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

e-Meeting, May 25th – June 5th, 2020

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

**Source: AT&T**

**Title: Summary of Mechanisms for resource multiplexing among backhaul and access links**

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

# Introduction

This contribution provides a summary on maintenance issues for IAB resource multiplexing among backhaul and access links.

# Resource multiplexing among backhaul and access links

The following issues for maintenance of Rel-16 IAB are under consideration for discussion in RAN1#101-e:

1. Response to RAN2 LS on IAB Guard Symbols
2. Response to RAN3 LS on Cell-specific signals/channels configurations in IAB
3. IAB-DU/IAB-MT Transition Location/Type
4. Configuration of tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT
5. Alignement of 38.331 and 38.213 parameters related to DCI Format 2\_5
6. Updates on IAB terminology

## Response to RAN2 LS on IAB Guard Symbols

**Source**: R1-2003252, R1-2003542, R1-2004126, R1-2004133, R1-2004280, R1-2004449, R1-2004582, R1-2004618

**Background:** During RAN2#109bis-e a LS was sent to RAN1 regarding the following RAN1 and RAN2 agreements:

RAN1#99 agreement:

Agreements:

*Desired Guard* Symbols and *Provided Guard Symbols* are provided per cell and use 3 bits for each of the 8 transitions to indicate the number of guard symbols.

* In Rel-16, a range of 0-4 symbols are supported for each transition. Additional entries are reserved for future use
* A new parameter *GuardSymbol-SCS* is also provided which indicates the reference SCS (FR1: {15kHz, 30kHz, 60kHz}, FR2: {60kHz, 120kHz}) to be used for the guard symbols.

RAN2#109-e agreement:

* RAN2 will design one single fixed-length Guard Symbols MAC CE, containing values (or indices mapped thereto) of all 8 parameters introduced by RAN1.

with the following action for RAN1:

RAN2 would very much appreciate it if RAN1 could inform RAN2 at their earliest convenience whether there is a requirement that Number of Guard Symbols should be applied to a specific cell, or if the Number of Guard Symbols applies across all the cells in the cell group.

**FL Observation:** While the RAN1 agreement states that the Number of Guard Symbols is provided per cell, in case of CA, multiple cells could in theory share a common value and thus reduce the signaling overhead of multiple MAC CEs. However the majority of companies providing feedback on the RAN2 LS indicated a desire to keep the RAN1 agreement to be applicable only to a specific cell and not to a group of cells (i.e. a TAG).

**FL Proposal 2.1.1: Inform RAN2 that the Number of Guard Symbols should be applied to a specific cell and not all the cells in the cell group.**

**Discussion:**

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| **Company** | **Do you agree with Proposal 2.1.1? If the answer is No, what would be the proposed response to RAN2?** | **Comments** |
| **Huawei** | **More discussion is needed.** | **In our view, at least for typical deployment and implementations, the number of Guard Symbols are same within a TAG for an IAB node. This could also save some signaling overhead between the parent node and IAB node. It is arguable that RAN1 agreement needs to be reverted since the signaling can still be per TAG while the number of Guard Symbols assumed for all cells are the same within one TAG.** |
| Qualcomm | Yes | In principle, as noted in our contribution R1-2004449, the amount of guard symbols is really specific to each (MT cell, DU cell) pair within an IAB-node. It might be acceptable to provide guard symbols on a per MT cell basis, with the understanding that a value can be selected to work across all DU cells with a TDM constraint with the MT cell. |
| Intel | Yes | We agree with Qualcomm. Considering current resource configurations for MT and DU (D/F/U for MT and D/F/U/NA/H/S for DU) are cell-specific, the # of guard symbols to each (MT cell, DU cell) pair should also be cell-specific. |
| ZTE, Sanechips | Agree FL proposal. |  |
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## Response to RAN3 LS on Cell-specific signals/channels configurations in IAB

**Source**: R1-2003543, R1-2004449, R1-2004620, R1-2004621, R1-2004685

**Background:** RAN3 sent to RAN1 an LS on cell-specific signals/channels configurations in IAB, concerning the F1-AP signaling storm issue due to UE/MT-specific configuration of CSI-RS/SR resources. The requested action for RAN1 is given below:

ACTION: RAN3 kindly asks RAN1 to provide feedback whether the following approaches are feasible from RAN1 perspective and whether any additional alternatives should be considered.

* Explicitly configure these resources used for CSI-RS and SR as Hard at the child node or Not Available at the parent node. Meanwhile, exclude CSI-RS and SR configurations from the list of cell-specific signals/channels configurations.
* Make the CSI-RS and SR configurations as optional in the cell-specific signals/channels configurations so that they do not have to be configured if signaling storm becomes a concern.

FL Observation: The RAN1 agreement leading to the signaling in question is the following:

**RAN1 #99 Agreements:**

A parent IAB node/donor can be provided with cell-specific signals/channels configurations of each child IAB-DU. How/whether to use the information to handle any potential conflict at the parent IAB node/donor is left to network implementation

The list of cell-specific signals/channels includes:

- resources for SSB transmission at DU, including both CD-SSB and non-CD-SSB;

- configured RACH occasions for receiving at the DU

- periodic CSI-RS transmission at the DU

- scheduled resource for receiving SR at DU

The first solution presented by RAN3 effectively reverts the above RAN1 agreement by not enabling the indication of the CSI-RS and SR configurations:

* Solution 1: Explicitly configure these resources used for CSI-RS and SR as Hard at the child node or Not Available at the parent node. Meanwhile, exclude CSI-RS and SR configurations from the list of cell-specific signals/channels configurations.

The second solution presented by RAN3 is aligned with the existing RAN1 agreements since it is stated that the configurations “can” be provided and not “must be” provided:

* Solution 2: Make the CSI-RS and SR configurations as optional in the cell-specific signals/channels configurations so that they do not have to be configured if signaling storm becomes a concern.

Depending on the desired network operation there may be a need to use soft resources aligned with CSI-RS and SR configurations. Alternatively, if the signaling overhead this would entail is too large, it is reasonable to exclude those configurations. This is also in the spirit of the agreements that usage of the information exchanged is not mandatory, but left to network implementation. Contributions on this topic have so far indicated a split of views on preferences for supporting Solution 1, Solution 2, or support for both. However given the high bar for reverting RAN1 agreements, it is recommended to start discussion based on the solution which is both feasible and aligned with existing RAN1 agreements.

FL Proposal 2.2.1: Inform RAN3 that it is feasible from a RAN1 perspective to make the CSI-RS and SR configurations as optional in the cell-specific signals/channels configurations so that they do not have to be configured if ignalling storm becomes a concern.

**Discussion:**

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| **Company** | **Do you agree with Proposal 2.2.1?** | **Comments** |
| **Huawei** | **More discussion is needed.** | **We prefer Solution 1 with the understanding this may incur some confliction with RAN1 agreement. However, it should be clear that when RAN1 has the discussion, we focus on cell-specific signals/channels. CSI-RS and SR were also included but not discussed thoroughly. Though making the configuration optional could be feasible from implementation point of view, this also brings unneccessry complication to the specification.** |
| Qualcomm | Yes | At this stage it is preferred not to further change RAN1 agreements, also considering this particular agreement has already been reversed once. Making CSI-RS and SR configuration optional is actually consistent with the agreement as the whole set of child DU configuration information is optional anyway. |
| Intel | Yes | The agreement in RAN1#99 does not require ALL cell-specific signals/channels on the list be provided to parent DU, which already means they are optional on the F1AP signaling to parent DU. Therefore, Solution 2 is already supported by current RAN#1 agreements.  Solution 1 can be done by implementation and no additional spec impact on RAN1 side. |
| ZTE, Sanechips | Partially agree. | The FL proposal only mentions the 2nd solution in RAN3 LS. We agree this 2nd solution is feasible. Besides, we think the 1st solution in RAN3 LS is also feasible, because   * The RAN1 #99 agreement says “A parent IAB node/donor can be provided with…” – it does not say “A parent IAB node/donor **should/shall** be provided with …”. * The RAN1 #99 agreement also says the parent node is allowed to ignore (as implementation choice) the cell-specific signals/channels configurations.   What RAN3 LS asks is the technical feasibility of the solutions. It seems not expected by RAN3 that the 1st solution is not feasible just because it effectively reverts RAN1 agreement, which RAN3 was certainly aware of when agreeing to send the LS. Further, regardless which solution is eventually adopted by RAN3, the RAN1 specified behavior in 38.213 (copied as following) is not necessarily impacted.  “*A symbol of a slot is equivalent to being configured as hard if an IAB-node DU would transmit a SS/PBCH block, PDCCH for Type0-PDCCH CSS sets configured by pdcchConfigSIB1, or a periodic CSI-RS in the symbol of the slot, or would receive a PRACH or a SR in the symbol of the slot.*”  Our preference is to answer that both solutions in RAN3 LS are feasible. As a compromise if needed to help reach consensus, the reply LS can say that RAN1 thinks both solutions are feasible but prefers to the 2nd one if one of the two has to be selected. |

## 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:

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| *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 contributions to RAN1#101-e mentioning this topic, the following views were expressed:

Specification of MT->DU and DU->MT transition conditions:

YES: 1

NO: 3 (left to implementation in Rel-16)

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:

YES: 3

NO: 1 (left to implementation in Rel-16)

FL Proposal 2.3.1: Discuss 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. Determination of MT->DU and DU->MT transitions is left to IAB-node implementation in Rel-16.

**Discussion:**

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| **Company** | **Do you agree with FL Proposal 2.3.1?** | **Comments** |
| **Huawei** | **Agree** | **For issue 1, there are already two straightforward solutions on the table which have been discussed for several meetings. We can have some further discussion on which way is better.** |
| Qualcomm | Yes to the first sentence.  **No to the second sentence.** | Minimally there needs to be a discussion in which companies supporting that the determination of MT🡨🡪DU transitions can be left to implementation should explain how this would work when there is a parent node from vendor A with implementation A and a child node from vendor B with implementation B different from implementation A. |
| Intel | Agree | We agree with the FL proposal. |
| ZTE, Sanechips | No to the 1st part. Yes to the 2nd part. | RAN1 does not specify parent node behaviors. |

## Configuration of tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT

**Source**: R1-2003544

**Background:** During RAN1#100bis-e the following agreements and conclusion were made:

Agreements: TS 38.213 Section 14 should be updated with a TP capturing the following behavior when an IAB-MT is provided with tdd-UL-DL-ConfigurationDedication-IAB-MT:

* Clarification that the behaviors described in Section 11.1 of 38.213 for a UE provided with tdd-UL-DL-ConfigurationDedicated are also applicable ~~apply~~ for an IAB-node MT when provided with tdd-UL-DL-ConfigurationDedicated-IAB-MT
* The IAB-node MT does not expect to be configured with both tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT.

**Conclusion:** The following note is not captured in 38.213 Section 14 in RAN1#100b-e:

* [Note (up to 38.213 editor to decide whether to include or not): The IAB-node MT does not expect to be configured with both tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT.]

R1-2003544 raises the issue of potential ambiguity of the IAB-MT behavior in 38.213 as a consequence of not capturing the Note according to the RAN1#100bis-e conclusion. However given that this was extensively discussed in RAN1#100bis-e and confirmed by the 38.213 Editor that error behaviors do not need to be captured, it is proposed to not revisit this issue during RAN1#101-e unless there is consensus to do so.

FL Conclusion 2.4.1: The Agreements and Conclusion from RAN1#100bis-e regarding IAB-node MT behavior related to tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT do not need to be revisted in RAN1#101-e.

**Discussion:**

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| **Company** | **Do you agree with FL Conclusion 2.4.1?** | **Comments** |
| **Huawei** | **Yes** | **This was discussed extensively in RAN1#100bis-e and it was agreed not to capture the error configuration into the spec hence there is no need to discuss this further.** |
| Qualcomm | Yes | In our view there might still be an issue in the sense that it is not clear where in the specs the aforementioned condition is defined as an error. However, the proposed note as is does not address the potential issue, as it simply pushes the decision to the editor and based on RAN1 #100bis-e discussion the reported feedback from the editor was not to include it under the assumption it was an error condition. |
| Intel | No | We think adding the note make it more clear. |
| ZTE, Sanechips | Not really. | We would like to know whether the following statement in the RAN1 #100bis-e agreement is still an agreement, given it is now neither captured in RAN1 spec nor informed to RAN2.  “*The IAB-node MT does not expect to be configured with both tdd-UL-DL-ConfigurationDedicated and tdd-UL-DL-ConfigurationDedicated-IAB-MT*”.   * If it is no longer an agreement, RAN1 needs to further determine the IAB-MT behavior when both IEs are configured but conflicting to each other on certain parameters. * If it is still an agreement but just not captured in RAN1 spec, RAN1 may need to at least inform RAN2 of this agreement and leave RAN2 to decide how to proceed with it. This particular issue could be just one example of general question: whether the IAB-MT could be configured at the same time with both a UE-oriented RRC parameter and a MT-oriented RRC parameter for the same signaling parameter purpose. Then RAN1 should inform RAN2 of RAN1’s understanding for a reference, otherwise, there would be a chance for RAN1 to have to specify PHY layer behaviors to handle parameter conflictions. |

## Alignement of 38.331 and 38.213 parameters related to DCI Format 2\_5

**Source**: R1-2003732, R1-2004133, R1-2004582

**Background:** During RAN1#100bis-e the following agreements were reached:

Agreements: Confirm that from a RAN1 perspective all Rel-15 UE common search space types are also applicable to Rel-16 IAB nodes. Signaling details are left to RAN2.

Agreements: Confirm DCI Format 2\_0 and DCI Format 2\_5 can be monitored by an IAB-MT in at least a common search space. The same number of aggregation levels and candidates can be separately configured for both DCI Format 2\_0 and DCI Format 2\_5.

Agreements: DCI Format 2\_0 is not monitored by an IAB-MT in a UE(MT)-specific search space. DCI Format 2\_5 can be additionally monitored by an IAB-MT in a UE(MT)-specific search space. Signaling details (e.g. whether the configuration is in the existing UE-specific search space configuration or a new MT-specific search space configuration is left up to RAN2).

Based on these agreements there is a need to align RAN1 specifications with the RRC configurations for an IAB-MT related to DCI Format 2\_0 and 2\_5. Specifically the following issues were identified:

1. Add reference SCSs for soft resource availability indication configuration in the RRC IE AvailabilityCombinationPerCell (R1-2003732)
2. Extensions of DCI Format 2\_5 optimzied for paired spectrum operation (R1-2003732)
3. positionInDCI-AI/dci-PayloadSize-AI used for USS (R1-2004133)
4. Relationship between DownlinkPreemption and availabilityIndicator (R1-2004133)
5. Usage of SearchSpace vs. SearchSpace-IAB in 38.213 (R1-2004582)

* Subtopics 1, 3, 4, and 5 are related to alignment of 38.213 and 38.331 parameters without need for new RAN1 agreements. Therefore they can be handled as editorial corrections in RAN1 and RAN2 without requiring dedicated RAN1 email discussions.
* Subtopic 3 is an optimization for operation in paired spectrum and is out of scope for Rel-16 based on the RAN1#100bis-e decision:

Agreements No additional specification impact for 38.213 is required for the definition of half-duplex operation in case of IAB nodes operating in paired spectrum. Further discussion of the default multiplexing capability indication for IAB nodes operating in paired spectrum can be discussed under the IAB-MT Features agenda item in the future (if needed).

FL Conclusion 2.5.1: The following issues can be considered as editorial corrections to be handled by the 38.213 and 38.331 editors

1. Add reference SCSs for soft resource availability indication configuration in the RRC IE AvailabilityCombinationPerCell (R1-2003732)
2. ~~Extensions of DCI Format 2\_5 optimzied for paired spectrum operation (R1-2003732)~~
3. positionInDCI-AI/dci-PayloadSize-AI used for USS (R1-2004133)
4. Relationship between DownlinkPreemption and availabilityIndicator (R1-2004133)
5. Usage of SearchSpace vs. SearchSpace-IAB in 38.213 (R1-2004582)

**Discussion:**

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| **Company** | **Do you agree with FL Conclusion 2.5.1?** | **Comments** |
| **Huawei** | **Yes** | **We agree with most of the proposed corrections in 1, 4, 5 while some changes are not accurate. This can be handled when all the editorial changes will summarized in the end. For the issue raised by LGE, we are not sure whether there is a need to monitor DCI format 2\_5 in CSS and USS/MSS at the same time.** |
| Qualcomm | Yes | Details can be discussed/finalized. |
| Intel | Partially | * Regarding item 2, we think it should be further discussed, since currently there is no solution/description in spec how does soft availability indication work in paired spectrum. * Regarding item 3, *positionInDCI-AI* is used to differentiate different serving cells, not to differentiate different MTs in case of one DCI format 2\_5 sending to multiple MTs.   When CSS is used for DCI format 2\_5, the configuration is supposed to be common for multiple MTs; when USS is used for DCI format 2\_5, the configuration is supposed to be MT-specific. So there will be no case that part of DCI format 2\_5 payload is used for one MT, and part of DCI format 2\_5 payload is used for another MT. |
| ZTE, Sanechips | No for issues 1 and 3. | For issue 1:  The current 38.213 statement “The IAB-node DU can assume a same SCS configuration for *availabilityCombinations* for a serving cell as an SCS configuration provided by *IAB-DU-Resource-Configuration-TDD-Config* for the serving cell” still works when DCI 2\_5 is in CSS, given the table entry pointed by the index contained in DCI 2\_5 can be interpreted per IAB-node. There is no need to have a common ref-SCS for all IAB-MT decoding DCI 2\_5 in the same CSS. In addition, RAN1 agreed that the DU resource configuration would be separately configured for DL and UL in paired spectrum, which naturally means the ref-SCS would have different copies for DL and UL in paired spectrum.  Further, the current 38.331 does not either define ref-SCS in AvailabilityCombinationsPerCell-r16. In other words, there is no misalignment between 213 and 331 for this matter at this time. In contrast, proposal of 1 just targets to build another different solution by modifying both spec.  While both the existing mechanism (ref-SCS given by *IAB-DU-Resource-Configuration-TDD-Config*) and the DCI 2\_0-alike solution (i.e., adding ref-SCS in AvailabilityCombinationPerCell) can work, there is certain difference. In the DCI 2\_0 alike solution, the spec may need to handle the relationship among three SCS’s: the actual SCS, ref-SCS in AvailabilityCombinationsPerCell-r16 and ref-SCS in *IAB-DU-Resource-Configuration-TDD-Config*, while the existing solution may only need to handle the relationship between the 1st and the 3rd ones.  For issue 3, we share the same view as Intel. |

## Updates on IAB terminology

**Source**: R1-2004280

**Background:** In the latest version of TS 38.300 the following definitions for IAB have been agreed:

**IAB-donor**:gNB that provides network access to UEs via a network of backhaul and access links.

**IAB-donor-CU**: as defined in TS 38.401 [4].

**IAB-donor-DU**:as defined in TS 38.401 [4].

**IAB-DU**: gNB-DU functionality supported by the IAB-node to terminate the NR access interface to UEs and next-hop IAB-nodes, and to terminate the F1 protocol to the gNB-CU functionality, as defined in TS 38.401 [4], on the IAB-donor.

**IAB-MT**: IAB-node function that terminates the Uu interface to the parent node using the procedures and behaviours specified for UEs unless stated otherwise. IAB-MT function used in 38series of 3GPP Specifications corresponds to IAB-UE function defined in TS 23.501 [3].

**IAB-node**: RAN node that supports NR access links to UEs and NR backhaul links to parent nodes and child nodes. The IAB-node does not support backhauling via LTE.

As a result, there is no longer a notion of a IAB-node DU or IAB-node MT, rather an IAB-node contains IAB-DU and IAB-MT functionality.

**FL Conclusion 2.6.1: All instances of IAB-node DU should be replaced with IAB-DU and all instances of IAB-node MT should be replaced with IAB-MT in TS 38.211, 38.212, and 38.213 (to be handled by the editors).**

**Discussion:**

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| **Company** | **Do you agree with FL Conclusion 2.5.1?** | **Comments** |
| **Huawei** | **Yes** | **An explicit agreement is helpful to remind the spec editor to implement the change.** |
| Qualcomm | Yes |  |
| Intel | Yes |  |

# Summary

The following issues are considered by RAN1 during RAN1#101-e:

1. Response to RAN2 LS on IAB Guard Symbols – Deadline for LS response: 5/27
2. Response to RAN3 LS on Cell-specific signals/channels configurations in IAB– Deadline for LS response: 5/27

TBD others