IAB-~~node~~DU a soft symbol availability in each slot for a number of slots starting from the earliest slot of the IAB-DU which overlaps in time with the slot ~~of the IAB-MT~~ where the IAB-MT~~node~~ detects the DCI format 2\_5.”**

* **Update 38.213 with a TP (discuss until 8/21).**

# TP For TS 38.213

# 14 Integrated access-backhaul operation

< Unchanged parts are omitted >

An AI index field value in a DCI format 2\_5 indicates to an IAB-DU a soft symbol availability in each slot for a number of slots starting from ~~a~~the earliest slot of the IAB-DU which overlaps in time with the slot of the IAB-MT where the IAB-MT~~node~~ detects the DCI format 2\_5. The number of slots is equal to or larger than a PDCCH monitoring periodicity for DCI format 2\_5 as provided by *SearchSpace*. The AI index field includes bits where maxAIindex is the maximum of the values provided by corresponding availabilityCombinationId. An availability for a soft symbol in a slot is identified by a corresponding value resourceAvailability as provided in Table 14-3.



< Unchanged parts are omitted >