**3GPP TSG RAN WG1 #108-e** **R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

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| *CR-Form-v12.1* |
| **DRAFT CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | Corrections on eIAB  |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_IAB\_enh |  | ***Date:*** | 2022-03-07 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Corrections on enhancements for IAB in NR |
|  |  |
| ***Summary of change:*** | 1. Updated equation for derivation of DU-MT time difference for Case 1 and 7 timing (from using N\_TA to using T\_TA).
2. Added the case of same T\_delta value for Case 1 and Case 7 timing.
3. Captured eIAB directional collision handling when configured with NR-DC using Rel-16 TDM HSNA resources and/or Rel-17 FDM HSNA resources.
4. Added resource definitions for Rel-17 FDM HSNA.
5. Captured conditions for IAB-DU when receiving the child IAB-DU restricted beam indication MAC CE.
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| ***Consequences if not approved:*** | Incomplete support for IAB enhancements in NR |
|  |  |
| ***Clauses affected:*** | 14 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.212, TS 38.214, TS 38.331 |
| ***affected:*** |  | **X** |  Test specifications | N/A |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | N/A  |
|  |  |
| ***Other comments:*** | (…) |
|  |  |
| ***This CR's revision history:*** | N/A |

\*\*\* Unchanged parts are omitted \*\*\*

# 14 Integrated access-backhaul operation

Throughout this specification, unless otherwise noted, statements using the term "UE" in clauses 4 through 13 are equally applicable to the IAB-MT of an IAB node.

A procedure for an IAB-MT to perform cell search, system information acquisition, or random access procedure is same as a corresponding one for a UE except for the following.

For initial cell selection, an IAB-MT may assume that half frames with SS/PBCH blocks occur with a periodicity of 16 frames.

For PRACH transmission, an IAB-MT determines frames and subframes/slots within the frames containing PRACH occasions as described in [4, TS 38.211].

The IAB-MT determines an association period for mapping SS/PBCH blocks to PRACH occasions based on a PRACH configuration period as described in clause 8.1 and according to Table 14-1 instead of Table 8.1-1. An association pattern period includes one or more association periods and is determined so that a pattern between PRACH occasions and SS/PBCH blocks repeats at most every 640 msec. A PRACH occasion in a PRACH slot is valid according to the conditions in clause 8.1.

Table 14-1: Mapping between PRACH configuration period and SS/PBCH block to PRACH occasion association period for an IAB-MT

|  |  |
| --- | --- |
| PRACH configuration period (msec) | Association period (number of PRACH configuration periods) |
| 10 | {1, 2, 4, 8, 16, 32, 64} |
| 20 | {1, 2, 4, 8, 16, 32} |
| 40 | {1, 2, 4, 8, 16} |
| 80 | {1, 2, 4, 8} |
| 160 | {1, 2, 4} |
| 320 | {1, 2} |
| 640 | {1} |

If an IAB-node is provided an index in a Timing Delta MAC CE [11, TS 38.321] from a serving cell, the IAB-node may assume that is a time difference between a DU transmission of a signal from the serving cell and a reception of the signal by the IAB-MT when , where

- is the difference between the IAB-MT reception time and the IAB-MT transmission time for IAB-MT transmission timing mode ‘Case6’, and is defined in clause 4.3.1 of [4, TS 38.211] for transmission timing modes ‘Case1’ and ‘Case7’

- and are determined as

- and , if the serving cell providing the Timing Delta MAC CE operates in FR1

- and , if the serving cell providing the Timing Delta MAC CE operates in FR2

The IAB-node may use the time difference to determine a DU transmission time.

For a serving cell of an IAB-MT, the IAB-MT can be provided by Timing Case Indication MAC CE [11, TS 38.321] an indication of the IAB-MT transmission timing mode in a slot. Upon reception of the Timing Case Indication for a serving cell in a TAG, the IAB-MT applies a same IAB-MT transmission timing mode in a slot on all serving cells in the TAG.

If the indicated IAB-MT transmission timing mode in a slot is set to 'Case1', the IAB-MT transmission time is determined as for a "UE" in clause 4.2.

If the indicated IAB-MT transmission timing mode in a slot is set to 'Case6', the IAB-node sets the IAB-MT transmission time to the transmission time of the IAB-DU.

If the indicated IAB-MT transmission timing mode in a slot is set to 'Case7', the IAB-MT is provided a timing advance offset value for a serving cell by Case7 Timing Offset MAC CE [11, TS 38.321]. The IAB-MT determines its uplink transmission timing as where and are obtained as for a "UE" in clause 4.2 and where is provided by the Absolute Time Offset MAC CE [11, TS 38.321]. The IAB node may assume that a same value of index Tdelta is provided from a serving cell for the IAB-MT transmission timing modes ‘Case7’ and ‘Case1’.

A slot format for an IAB-DU or an IAB-MT includes downlink symbols, uplink symbols, and flexible symbols.

For each cell of an IAB-DU, the IAB-DU can be provided an indication for a slot format over a number of slots by *gNB-DU Cell Resource Configuration* [16, TS 38.473].

For each serving cell, an IAB-MT can be provided an indication for a slot format over a number of slots by *tdd-UL-DL-ConfigurationDedicated-IAB-MT*. If the IAB-MT is provided *tdd-UL-DL-ConfigurationDedicated-IAB-MT*, the statements in clause 11.1 that include "*tdd-UL-DL-ConfigurationDedicated*" apply to the IAB-MT of an IAB node by replacing "*tdd-UL-DL-ConfigurationDedicated*" with "*tdd-UL-DL-ConfigurationDedicated-IAB-MT*" for the IAB-MT, except that the *tdd-UL-DL-ConfigurationDedicated-IAB-MT* provides

- a set of slot configurations by *slotSpecificConfigurationsToAddModList-IAB-MT*

- for each slot configuration from the set of slot configurations

- a slot index for a slot provided by *slotIndex*

- a set of symbols for a slot by *symbols-IAB-MT* where

- if *symbols-IAB-MT* = *allDownlink*, all symbols in the slot are downlink

- if *symbols-IAB-MT* = *allUplink*, all symbols in the slot are uplink

- if *symbols-IAB-MT* = *explicit*, *nrofDownlinkSymbols* provides a number of downlink first symbols in the slot and *nrofUplinkSymbols* provides a number of uplink last symbols in the slot. If *nrofDownlinkSymbols* is not provided, there are no downlink first symbols in the slot and if *nrofUplinkSymbols* is not provided, there are no uplink last symbols in the slot. The remaining symbols in the slot are flexible.

- if *symbols-IAB-MT* = *explicit-IAB-MT*, *nrofUplinkSymbols* provides a number of uplink first symbols in the slot and *nrofDownlinkSymbols* provides a number of downlink last symbols in the slot. If *nrofUplinkSymbols* is not provided, there are no uplink first symbols in the slot and if *nrofDownlinkSymbols* is not provided, there are no downlink last symbols in the slot. The remaining symbols in the slot are flexible.

If an IAB-MT is configured with an MCG and an SCG, is not capable of simultaneous transmission and reception, and would simultaneously transmit and receive on the MCG and the SCG, the IAB-MT operates according to the scheduling from the MCG if flexible symbols are configured by both parent nodes for operation with inter-donor NR-DC; otherwise, if the IAB-MT is configured with multiple serving cells, is provided *directionalCollisionHandling-*r17 = ‘enabled’ for a set of serving cell(s) from the multiple serving cells, and indicates *half-DuplexTDD-CA-SameSCS* capability across MCG and SCG for NR-DC operation,the IAB-MT applies the procedures for resolving directional collisions across the cell groups as described in clause 11.1 by replacing “cell” with “cell group”.

An IAB-MT can be provided, by *SlotFormatCombinationsPerCell*, a list of slot format combinations applicable for one serving cell and, by *SlotFormatIndicator*, a configuration for monitor a DCI format 2\_0 indicating a slot format combination, from the list of slot format combinations, over a number of slots as described in clause 11.1.1. In addition to the slot formats in Table 11.1.1-1, an SFI field for an IAB-MT in DCI format 2\_0 can indicate to the IAB-MT a slot format from the slot formats in Table 14-2.

Table 14-2: Slot formats for normal cyclic prefix

|  |  |
| --- | --- |
| **Slot****Format** | **Symbol number in a slot** |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
| 56 | U | U | U | U | U | U | U | U | U | U | U | U | U | F |
| 57 | U | U | U | U | U | U | U | U | U | U | U | U | F | F |
| 58 | U | U | U | U | U | U | U | U | U | U | U | F | F | F |
| 59 | U | U | U | U | U | U | U | U | U | U | F | F | F | F |
| 60 | U | U | U | U | U | U | U | U | U | F | F | F | F | F |
| 61 | U | U | U | U | U | U | U | U | F | F | F | F | F | F |
| 62 | U | U | U | U | U | U | U | F | F | F | F | F | F | F |
| 63 | U | U | U | U | U | U | F | F | F | F | F | F | F | F |
| 64 | U | U | U | U | U | F | F | F | F | F | F | F | F | F |
| 65 | U | U | U | U | F | F | F | F | F | F | F | F | F | F |
| 66 | U | U | U | F | F | F | F | F | F | F | F | F | F | F |
| 67 | U | U | F | F | F | F | F | F | F | F | F | F | F | F |
| 68 | U | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 69 | U | F | F | F | F | F | F | F | F | F | F | F | F | D |
| 70 | U | U | F | F | F | F | F | F | F | F | F | F | F | D |
| 71 | U | U | U | F | F | F | F | F | F | F | F | F | F | D |
| 72 | U | F | F | F | F | F | F | F | F | F | F | F | D | D |
| 73 | U | U | F | F | F | F | F | F | F | F | F | F | D | D |
| 74 | U | U | U | F | F | F | F | F | F | F | F | F | D | D |
| 75 | U | F | F | F | F | F | F | F | F | F | F | D | D | D |
| 76 | U | U | F | F | F | F | F | F | F | F | F | D | D | D |
| 77 | U | U | U | F | F | F | F | F | F | F | F | D | D | D |
| 78 | U | U | U | U | U | U | U | U | U | U | U | U | F | D |
| 79 | U | U | U | U | U | U | U | U | U | U | U | F | F | D |
| 80 | U | U | U | U | U | U | U | U | U | U | F | F | F | D |
| 81 | U | U | U | U | U | U | U | U | U | U | U | F | D | D |
| 82 | U | U | U | U | U | U | U | U | U | U | F | F | D | D |
| 83 | U | U | U | U | U | U | U | U | U | F | F | F | D | D |
| 84 | U | F | D | D | D | D | D | D | D | D | D | D | D | D |
| 85 | U | U | F | D | D | D | D | D | D | D | D | D | D | D |
| 86 | U | U | U | F | D | D | D | D | D | D | D | D | D | D |
| 87 | U | F | F | D | D | D | D | D | D | D | D | D | D | D |
| 88 | U | U | F | F | D | D | D | D | D | D | D | D | D | D |
| 89 | U | U | U | F | F | D | D | D | D | D | D | D | D | D |
| 90 | U | F | F | F | D | D | D | D | D | D | D | D | D | D |
| 91 | U | U | F | F | F | D | D | D | D | D | D | D | D | D |
| 92 | U | U | U | F | F | F | D | D | D | D | D | D | D | D |
| 93 | U | U | U | U | U | U | U | U | U | F | F | F | F | D |
| 94 | U | U | U | U | U | U | F | F | F | F | F | F | D | D |
| 95 | U | U | U | U | U | U | F | F | D | D | D | D | D | D |
| 96 | U | U | U | U | U | U | U | D | D | D | D | D | D | D |

For a serving cell of an IAB-MT, the IAB-MT can be provided by Provided Guard Symbols MAC CE a number of symbols that will not be used for the IAB-MT in slots where the IAB-node transitions between IAB-MT and IAB-node DU and a SCS configuration for the number of symbols [11, TS 38.321].

With reference to slots of an IAB-DU cell, a symbol in a slot of an IAB-DU cell can be configured to be of hard, soft, or unavailable type by *HSNA Slot Configuration List* in *gNB-DU Cell Resource Configuration* [16, TS 38.473]. When a downlink, uplink, or flexible symbol is configured as hard, the IAB-DU cell can respectively transmit, receive, or either transmit or receive in the symbol.

When a downlink, uplink, or flexible symbol is configured as soft, the IAB-DU cell can respectively transmit, receive or either transmit or receive in the symbol only if

- the IAB-MT does not transmit or receive during the symbol of the IAB-DU cell, or

- with respect to all serving cells, the IAB-MT would transmit or receive during the symbol of the IAB-DU cell, and the transmission or reception during the symbol of the IAB-DU cell is not changed due to a use of the symbol by the IAB-DU, or

- the IAB-MT detects a DCI format 2\_5 with an AI index field value indicating the soft symbol as available if the IAB-MT is not configured with an SCG, or

- the IAB-MT detects a DCI format 2\_5 with an AI index field value indicating the soft symbol as available if the IAB-MT is not configured with an SCG, or

- the IAB-MT detects two DCI formats 2\_5 with an AI index field indicating the soft symbol as available from the MCG and SCG, respectively, if the IAB-MT is configured with an SCG, or

- the IAB-MT detects a DCI format 2\_5 with an AI index field value indacting the soft symbol as available from one cell group and with respect to all serving cells of the other cell group if the IAB-MT is configured with an SCG, the IAB-MT would transmit or receive during the symbol of the IAB-DU cell, and the transmission or reception during the symbol of the IAB-DU cell does not change due to a use of the symbol by the IAB-DU.

When the IAB-MT receives a DCI format 2\_5 from a serving cell in a cell group, the IAB-MT applies the information of the DCI format 2\_5 to all serving cells of the cell goup.

When a symbol is configured as unavailable, the IAB-DU neither transmits nor receives in the symbol.

A symbol of a slot is equivalent to being configured as hard if an IAB-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.

With reference to slots of an IAB-DU cell, the IAB-DU can be provided an indication of hard, soft or unavailable type per RB set for symbols configured as downlink, uplink or flexible in a slot by *Rel-17 frequency-domain IAB-DU-Resource-Configuration-H/S/NA-Config* [16, TS 38.473]. The RB set size and the number of RB sets are configured by *RB-Set-Configuration*. If an indication of hard, soft or unavailable type is not provided for an RB set of a symbol in a slot, the IAB-DU applies the configuration of hard, soft or unavailable type provided by *HSNA Slot Configuration List* in *gNB-DU Cell Resource Configuration* [16, TS 38.473] for the RB set of the symbol in the slot. If an indication of hard, soft, or unavailable type is provided for an RB set in a symbol of a slot, the IAB-DU applies the configuration of hard, soft, or unavailable type provided by *HSNA Slot Configuration List* when the IAB-node uses simultaneous transmission and reception in the slot.

When an RB set of a downlink, uplink, or flexible symbol is configured as hard, the IAB-DU cell can respectively transmit, receive, or either transmit or receive on the RB set in the symbol if a use of the RB set in the symbol by the IAB-DU does not change an ability of the IAB-MT to transmit and receive in any other RB set configured as unavailable, or configured as soft and not indicated as available, in the symbol.

When an RB set of a downlink, uplink, or flexible symbol is configured as soft, the IAB-DU cell can respectively transmit, receive or either transmit or receive on the RB set in the symbol only if

- the IAB-MT does not transmit or receive on the RB set during the symbol of the IAB-DU cell, or

- with respect to all serving cells, the IAB-MT would transmit or receive on the RB set during the symbol of the IAB-DU cell, and the transmission or reception on the RB set or any RB set that is configured as unavailable or configured as soft and not indicated as available during the symbol of the IAB-DU cell is not changed due to a use of the RB set in the symbol by the IAB-DU, or

- the IAB-MT detects a DCI format 2\_5 with an AI index field value indicating the soft RB set as available if the IAB-MT is not configured with an SCG, or

- the IAB-MT detects two DCI formats 2\_5 with an AI index field value indicating the soft RB set as available from the MCG and SCG, respectively, if the IAB-MT is configured with an SCG, or

- the IAB-MT detects a DCI format 2\_5 with an AI index field value indicating the soft RB set as available from one cell group and with respect to all serving cells of the other cell group, the IAB-MT would transmit or receive on the RB set during the symbol of the IAB-DU cell, and the transmission or reception on the RB set during the symbol of the IAB-DU cell does not change due to a use of the RB set in the symbol by the IAB-DU.

When an RB set of a downlink, uplink, or flexible symbol is configured as unavailable, the IAB-DU neither transmits nor receives in the RB set in the symbol.

If an IAB-node is provided an AvailabilityIndicator, the IAB-node is provided an AI-RNTI by *ai-RNTI* and a payload size of a DCI format 2\_5 by *dci-PayloadSizeAI*. The IAB-node is also provided a search space set configuration, by *SearchSpace*, for monitoring PDCCH.

For each cell of an IAB-DU in a set of cells of the IAB-DU, the IAB-DU can be provided:

- an identity of the IAB-DU cell by *iab-DU-CellIdentity*

- a location of an availability indicator (AI) index field in DCI format 2\_5 by positionInDCI-AI

- a set of availability combinations by availabilityCombinations, where each availability combination in the set of availability combinations includes

- resourceAvailability indicating availability of soft symbols in one or more slots for the IAB-DU cell, or one or multiple *resourceAvailability* with each *resourceAvailablity* indicating availability of soft resources in one or more slots for one RB set group where one RB set group includes one or multiple RB sets, and

- a mapping for the soft symbol availability combinations provided by *resource*Availability to a corresponding AI index field value in DCI format 2\_5 provided by availabilityCombinationId

The IAB-DU can assume a same SCS configuration for *availabilityCombinations* for a cell as an SCS configuration provided by *gNB-DU Cell Resource Configuration* for the cell.

An AI index field value in a DCI format 2\_5 indicates to an IAB-DU a soft symbol or a soft RB set in an RB set group 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 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 or a soft RB set in an RB set group in a slot is identified by a corresponding value resourceAvailability as provided in Table 14-3.

Table 14-3: Mapping between values of resourceAvailability elements and types of soft symbol or soft RB set availability in a slot

|  |  |
| --- | --- |
| Value | Indication |
| 0 | No indication of availability for soft symbols or soft RB sets in an RB set group |
| 1 | DL soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for UL and Flexible soft symbols or RB set group |
| 2 | UL soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for DL and Flexible soft symbols or RB set group |
| 3 | DL and UL soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for Flexible soft symbols or RB set group |
| 4 | Flexible soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for DL and UL soft symbols or RB set group |
| 5 | DL and Flexible soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for UL soft symbols or RB set group |
| 6 | UL and Flexible soft symbols or soft RB sets in an RB set group are indicated available No indication of availability for DL soft symbols or RB set group |
| 7 | DL, UL, and Flexible soft symbols or soft RB sets in an RB set group are indicated available |

If a PDCCH monitoring periodicity for DCI format 2\_5is smaller than a duration of an availability combination of soft symbols over a number of slots that the IAB-MT obtains at a PDCCH monitoring occasion for DCI format 2\_5 by a corresponding AI index field value, and the IAB-MT detects more than one DCI formats 2\_5 indicating an availability combination of soft symbols or of soft RB sets in RB set groups in a slot, the IAB-MT expects that each of the more than one DCI formats 2\_5 indicates a same value for the availability combination of the soft symbols or of soft RB sets in an RB set group in the slot. An IAB-MT monitors PDCCH candidates for a DCI format 2\_5 with CRC scrambled by AI-RNTI in one or both of the following search space sets:

- a Type3-PDCCH CSS set configured by *SearchSpace* in *PDCCH-Config* with *searchSpaceType* = *common*;

- a USS set configured by SearchSpace in PDCCH-Config with searchSpaceType = ue-Specific.

The IAB-node can be provided a set of RS resource indexes that indicate quasi co-location properties of the IAB-DU serving cell by the parent node where simultaneous transmission from the IAB-MT and IAB-DU serving cells is restricted by Child IAB-DU Restricted Beam Indication MAC CE as described in [11, TS 38.321]. The IAB-DU does not transmit on a serving cell if the IAB node is operating in a non-TDM multiplexing mode using an indicated RS resource index on a symbol or RB set group configured as soft in an IAB-DU cell

- when it is not indicated as available by *resourceAvailability*, and

- when the IAB-MT is operating on an associated carrier, if provided, and

- when the current IAB-DU transmission mode corresponds to a multiplexing capability indicated as supported and/or required by *Multiplexing Mode Info* in [16, TS 38.473], and

- when one of the associated TCI states, RS resource indexes, or SRI of the IAB-MT, if provided, is simultaneously used for reception or transmission of the IAB-MT.

For a serving cell of an IAB-MT, the IAB-MT can be provided a set of TCI states or a set of RS resource indexes corresponding to a SS/PBCH block or to a CSI-RS resource index for a slot where a PDSCH EPRE adjustment is indicated by DL Tx Power Adjustment MAC CE as described in [11, TS 38.321]. The PDSCH EPRE can be derived from a downlink CSI-RS EPRE as described in [6, TS 38.214] and a PDSCH power offset provided by *powerControlOffsetIAB* as described in [11, TS 38.321]. For a downlink DM-RS and/or PT-RS associated with a PDSCH, the IAB-MT may assume that the ratio of PDSCH EPRE to DM-RS EPRE, and/or PT-RS EPRE to PDSCH EPRE,is obtained as for a "UE" in [6, TS 38.214]. If no TCI state or RS resource index is provided to the IAB-MT, the IAB-MT may assume that a same PDSCH EPRE adjustment applies to all TCI states or RS resource indexes configured for the IAB-MT. A PDSCH EPRE adjustment provided by DL Tx Power Adjustment MAC CE may be restricted to frequency resources of an IAB-node that do not result in simultaneous reception on the same frequency resources by an IAB-MT and IAB-DU in a slot.