**3GPP TSG RAN WG1 #106-e R1-21xxxxx e-Meeting, August 16th – 27th, 2021**

**Agenda Item:** **8.10.1**

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

**Title: Feature Lead Summary #1 of 8.10.1**

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

# Introduction

This contribution provides a summary of the discussion in RAN1#106-e for the following email discussion:

[106-e-NR-eIAB-01] Email discussion on enhancements to resource multiplexing between child and parent links of an IAB node – Thomas (AT&T)

* 1st check point: August 19
* 2nd check point: August 25
* 3rd check point: August 27

# Simultaneous Operation of Access and Backhaul Links

**From the eIAB WID:**

* Specification of enhancements to the resource multiplexing between child and parent links of an IAB node, including:
  + **Support of simultaneous operation (transmission and/or reception) of IAB-node’s child and parent links (i.e., MT Tx/DU Tx, MT Tx/DU Rx, MT Rx/DU Tx, MT Rx/DU Rx)**
  + Support for dual-connectivity scenarios defined by RAN2/RAN3 in the context of topology redundancy for improved robustness and load balancing.

**Summary of input contributions:**

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| **Company** | **Proposals** |
| **Huawei, HiSilicon (R1-2106454,R1-2107665)** | ***Proposal 1:*** *the IAB node should report conditions for different multiplexing cases per {MT-CC, DU cell}-pair as follows:*   * *Multiplexing case A (Simultaneous MT-Tx/DU-Tx): Case #6 timing, additional uplink PC parameters, guard band, and desired Tx beam* * *Multiplexing case B (Simultaneous MT-Rx/DU-Rx): Additional downlink PC parameters, guard band, preferred TCI, and orthogonal DMRS ports* * *Multiplexing case C (Simultaneous MT-Rx/DU-Tx): Additional downlink PC parameters, guard band, preferred TCI, and orthogonal DMRS ports* * *Multiplexing case D (Simultaneous MT-Tx/DU-Rx):* *Additional uplink PC parameters, guard band, and desired Tx beam*   ***Proposal 2:*** *To support the parent node indicating restricted beams to IAB node, dedicated reference signals and preferably SRS should be defined/configured.*  ***Proposal 3:*** *The IAB node can report the preferred TCI of IAB-MT as a condition for simultaneous MT-Rx/DU-Rx.*  ***Proposal 4:*** *To facilitate the co-existence of TDM and FDM slots and backward compatibility, a two-step H/S/NA configuration is supported in Rel-17*   * *Step 1: Configure time domain H/S/NA for each slot in one period by reusing Rel-16 mechanism* * *Step 2: Configure frequency domain H/S/NA for a subset of the slots within one period, which overrides the time domain H/S/NA configuration in the slots*   ***Proposal 5:*** *Reuse Rel-16 DCI format 2\_5 to indicate the availability of frequency domain soft resources.*  ***Proposal 6:*** *For intra-CC FDM, the guard band should be placed in MT resources.*  ***Proposal 7:*** *If an IAB-MT is additionally provided TDD-UL-DL-ConfigDedicated-IAB-MT, the parameter tdd-UL-DL-ConfigurationDedicated-IAB-MT overrides all symbols per slot over the number of slots as provided by tdd-UL-DL-ConfigurationCommon.*  ***Proposal 8:*** *To increase the resources for simultaneous operation, the specification should allow the collision between tdd-UL-DL-ConfigurationDedicated-IAB-MT and cell-specific signals/channels. In the slots with the collision, the IAB node should ignore tdd-UL-DL-ConfigurationDedicated-IAB-MT. The list of cell-specific signals/channels includes:*   * *SS/PBCH block* * *CORESET for Type0-PDCCH CSS set* * *PRACH*   ***Proposal 9:*** *Donor CU can provide two sets of resource configurations to each DU cell: a basic resource configuration for access UEs and one additional resource configuration for child IAB node MTs, and the DU cell should maintain two sets of DU resource configurations simultaneously.*  ***Proposal 1:*** *Number of guard symbols for MT and DU flexible symbols = min(Number of guard symbols for MT and DU downlink switching, Number of guard symbols for MT and DU uplink switching)*  ***Proposal 2****: Introduce negative value of Ng to support efficient resource utilization.* |
| **Vivo (R1-2106617)** | **Proposal 1: IAB MT reports to parent node the supported timing mode, guard symbol, interference information, DL/UL power control information and desired DL/UL beam to assist parent node to indicate the applicability of a given multiplexing case.**   * The required guard symbol should be reported per timing mode. * FFS whether some of the information is indicated from parent node to IAB node, and the IAB node decides the applicability of a given multiplexing case accordingly.   **Proposal 2: Support both semi-static and dynamic adaptation of an IAB-node’s multiplexing operation on a given set of time/frequency resources.**  **Proposal 3: Support to indicate the allowance of a given multiplexing case on a given set of time/frequency resources by parent node/CU.**  **Proposal 4: Support IAB node to report the expected operation (e.g., simultaneous operation or TDM operation) on a given set of time/frequency resources to parent node/CU.**  **Proposal 5: The Rel-16 H/S/NA configuration and frequency domain configuration should be jointly applied.**  **Proposal 6: The availability indication of the frequency resource should be applied to H/S resource in the time domain.**  Proposal 7: Support separate indication of time and frequency resources availability in DCI format 2\_5, where different fields in DCI format 2\_5 are used for time and frequency resource availability indication.  Proposal 8: The child node can dynamically report recommended CRI(s)/SRI(s) to the parent node per multiplexing case.  Proposal 9: Regarding applicability of the indicated restricted beams from parent node to child IAB-DU, the following should be supported.   * The beam restriction is applied to the occasions of simultaneous DU TX and MT TX at child IAB node. * The beam restriction is not applied cell-specific signaling transmission, e.g., SSB and periodic CSI-RS.   **Proposal 10: Parent node indicates a set of restricted beams in the form of CRI of child DU.**  **Proposal 11: Clarify the applicability of the beam restriction indications from different parent nodes in case of dual connectivity of the child IAB node.**  Proposal 12: If multiple timing modes are configured in TDMed manner for an IAB node, additional guard symbol types should be defined for new transition cases, e.g.,   * The transition between Case 1 timing mode and Case 6 timing mode; * The transition between Case 1 timing mode and Case 7 timing mode； * The transition between Case 6 timing mode and Case 7 timing mode. |
| **Nokia, Nokia Shanghai Bell (R1-2106828)** | ***Proposal 2.1: Separate TDM H/S/NA configuration is given just for preparing changes in multiplexing capability requiring switching to TDM. Otherwise, TDM configuration e.g. in some slots may be obtained with a proper FDM configuration (same H/S/NA type indicated for all RB sets).***  ***Proposal 2.2: If the Rel-16 H/S/NA configuration and frequency domain configuration are jointly applied,******specify a method for resolving conflicts between conflicting FDM and TDM configurations.***  ***Observation 2.1: Frequency resource set allocation that does not align with RBG boundaries, can result in reduced spectral efficiency for PDSCH and PUSCH using resource allocation type 0.***  ***Proposal 2.3: Limit the number of configurable frequency resource sets to M.***  ***Proposal 2.4: DCI 2-5 format is kept, and definition of an availability combination is enhanced to frequency domain.***  ***Proposal 2.5: Indicate beam restrictions independently for nodes operating in case A and case B multiplexing modes.***  ***Proposal 2.6: Identify at least one signaling mechanism for how beam restriction/preference will be indicated form the parent node to the child node.***  ***Observation 2.2: Support for panel-resolution restriction and preference indication is not well motivated.***  ***Proposal 2.7: Support semi-static signaling for configured beam restriction for simultaneous MT/DU operation.***  ***Proposal 2.8: To report changes on active beams used for IAB-MT reception or IAB-MT transmission, introduce new dynamic signaling (MAC-CE) such that the IAB-MT can report the preferred/restricted beams (e.g., a sub-set of TCI states from the activated TCI states of PDCCH/PDSCH) for the IAB-MT to support SDM operation.***  ***Proposal 2.9: For FDM/SDM operation, allowed direction of the transmission for the IAB DU in F-S resources may be further controlled by the parent node by using a dynamic indication.***  ***Observation 2.3: Rel-16 signaling framework of reporting desired guard symbols can be reused for indicating required guard symbols of FDM/SDM operation.***  ***Proposal 2.10: For FDM/SDM operation, Rel-16 defined MAC-CE on desired Guard symbols shall be reused to provide additional information related to simultaneous operations. RAN1 shall further investigate 1) the maximum number of guard symbols for simultaneous operation switching modes 2) the interpretation or extension on number of indicated fields.***  ***Observation 2.4: Guard band indication may be necessary from an IAB node operating in case#7 timing mode towards its parent. The parameters of the guard band sizes must account for expect power imbalance between the signals being multiplexed.*** |
| Samsung (R1-2106907) | *Proposal 1: N is determined based on the bandwidth part size of IAB-MT.*  *Proposal 2: Guard band can be generated by each IAB node or parent IAB.*  *Proposal 3: The following H/S/NA resource types are supported for FDM*  *- H type for frequency resource: the IAB DU can assume it can use the frequency resource regardless of the MT’s configuration on the frequency resource*  *- S type for frequency resource: the IAB DU can assume it can use the frequency resource without an impact on the MT’s configuration on the frequency resource*  *- NA type for frequency resource: the IAB DU cannot assume it can use the frequency resource*  *Proposal 4: Either the Rel-16 H/S/NA configuration or frequency domain configuration is applied for a given resource.*  *Proposal 5: The existing beam management framework is reused for SDM as much as possible.*  *Proposal 6: Both semi-static and dynamic adaptation for IAB node's multiplexing operations are supported.* |
| Lenovo, Motorola Mobility (R1-2107188) | Proposal 1: Support joint application of time- and frequency-domain H/S/NA configurations.  Proposal 2: Specify rules for determining H/S/NA resource types for time-frequency resources based on separate configurations in time and frequency domains.  Proposal 3: Support conditional availability indication as a balance between existing best-effort non-TDM and TDM-only availability indication.  Proposal 4: Extend DCI 2-5 to cover frequency-domain availability indication by replacing a unit of slots by a unit of N PRBs or N RBGs.  Proposal 5: No need to introduce scaling of N based on system BW or IAB-MT BWP.  Proposal 6: Support per-panel granularity by allowing dynamic indication of restricting/using beams and their associated antenna panels for specific time-frequency resources.  Proposal 7: Support early beam/panel indications for the upstream link in addition to downstream indications.  Proposal 8: Support applicability of beam/panel indications to specific time-frequency resources.  Proposal 9: Support signaling IAB node capabilities for timing alignment and multi-panel and baseband characteristics.  Proposal 10: Support dynamic signalling for communicating operation constraints such as beam, power, interference, and timing alignment constraints along with information of time, frequency, and spatial resources.  Proposal 11: Support a guard symbol for switching between timing modes. |
| Qualcomm (R1-2107365) | **Observation 2.1:**  **For frequency domain multiplexing, Alt1 can be viewed as a special case of Alt2, where switching between configurations is one specific scheme within the general space of joint application.**  **Proposal 2.1:**  **To help with down-selection for frequency domain multiplexing, clarify whether the frequency domain configuration in Alt1 and Alt2 refers to a configuration in frequency-domain only or a configuration in time-frequency grid.**  **Proposal 2.2:**  **Support *RB-set based H/S/NA time-domain configuration* within the general scheme space of Alt2, wherein Rel-16 H/S/NA time-domain configuration is applied within each RB set.**   * **Each RB set can be configured as (starting PRB, number of consecutive PRBs).** * **Different Rel-16 time-domain H/S/NA patterns can be configured for different RB-sets.** * **If an RB set overlaps with any of SSB, Type0-PDCCH, periodic CSI-RS, PRACH, or SR at a symbol, this RB set at this symbol shall be treated as “Hard”.**   **Observation 2.2:**  **The *RB-set based H/S/NA time-domain configuration* provides a good trade-off between configuration flexibility and signalling overhead.**   * **Alt1 can be achieved by *RB-set based H/S/NA time-domain* configuration as a special case, wherein the same H/S/NA pattern is applied over a 1st subset of time-resources cross RB-sets and different H/S/NA patterns over different RB-sets are applied over a 2nd subset of time-resources.**   **Proposal 2.3:**  **Support joint TDM and FDM indication for soft resource availability, wherein DCI2\_5 format is kept unchanged and RRC configured table for availability combinations can be extended to allow for indication of availability in frequency-domain in granularity of RB set.**  **Proposal 2.4:**  **Update resourceAvailability mapping table defined in TS38.213 so that the indication of availability can be applied over soft resources in frequency-domain for DL or UL or Flexible symbols.**   * **E.g. replacing “soft DL/UL/Flexible symbols” with “soft resources in DL/UL/Flexible symbols”**   **Proposal 3.1:**  **Support dynamic indication by the IAB-node to its parent-node (via MAC-CE) to indicate whether the semi-static capability for enhanced multiplexing is applicable at the time.**  **Proposal 3.2:**  **Support indication of conditions required to realize the enhanced multiplexing capability by the IAB-node to donor CU (via F1-AP) and/or parent node (via MAC-CE), such as**   * **Required timing mode,** * **DL RX/UL TX power constraints,** * **Required number of guard tones for FDM.** * **Required number of guard symbols for adaptation of enhanced multiplexing operation.** * **A set of applicable beam directions (SSBs/TRPs) or child nodes.**   **Proposal 3.3:**  **Extend the Rel-16 DU resource management to spatial-domain by indicating DU resource type (Hard/Soft/NA) per SSB area or per TRP or per child node by donor CU to an IAB-node DU.** |
| ETRI (R1-2107479) | **Proposal 1: Introduce L2 (MAC CE) based report/indication on conditions/parameters to facilitate adaptation between multiplexing operation modes, where the report/indication includes the following contents, at least:**   * **Supported multiplexing mode (FDM and/or SDM).** * **Required timing mode.** * **Required DL/UL power control support.** * **Information on the “non-preferred” beam.** * **Required number of guard symbols for switching of multiplexing mode.** * **Required guard band for FDM**   **Proposal 2: Introduce higher-layer parameter(s) to configure the following information:**   * **Periodicity or timing of report/indication on conditions/parameters to facilitate adaptation between multiplexing operation modes.** * **Recommendations on the conditions/parameters from parent node perspectives.**   **Proposal 3: Enhance DCI format 2\_5 to enable frequency domain resource availability indication.**   * **Opt.1: Extend of the mapping between values of resourceAvailability elements and types of soft symbol availability to frequency domain resource availability (to fit Alt. 2: The Rel-16 H/S/NA configuration and frequency domain configuration are jointly applied).** * **Opt.2: Introduce a new RNTI to indicate frequency domain resource availability (to fit Alt. 1: Either the Rel-16 H/S/NA configuration or frequency domain configuration is applied for a given resource).**   **Proposal 4: Support Alt. 2 (the Rel-16 H/S/NA configuration and frequency domain configuration are jointly applied).**  **Proposal 5: Consider specification supports on handling of cell-specific or semi-static signals/channels when the signals/channels are associated with the non-preferred DU beams.**  **Proposal 6: Consider specification supports to report non-preferred MT beams for simultaneous operations.**  **Proposal 7: Define preferred/non-preferred beams by one or more among the following options:**   * **Option 1: TCI state ID** * **Option 2: Spatial relation information ID** * **Option 3: RS ID (including CSI-RS, SRS, SSB, etc.)**   **Proposal 8: RAN1 to strive concurrent support of “Rel-16 simultaneous TCI/spatial relation update” and “Rel-17 simultaneous DU/MT operations”.**  **Proposal 9: Clarify that there is no impact on IAB-MT behavior due to conflicts between cell-specific signals/channels and other resource configurations of the IAB-MT, when the IAB node supports SDM between DU and MT resources at least.**  **Proposal 10: Study BD/CCE limits enhancement to allocate more BD/CCE budgets for the cells with simultaneous operations**. |
| LG Electronics (R1-2107553) | ***Proposal 1: Time resource for TDM and non-TDM operation of an IAB-node can be semi-statically configured by the network.***  ***Proposal 2: During the time resource for non-TDM operation, the multiplexing operation mode of an IAB-node can be determined implicitly based on semi-static D/U/F resource type of MT and DU at least.***  ***Proposal 3: Discuss to report the applicability of the given multiplexing operation mode to the parent node at least for DU flexible resource.***  ***Proposal 4: Discuss to support guard symbols for timing boundary overlapping in case of timing mode transition for an IAB-node.***  ***Proposal 5: Discuss to adapt the required guard symbols according to the applied timing mode.***  ***Proposal 6: Guard band for FDM between MT and DU is determined by DU and allocated in DU frequency resource.***  ***Proposal 7: Either the Rel-16 H/S/NA configuration or frequency domain configuration is applied for a given resource.***  ***Proposal 8: Switching granularity between Rel-16 H/S/NA configuration and frequency domain H/S/NA configuration is aligned to switching granularity of multiplexing operation mode.***  ***Proposal 9: The same candidate values are used for the configuration of resource granularity N regardless of the RBG size of the corresponding MT.***  ***Proposal 10: Reference SCS is configured for frequency domain H/S/NA configuration.***  ***Proposal 11: The time domain and frequency domain soft resource availability indication are indicated independently within a DCI.***  ***Proposal 12:******Adopt that the beam resource of the IAB-DU of the child node is semi-statically controlled by the parent DU.***  ***Proposal 13: Support that child node reports information on beam pair(s) capable of simultaneous operation between DU and MT (i.e., simultaneous Tx-Tx, simultaneous Rx-Rx, simultaneous Tx-Rx, and simultaneous Rx-Tx) to its parent DU*** |
| Intel (R1-2107607) | **Proposal 1:** Either the Rel-16 H/S/NA configuration or frequency domain configuration is applied for a given resource. Per-slot level or per-resource type level switching granularity is preferred.  **Proposal 2:** For frequency-domain soft resource availability indication, enhancements of DCI format 2\_5 are based on the following semi-static configurations:   * Whether frequency-domain H/S/NA is applied per-slot level or per-resource type level * The maximum number of soft regions of one frequency-domain H/S/NA application   **Proposal 4:** Add reference SCSs for soft resource availability indication configuration in the RRC IE *AvailabilityCombinationPerCell*.   * For unpaired spectrum operation, a reference SCS configuration is provided by *subcarrierSpacing-AI* and, when a supplementary UL carrier is configured for the serving cell, a reference SCS configuration is provided by *subcarrierSpacing2-AI* for the supplementary UL carrier. * For paired spectrum operation, a reference SCS configuration for a DL BWP is provided by *subcarrierSpacing-AI* and a reference SCS configuration is provided for an UL BWP by *subcarrierSpacing2-AI*.   **Proposal 5:** For DCI format 2\_5 operation in paired spectrum with a reference SCS configuration provided for the reference DL BWP of the serving cell and a reference SCS configuration provided for the reference UL BWP of the serving cell:   * If : for each values provided by *resourceAvailability*, the first values for the combination of availability indication values are applicable to the reference DL BWP and the next value is applicable to the reference UL BWP. * If : for each values provided by *resourceAvailability*, the first value for the combination of availability indication values are applicable to the reference DL BWP and the next values are applicable to the reference UL BWP. |
| AT&T (R1-2107692) | **Proposal 1: Support dynamic adaptation of multiplexing capability for a subset of time/frequency resources of a given backhaul link via enhancements to DCI Format 2\_5 and adaptation of the desired/available guard symbols per multiplexing capability via enhancements to MAC-based signaling between an IAB node and its parent node.**  **Proposal 2: If an IAB node is configured with a frequency-domain H/S/NA configuration, either the Rel-16 H/S/NA configuration or frequency domain configuration is applied for a given resource with per-resource type within a slot granularity.**  **Proposal 3: The configured resource size for an IAB-DU’s frequency domain H/S/NA granularity is a set of N RBs, where N is exactly the number of PRBs that are configured for the corresponding MT’s RBG.**  **Proposal 4: The parent node can dynamically indicate to the child node a set of restricted beams at the IAB-DU of the child node which are associated with a given set of H/S/NA resource(s) and multiplexing capabilities at the IAB-DU.**  **Proposal 5: The child node can dynamically report to the parent node a set of recommended beams, not preferred beams, or both recommended and not preferred beams of the IAB-MT of the child node which are associated with different QCL assumptions of the IAB-MT using the existing beam-management framework and potential extensions to support panel-level granularity (if supported by the Rel-17 MIMO WI).** |
| Apple (R1-2107758) | **Proposal 1**: For simultaneous operation, either parent IAB-DU or IAB-DU can initiate and control the flow.  **Proposal 2**: The entity with higher data priority will control the flow by initiating the scheduling on high priority link and/or indicating the desired parameters to the other link  **Proposal 3**: For the case of parent IAB-DU indicating IAB node about the receiving beams/panels for Lp,DL and LA,UL / Lc,UL links, the indication can be dynamic and/or semi-static:   * Dynamic e.g. through TCI index in DCI for scheduling PDSCH Lp,DL * Semi-static, e.g. through MAC-CE/RRC to IAB-MT or through F1 interface to IAB-DU   **Proposal 4**: For the case of IAB indicating desired reception beams/panels on Lp,DL and LA,UL / Lc,UL links, the indication to parent IAB-DU can be dynamic and/or semi-static:   * Dynamic e.g. through UCI transmission from IAB-MT to parent DU * Semi-static, e.g. through MAC-CE from IAB-MT or through F1 interface from IAB-DU * Alternatively, IAB-MT performs SR or initiates PRACH to indicate desired receiving beam on Lp,DL   **Proposal 5**: To achieve a simultaneous reception within an IAB node, i.e. DU-Rx & MT-Rx, a two-step indication is deployed   * Step1: Parent IAB-DU indicates initial beam/panel, K0, SLIV, etc, and a grace time for IAB node in which IAB-MT can indicate its desired parameters like beam/panel, K0, SLIV, etc * Step2: IAB indicates its desired parameters (beam/panel, K0, SLIV, Tx power, etc), for example, on PUCCH indicated by DL DCI from parent IAB-DU   **Proposal 6**: To utilize SDM resource multiplexing, support PDSCH allocation for IAB-MT with crossing the slot border. |
| ZTE (R1-2107824, R1-2107826) | [Observation 1: It may aggravate interference and resource collision if a given resource were applied with both Rel-16 H/S/NA and frequency-domain H/S/NA.](#_Toc79164566)  [Observation 2: Semi-static H/S/NA configuration is not applicable for SDM due to time-variant channel conditions.](#_Toc79164567)  [Proposal 1: For the minimum resource size (a set of N RBs) for configuring the frequency domain granularity,](#_Toc79164569)  [• Candidate values for N can be 1, 4, 8, 16.](#_Toc79164570)  [• It is up to CU implementation how to set the actual value of N.](#_Toc79164571)  [Proposal 2: Frequency-domain H/S/NA should be configured per RB set within a carrier.](#_Toc79164572)  [• One RB set is configured as a multiple of N RBs.](#_Toc79164573)  [• Each RB set is defined based on a reference carrier/SCS, FFS how to determine the reference carrier/SCS of a DU cell.](#_Toc79164574)  [Proposal 3: For a given resource of an IAB DU cell, IAB node can be configured with either Rel-16 H/S/NA or frequency-domain H/S/NA.](#_Toc79164575)  [Proposal 4: Rel-16 DCI Format 2\_5 is reused to indicate soft resource availability for TDM and FDM slots:](#_Toc79164576)  [• For TDM slot, availability indication is valid for all soft symbols in the slot](#_Toc79164577)  [• For FDM slot, availability indication is only valid for all soft resource in the slot.](#_Toc79164578)  [Proposal 5: Additional enhancements to DCI Format 2\_5 are not necessary.](#_Toc79164579)  [Proposal 6: It is sufficient to indicate the one of the preferred beams and the not preferred beams for IAB node MT, and it is not necessary to indicate both of them at the same time.](#_Toc79164580)  [Proposal 7: It is not necessary to limit the applicability of beam indication to specific multiplexing cases or time-frequency resources.](#_Toc79164581)  [Proposal 8: H/S/NA configuration per beam (i.e. additional semi-static configuration signaling) is not supported.](#_Toc79164582)  [Proposal 9: Per-panel granularity for resource management in the spatial domain is not supported.](#_Toc79164583)  [Proposal 10: Different beam indications (i.e. child IAB-MT beam indication and parent IAB-DU beam indication) are applied to different links, i.e. backhaul link and access link of an IAB node.](#_Toc79164584)  [Proposal 11: Rel-16 guard symbols mechanism is reused in Rel-17 IAB.](#_Toc79164585)  [Proposal 12: Guard band for FDM between backhaul link and access link at an IAB node depends on implementation.](#_Toc79164586)  [Observation 1: If more than one SCS-specific carrier for an IAB-node DU cell is reported to CU, IAB-node DU should know which carrier (e.g. either which one of the SCS-specific carriers or the carrier defined/determined by CU) is used by CU to define the RB sets for H/S/NA resource configuration in frequency domain.](#_Toc79164250)  [Proposal 1: A reference carrier used for H/S/NA resource configuration in frequency-domain for an IAB-node DU cell should be specified.](#_Toc168)  [Proposal 2: Parent nodes should be made aware of the carrier frequency information and reference carrier of an IAB DU cell.](#_Toc10069)  [• FFS: how to indicates the IAB-node DU cell H/S/NA resource configuration in frequency-domain to the parent node by CU](#_Toc27790) |
| NTT DOCOMO (R1-2107877) | **Proposal 1: Semi-static configuration of H/S/NA resource type in frequency domain can be provided per RB set (e.g., *N* RBs) per slot per D/U/F resource type.**  **Proposal 2: To save signaling overhead, H/S/NA in freq. domain can be provided only for some time units indicated by explicit signaling and/or determined by predefined rules.**   * **For a given symbol, if frequency domain H/S/NA is not provided, time domain H/S/NA can be applied** * **For a given symbol, if both frequency domain H/S/NA and time domain H/S/NA are provided, whether frequency domain H/S/NA or time domain H/S/NA is applied can be determined by predefined rules considering e.g., multiplexing capability, MT/DU’s DL/UL direction, timing mode, power control, beam indication, etc.**   **Proposal 3: DCI format 2\_5 framework can be reused, and *ResourceAvailability* can be enhanced to indicate availability per RB set per slot per D/U/F resource type.**  **Proposal 4: In addition to legacy beam reporting, IAB node can report M best beams that are suitable for simultaneous MT/DU operation via CSI reporting framework.**  **Proposal 5: Restricted DU beams can be configured for each SSB/CSI-RS of MT serving cell via RRC signaling.**  **Proposal 6: If case#6 timing mode is required for simultaneous MT-Tx/DU-Tx, simultaneous MT-Tx/DU-Tx can be performed only if case#6 UL Tx timing is indicated by parent node; otherwise, simultaneous Tx cannot be performed.**  **Proposal 7: On a DU flexible symbol, parent node can configure/indicate IAB node MT Tx/Rx, and IAB node DU will Tx/Rx on the symbol based on MT transmission/reception direction and its multiplexing capability.**  **Proposal 8: Whether different value range of the number of guard symbols is needed for the new timing modes needs to be studied.**  **Proposal 9: Guard symbol is provided for each combination of MT case1 Tx/case6 Tx/case7 Tx/Rx and DU Tx/Rx.**  **Proposal 10: Guard band can be handled by IAB node implementation.** |
| Ericsson (R1-2108107,2108109) | *Proposal 1 The frequency domain granularity, i.e., the N RBs in an RB set is related to MT’s number of PRBs in an RBG, NRB(RBG), such that:*  *N = {1, 2, 4, 8} × NRB(RBG) or N = {1, 2, 3, 4} × NRB(RBG).*  *Proposal 2 If a resource is configured as Hard, the IAB-DU can transmit, receive, or either transmit or receive according to its configuration only if it does not impact the IAB-MT’s actual ability to operate in any other resource according to the configuration of that resource.*  *FFS: How to address the Soft Indicated Available IAB-DU resources.*  *Proposal 3 Time-domain H/S/NA configuration is always provided to the IAB-node even if ”TDM not required” is indicated to the IAB-donor-CU.*  *Proposal 4 Support separate TDM and FDM configurations in an IAB-node.*  *Proposal 5 Support operation in either TDM or FDM modes on a per-slot basis.*  *Proposal 6 Support indicating both time-domain and frequency-domain H/S/NA in the same gNB-DU Cell Resource Configuration (9.3.1.107 in TS 38.473 [7]).*  *Proposal 7 The frequency-domain H/S/NA is provided per slot.*  *Proposal 8 Support multiple frequency domain DCI format 2\_5 associated to the same time slot.*  *Proposal 9 Resources for SDM are available in FDM (and TDM for IAB nodes that do not require TDM) Soft resources through implicit indication.*  *Proposal 10 Beam restrictions (contrary to interference management restrictions) are only applicable to resources where SDM is used (i.e., Soft).*  *Proposal 11 Explicit availability indication overrides SDM beam restrictions in Soft resources.*  *Proposal 12 The child node indicates a set of preferred beams to the parent node, which can include preferred IAB-MT DL RX beams and/or IAB-MT UL TX beams.*  *Proposal 13 A parent node can be made aware of all IAB-DU resource configurations, including both time-domain and frequency-domain H/S/NA configurations.*  *Proposal 14 The parent IAB-node is dynamically provided with changes of the IAB-node’s ability to exploit a multiplexing capability.*  *Proposal 15 The multiplexing ability reporting is signaled separately from the operational conditions/parameters for determined multiplexing operation modes.*  *Proposal 16 Whether or not to switch to FDM/SDM should be based on the ACK/NACK response from the parent IAB-node.*  *Proposal 17 Whether the simultaneous operation is TX or RX is determined according to the UL/DL configuration of the IAB-DU.*  *Proposal 18 In a slot when FDM configuration is not provided, TDM configuration applies.*  *Proposal 19 Fallback to TDM does not need an ACK response from the parent IAB-node.*  *Proposal 20 RAN1 should consider how an IAB-node can determine which timing mode to use for which multiplexing mode.*  *Proposal 21 RAN1 should consider how to configure timing for IAB node(s) based on multiplexing ability (including parent IAB-node (Case-6) and child IAB-node (Case-7)).*  *Proposal 22 In a slot when FDM configuration is not provided, Case-6 timing is not required.*  *Proposal 23 Desired/Provided Guard Symbols are signaled in multiple groups that covers all relevant switching combinations among Case #1, Case #6 and Case #7 timing alignments.*  *Proposal 24 Dedicated transmission directions in terms of DL/UL for cell-specific signals/channels should be maintained when configuring simultaneous operation at an IAB-node.*  *Proposal 25 For an IAB-MT,*  *a. an indicated transmission overrides a configured SSB reception,*  *b. an indicated reception overrides a configured PRACH transmission, and*  *c. an indicated transmission overrides a configured SIB reception.*  *Proposal 26 Rel-17 enhancement on DCI format 2\_5 should at least consider extension of the maximum payload size of DCI format 2\_5 to increase the number of IAB-DU cells that can be provided with availability information for Soft resources. FFS: Further enhancement to further increase the number of IAB-DU cells that can be indicated AI.*  *Proposal 27 One resourceAvailability element of the availabilityCombinations table is reserved to signal to the IAB-DU that “No Availability Indication is provided” in DCI format 2\_5 for slots which receive multiple Availability Indicators.* |
| CEWiT, Tejas Networks, IITM, IITH, IITB (R1-2108161) | **Proposal 1:** Mechanism to inform multiplexing capability of parent nodes to IAB node is supported  **Proposal 2:** Signalling of multiplexing capability and supported modes from IAB node to CU and parent-DU is supported  **Proposal 3:** Following alternatives are proposed for configuring active mode of operation at an IAB node   * Alt1: Donor configuring the active mode of operation of IAB node * Alt2: Parent node configuring the active mode of operation of IAB node   **Observation 1:** IAB node and its parent node should have same understanding of the active mode of operation of the IAB node at every time instant  **Proposal 4**: Parent node updating the parameters like TA and guard required at IAB node based on active mode of operation of parent node and IAB node before mode switching is supported  **Proposal 5:** Dynamic switching between multiplexing modes of IAB node is supported under the control of parent node  **Proposal 6:** Mechanism to fall back to TDM mode from simultaneous mode at IAB node is supported  **Observation 2:** Frequent switching between multiplexing modes leads to signaling storm  **Proposal 7:** Define minimum duration for active mode of operation  **Proposal 8:** An IAB node apply either the time domain H/S/NA configuration or frequency domain H/S/NA configuration for a given resource based on the active mode of operation  **Proposal 9:** The switching between time domain H/S/NA configuration and frequency domain H/S/NA configuration occur based on the granularity of active mode of operation  **Observation 3:** Explicit signalling of IA for a S resource is needed based active mode of operation  **Proposal 10:** In case of IAB-MT, the resource configuration given by *tdd-UL-DL-ConfigurationDedicated-IAB-MT* override the configuration of cell specific signal/channel |

**ISSUE 2.1: FREQUENCY DOMAIN MULTIPLEXING**

**Agreement**

The semi-static configuration of H/S/NA resource type in frequency domain is provided per RB set, per D/U/F resource type within a slot.

**Agreement**

A Reference SCS is configured for frequency domain H/S/NA configuration.

**Proposal 2.1.2:**

* **For a given symbol, if the frequency domain H/S/NA configuration is not provided, the time domain H/S/NA is applied**
* **For a given symbol, if both frequency domain H/S/NA and time domain H/S/NA are provided, whether frequency domain H/S/NA or time domain H/S/NA is applied can be determined by predefined rules e.g., based on multiplexing capability, MT/DU’s DL/UL direction, timing mode, semi-static/cell specific configurations, etc.**

**Discussion: Views on proposal 2.1.2?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support the proposal** |
| **ZTE, Sanechips** | The first bullet is clear and OK for us.  Disagree with the second bullet. We agree that both frequency domain H/S/NA and time domain H/S/NA can be provided to an IAB DU, but these two kind of HSNA should be configured on separate DU symbols. From our point of view, CU is aware of almost all the listed factors(e.g., multiplexing capability, MT/DU’s DL/UL direction, .etc) that may be used to determine the applied type of HSNA configuration, and it is more suitable to let CU make the final decision and provide only one type of configuration for a given symbol , and this can make IAB node and its parent node as well as the CU have a consistent understanding on the used HSNA configuration on the IAB node, this also has less signalling overhead and spec changes. |
| **Ericsson** | Support |
| **LG** | We support the proposal. |

**Proposal 2.1.4: To support soft resource availability in the frequency domain, the existing DCI 2\_5 format is reused and the values of configured availability combinations extended to support indication of availability in the frequency-domain with the granularity of an RB set.**

**Discussion: Views on proposal 2.1.4?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support the proposal** |
| **ZTE, Sanechips** | We prefer to fully reuse current DCI 2\_5 format without enhancement, and the values in 2\_5 is used to indicated the availability of all the soft RB sets. We think it is not necessary to indicate the AI per RB set since FDM is already supported by semi-static per RB set HSNA in frequency domain.  **To support soft resource availability in the frequency domain, the existing DCI 2\_5 format is reused ~~and the values of configured availability combinations extended to support indication of availability in the frequency-domain with the granularity of an RB set~~.** |
| **Ericsson** | Support |
| **LG** | We are fine with the proposal. |

**Proposal 2.1.5: To support soft resource availability in the frequency domain, multiple DCI format 2\_5 can be received corresponding to the same time resources of the child IAB-DU cell.**

**Discussion: Views on proposal 2.1.5?**

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| **Company** | **Comments** |
| **NTT Docomo** | **We would like to understand the intention of this proposal. We think more clarification is needed.**  **One interpretation is each DCI format 2\_5 indicates resource availability for different RB sets, e.g. one DCI format 2\_5 indicates availability for RB sets #1, a second DCI format 2\_5 indicates availability for RB set #2. If this is the interpretation of this proposal, we do not support. We think one DCI format 2\_5 is sufficient to indicate an availability combination that include availability of all RB sets. We don’t see the need to have multiple DCI format 2\_5.** |
| **ZTE, Sanechips** | Share similar view with Docomo, this proposal is also not clear to us. |
| **Ericsson** | Support |
| **LG** | If Proposal 2.1.4 is agreed, in our understanding, frequency domain availability for multiple RB sets can be indicated by a DCI. Then, we don’t think this proposal is necessary. If multiple DCIs are received corresponding to the same time resource, the indicated availability information should be the same. |

**Proposal 2.1.6: The frequency domain granularity N of an RB set is M times the number of PRBs in an RBG of the IAB-MT, RBG\_MT:**

**N = M × RBG\_MT**

**Where M = {1, 2, 4, 8, 16}**

**Discussion: Views on proposal 2.1.6?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Do not support.**  **We think it is more straightforward that N is configured directly without linkage with MT RBG size.**  **Because the size of MT RBG is configured per MT DL/UL BWP. If N is provided based on the size of MT RBG, the reference MT BWP need to be provided, which is more complicated.** |
| **ZTE, Sanechips** | Disagree,  It is more simple to configure N directly, we do not see the benefit to specify the bonding of N and RBG\_MT. And it is also not clear how this would work, for example, multiple BWPs/RBG\_MTs may be configured, which RBG would be used? and the dynamic BWP switching may be performed, whether N is also dynamically changed according to the MT\_BWP switching? |
| **Ericsson** | Support, although we doubt the justification for 16 since the maximum number of RBGs for any size of BWP is 18 and hence only two resource availability types (H/S/NA) would be included.  With respect to comments by Docomo and ZTE, we think RBG scaling is needed if we are to honor the agreement from RAN1#105, stating that “*N is at least the # PRBs that are corresponding to the MT’s # PRBs of an RBG.*” Without scaling, it would mean that N ≥ 16 RBs since the largest RBG size is 16 RBs. Clearly, this size is not desirable for smaller BWPs. |
| **LG** | Regarding on RBG\_MT, some clarifications are required.  First, since the RBG size is determined according to the BWP size, the RBG size may be different for each BWP of the MT. When the MT has multiple BWPs, RBG\_MT means the RBG size for which BWP?  In addition, when considering a multiple carrier environment, there may be multiple MT-CCs that should be FDMed with a specific DU-cell. It means that there can be multiple corresponding MT-CCs for a DU-cell. At this time, RBG\_MT for determining the value of N means the RBG size for which MT?  Considering these things, rather than the value of N corresponding to the RBG size of the MT, we prefer to keep the same candidate values for N regardless of RBG size of the corresponding MT. Then, the determination of the value N is up to the CU. |

**ISSUE 2.2: SPATIAL DOMAIN MULTIPLEXING**

Proposal 2.2.1: Spatial domain restrictions/recommendations from a child or parent node can be indicated to be applicable to specific time-frequency resources.

**Discussion: Views on proposal 2.2.1?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support in general.**  **But we would like to make sure we have correct understanding on this proposal. Does the proposal mean the spatial domain restrictions/recommendations indicated by parent node or child node are applicable to specific time-freq. resources and we will further discuss applicability? If so, we suggest having an FFS to make it clear.**  Proposal 2.2.1: Spatial domain restrictions/recommendations from a child or parent node can be indicated to be applicable to specific time-frequency resources.   * **FFS: applicability of spatial domain restrictions/recommendations from child node or parent node.** |
| **ZTE, Sanechips** | Agree in principle, and if my understanding is correct, this proposal is for dynamic indication/reporting from a parent or child node, and we propose to update the proposal as:  **Spatial domain restrictions/recommendations from a child or parent node can be dynamically reported/indicated to be applicable to specific time-frequency resources.** |
| **Ericsson** | We can support limiting spatial restrictions to slots in which simultaneous operation is performed. In addition, a natural restriction is that simultaneous operation itself is restricted to Soft resources (that we admittedly have not yet agreed to) with the existing interpretations of H/S/NA. Furthermore, the interpretation in case of a missing indication is undefined.  We propose the following modification:  ***Spatial domain restrictions from a parent node or recommendations from a child node can be limited to a subset of the T/F resources in which simultaneous operation is configured.***  Furthermore, we do not support dynamic reporting. The MT link can be assumed to be fairly stationary and any introduced signaling should reflect that. |
| **LG** | Because of two different subjects (i.e., a child node a parent node) for spatial domain restriction/recommendation are mixed in one sentence this sentence makes confuse the intention of the proposal.  Could you elaborate the motivation of Proposal 2.2.1? |

**Proposal 2.2.3: Semi-static signaling is supported for indication of restricted SSB beams of an IAB-DU.**

**Discussion: Views on proposal 2.2.3?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support.** |
| **ZTE, Sanechips** | More clarification is needed, e.g.,  whether such restricted SSB beams is apply to specific multiplexing cases or specific time-frequency resources.  The necessity to support this since dynamic indication of restricted beams has been supported. |
| **Ericsson** | In general, we support the intention, but we don’t think involvement from the donor-CU is necessary. Instead, we propose this being handled between parent and child IAB nodes by infrequent, aperiodic MAC-CE signaling. Additionally, SSB beams should not be restricted, but operation in the direction of said SSB beams.  ***Aperiodic MAC-CE ~~Semi-static~~* *signaling is supported for indication of ~~restricted~~ SSB beams of an IAB-DU in the direction of which simultaneous operation is restricted.*** |
| **LG** | We are fine with Proposal 2.2.3. |

**Proposal 2.2.4: The child node indication of recommended/not prefered beams (e.g. corresponding to a subset of TCI states) to the parent node can include both IAB-MT DL RX beams and/or IAB-MT UL TX beams. Signaling alternatives include:**

* **Alt. 1 UCI transmission**
* **Alt. 2 MAC-CE**
* **Alt. 3. SR/PRACH**

**Discussion: Views on proposal 2.2.4?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support Alt.1.**  **We think it is reasonable that CSI reporting framework is reused. In our understanding the beam management mechanism should be IAB-MT reports recommended beams as SSBRI/CRI in beam reporting, then parent node decide DL Rx beam (as DL TCI) and UL Tx beam (as spatial relation, SRI) of MT.**  **We suggest adding reporting beams corresponding to SSBRI/CRI as an example.**  **Proposal 2.2.4: The child node indication of recommended/not prefered beams (e.g. corresponding to a subset of TCI states, or corresponding to SSBRI/CRI) to the parent node can include both IAB-MT DL RX beams and/or IAB-MT UL TX beams. Signaling alternatives include:**   * **Alt. 1 UCI transmission** * **Alt. 2 MAC-CE** * **Alt. 3. SR/PRACH** |
| **ZTE, Sanechips** | Agree in principle, and Alt1/Alt 2 has less spec impact and is preferred. |
| **Ericsson** | We can **support *recommended* beams**, but **do not support *not preferred*** beams since there is no guarantee that the child node will be able to receive all not preferred beams. Furthermore, we think **MAC-CE** should be used for this and are willing to agree to that already now. |
| **LG** | In current specification, there is not exact description for indicating DL Rx beam and UL Tx beam. We think the definition and index of IAB-MT DL Rx beam and IAB-MT UL Tx beam should be clarified first. |

**ISSUE 2.3: MULTIPLEXING OPERATION ADAPTATION**

**Proposal 2.3.1: To facilitate adaptation of multiplexing operation modes, the IAB node should report the following conditions/parameters for different multiplexing cases per {MT-CC, DU cell}-pair:**

* **Timing mode (e.g. Case #6/#7)**
* **Guard band**
* **Downlink or uplink PC parameters**
* **Desired IAB-MT Tx and/or Rx beam(s)**
* **Orthogonal DMRS ports**

**Discussion: Views on proposal 2.3.1?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **First, we think reporting these conditions per MT serving cell is sufficient. We don’t think the report needs to be per {MT-CC, DU cell} pair, because parent node may not know how DU will Tx/Rx on which DU cell for a given slot. We would like to understand from other companies e.g. if different conditions/parameters are provided for {MT-CC#1, DU cell#1} and {MT-CC#1, DU cell#2}, how parent node will use these information.**  **For guard band, we think it can be handled by IAB node implementation and does not need to be reported to parent node.**  **For desired IAB-MT Tx and/or Rx beam(s), we would like to understand whether it is the same report as proposal 2.2.4, if so, we think it can be discussed under proposal 2.2.4.** |
| **ZTE, Sanechips** | For the main bullet, share similar view as Docomo, it is not necessary to report these conditions/parameters per {MT-CC, DU cell}-pair, per MT CC or per DU cell reporting is sufficient.  For the sub-bullets:  For PC parameters and timing modes, we think it is better to discuss these in 8.10.2, actually, there already some discussion about these, i.e., PC assistance information report from IAB node to its parent node.  For guard band, it can be left to implementation, e.g., it is up to IAB DU implementation to insert proper guard band. |
| **Ericsson** | We should separate capability signaling from control signaling. We think the above is a mix of both. Also, the descriptors are a bit brief to be properly understood.  We **support** to the following capabilities:   * Timing mode requirements for simultaneous (Tx or Rx) operation * DL and/or UL power control capability * MT Tx/Rx beam prioritization   We do **not support**:   * Guard band – this should be handled internally by the DU since it is dynamic, e.g., due to its relation to power control.   Regarding orthogonal DMRS ports, we think further discussion is needed. In our understanding, this is beneficial for MIMO transmissions that a (LoS) parent-child link would not benefit from. |
| **LG** | We are generally fine with proposal.  But, regarding the guard band, we think it is up to DU implementation, so related reporting is not required. |

**Proposal 2.3.2:**

**Multiplexing capability adaptation is signaled separately from the operational conditions/parameters reported for different multiplexing operation cases.**

* **FFS: Need for explicit parent acknowledgement for multiplexing capability adaptation**

**Discussion: Views on proposal 2.3.2?**

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| --- | --- |
| **Company** | **Comments** |
| **NTT Docomo** | **Support** |
| **ZTE, Sanechips** | Do not support.  Here the benefit to dynamically report the multiplexing **capability** is not clear. And for the multiplexing **mode** adaptation as discussed in 2.3.1, it is more suitable to let such adaptation under the control of the parent node, i.e., the procedure could be: 1)IAB node can report the operational conditions/parameters to facilitate adaptation of multiplexing operation modes, 2)and the parent node can indicate the adaptation of multiplexing operation modes to the IAB node. |
| **Ericsson** | Support |
| **LG** | We’d like to clarify the meaning of ‘multiplexing capability adaption’. If it means adaptation of an IAB-node’s multiplexing as agreed in RAN1#104bis-e, it would be better to use ‘multiplexing operation mode adaptation’ rather than ‘multiplexing capability adaptation’.  Under the assumption the proposal is for the adaptation of a multiplexing operation mode, the intention of the proposal is still not clear. Is the subject transmitting the proposed signaling in the main bullet IAB-MT? Or is it the parent DU/CU? We basically think that the multiplexing operation mode of IAB-node is configured from the network explicitly and/or implicitly. In addition, if necessary, it may be considered that the IAB-MT reports the applicability of the configured multiplexing operation mode to the parent-DU. |

**ISSUE 2.4: GUARD SYMBOL INDICATION ENHANCEMENTS**

**Proposal 2.4.1: MAC-CE signaling of Desired/Provided Guard Symbols is enhanced to support indication of guard symbols required for switching among Case #1, Case #6 and Case #7 timing cases.**

**Discussion: Views on proposal 2.4.1?**

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| **Company** | **Comments** |
| **NTT Docomo** | **We think the proposal need to be clarified that guard symbols are reported/provided for switching between a MT Tx/Rx with Case #1, Case #6 and Case #7 timing cases and a DU Tx/Rx**  **Because in our understanding, the motivation of indication of guard symbols is for switching between MT and DU due to timing misalignment between MT and DU.**  **We suggest following revision.**  **Proposal 2.4.1: MAC-CE signaling of Desired/Provided Guard Symbols is enhanced to support indication of guard symbols required for switching between a MT Tx/Rx with Case #1, Case #6 and Case #7 timing cases and a DU Tx/Rx  ~~among Case #1, Case #6 and Case #7 timing cases.~~** |
| **ZTE, Sanechips** | It is more simple to reuse the Rel-16 mechanism, and the number of guard symbols actually reserved may depend on the implementation. |
| **Ericsson** | Support |
| **LG** | In our perspective, there are two discussion points regarding on guard symbols enhancements.   1. Introduction of guard symbols for timing case switching   If operating timing mode for a IAB-node is switched, overlapping between timing boundaries before and after switching of the timing mode may occur. For example, the UL Tx timing of MT for case 1 timing mode and case 6 timing mode may be different, so overlapping between the UL Tx timing boundaries may occur, and a guard symbol for this overlapping case needs to be introduced.   1. Adaptation of guard symbols for MT/DU transition for different timing cases   Considering that additional timing cases are supported in Rel-17, the amount of guard symbols required for MT/DU transition (which is introduced in Rel-16) when the IAB-node operates in case 6 or 7 timing mode is different from the amount of guard symbols applied for the case 1 timing mode. Therefore, it seems necessary to adapt the required guard symbols for MT/DU transition according to the timing mode.  We think Proposal 2.4.1 handles the first points, and we are fine with the proposal.  In addition, it seems necessary to handle the issue on the adaptation of guard symbols for MT/DU transition. |

# Resource allocation for dual-connectivity scenarios (i.e. IAB-MT with concurrent BH links with two parent nodes)

**From the eIAB WID:**

* Specification of enhancements to the resource multiplexing between child and parent links of an IAB node, including:
  + Support of simultaneous operation (transmission and/or reception) of IAB-node’s child and parent links (i.e., MT Tx/DU Tx, MT Tx/DU Rx, MT Rx/DU Tx, MT Rx/DU Rx)
  + **Support for dual-connectivity scenarios defined by RAN2/RAN3 in the context of topology redundancy for improved robustness and load balancing.**

**Summary of input contributions:**

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| **Huawei, HiSilicon (R1-2106454)** | ***Proposal 10:*** *For inter-carrier intra-band DC, simultaneous Rx/Tx is not supported in Rel-17 for IAB.*  ***Proposal 11:*** *To avoid inefficient resource partitioning between IAB-MT and IAB-DU in case of DC, resource coordination between the two parent nodes is supported so that more resources can be released to the IAB-DU.* |
| **Vivo (R1-2106617)** | **Proposal 13: RAN1 supports both intra-carrier DC and inter-carrier DC.**  **Observation 2: Semi-static U/D/F configurations are aligned between the associated IAB-MT’s cells belonging to MCG and SCG after coordinating the IAB-MT’s TDD configurations from different parent nodes.**  **Observation 3: UL/DL conflict between the associated IAB-MT’s cells belonging to MCG and SCG may still appear at the semi-static flexible symbols.**  **Proposal 14: Dynamic grant or dynamic SFI indication overrides semi-static grant in case of UL/DL conflict.**   * FFS UL/DL conflict between dynamic grants or between dynamic SFI indications. * FFS UL/DL conflict between semi-static grants.   **Proposal 15: Consider the impact of parent node’s H/S/NA when specifying the prioritization rules in case of UL/DL conflict.**  Proposal 16: RAN1 specifies IAB DU behavior when IAB DU receives conflicted indications for Rel-17 features from two parent nodes, e.g., restricted beam indication, multiplexing case indication, etc.  Proposal 17: Support child node to report soft resource availability from one parent node to the other parent node in DC scenario. |
| **Nokia, Nokia Shanghai Bell (R1-2106828)** | ***Observation 3.1: For intra-donor DC scenario, it can be assumed that the TDD configurations are aligned within the IAB network and therefore common for the DC parent nodes.***  ***Observation 3.2: In inter-carrier DC scenario, simultaneous Rx/Tx operation at the IAB MT may occur if the DCI 2\_0 sent by parents are indicating conflicting DL/UL.***  ***Proposal 3.1: In intra-donor inter-band inter-carrier DC scenario, if the IAB MT does not support simultaneous Tx and Rx on different carriers, it does not expect to receive conflicting DCI 2\_0 from different parents.***   * ***Note: This must be handled by the CU and the parent nodes.***   ***Proposal 3.2: In inter-donor inter-band inter-carrier DC scenario, if the IAB MT does not support simultaneous Tx and Rx on different carriers, it must apply conflict resolution rules when it receives indications/configurations of conflicting DCI 2\_0 and/or semi static TDD configurations from different parents.***   * ***FFS: required resolution rules***   ***Proposal 3.3: In inter-carrier DC, the indication of availability of soft resources via DCI format 2-5 from a parent node is only valid for the IAB-DU cell(s) which uses the same carrier(s) in the backhaul link for the same parent.***  ***Proposal 3.4: Support per-child-link resource configurations for an IAB-DU in the case of dual connectivity.*** |
| **Samsung (R1-2106907)** | *Proposal 7: The reference cell concept from Rel-16 CA is sufficient when there are configuration and scheduling collisions between MCG and SCG.*  *Proposal 8: Consider per-backhaul link signaling between IAB MT and different parent IABs in Table 1.* |
| **Lenovo, Motorola Mobility (R1-2107188)** | Proposal 12: Support signaling from an IAB node in the DC mode to its parent node for informing the parent node of the status of availability of soft resources. Further discuss specification of mechanisms to handle availability indication collisions by two parent nodes in the DC mode.  Proposal 13: In order to reuse the Rel-16 CA TDD prioritization rules:   support inter-donor signaling for inter-parent coordination;   include scenarios of resource conflicts due to timing misalignment. |
| **Qualcomm (R1-2107365)** | **Observation 4.1:**  **In Rel16, the CA TDD prioritization rules are defined only for the case when DCI2\_0 is not configured for a UE, and it is stated in the spec that UE does not expect any directional collision among serving cells after applying the procedure.**  **Observation 4.2:**  **In Rel16, the CA TDD prioritization rules can be divided into two sets**   * **Set1 for confliction avoidance, wherein rules are defined as “*UE does not expect …*.” over a potential conflicting scenario. These rules impose constraint on gNB’s resource configuration or MAC scheduler to avoid specified conflicting scenario.** * **Set2 for confliction resolution, wherein rules are defined for UE to select one operation over the other operation when a confliction scenario occurs.**   **Observation 4.3:**  **The reuse of Rel-16 CA TDD prioritization rules to NR-DC can be possible if the required resource coordination between Donor CUs to avoid the specified confliction scenarios is supported.**  **Proposal 4.1:**  **To minimize spec impact, support of reusing CA TDD prioritization rules to NR-DC and rely on proper resource coordination between parents/Donors for achieving these rules.**   * **FFS: resource coordination messages**   **Observation 4.4:**  **In FR2 or higher band, due to analog beam constraint, a dual-connected UE/MT may not have the capability to simultaneously receive from two parent nodes and/or simultaneously transmit to two parent nodes, and the impact to support multiple-parent in IAB needs to be investigated.**  **Proposal 4.2:**  **For an IAB-node with multi-parents, the DCI2\_5 received from one parent indicates availability of soft resources at an IAB-DU cell relative to the serving cells of IAB-MT in the cell group associated with this parent node.**  **Proposal 4.3:**  **The RAN1-105e agreement on availability of soft resources at an IAB-node shall be modified as “*For an IAB-MT with multiple serving cells (including the case with two parent nodes), a per-cell IAB-DU soft resource is considered as available if the resource ~~is either explicitly indicated (via DCI 2\_5), or implicitly determined as available with respect to all serving cells~~ can be determined as available with respect to all serving cells of IAB-MT, where the determination with respect to a serving cell can be done either by explicit indication via DCI2\_5 or implicit determination.”*** |
| **ETRI (R1-2107479)** | **Proposal 11: Clarify the possible target scenarios for intra-band inter-carrier DC as follows:**   * **Case #1: The IAB-MT has two parent DUs through intra-band inter-carrier DC while the IAB-DU establishes a single set of cells to the MT of child node within a single band (i.e. without configuring DC for the child node).** * **Case #2: The IAB-MT has two parent DUs through intra-band inter-carrier DC and the IAB-DU also configures DC to the MT of child node.**   **Proposal 12: For Case #2 in proposal 7, adopt the TP in Table 8.** |
| **LG Electronics (R1-2107553)** | ***Proposal 14: It is not sufficient to reuse Rel-16 CA TDD prioritization rules for NR-DC. Enhancements to handle UL/DL conflict issue in NR-DC should be discussed.***  ***Proposal 15: It is necessary to support a MT which cannot perform simultaneous Tx/Tx and Rx/Rx for two parent links.*** |
| **Intel (R1-2107607)** | **Proposal 3:** For the semi-static DU resource configurations, additionally support per-backhaul link (e.g. per child IAB-MT link) configuration. |
| **AT&T (R1-2107692)** | **Proposal 6: Per-backhaul link resource configurations and multiplexing capability indications independent of the per-IAB-DU configuration and multiplexing capability indication are supported in Rel-17. Coordination signaling to exchange the per-link resource configurations and multiplexing capability indications between up to two parent IAB-nodes/donors should be additionally supported in Rel-17.** |
| **ZTE (R1-2107824)** | **Proposal 13: To minimize the transmission direction conflict at the IAB MT side：**  **• Coordinating the Semi-static or cell-common high layer configuration(such as SSB , CORESET 0 configuration, Valid PRACH occasion and TDD configurations) from/for different parent nodes are needed at least for inter-donor scenarios。**  **• From RAN1 perspective, the Semi-static or cell-common high layer configuration from/for different parent nodes are assumed not conflicted for intra-band inter-carrier DC.**  **Proposal 14: Coordinating the dynamic indication/scheduling form different parents is not supported, the dynamic indication conflict can be left to implementation in DC scenario.**  **Proposal 15: When IAB MT detect more than one DCI format 2\_5, the IAB-MT expects that each of the more than one DCI formats 2\_5 from the same CG indicates a same value for the availability combination of the soft resources in the slot.**  **Proposal 16: For explicitly availability indication case, a per-cell IAB-DU soft resource is considered as available with respect to a IAB MT serving cell only if the IAB MT is explicitly indicated as IA by DCI 2\_5 from the CG that the serving cell belongs to.** |
| **Ericsson (R1-2108107)** | **Proposal 28 For inter-carrier DC, the IAB-donor-CU can be made aware of the IAB-MT’s capability regarding simultaneous transmission and reception on multiple serving cells in a frequency band, configured by the two parent nodes. FFS: How CUs are made aware of the capability in case of inter-donor DC scenarios.**  **Proposal 29 If an IAB-MT is not capable of simultaneous transmission and reception on any pair of the multiple serving cells in the frequency band configured for two parent nodes, the IAB-MT does not expect any conflict. FFS: Whether the IAB-MT can assume all serving cells configured for the two parent nodes have aligned UL/DL directions.**  **Proposal 30 In intra-donor-DC and inter-donor-DC operations, a parent-node can be made aware of the DU resource configuration (UL/DL/FL, H/S/NA) of the other peer parent node that connects to the same IAB-node.**  **Proposal 31 In intra-donor-DC and inter-donor-DC operation, one parent IAB-node is not expected to indicate the DL/UL direction of a flexible symbol which is in conflict with the time-wise aligned non-flexible symbol at the other parent IAB-node.**  **Proposal 32 RAN1 considers the following options to handle potential indication conflict of overlapping flexible symbols between two parent IAB-nodes:**  **Option 1: If the dual-connected IAB-node is not capable of simultaneous transmission and reception on any pair of the multiple serving cells in the frequency band configured for two parent nodes, semi-static flexible symbols are not expected.**  **Option 2: If a conflict occurs, the dual-connected IAB-node is expected to perform DL reception than UL transmission.**  **Option 3: If a conflict occurs, the dual-connected IAB-node is expected to perform UL transmission than DL reception.** |

**ISSUE 3.1: ENHANCEMENTS FOR NR-DC SUPPORT**

**Proposal 3.1.1: To support extension of CA TDD prioritization rules to NR-DC, the following resource coordination mechanisms between parents/donors are supported:**

* **For intra-donor inter-donor DC scenarios, a parent-node can be made aware of the DU resource configuration (UL/DL/FL, H/S/NA) of the other peer parent node that connects to the same IAB-node.**
* **At least for inter-donor DC scenarios, coordinating the semi-static and/or cell-common higher layer configuration (e.g. SSB, CORESET 0, and RACH and configurations) from/for different parent nodes.**

**Discussion: Views on proposal 3.1.1?**

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| **Company** | **Comments** |
| **ZTE, Sanechips** | Agree with the main bullet and the second sub-bullet.  For the first sub-bullet, semi-static TDD and HSNA configurations for the two parent nodes should be aligned(i.e., there is no conflicting between the parents), this can be achieved by the donor-CU in intra-donor cases, while in the inter-donor case the configurations can be aligned via the coordination of the donor-CUs. So it is not necessary to make a parent-node be aware of the DU resource configuration of its peer parent node. |
| **Ericsson** | Support |
| **LG** | We support the proposal. |

**ISSUE 3.2: FLEXIBLE SYMBOL CONFLICTS**

**Agreement**

The following solutions are supported to handle potential indication conflict of overlapping flexible symbols between two parent IAB-nodes:

* In intra-donor DC scenarios, if the IAB MT does not support simultaneous Tx and Rx on different carriers, it does not expect to receive conflicting DCI 2\_0 from different parents.

**Proposal 3.2.1’ The following solutions are supported to handle potential indication conflict of overlapping flexible symbols between two parent IAB-nodes:**

* **In inter-donor DC scenarios, if the IAB MT does not support simultaneous Tx and Rx on different carriers, it must apply one of the following alternatives of conflict resolution rules when it receives indications/configurations of conflicting DCI 2\_0 and/or semi static TDD configurations from different parents:**
  + **Alt. 1: If the dual-connected IAB-node is not capable of simultaneous transmission and reception on any pair of the multiple serving cells in the frequency band configured for two parent nodes, semi-static flexible symbols are not expected.**
  + **Alt. 2: If a conflict occurs, the dual-connected IAB-node is expected to perform DL reception than UL transmission.**
  + **Alt. 3 3: If a conflict occurs, the dual-connected IAB-node is expected to perform UL transmission than DL reception.**
  + **FFS: Consideration of the impact of parent node’s H/S/NA when specifying the prioritization rules in case of UL/DL conflict.**

**Discussion: Views on proposal 3.2.1’?**

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| **Company** | **Comments** |
| **ZTE, Sanechips** | Alt1 is preferred, both Alt 2 and Alt 3 would cause packet loss. |
| **Ericsson** | Support |
| **LG** | We are ok with the proposal. |

**ISSUE 3.3: MULTI-PARENT SOFT RESOURCE AVAILABILITY INDICATION**

**RAN1#105-e agreement: For an IAB-MT with multiple serving cells (including the case with two parent nodes), a per-cell IAB-DU soft resource is considered as available if the resource is either explicitly indicated (via DCI 2\_5), or implicitly determined as available with respect to all serving cells.**

**Proposal 3.3.1 The RAN1-105e agreement on availability of soft resources at an IAB-node is modified/extended according to one of the following alternatives:**

* **Alt. 1: “For an IAB-MT with multiple serving cells (including the case with two parent nodes), a per-cell IAB-DU soft resource is considered as available if the resource ~~is either explicitly indicated (via DCI 2\_5), or implicitly determined as available with respect to all serving cells~~ can be determined as available with respect to all serving cells of IAB-MT, where the determination with respect to a serving cell can be done either by explicit indication via DCI2\_5 or implicit determination.”**
* **Alt. 2 “For an IAB-MT with multiple serving cells (including the case with two parent nodes), a per-cell IAB-DU soft resource is considered as available if the resource is either explicitly indicated (via DCI 2\_5), or implicitly determined as available with respect to all serving cells. For an IAB-node with multi-parents, the DCI2\_5 received from one parent indicates availability of soft resources at an IAB-DU cell relative to the serving cells of IAB-MT in the cell group associated with this parent node.**

**Discussion: Views on proposal 3.3.1?**

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| **Company** | **Comments** |
| **NTT Docomo** | **Support to modify with Alt.1.** |
| **ZTE, Sanechips** | According to current text, Alt 2 is slightly preferred.  Need more clarification for Alt 1, ‘the explicit indication via DCI2-5’ means:   * Interpretation 1:a DCI2-5 from the serving cell, or * Interpretation 2: A DCI2-5 from the CG that the serving cell belongs to, no different from Alt 2, or * Interpretation 3:a DCI2-5 from any serving cell |
| **Ericsson** | Do not support. We think the present formulation is sufficiently clear. |
| **LG** | We are fine with the proposal and prefer Alt. 2.  When the IAB-MT has multiple serving cells belonging to one parent node, it is not necessary to receive soft resource availability indication from all serving cells. When the availability of soft resource is received from one serving cell belonging to the same CG, it indicates availability for serving cells belonging to the corresponding CG. |

**Proposal 3.3.2: A child IAB node can report soft resource availability from one parent node to the other parent node in DC scenarios.**

**Discussion: Views on proposal 3.3.2?**

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| **Company** | **Comments** |
| **NTT Docomo** | **We don’t see the report is necessary. And it is hard to report a dynamic indication from one parent node to the other.** |
| **ZTE, Sanechips** | Do not support. It is difficult to report such kind of dynamic indication timely. |
| **Ericsson** | Do not support. Share views of Docomo and ZTE. |
| **LG** | We think that the proposed report will be helpful in terms of resource utilization, but it is not considered to be of high priority as an optimization issue. |

**ISSUE 3.4: MULTI-PARENT RESOURCE COORDINATION**

**Agreement**

The IAB-donor-CU can be made aware of the IAB-MT’s capability regarding simultaneous transmission and reception on multiple serving cells in a frequency band, configured by the two parent nodes in intra-donor DC scenarios.

**Proposal 3.4.2: Per-child-link resource configurations can be configured for an IAB-DU in DC scenarios.**

**Discussion: Views on proposal 3.4.2?**

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| **Company** | **Comments** |
| **ZTE, Sanechips** | Do not support. The benefit is unclear. With current per DU cell configuration, per-child-link resource scheduling at IAB DU can also be done, no more per-link configuration is needed from CU. |
| **Ericsson** | Support |

# Summary

**TBD**