3GPP TSG-RAN WG1 Meeting #101-e R1-200xxxx

e-Meeting, May 25th – June 5th, 2020

**Agenda Item:** **7.2.3.3**

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

**Title: Summary of [101-e-NR-IAB-03]: Email discussion on IAB-DU/IAB-MT Transition Location/Type**

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

# Introduction

This contribution provides a summary of [101-e-NR-IAB-03]: Email discussion on IAB-DU/IAB-MT Transition Location/Type.

# IAB-DU/IAB-MT Transition Location/Type

**Source**: R1-2003505, R1-2003544, R1-2003948, R1-2004449

**Background:** During RAN1#100-e the following conclusion was reached:

***Conclusion:*** *No consensus to adopt a TP to address the issue of transition detection or transition type determination at the parent IAB node in RAN1#100-e. Consideration of whether this issue is critical and whether specification support is necessary may be revisited in the future as several companies raised concerns that the potential impact of improper transition detection may lead to system performance degradation when guard symbols are introduced by the parent node.*

The related agreement was reached in RAN1#98:

Agreements:

A parent IAB node can be made aware of the number of symbols Ng the child IAB node would like the parent IAB node not to use at the edge (beginning or end) of a slot when there is a transition between child MT and child DU. Separately or additionally, the child IAB node can be made aware of the number of guard symbols that the parent IAB node will provide.

* Ng can be provided for each of the [8] possible transitions with potential overlap:

|  |  |  |
| --- | --- | --- |
| *MT to DU* | *DL Tx* | *UL Rx* |
| *DL Rx* |  |  |
| *UL Tx* |  |  |
| *DU to MT* | *DL Rx* | *UL Tx* |
| *DL Tx* |  |  |
| *UL Rx* |  |  |

* If Ng is not provided it is assumed to be 0

NOTE: this agreement does not introduce any performance requirement on IAB nodes.

These issues were extensively discussed during RAN1#100-e, but were not discussed during RAN1#100bis-e. Based on the preparation phase the following issues should be discusses in RAN1#101-e:

1. Specification of parent node behavior for inserting guard symbols in case of flexible symbols at the edge of a MT->DU or DU->MT transition
2. Whether determination of MT->DU and DU->MT transitions is left to IAB-node implementation in Rel-16.

## IAB-DU/IAB-MT Transition Type

One solution proposed my several companies to solve the ambiguity caused by flexible symbols at the edge of MT->DU or DU->MT transitions is to take the minimum possible number of guard symbols based on the potential transition (e.g. DL MT -> DL DU, DL MT -> UL DU, UL MT -> DL DU, UL MT -> UL DU, etc.).

**FL Proposal 2.1.1:** In presence of F symbols in the child DU configuration at the edge of a MT to DU transition (or vice versa) the parent node inserts the minimum number of guard symbols amongst the two possible transition types corresponding to child DU Tx or child DU Rx. Adopt the following TP to TS 38.213 Section14:

|  |
| --- |
| ----------------------------------------------- Start of Text Proposal --------------------------------------< Unchanged parts are omitted >For a serving cell of an IAB-node MT, the IAB-node MT can be provided by *guard-SymbolsProvided* a number of symbols that will not be used for the IAB-node MT in slots where the IAB-node transitions between IAB-node MT and IAB-node DU. A SCS configuration for the number of symbols is provided by *guardSymbol-SCS*.For a transition between IAB-node MT with either uplink or downlink symbols and IAB-node DU with flexible symbols, the IAB-node may assume the number of guard symbols for the transition is equal to the smaller value of the numbers of guard symbols for a transition between the IAB-node MT with either uplink or downlink symbols and IAB-node DU with downlink symbols and the number of guard symbols for a transition between IAB-node MT with either downlink or uplink symbols and IAB-node DU with uplink symbols.< Unchanged parts are omitted >----------------------------------------------- end of Text Proposal ---------------------------------------- |

**Discussion:**

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| **Company**  | **Do you agree with FL Proposal 2.1.1?** | **Comments**  |
| Qualcomm | Yes | The proposed TP might require some modifications to remove the uncertainty (depending on the text interpretation) on the the IAB-MT side (i.e. either downlink or uplink) since there is no ambiguity on that part. In other words, the transition type on the IAB-MT side is known hence it suffices the take the minimum between the two possible transitions corresponding to the IAB-DU being downlink or uplink.Also we would need to cover the transition in the other direction, from the IAB-DU to the IAB-MT. |
| ZTE, Sanechips | No, need more discussion | The concern from Huawei in email thread [IAB-01] also applies here. In case the child node has multiple DU cells, the parent node may not be able to know which DU cell the child node picks up around a transition. Although it is uncommon for one DU cell to be configured with D on a resource and another DU cell to be configured with opposite U on the same resource, it would be fairly possible for one DU cell to be configrued with D (or U) on a resource and another DU cell to be configrued with F on the same resource. Should this flexibility be thrown away? i.e., if F-symbol is on transition edge on one DU cell, the other DU cell should follow the same F-symbol configuration for the same transition? It seems more discussions are needed, leading to additional patch, after every optimization step RAN1 takes on guard symbol. Our current preference is to stop introducing more specification impacts at this point and to leave IAB-node implementation to handle the issue, such as:* “F” symbol is configured not with any potential MT-DU transition, or
* For any timing conflicting between MT and DU (due to lack of accurate information at parent node), it is up to child node how to handle (e.g, dynamically drop operation on MT or DU).

On the other hand, if the majority companies prefer to define additional behaviors upon determining number of guard symbols when the transition involves with “F” symbol on DU, we see some simpler solutions that may have somehow similar effect as the proposed min() operation, such as: * The number of guard symbol is 0 (rational: the uncertainty with F-symbol can be equivalent to the case where the number of guard symbol is not provided); or

The number of guard symbol is the given number assuming F symbol is used as DL symbol (rational: the most-likely use case is the beginning of DU slot overlapping with a proceeding MT slot; and the slot normally starts with DL transmission).  |
| vivo | No | Based on current spec., if child node has UL transmission on ‘F’, the child node assume guard symbol as configured for MT UL🡨🡪DU. If child node has DL transmission on ‘F’, the child node assume guard symbol as configured for MT DL🡨🡪DU. This behavior is known by parent node, thus parent node performs proper scheduling, i.e., assuming larger number of guard symbol between MT DL🡨🡪DU and MT UL🡨🡪DU transition. There is no ambiguity between child and parent node, i.e., no issue.The proposal seems to be a small optimization, which incur additional spec. complexity as mentioned by ZTE |
| Ericsson | Yes | We think it can be left for implementation, but can also agree with the FL Proposal 2.1.1. |
| Nokia | Need more discussion | As we see already from the previous comments, companies have different views. If FL thinks that there can be reasonable progress on this, we are open to discuss more.First, we could try to focus on the main proposal before going into the TP (as mentioned by QC, the TP seems not accurate). We have several questions, 1. When the MT is configured with DL/UL at the edge, the best way to have good utilization of resources is that the **Hard-Flexible symbols (**do not think we should optimize for soft flexible) are not configured at the edge. Do proponents think that such configuration is not possible?
2. If the answer for the above is “yes”, how beneficial to assume a minimum between possible transitions compared to the knowledge of the actual use of the DU flexible resources at the parent?
3. Our understanding is that whatever we introduce Min or Max in the specification now, it still a sub-optimal solution, is that understanding is correct?
4. Compared to the proposed solution, the network can easily use full resource efficiency with proper configuration by avoiding H-F resources at the edges. Any objections for such operation?

We appreciate if proponents can clarify these, so that we can further think on supporting the proposal.  |
| Intel | Yes | Since the parent node does not know which direction child DU “F” symbols will schedule, it is better to clear define parent DU guard symbols as min(MT->DU DL, MT->DU UL).  |
| Huawei | Yes | We support the FL proposal but open to refine the wordingResponse to QC: * For the first point, the reason why the link direction at the MT side is mentioned there is that later the link direction of DU (flexible) is mentioned, i.e. For a transition between IAB-node MT with either uplink or downlink symbols and IAB-node DU with flexible symbols. We are open to removing “with either uplink or downlink symbols” if this is already clear to everyone.
* For the second point, we think the current wording covers both transition directions between MT and DU.

Response to ZTE:There are two separate issues: * Issue 1: How to determine the number of Guard symbols for the transition between MT and DU when DU has flexible symbols?
* Issue 2: When DU has multiple CCs, how to indicate the number of Guard symbols for a given MT cell?

We believe the focus in this thread is the first issue while second one can be discussed in the other thread if needed. Currently, there are 8 transistion types that can be indicated, clearly we are missing four cases that has flexbile symbols at the DU during the transition. The proposal is to fix it by introducing a rule. The motivation is to avoid resource collision and improve resource ultilization. For the second issue, we are open to discuss it further but if the majority think there is no need to do anything further, we are fine with this as well.Response to vivo:The case discussed here is when the IAB DU has flexbile symbols how to determine the number of guard symbols, the link direction for the flexbile symbols of the IAB DU cannot be known by the parent node since it is decided by the IAB node itself and there is no signaling back to the parent node.Response to Nokia:1. The transition happens in several different cases as discussed below in section 2.2, on the edge of DU hard symbol is just one case. Even on the edge of DU soft symbols, if it is indicated available by the parent node, there will still be MT-DU transistions.
2. See answer to 1.
3. The benefit of introducing min or max rule is to eliminate the ambiguity hence both the parent node and IAB node know how many guard symbols will be reserved hence both can ultilize the resources more efficiently. There is a clear benefit comparing to not introducing any rules.
4. See answer to 1.
 |
| CMCC | YES to specify the parent node behavior; NO to the min number | From our point of view, explicitly specify the parent node behavior for inserting guard symbols in case of flexible symbols at the edge of a MT->DU or DU->MT transition has pros for multi-vendor deployment. But we would like to further discuss the number of guard symbols to be inserted. We understand that by inserting the minimum number, less symbols are occupied and it can provide more transmission efficiency to the backhaul links. However, in such a case, there are still potential collisions between DU and MT, and the impact to the transmission efficiency is marginal. In our view, we prefer to insert the maximum number of guard symbols. |
| LG | No, need more discussion | Even though we go with proposed solution (i.e., based on minimum number of guard symbols amongst the two possible transition), the problem cannot be resolved perfectly. For example, in case of actual transition requires larger number of guard symbols amonst two possible transition, the guard symbol is not sufficient, so child IAB node will handle the conflict. Therefore, we think it is a small optimization with some RAN1 spec impact.  |
| NTT DOCOMO | Need more discussion | We have the same view with LG, so that the proposed solution can not sovle the prolem perfectly, and if we try to solve the problem perfectly, we may apply the max value, however we also lose the effeicnt resrouce management. Thus we believe that CU may handle the problem (e.g. not congigure F resource at the edge). |
| Samsung | No | Either min or max is not optimum way to address the issue. In this sense, we see two possible ways on the table. First one is to adopt sub-optimal solution even though it cannot address the issue perfectly. Second one is to leave it to proper implementation even though it may restrict a configuration of flexible resources a little bit. Our preference is the second one because we don’t think it is a big issue at least for Rel-16.  |

## FL Observation 2.1.2: There is no clear majority for or against Proposal 2.1.1. There does seem to be consensus that a simple rule as proposed is technically feasible and many of the concerns raised with the proposal are related to the fact that the solution may be suboptimal in certain cases. Given that there does seem to be ambiguity in the current RAN1 specifications, a possible compromise would be to introduce a basic solution in Rel-16 and note that this issue should be revisited in Rel-17 to determine if a more optimized solution can be found.

**FL Proposal 2.1.3:** In presence of F symbols in the child DU configuration at the edge of a MT to DU transition (or vice versa) the parent node inserts [X] guard symbols.

Downselect [X] from the following options:

Alt 1. The **minimum** number amongst the two possible transition types corresponding to child DU Tx or Rx

Alt 2. The **maximum** number amongst the two possible transition types corresponding to child DU Tx or Rx

Alt 3. 0

Note: This does not preclude RAN1 from further considering additional solutions in Rel-17

**Discussion:**

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| --- | --- | --- |
| **Company**  | **Is FL Proposal 2.1.3 an acceptable compromise? Which alternative is preferred?** | **Comments**  |

## IAB-DU/IAB-MT Transition Location

One solution was proposed to specify behaviour related to determination of a DU->MT or MT->DU transition location at the parent and child IAB nodes:

FL Proposal 2.2.1: Discuss whether the following rules for Guard symbol insertion and definitions of MT to DU and DU to MT transitions should be specified in Rel-16:

**Guard symbols are inserted by the parent node according to the advertised guard-Symbols Provided only when all the following conditions are satisfied:**

* **there is a candidate MT to DU transition or a candidate DU to MT transition,**
* **the MT is scheduled to be active at the edge of such candidate transition,**
* **the guard symbols do not overlap with a planned transmission or reception (as applicable) of NA-exempt channels by the MT.**

**A candidate MT to DU transition occurs when:**

* **the DU is configured to transition from a NA or S-NIA resource to a H or S-IA resource,**
* **the DU is configured to transition from a NA or S-NIA resource to a NA or S-NIA resource with an allocation of NA-exempt channels.**

**A candidate DU to MT transition occurs when:**

* **the DU is configured to transition from a H or S-IA resource to a NA or S-NIA resource,**
* **the DU is configured to transition from a NA or S-NIA resource with an allocation of NA-exempt channels to a NA or S-NIA resource.**

**Discussion:**

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| **Company**  | **Do you agree with specifying the rules and definitions provided in FL Proposal 2.2.1? If these are not specified, is anything required (e.g. a note in 38.213) to clarify the expected behavior in Rel-16 in case of multi-vendor operation?** | **Comments**  |
| Qualcomm | Yes, agree on the rules and definitions in FL 2.2.1, however there could be other acceptable variations. | Our main point is that no rules are defined, in case of parent node from vendor A and a child node from vendor B, it is not clear how leaving this to implementation (which could be different between vendor A and vendor B) results in a system that works well, i.e. with the parent node inserting the guard symbols exactly when the child node expects them.We don’t thin the details of the rules are critical, as there could be various levels of optimization. However it is important that parent and child follow the same rules or there will be disconnects, leading to some system performance impact when parent and child are not aligned on the presence of guard symbols at a given boundary.We recognize the whole scheme about these guard symbols for MT🡨🡪DU transitions is an optimization, and there was a lot of debate on the need to introduce it. Eventually, consensus was achieved on the premise that we would devise a scheme that works for all envisioned scenarios (NOTE: we chaired that discussion in RAN1 #98 offline sessions). Hence, to remain truthful to that promise, our position is that we should address this last aspect that will ensure proper inter-vendor operation.If companies think that there is no need to specify such rules because it is clear when guard symbols should be inserted by a parent node, then either 1) every company is in agreement with the rules in the proposal 2.2.1 above or 2) there is at least one company not aligned with the others.In case 1), there should be no issue documenting the corresponding rules. In case 2), there would the need to align the rules amongst companies (and then document them) or we would need to agree that we don’t want to properly address the inter-vendor scenario in Rel-16.  |
| ZTE, Sanechips | Not really, need more discussion.  | There are several reasons for us to say no:1). The RAN1 specification should not specify parent node behavior. For example, in case-1 timing, the spec does not say how T\_delta is determined by the parent node(i.e., the time interval at the parent node between DL-Tx and UL-Rx). Similarly, here the spec should avoid saying how guard symbols are calculated and inserted. 2). If spec follows the proposal to say “insert guard symbol”, it means the guard symbol is a certain type of signal in unit of symbol. However, it is RAN1’s tradition not to define guard symbol itself (so far IAB spec does not even specifiy what is guard symbol and whether guard symbol should have zero power); instead, usually the spec describes the guard interval by the signal before the guard interval and the signal after the guard interval. Nevertheless, the difficulty here is that the signal before the interval and the signal after the interval may belong to different cells. The RAN1 38-series spec seems not handle such issue before. The best consequence is to avoid further defining behaviors upon guard symbol itself. 3). The proposal defines a parent node behavior (insert guard symbol) according to conditions happening at the child node, where some of condition may not be known by the parent, like the potential guard symbol overlapping with NA-exempt channels (because the parent node may not know the timing overlapping relation on child node). 4) The parent node may not be able to know the symbols that are turned into Available (S-IA) by child node in an implicit way. As for multi-vendor deployment, * For guard symbol insertion, in a worst case where no correct coordination can happen between parent node and child node that come from different vendors, both parent and child node can run as if the number of guard symbols were not signaled (i.e., equal to zero as RAN1 agreed). Then the system can either rely on parent node scheduling to avoid the DU-MT overlapping collision and/or rely on the child node to handle the occurring conflict under implementation-based method. Of course, the network can also reduce the number of transition instances in a given time cycle via proper configuration.
* For the determination of MT-DU transition location, first, this is something independent from guard symbol discussion; secondly, we do not see strong need for RAN1 to agree anything new for specification purpose. Is there a case that the child node thinks a MT-DU transition happens while the parent node thinks the opposite? If yes, the problem seems to be that the two nodes do not have common understanding on when to communicate on MT and when not to. The spec fix should be somewhere else, beyond transition instance.
 |
| Vivo | Not sure | Regarding location of so-called candidate MT to DU transition, we do not find scenario where parent node and child node assume different candidate location, it seems not necessary to specify a rule for that.Regarding second part, i.e., active MT scheduling, if the MT resource is CG type 1 or SR or …, how the parent node recoginize whether the MT is active or not in advance. We think further specification complexity will be incurred finally. |
| Ericsson | No | The RAN1 specification should not specify parent node behavior, but the determination should be left for implementation. In any way, the IAB-DU can know whether, when and how many guard symbols are provided by the parent node and adjust its operation accordingly. |
| Nokia | No | Agree with ZTE comments. We are open with first proposal before. But, this proposal is defining parent node behaviour. Even when handling resource conflicts, RAN1 specs do not have any text defining parent node behaviours. We wonder why this case is more important than them.  |
| Qualcomm 2 | We maintain our yes position. | Additional comments in response to comments / concerns brought up by other companies:In regard to points 1) and 2) from ZTE and the first comment from Ericsson and the comment from Nokia – all related to “reluctance to specify parent node behavior”, RAN1 has already agreed the parent node can insert guard symbols and signaling has been defined for the parent to indicate to the child how many guard symbols are inserted / provided for each MT🡨🡪DU transition type. So the proposal here is not to define any new parent behavior, but just to clarify the conditions under which an already agreed behavior can take place.In regard to point 3) from ZTE, it is a valid point that not all the information may be available at the parent. The conditions can be updated accordingly to be conditioned on the availability of such information.In regard to point 4) from ZTE, the intent of S-IA was to cover only the explicit indication case. As noted, it is not possible for the parent to know when the child autonousmly and independently makes an implicit determination of availability.In regard to the two bullets of the multi-vendor discussion by ZTE:* We agree that system can work without guard symbols, which are indeed optional. Our intent was to have the guard symbols also work in a multi-vendor environment.
* The second bullet seems to recognize the problem, i.e. determination of MT-DU transition location. To us it seems natural to have any related fix in RAN1 specifications but if there are alternative solutions, they can certainly be considered, although at this stage we should avoid creating additional load on RAN2/RAN3.

In summary, we still maintain there is a problem with guard symbols operation in a multi-vendor environment.We can be amenable to not address this issue in Rel-16, however the fact that for the inter-vendor case there is an issue in the context of guard symbols should be recognized. In fact we should also forgo FL proposal 2.1.1 if we decide not to address this one, since that is a smaller issue in our view.We would strongly object to any conclusion stating that the issue can be addressed by implementation, unless the companies supporting this conjecture can describe in more detail how it would work in a multi-vendor environment. |
| Intel | Not sure | The main issue is parent DU does not know child DU’s dynamic scheduling, i.e. the semi-static configured D/F/U resource is scheduled or not, which makes MT/DU transition position floating. We are not sure whether the FL Proposal 2.2.1 captures this issue or not really.  |
| Huawei | We agree with the motivation and would like share some of our thinking on current specification | In our understanding, the reporting and configuration procedure of guard symbol ensures that the parent node and IAB node can obtain the number of guard symbols consistently. According to the definition, guard symbols should be inserted at the transition points between MT and DU; therefore, the key question is whether the IAB node and parent node can have same understanding on the locations of the transition points.* The IAB-node DU can always transmit or receive in *hard symbols* and *soft symbols which are indicated available (SIA)*, which means the overlapped MT resources cannot be used for backhaul transmission in TDM operation. Therefore, guard symbols should be inserted in the MT resource at the transition points between the MT and DU, i.e., the edge of *hard* or *SIA* resources of DU.
* The DU resource configuration of an IAB node can be made aware to its parent node and the availability indication of soft resource is sent from the parent node.

Therefore, both the IAB node and its parent node can know the location of *hard* and *SIA* symbols of IAB-node DU, and thus they can have same understanding on the location of guard symbols. Note that the *hard* resources include those configured directly by CU and those converted by DU cell-specific signals.An exceptional case is the reception and transmission of cell-specific signals/channels by IAB-node MT. Typically, the cell-specific signals/channels have fixed structures and they are for all the UEs and child nodes, and thus the IAB node should not expect guard symbols will be inserted by parent DU for the cell-specific signals/channels.In summary, we believe the current specification is sufficient to cover all cases but one possible compromise is to capture QC’s proposal as a conclusion if everyone agrees with it. |
| CMCC | No | The guard symbol insertion happens at the MT to a DU Hard (NA + cell-specific that treated as Hard) or Soft as IA, or vice versa. For these locations, in our view, the parent and child nodes (no matther they are from different vendors or not) share the same understanding.  |
| LG | Not sure |  We agree with ZTE that the rule for guard symbol insertion is parent node behavior, so it is not necessary to specify in RAN1 spec.  |
| Samsung | No | It may be difficult for us to understand why it is an issue for multi-vendor scenarios because we share similar view with HW and CMCC about Guard symbol insertion.  |

FL Observation 2.2.2: There is no consensus about whether this is 1) already sufficiently addressed by current specifications and 2) whether parent node behaviour should be defined to solve any ambiguities on the transition locations. However, as suggested by Qualcomm and Huawei, capturing RAN1’s common understanding can be helpful in case there is a desire to address this further in Rel-17.

FL Conclusion 2.2.3: No specification in Rel-16 is introduced defining rules for Guard symbol insertion at a parent node or definitions of MT to DU and DU to MT transitions. However the following is the common understanding in RAN1 of the expected behaviour in Rel-16:

**Guard symbols are inserted by the parent node according to the advertised guard-Symbols Provided only when all the following conditions are satisfied:**

* **there is a candidate MT to DU transition or a candidate DU to MT transition,**
* **the MT is scheduled to be active at the edge of such candidate transition,**
* **the guard symbols do not overlap with a planned transmission or reception (as applicable) of NA-exempt channels by the MT.**

**A candidate MT to DU transition occurs when:**

* **the DU is configured to transition from a NA or S-NIA resource to a H or S-IA resource,**
* **the DU is configured to transition from a NA or S-NIA resource to a NA or S-NIA resource with an allocation of NA-exempt channels.**

**A candidate DU to MT transition occurs when:**

* **the DU is configured to transition from a H or S-IA resource to a NA or S-NIA resource,**
* **the DU is configured to transition from a NA or S-NIA resource with an allocation of NA-exempt channels to a NA or S-NIA resource.**

**Discussion:**

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| **Company**  | **Is FL Conclusion 2.2.3 an acceptable compromise?**  | **Comments**  |

# Summary

TBD