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.** |
| **Nokia** | **Agree with the FL proposal** | **Follow the RAN1 agreement.**  **As mentioned by HW, the guard symbols may be the same within a TAG, but the MAC-CE overhead is not a significant issue to change the agreement.** |
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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.** |
| **Nokia** | **Partially agree with the FL proposal.** | We think that the first approach is also feasible.  The first option from RAN3 “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. “  RAN1 spec says “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.”  Configuring IAB parent resources as NA could be problematic. In some cases, the same resources (used by UEs CSI-RS and SR) can be used for other UEs. Therefore, configuring P CSI-RS and SR as hard resources makes more sense. In such cases, child DU configuration shall be known to the parent (but that should be less overhead for F1-signalling).  The second option from RAN3 “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.”  This option is fine. However, it is not clear the spec impact on this. This anyways seems to be an implementation option allowed now. |

## 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.** |
| **Nokia** | **No** | **Not sure why discussing this again in Rel-16 maintenance. There was a clear conclusion last time, and this is not an essential correction.** |

## 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.** |
| **Nokia** | **Yes** | **Agree with HW.** |

## 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.** |
| **Nokia** | **Yes** | **None.** |

## 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.** |
| **Nokia** | **Yes** | **None** |

# 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