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(71) Applicants: **SHARP KABUSHIKI KAISHA** [JP/JP]; 1, Takumi-cho, Sakai-ku, Sakai City, Osaka, 5908522 (JP). **FG INNOVATION COMPANY LIMITED** [CN/CN]; Flat 2623, 26/F Tuen Mun Central Square, 22 Hoi Wing Road, Tuen Mun, New Territories, Hong Kong, (CN).

(72) Inventors: **KOWALSKI, John Michael**. **AIBA, Tatsushi**. **YOKOMAKURA, Kazunari**. **ISHII, Atsushi**.

(74) Agent: **HARAKENZO WORLD PATENT & TRADEMARK**; Daiwa Minamimorimachi Building, 2-6, Tenjinbashi 2-chome Kita, Kita-ku, Osaka-shi, Osaka, 5300041 (JP).

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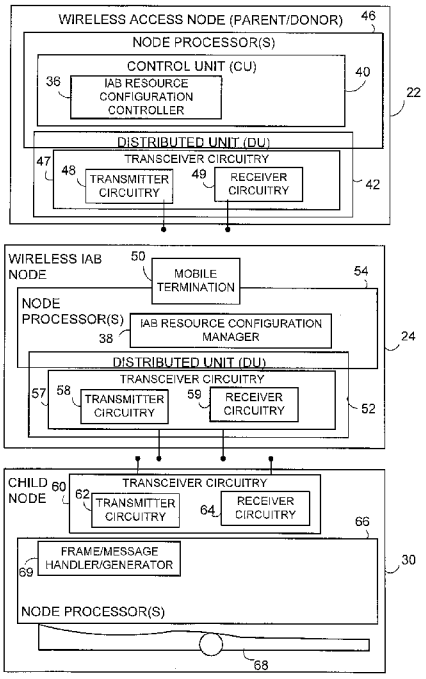

Fig. 3

(57) Abstract: A donor Integrated Access and Backhaul (IAB) node communicates with an IAB node in an Integrated Access and Backhaul (IAB) network. The donor node comprises processor circuitry and transmitter circuitry. The processor circuitry is configured to generate one or more signals that affect IAB resource configuration. The transmitter circuitry s configured to transmit the one or more signals to the IAB node.

[Continued on next page]

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Description

Title of Invention: RESOURCE MANAGEMENT FOR WIRELESS BACKHAUL NETWORKS

Technical Field

[0001] The technology relates to wireless communications, and particularly to radio configuration and use of on wireless backhaul links of an Integrated Access and Backhaul (IAB) network.

Background Art

[0002] A radio access network typically resides between wireless devices, such as user equipment (UEs), mobile phones, mobile stations, or any other device having wireless termination, and a core network. Example of radio access network types includes the GRAN, GSM radio access network; the GERAN, which includes EDGE packet radio services; UTRAN, the UMTS radio access network; E-UTRAN, which includes Long-Term Evolution; and g-UTRAN, the New Radio (NR) .

[0003] A radio access network may comprise one or more access nodes, such as base station nodes, which facilitate wireless communication or otherwise provides an interface between a wireless terminal and a telecommunications system. A non-limiting example of a base station can include, depending on radio access technology type, a Node B ("NB"), an enhanced Node B ("eNB"), a home eNB ("HeNB"), a gNB (for a New Radio ["NR"] technology system), or some other similar terminology.

[0004] The 3rd Generation Partnership Project ("3GPP") is a group that, e.g., develops collaboration agreements such as 3GPP standards that aim to define globally applicable technical specifications and technical reports for wireless communication systems. Various 3GPP documents may describe certain aspects of radio access networks. Overall architecture for a fifth generation system, e.g., the 5G System, also called "NR" or "New Radio", as well as "NG" or "Next Generation", is shown in Fig. 18, and is also described in 3GPP TS 38.300. The 5G NR network is comprised of NG RAN (Next Generation Radio Access Network) and 5GC (5G Core Network). As shown, NGRAN is comprised of gNBs (e.g., 5G Base stations) and ng-eNBs (i.e. LTE base stations). An Xn interface exists between gNB-gNB, between (gNB)-(ng-eNB) and between (ng-eNB)-(ng-eNB). The Xn is the network interface between NG-RAN nodes. Xn-U stands for Xn User Plane interface and Xn-C stands for Xn Control Plane interface. ANG interface exists between 5GC and the base stations (i.e. gNB & ng-eNB). A gNB node provides NR user plane and control plane protocol terminations towards the UE, and is connected via the NG interface to the 5GC. The 5G NR (New Radio) gNB is connected to AMF (Access and Mobility Management Function) and

UPF (User Plane Function) in 5GC (5G Core Network).

[0005] In some cellular mobile communication systems and networks, such as Long-Term Evolution (LTE) and New Radio (NR), a service area is covered by one or more base stations, where each of such base stations may be connected to a core network by fixed-line backhaul links (e.g., optical fiber cables). In some instances, due to weak signals from the base station at the edge of the service area, users tend to experience performance issues, such as: reduced data rates, high probability of link failures, etc. A relay node concept has been introduced to expand the coverage area and increase the signal quality. As implemented, the relay node may be connected to the base station using a wireless backhaul link.

[0006] In 3rd Generation Partnership Project (3GPP), the relay node concept for the fifth generation (5G) cellular system has been discussed and standardized, where the relay nodes may utilize the same 5G radio access technologies (e.g., New Radio (NR)) for the operation of services to User Equipment (UE) (access link) and connections to the core network (backhaul link) simultaneously. These radio links may be multiplexed in time, frequency, and/or space. This system may be referred to as Integrated Access and Backhaul (IAB).

[0007] Some such cellular mobile communication systems and networks may comprise IAB-donors and IAB-nodes, where an IAB-donor may provide interface to a core network to UEs and wireless backhauling functionality to IAB-nodes; and additionally, an IAB-node may provide IAB functionality combined with wireless self-backhauling capabilities.

[0008] What is needed are methods, apparatus, and/or techniques to configure radio resources for Integrated Access and Backhaul (IAB) operation and to do so flexibly and efficiently.

Summary of Invention

[0009] In one example, a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitter circuitry configured to transmit the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0010] In one example, a method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method node comprising: using processor circuitry to generate an IAB resource configuration scheme indicator for providing a coded description of how

plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitting the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0011] In one example, an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; processor circuitry arranged to configure radio resources of the IAB node according to the indication.

[0012] In one example, a method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB nodes in an Integrated Access and Backhaul (IAB) network, the method node comprising: receiving an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; using processor circuitry to configure radio resources of the IAB node according to the indication.

Brief Description of Drawings

[0013] The foregoing and other objects, features, and advantages of the technology disclosed herein will be apparent from the following more particular description of preferred embodiments as illustrated in the accompanying drawings in which reference characters refer to the same parts throughout the various views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the technology disclosed herein.

[fig.1]Fig. 1 is a diagrammatic view illustrating a mobile network infrastructure using 5G signals and 5G base stations, and particularly showing a donor IAB node comprising an IAB resource configuration controller and plural IAB nodes each comprising an IAB resource configuration manager.

[fig.2]Fig. 2 is a diagrammatic view depicting an example of functional block diagrams for donor IAB node and a representative IAB node of Fig. 1.

[fig.3]Fig. 3 is a diagrammatic view showing in more detail various functional units and components of a representative donor IAB node, a representative IAB node, and a representative user equipment (UE) according to an example embodiment and mode of Fig. 1.

[fig.4]Fig. 4 is a diagrammatic view showing in more detail portions of an example embodiment and mode of a telecommunications system comprising representative donor IAB node which include a resource configuration scheme indicator generator and a representative IAB node which includes a resource configuration scheme indicator handler.

[fig.5A]Fig. 5A is a diagrammatic view of differing example grid schemes for IAB resource configuration.

[fig.5B]Fig. 5B is a diagrammatic view of differing example grid schemes for IAB resource configuration.

[fig.6]Fig. 6 is a diagrammatic depiction of a resource configuration scheme indicator generator of the resource configuration scheme indicator generator of Fig. 4 which selects and transmits a scheme indicator signal.

[fig.7]Fig. 7 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by a donor IAB node of the example embodiment and mode of Fig. 4.

[fig.8]Fig. 8 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by an IAB node of the example embodiment and mode of Fig. 4.

[fig.9]Fig. 9 is a diagrammatic view showing in more detail portions of an example embodiment and mode of a telecommunications system comprising representative donor IAB node which include an IAB resource MT utilization override signal generator and a representative IAB node which includes an IAB resource MT utilization override signal handler.

[fig.10]Fig. 10 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by a donor IAB node of the example embodiment and mode of Fig. 9.

[fig.11]Fig. 11 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by an IAB node of the example embodiment and mode of Fig. 9.

[fig.12]Fig. 12 is a diagrammatic depiction of generation by donor IAB node 22 and use by IAB node 24 of an IAB resource MT utilization override signal.

[fig.13]Fig. 13 is a diagrammatic view showing in more detail portions of an example embodiment and mode of a telecommunications system comprising representative donor IAB node which include an IAB resource configuration switch signal generator and a representative IAB node which includes an IAB resource configuration switch signal handler.

[fig.14A]Fig. 14A is a diagrammatic view showing differing example of a change of a utilization attribute of a radio resource configured for an IAB node without releasing the radio resource.

[fig.14B]Fig. 14B is a diagrammatic view showing differing example of a change of a utilization attribute of a radio resource configured for an IAB node without releasing the radio resource.

[fig.15]Fig. 15 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by a donor IAB node of the example embodiment and mode of Fig. 13.

[fig.16]Fig. 16 is a flowchart showing example, non-limiting, basic acts or steps that

may be performed by an IAB node of the example embodiment and mode of Fig. 13.

[fig.17]Fig. 17 is a diagrammatic view showing example elements comprising electronic machinery which may comprise a wireless terminal, a radio access node, and a core network node according to an example embodiment and mode.

[fig.18]Fig. 18 is a diagrammatic view of overall architecture for a 5G New Radio system.

Description of Embodiments

[0014] In one of its example aspects the technology disclosed herein concerns a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, and method in such donor node. In an example embodiment and mode the donor IAB node comprises processor circuitry and transmitter circuitry. The processor circuitry is configured to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network. The transmitter circuitry is configured to transmit the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0015] In another of its example aspects the technology disclosed herein concerns an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network and method in such node. In an example embodiment and mode the node comprises receiver circuitry and processor circuitry. The receiver circuitry is configured to receive an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node. The processor circuitry is arranged to configure radio resources of the IAB node according to the indication.

[0016] In another of its example aspects the technology disclosed herein concerns a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, and method in such node. In an example embodiment and mode the donor node comprises processor circuitry and transmitter circuitry. The processor circuitry is configured to make or receive a determination of a network condition and, in response to the condition, generate an IAB resource utilization override signal, the IAB resource utilization override signal being configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU). The transmitter circuitry is configured to transmit the IAB resource utilization override signal to the

IAB node.

[0017] In another of its example aspects the technology disclosed herein concerns an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, and method in such node. In an example embodiment and mode the node comprises receiver circuitry, a Mobile-Termination (MT) unit, a Distributed Unit (DU), and processor circuitry. The receiver circuitry is configured to receive an IAB resource utilization override signal from the donor IAB node. The processor circuitry is configured to: determine from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); and govern the Mobile-Termination (MT) 50 so that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0018] In another of its example aspects the technology disclosed herein concerns a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, and method in such node. In an example embodiment and mode the donor node comprises processor circuitry and transmitter circuitry. The processor circuitry is configured to generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource. The transmitter circuitry is configured to transmit the IAB resource configuration switch signal to the IAB node.

[0019] In another of its example aspects the technology disclosed herein concerns an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, and method in such node. In an embodiment and mode the node comprises receiver circuitry and processor circuitry. The receiver circuitry is configured to receive an IAB resource configuration switch signal from the donor IAB node. The processor circuitry is configured to use the IAB resource configuration switch signal to change a utilization attribute of a radio resource configured for the IAB node.

[0020] In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular architectures, interfaces, techniques, etc. in order to provide a thorough understanding of the technology disclosed herein. However, it will be apparent to those skilled in the art that the technology disclosed herein may be practiced in other embodiments that depart from these specific details. That is, those skilled in the art will be able to devise various arrangements which, although not ex-

plicitly described or shown herein, embody the principles of the technology disclosed herein and are included within its spirit and scope. In some instances, detailed descriptions of well-known devices, circuits, and methods are omitted so as not to obscure the description of the technology disclosed herein with unnecessary detail. All statements herein reciting principles, aspects, and embodiments of the technology disclosed herein, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

[0021] Thus, for example, it will be appreciated by those skilled in the art that block diagrams herein can represent conceptual views of illustrative circuitry or other functional units embodying the principles of the technology. Similarly, it will be appreciated that any flow charts, state transition diagrams, pseudo code, and the like represent various processes which may be substantially represented in computer readable medium and so executed by a computer or processor, whether or not such computer or processor is explicitly shown.

[0022] As used herein, the term "core network" can refer to a device, group of devices, or sub-system in a telecommunication network that provides services to users of the telecommunications network. Examples of services provided by a core network include aggregation, authentication, call switching, service invocation, gateways to other networks, etc.

[0023] As used herein, the term "wireless terminal" can refer to any electronic device used to communicate voice and/or data via a telecommunications system, such as (but not limited to) a cellular network. Other terminology used to refer to wireless terminals and non-limiting examples of such devices can include user equipment terminal, UE, mobile station, mobile device, access terminal, subscriber station, mobile terminal, remote station, user terminal, terminal, subscriber unit, cellular phones, smart phones, personal digital assistants ("PDAs"), laptop computers, tablets, netbooks, e-readers, wireless modems, etc.

[0024] As used herein, the term "access node", "node", or "base station" can refer to any device or group of devices that facilitates wireless communication or otherwise provides an interface between a wireless terminal and a telecommunications system. A non-limiting example of a base station can include, in the 3GPP specification, a Node B ("NB"), an enhanced Node B ("eNB"), a home eNB ("HeNB"), a gNB (for a New Radio ["NR"] technology system), or some other similar terminology.

[0025] As used herein, the term "telecommunication system" or "communications system" can refer to any network of devices used to transmit information. A non-limiting

example of a telecommunication system is a cellular network or other wireless communication system. Furthermore, the "node" may comprise a portion of a gNB's architecture, in particular, a gNB-DU (gNB Distributed Unit), which would be a logical node hosting RLC, MAC and PHY layers of the gNB, under the control of a gNB-CU (gNB Central Unit), which would reside in a "donor node," and hosting RRC, SDAP and PDCP protocols of the gNB or RRC and PDCP protocols of the en-gNB that controls the operation of one or more gNB-DUs.

[0026] As used herein, the term "cellular network" or "cellular radio access network" can refer to a network distributed over cells, each cell served by at least one fixed-location transceiver, such as a base station. A "cell" may be any communication channel that is specified by standardization or regulatory bodies to be used for International Mobile Telecommunications-Advanced ("IMTAdvanced"). All or a subset of the cell may be adopted by 3GPP as licensed bands (e.g., frequency band) to be used for communication between a base station, such as a Node B, and a UE terminal. A cellular network using licensed frequency bands can include configured cells. Configured cells can include cells of which a UE terminal is aware and in which it is allowed by a base station to transmit or receive information. Examples of cellular radio access networks include E-UTRAN, and any successors thereof (e.g., NUTRAN).

[0027] Any reference to a "resource" herein means "radio resource" unless otherwise clear from the context that another meaning is intended. In general, as used herein a radio resource ("resource") is a time-frequency unit that can carry information across a radio interface, e.g., either signal information or data information. An example of a radio resource occurs in the context of a "frame" of information that is typically formatted and prepared, e.g., by a node. In Long Term Evolution (LTE) a frame, which may have both downlink portion(s) and uplink portion(s), is communicated between the base station and the wireless terminal. Each LTE frame may comprise plural subframes. For example, in the time domain, a 10 ms frame consists of ten one millisecond subframes. An LTE subframe is divided into two slots (so that there are thus 20 slots in a frame). The transmitted signal in each slot is described by a resource grid comprised of resource elements (RE). Each column of the two dimensional grid represents a symbol (e.g., an OFDM symbol on downlink (DL) from node to wireless terminal; an SC-FDMA symbol in an uplink (UL) frame from wireless terminal to node). Each row of the grid represents a subcarrier. A resource element (RE) is the smallest time-frequency unit for downlink transmission in the subframe. That is, one symbol on one sub-carrier in the sub-frame comprises a resource element (RE) which is uniquely defined by an index pair (k,l) in a slot (where k and l are the indices in the frequency and time domain, respectively). In other words, one symbol on one sub-carrier is a resource element (RE). Each symbol comprises a number of sub-carriers in the

frequency domain, depending on the channel bandwidth and configuration. The smallest time-frequency resource supported by the standard today is a set of plural sub-carriers and plural symbols (e.g., plural resource elements (RE)) and is called a resource block (RB). A resource block may comprise, for example, 84 resource elements, i.e., 12 subcarriers and 7 symbols, in case of normal cyclic prefix
A mobile network used in wireless networks may be where the source and destination are interconnected by way of a plurality of nodes. In such a network, the source and destination may not be able to communicate with each other directly due to the distance between the source and destination being greater than the transmission range of the nodes. That is, a need exists for intermediate node(s) to relay communications and provide transmission of information. Accordingly, intermediate node(s) may be used to relay information signals in a relay network, having a network topology where the source and destination are interconnected by means of such intermediate nodes. In a hierarchical telecommunications network, the backhaul portion of the network may comprise the intermediate links between the core network and the small subnetworks of the entire hierarchical network. Integrated Access and Backhaul (IAB) Next generation NodeB use 5G New Radio communications such as transmitting and receiving NR User Plane (U-Plane) data traffic and NR Control Plane (C-Plane) data. Both, the UE and gNB may include addressable memory in electronic communication with a processor. In one embodiment, instructions may be stored in the memory and are executable to process received packets and/or transmit packets according to different protocols, for example, Medium Access Control (MAC) Protocol and/or Radio Link Control (RLC) Protocol.

[0028] Fig. 1 shows an example telecommunications system 20 comprising core network 21 and plural wireless access nodes including donor or parent IAB node 22 and other IAB nodes 24 which are not donor or parent IAB nodes; and plural user equipments (UE) 30 that are served by one or more of the access nodes. Fig. 1 further shows that the donor IAB node 22 may be connected to core network 21, e.g., by a wireline 31 or other suitable connection; and that wireless access links may connect the donor IAB node 22, the IAB nodes 24, and the user equipments (UEs) 30. Fig. 1 particularly shows, for example, that donor IAB node 22 is connected by downlink parent backhaul link 32 and uplink parent backhaul link 33 to one or more IAB nodes 24. Fig. 1 further shows that an IAB node 24 may be connected by downlink child backhaul link 34 and uplink child backhaul link 35 to one or more child nodes, e.g., to a user equipment (UE) 30 or to another IAB node 24. . It should be understood that in this invention some parts of operations and behaviors that are performed by the donor IAB node may be able to be performed by a parent IAB node.

[0029] With reference to Fig. 1, the present embodiments include a mobile network infras-

tructure using 5G signals and 5G base stations (or cell stations). Depicted is a system diagram of a radio access network utilizing IAB nodes, where the radio access network may comprise, for example, one IAB-donor and multiple IAB-nodes. Different embodiments may comprise different number of IAB-donor and IAB-node ratios. Herein, the IAB nodes may be referred to as IAB relay nodes. The IAB-node may be a Radio Access Network (RAN) node that supports wireless access to UEs and wirelessly backhauls the access traffic. The IAB-donor may be a RAN node which may provide an interface to the core network to UEs and wireless backhauling functionality to IAB nodes. An IAB-node/donor may serve one or more IAB nodes using wireless backhaul links as well as UEs using wireless access links simultaneously. Accordingly, network backhaul traffic conditions may be implemented based on the wireless communication system to a plurality of IAB nodes and UEs.

[0030] With further reference to Fig. 1, plural UEs 30 are depicted as in communication with IAB nodes, for example, IAB nodes 24 and IAB donor node 22, via wireless access link(s). Additionally, the IAB-nodes (child nodes) may be in communication with other IAB-nodes and/or an IAB-donor (all of which may be considered IAB parent nodes) via wireless backhaul link. For example, a UE may be connected to an IAB-node which itself may be connected to a parent IAB-node in communication with an IAB-donor, thereby extending the backhaul resources to allow for the transmission of backhaul traffic within the network and between parent and child for integrated access. The embodiments of the system provide for capabilities needed to use the broadcast channel for carrying information bit(s) (on the physical channels) and provide access to the core network.

[0031] Fig. 1 further shows that the donor IAB node 22 comprises IAB resource configuration controller 36, and that the IAB nodes 24 each comprise IAB resource configuration manager 38. In certain example aspects of the technology disclosed herein, and as explained hereinafter in various differing example embodiments and modes, the IAB resource configuration controller 36 of donor IAB node 22, often working in conjunction with the IAB resource configuration managers 38 of the IAB nodes 24, facilitates enhanced and more efficient operation of the telecommunications system 20.

[0032] Fig. 2 depicts an example of functional block diagrams for the donor IAB node 22 and the IAB node 24 (see Fig. 1). The donor IAB node 22 may comprise at least one Central Unit (CU) 40 and at least one Distributed Unit (DU) 42. The Central Unit (CU) 40 is a logical entity managing the DU collocated in the donor IAB node 22 as well as the remote DUs resident in the IAB-nodes. The Central Unit (CU) 40 may also be an interface to the core network 21, behaving as a RAN base station (e.g., eNB or gNB).

[0033] In some embodiments, the Distributed Unit (DU) 42 is a logical entity hosting a radio interface (backhaul/access) for other child IAB-nodes and/or UEs. In one con-

figuration, under the control of Central Unit (CU) 40 , the Distributed Unit (DU) 42 may offer a physical layer and Layer-2 (L2) protocols (e.g., Medium Access Control (MAC), Radio Link Control (RLC), etc.) while the Central Unit (CU) 40 may manage upper layer protocols (such as Packet Data Convergence Protocol (PDCP), Radio Resource Control (RRC), etc.). As shown in Fig. 2, the Central Unit (CU) 40 may host or comprise the IAB resource configuration controller 36, as hereinafter discussed.

[0034] As also shown in Fig. 2, an IAB node 24 may comprise Mobile-Termination (MT) 50 and Distributed Unit (DU) 52. In some example embodiments the Distributed Unit (DU) 52 may have the same functionality as the Distributed Unit (DU) 42 in the IAB-donor, whereas the Mobile-Termination (MT) 50 may be a UE-like function that terminates the radio interface layers. As an example, the Mobile-Termination (MT) 50 may function to perform at least one of: radio transmission and reception, encoding and decoding, error detection and correction, signaling, and access to a SIM. Either or both of the Mobile-Termination (MT) 50 and Distributed Unit (DU) 52 may comprise or host the IAB resource configuration manager 38.

[0035] Embodiments include a mobile network infrastructure where a number of UEs are connected to a set of IAB-nodes and the IAB-nodes are in communication with each other for relay and/or an IAB-donor using the different aspects of the present embodiments. In some embodiments, the UE may communicate with the CU of the IAB-donor on the C-Plane using RRC protocol and in other embodiments, using Service Data Adaptation Protocol (SDAP) and/or Packet Data Convergence Protocol (PDCP) radio protocol architecture for data transport (U-Plane) through NR gNB. In some embodiments, the DU of the IAB-node may communicate with the CU of the IAB-donor using 5G radio network layer signaling protocol: F1 Application Protocol (F1-AP*) which is a wireless backhaul protocol that provides signaling services between the DU of an IAB-node and the CU of an IAB-donor. That is, the protocol stack configuration may be interchangeable, and different mechanism may be used.

[0036]

Various aspects of IAB networks and nodes, and in some cases the virtualization of such networks and nodes, are described in one or more of the following United States Patent Applications, all of which are incorporated herein by reference:

United States Provisional Patent Application 62/780,068, filed December 14, 2018, entitled "METHODS AND APPARATUS FOR CELL BARRING IN WIRELESS RELAY NETWORKS".

United States Provisional Patent Application 62/753,699, filed October 31, 2018, entitled "METHODS AND APPARATUS FOR USING CONDITIONAL HANDOVERS FOR WIRELESS";

United States Provisional Patent Application 62/758,020, filed November 8, 2018, entitled "NETWORK AND METHODS TO SUPPORT INTERDOMAIN MOBILITY IN VIRTUALIZED RADIO ACCESS NETWORK";

United States Provisional Patent Application 62/748,359, filed October 19, 2018, entitled "METHODS AND APPARATUS FOR CAPABILITY SIGNALING IN RADIO ACCESS NETWORK";

United States Provisional Patent Application 62/748,015, filed October 19, 2018, entitled "RADIO ACCESS NETWORK AND METHODS FOR EXPEDITED NETWORK ACCESS".

Fig. 3 shows in more detail a generic example embodiment and mode of arrangement and composition of certain functionalities and components of donor IAB node 22; an example, representative IAB node 24; and an example, representative user equipment (UE) 30. It should be understood that each of the nodes of Fig. 3 comprise additional components and functionalities known to the person skilled in the art, and that primarily those pertinent to the technology disclosed herein are illustrated for sake of simplicity.

[0037] As understood from the foregoing, Fig. 3 shows wireless access node 22 comprises central unit (CU) 40 and distributed unit (DU) 42. The central unit (CU) 40 and distributed unit (DU) 42 may be realized by, e.g., be comprised of or include, one or more processor circuits, e.g., node processor(s) 46. The one or more node processor(s) 46 may be shared by central unit (CU) 40 and distributed unit (DU) 42, or each of central unit (CU) 40 and distributed unit (DU) 42 may comprise one or more node processor(s) 46. Moreover, central unit (CU) 40 and distributed unit (DU) 42 may be co-located at a same node site, or alternatively one or more distributed units may be located at sites remote from central unit (CU) 40 and connected thereto by a packet network. The distributed unit (DU) 42 of donor IAB node 22 may comprise transceiver

circuitry 47, which in turn may comprise transmitter circuitry 48 and receiver circuitry 49. The transceiver circuitry 47 includes antenna(e) for the wireless transmission. Transmitter circuitry 48 includes, e.g., amplifier(s), modulation circuitry and other conventional transmission equipment. Receiver circuitry 49 comprises, e.g., amplifiers, demodulation circuitry, and other conventional receiver equipment.

[0038] As shown in Fig. 3 the IAB-node 24, also known as wireless relay node 24, in an example embodiment and mode comprises the IAB node mobile termination (MT) unit 50 and IAB node distributed unit (DU) 52. The IAB node mobile termination (MT) unit 50 and IAB node distributed unit (DU) 52 may be realized by, e.g., by comprised of or include, one or more processor circuits, e.g., IAB node processor(s) 54. The one or more IAB node processor(s) 54 may be shared by IAB node mobile termination (MT) unit 50 and IAB node distributed unit (DU) 52, or each of IAB node mobile termination (MT) unit 50 and IAB node distributed unit (DU) 52 may comprise one or more IAB node processor(s) 54. The IAB node distributed unit (DU) 52 may comprise IAB node transceiver circuitry 57, which in turn may comprise IAB node transmitter circuitry 58 and IAB node receiver circuitry 59. The IAB node transceiver circuitry 57 includes antenna(e) for the wireless transmission. IAB node transmitter circuitry 58 may include, e.g., amplifier(s), modulation circuitry and other conventional transmission equipment. IAB node receiver circuitry 59 may comprise, e.g., amplifiers, demodulation circuitry, and other conventional receiver equipment.

[0039] Fig. 3 shows child node 30, shown by way of example as user equipment (UE) 30, as comprising, in an example, non-limiting embodiment and mode, transceiver circuitry 60. The transceiver circuitry 60 in turn may comprise transmitter circuitry 62 and receiver circuitry 64. The transceiver circuitry 60 includes antenna(e) for the wireless transmission. Transmitter circuitry 62 may include, e.g., amplifier(s), modulation circuitry and other conventional transmission equipment. Receiver circuitry 64 may comprise, e.g., amplifiers, demodulation circuitry, and other conventional receiver equipment. Fig. 3 further shows child node 30, which (as indicated before) may be a user equipment or Integrated Access and Backhaul (IAB) node, as also comprising node processor circuitry, e.g., one or more node processor(s) 66, and interfaces 68, including one or more user interfaces. Such user interfaces may serve for both user input and output operations, and may comprise (for example) a screen such as a touch screen that can both display information to the user and receive information entered by the user. The user interface 68 may also include other types of devices, such as a speaker, a microphone, or a haptic feedback device, for example.

[0040] In an example, non-limiting embodiment and mode shown in Fig. 3, the child node 30 may include frame/message generator/handler 69. As is understood by those skilled in the art, in some telecommunications system messages, signals, and/or data are com-

municated over a radio or air interface using one or more "resources", e.g., "radio resource(s)". The frame/message generator/handler 69 serves to handle messages, signals, and data received from other nodes.

[0041] A. IAB RESOURCE CONFIGURATION: OVERVIEW

The IAB resource configuration controller 36 of donor IAB node 22 performs various functions related to resource configuration and utilization by the donor IAB node 22 and IAB nodes 24. In one example embodiment and mode, described herein with reference to Fig. 4 - Fig. 8, the IAB resource configuration controller 36 generates, communicates, and/or utilizes one or more resource configuration scheme indicator(s) which conveniently and compactly informs an IAB node as to which one of plural possible resource configuration schemes the plural radio resources available to the IAB node are to be configured and/or operated. The resource configuration scheme indicator may configure collectively configure radio resources of an IAB node 24, and thus avoids the necessity for the donor IAB node 22 to individually configure separate radio resources for the IAB node 24.

[0042] In another example embodiment and mode, described herein with reference to Fig. 9 - Fig. 12, the IAB resource configuration controller 36, although having configured certain radio resources as being potentially available for a IAB node mobile termination (MT) unit 50 when the IAB node distributed unit (DU) 52 is in a "soft configuration", overrides such potential availability by generating and sending a mobile termination (MT) resource utilization override signal. The mobile termination (MT) resource utilization override signal may be generated at a time when, although potentially available for the IAB node mobile termination (MT) unit 50, the donor IAB node 22 determines for one or more reasons that the IAB node mobile termination (MT) unit 50 should not transmit or act upon transmissions which the IAB node mobile termination (MT) unit 50 receives.

[0043] In another example embodiment and mode, described herein with reference to Fig. 13 - Fig. 16, the IAB resource configuration controller 36 expediently performs certain switching with regard to "flexible" resources that may be configured for an IAB node 24. In so doing, the IAB resource configuration controller 36 may generate a resource configuration switch signal which changes a utilization attribute of one or more radio resources configured for the IAB node 24. In one example implementation, the resource configuration switch signal affects a utilization attribute of link direction for which the radio resource is utilized. In another example implementation, the resource configuration switch signal affects a utilization attribute of IAB node 24 entity which may use the radio resource. Advantageously, in the various implementations described herein, a switching between attributes is performed without having to release a radio resource involved in the switch.

[0044] It should be understood that, unless otherwise indicate or apparent from context, one or more of the features of the example embodiments and modes of Fig. 4 - Fig. 8, Fig. 9 - Fig. 12, and Fig. 13 - Fig. 16 may be utilized in conjunction with features from other one or more of such example embodiments and modes.

[0045] B. IAB RESOURCE CONFIGURATION: RESOURCE CONFIGURATION SCHEME INDICATOR(S)

As mentioned above, radio resources that are utilized by nodes of a radio access network are configured and utilized, or at least expressed, with respect to a multi-dimensional resource grid. The dimensions of the grid may be described in terms of two or more of time, frequency, and space. Fig. 4 shows portions of a telecommunications system 20 wherein the IAB resource configuration controller 36 of donor IAB node 22 uses a resource configuration scheme indicator to express to nodes of the telecommunications system 20, e.g., to IAB nodes 24, which and how radio resources of the grid are to be configured for the IAB node 24. For the example embodiment and mode of Fig. 4, the IAB resource configuration controller 36 may comprise resource configuration scheme indicator generator 70. As explained below, resource configuration scheme indicator generator 70 generates one or more resource configuration scheme indicator(s) which are transmitted by transmitter circuitry 48 of distributed unit (DU) 42 to IAB node 24. At the IAB node 24 the one or more resource configuration scheme indicator(s) are received by IAB node mobile termination (MT) unit 50, and are processed by resource configuration scheme indicator handler 72 of IAB node 24. The resource configuration scheme handler 72 may comprise or be realized by IAB node processor(s) 54. In an example embodiment and mode, the one or more resource configuration scheme indicator(s) are transmitted over a Physical Downlink Control Channel (PDCCH) of the resource configuration scheme is signaled on the Physical Layer (or alternatively a Physical Downlink Shared Channel if the resource configuration scheme is transmitted via RRC Configuration signaling), which is shown in Fig. 4 as being scheme indicator signal 74.

[0046] Fig. 5A shows an example of a first grid scheme for IAB resource configuration. Fig. 5A, and other comparably depicted grid illustrations described herein, are simplified with respect to the number of dimensions utilized and the numbers of columns and rows that comprise the grid. It should be understood that any number of columns and rows may be utilized, and typically a far greater number of columns and rows comprise the grids that is shown. As indicated above, the dimensions of the grid may be any of time, frequency, and space. For sake of simplicity, two dimensional grids are illustrated, with the horizontal dimension or axis being time, and the vertical dimension or axis being frequency. The grid may also be conceptualized as a frame. The frame may be divided, e.g., on the horizontal axis, into subframes, and subframes in turn may

be divided into slots. Each square of the grid may represent a resource block (RB). In a time/frequency grid, each resource block may comprise plural number of slots on the horizontal axis, e.g., a number of symbols, and a plural number of subcarriers, e.g., 12 subcarriers, along the vertical axis.

[0047] For a IAB network, radio resources may be configured for the IAB node distributed unit (DU) 52 of the IAB node 24 as being any one or downlink hard (DL-H), downlink soft (DL-S), uplink hard (UL-H), uplink soft (DL-S), flexible hard (F-H), flexible soft (F-S), and not available (NA). The configuration of the IAB node mobile termination (MT) unit 50 for the IAB node 24 is dependent upon the configuration of the IAB node distributed unit (DU) 52.

[0048] Certain combinations of resource configuration/behavior for combinations of IAB node distributed unit (DU) 52 and IAB node mobile termination (MT) unit 50 have already been agreed in 3GPP, as reflected by Table 1 and Table 2 below. Table 1 and Table 2 are excerpted from (1) R1-1814190, TP for 38.874 on PHY Enhancements for NR IAB, AT&T, RAN1 #95, and (2) Chair's Notes, RAN1 #95. Table 1 applies in case of time division multiplexing (TDM) operation, where there can be no simultaneous transmission in the DU and the MT, nor any simultaneous reception in the DU and the MT.Table 2 applies in case of space division multiplexing (SDM) operation, where there can be simultaneous transmission in the DU and the MT, alternatively simultaneous reception in the DU and the MT. The definitions/ nomenclature/assumption(s) of Table 3 are applicable for Table 1 and Table 2.

[0049]

Table 1 TDM Operation (Half Duplex)

DU Configuration	**MT configuration**		
	DL	UL	F
DL-H	DU: Tx MT: NULL	DU: Tx MT: NULL	DU: Tx MT: NULL
DL-S	When DU resource: IA DU: Tx MT: NULL When DU resource: INA DU: NULL MT: Rx	When DU resource: IA DU: Tx MT: NULL When DU resource: INA DU: NULL MT: Tx	When DU resource: IA DU: Tx MT: NULL When DU resource: INA DU: NULL MT: Tx/Rx
UL-H	DU: Rx MT: NULL	DU: Rx MT: NULL	DU: Rx MT: NULL
UL-S	When DU resource: IA DU: Rx MT: NULL When DU resource: INA DU: NULL MT: Rx	When DU resource: IA DU: Rx MT: NULL When DU resource: INA DU: NULL MT: Tx	When DU resource: IA DU: Rx MT: NULL When DU resource: INA DU: NULL MT: Tx/Rx
F-H	DU: Tx/Rx MT: NULL	DU: Tx/Rx MT: NULL	DU: Tx/Rx MT: NULL
F-S	When DU resource: IA	When DU resource: IA	When DU resource: IA

	DU: Tx/Rx MT: NULL When DU resource: INA DU: NULL MT: Rx	DU: Tx/Rx MT: NULL When DU resource: INA DU: NULL MT: Tx	DU: Tx/Rx MT: NULL When DU resource: INA DU: NULL MT: Tx/Rx
NA	DU: NULL MT: Rx	DU: NULL MT: Tx	DU: NULL MT: Tx/Rx

Table 2 SDM, Assuming Full Duplex Can Happen

		DL	UL	F
DL-H		DU: Tx MT: NULL	DU: Tx MT: Tx	DU: Tx MT: Tx
DL-S		When DU resource: IA DU: Tx MT: NULL When DU resource: INA DU: NULL MT: Rx	When DU resource: IA DU: Tx MT: Tx When DU resource: INA DU: NULL MT: Tx	When DU resource: IA DU: Tx MT: Tx When DU resource: INA DU: NULL MT: Tx/Rx
UL-H		DU: Rx MT: Rx	DU: Rx MT: NULL	DU: Rx MT: Rx
UL-S		When DU resource: IA DU: Rx MT: Rx When DU resource: INA DU: NULL MT: Rx	When DU resource: IA DU: Rx MT: NULL When DU resource: INA DU: NULL MT: Tx	When DU resource: IA DU: Rx (only if MT is Rx and the DU knows that ahead of time) MT: Rx When DU resource: INA DU: NULL MT: Tx/Rx

F-H		DU: Tx/Rx MT: Rx (only if DU is Rx and the parent DU is aware in advance)	DU: Tx/Rx MT: Tx (only if DU is Tx and the parent is aware in advance)	DU: Tx/Rx MT: Tx (only if DU is Tx and the parent DU knows that ahead of time), Rx (only if DU is Rx and the parent DU is aware in advance)
F-S		When DU resource: IA DU: Tx/Rx MT: Rx (only if DU is Rx and the parent DU is aware in advance) When DU resource: INA DU: NULL MT: Rx	When DU resource: IA DU: Tx/Rx MT: Tx (only if DU is Tx and the parent DU is aware in advance) When DU resource: INA DU: NULL MT: Tx	When DU resource: IA DU: Tx/Rx MT: Tx (only if DU is Tx and the parent DU knows that ahead of time), Rx (only if DU is Rx and the parent DU is aware in advance) When DU resource: INA DU: NULL MT: Tx/Rx
NA		DU: NULL MT: Rx	DU: NULL MT: Tx	DU: NULL MT: Tx/Rx

Table 3: DEFINITIONS/NOMENCLAURE/ASSUMPTIONS

MT: Tx" means that the MT should transmit if scheduled
"DU: Tx" means that the DU may transmit
"MT: Rx" means that the MT should be able to receive (if there is anything to receive)
"DU: Rx" means that the DU may schedule uplink transmissions from child nodes or UEs
"MT: Tx/Rx" means that the MT should transmit if scheduled and should be able to receive, but not simultaneously
"DU: Tx/Rx" means that the DU may transmit and may schedule uplink transmission from child nodes and UEs, but not simultaneously
"IA" means that the DU resource is explicitly or implicitly indicated as available
"INA" means that the DU resource is explicitly or implicitly indicated as not available
"MT: NULL" means that the MT does not transmit and does not have to be able to receive
"DU: NULL" means that the DU does not transmit and does not schedule uplink transmission from child nodes and UEs
"NA" means the resources are "not available."
Tables 1 and 2 assume an IAB not capable of full-duplex operation

Table 1 and Table 2 are for one IAB node. For an IAB to work, there needs to be a series of connected nodes, from the RAN "edge" to the backhaul Donor node, e.g., the node directly connectable to a wired (or proprietary wireless) backhaul. Because of that connection of nodes obeying the properties of the Table 1 and Table 2 a well-functioning IAB network will operate according to certain constraints.

[0050]

> Thus, for example, based on Table 1 and Table 2, if a DU configuration is set to "NA," not available, then the MT if configured for DL is in "Rx," receive mode; if the DU configured is set for UL, then if the MT if configured for DL is in "Tx," Transmit mode, and if the DU configuration is "Flexible" the MT can operate in Receive or Transmit modes depending on L1 signaling. Such L1 signaling may include a specific grant for the resources or (more useful as it reduces signaling overhead). The resource grant may use a mechanism similar to semi-persistent scheduling or Type 2 Configured grant. That is, the L1 signaling may be "activation" (or "deactivation" or "release") signaling using potential variations of DCI Formats 0_0, 0_1, for uplink and DCI Formats 1_0, and 1_1 downlink (de)activation, where specific resources are indicated. (Note that deactivation or release would most certainly use "fallback" formats 0_0 and 1_0, as per NR **Error! Reference source not found.**)

Unless otherwise indicated or apparent from the context, the IAB resource configuration controller 36 of donor IAB node 22 and IAB resource configuration manager 38 of IAB node 24 operate in accordance with Table 1 and Table 2. Similarly, subject to Table 1 and Table 2, the resource configuration scheme indicator generator 70 may generate plural resource configuration schemes. Each resource configuration scheme generally indicates which radio resources are to be configured for an IAB node mobile termination (MT) unit 50 of the IAB node 24 on one hand, and which radio resources are to be configured for an IAB node distributed unit (DU) 52 on the other hand. Thus, the resource configuration scheme may be constructed or configured on the basis of node entity as one resource configuration scheme factor. In addition, each resource configuration scheme may be expressed using one or more other scheme factors.

[0051] For example, a resource configuration scheme may indicate which of the radio resources of the scheme are to be configured as "uplink" and which radio resources of the scheme are to be configured as "downlink".

[0052] As another example, a resource configuration scheme may indicate which of the radio resources of the scheme are to be configured as "hard" and which radio resources of the scheme are to be configured as "soft". The assignment of hard of soft resources either to UL or DL means that these resources are unusable for other purposes. Thus, for example, in a full duplex mode, with a DU configuration of "UL-H," (Uplink "Hard") the corresponding DU configuration "Rx" means the DU may schedule uplink transmissions from child nodes or UEs allowing the DU to receive them as it so schedules, and the MT part of the IAB node is "NULL," indicating that the MT does not transmit and does not have to be able to (or, anthropomorphizing, should not "expect to") receive anything in those resources.

[0053] Fig. 5A shows a first example resource configuration scheme for IAB radio resources. In the resource configuration scheme of Fig. 5A, a set of resources whose designation includes 5A-DU are to be configured for the IAB node distributed unit (DU) 52, and a set of resources whose designation includes 5A-MT are to be

configured for the IAB node mobile termination (MT) unit 50. Thus, the resource configuration scheme of Fig. 5A is characterized by entity factors. In actuality, both MT and DU resources can be described by a grid, with the MT resources are constrained according to the DU configuration, for which reason Fig. 5A depicts in essence a linking of the grids.

[0054] Moreover, the resource configuration scheme of Fig. 5A is also characterized by link direction factors. In this regard, of the set of resources 5A-DU which are to be configured for the IAB node distributed unit (DU) 52, a sub-set of resources whose designation includes 5A-DU-UL are to be configured for the uplink for IAB node distributed unit (DU) 52 and a sub-set of resources whose designation includes 5A-DU-DL are to be configured for the downlink for IAB node distributed unit (DU) 52.

[0055] Yet further, the resource configuration scheme of Fig. 5A is also characterized by resource dedication factors, e.g., as either "hard" or "soft" or "flexible", for example. In this further regard, sub-sets of the radio resources which are "hard" have designations which include the final suffix "-H", the sub-sets of the radio resources which are "soft" have designations which include the final suffix "-S", and the sub-sets of the radio resources which are "flexible" bear the final suffix "-F". The sets and sub-sets of Fig. 5A and other comparable figures are not intended to be to scale or to depict a certain amount of resources but are provided solely for sake of illustration.

[0056] Fig. 5B shows a second example resource configuration scheme for IAB radio resources, with resource designations following a similar convention as Fig. 5A except that the leading prefix of each designator is 5B rather than 5A. The second example resource configuration scheme of Fig. 5B may have a different combination of types of grid factors, and different numbers of radio resources configured for each set or sub-set. Likewise, as shown in Fig. 6, the resource configuration scheme indicator generator 70 may have several resource configuration schemes from which to choose, such as resource configuration schemes 5A, 5B, 5C, ... 5J, for example.

[0057] Fig. 6 further shows that the resource configuration scheme indicator generator 70 has chosen resource configuration scheme 5B for utilization by IAB node 24, and further depicts that the message or signal 74 bearing a scheme indicator which points to resource configuration scheme 5B is transmitted to the IAB node 24.

[0058] Fig. 7 shows example, non-limiting, basic acts or steps that may be performed by a donor IAB node of the example embodiment and mode of Fig. 4. Act 7-1 comprises generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network. As used herein, "coded" description means an abbreviated, short-form notation for the set of radio resources encompassed by the

selected resource configuration scheme, rather than a detailed cataloging or enumerating of the radio resources that are to be similar configured. The manner of coding may take any appropriate form, such as a mapping or pointer to a predetermined portion of the grid that is commonly understood by both donor IAB node 22 and IAB node 24 to be referenced by the pointer. The configuration of each resource configuration scheme may be pre-configured at each of the donor IAB node 22 and the IAB node 24, or may be configured by network download, e.g., to the IAB node 24. Act 7-2 comprises the donor IAB node 22 transmitting the IAB resource configuration scheme indicator over a radio interface to the at least one other IAB node.

[0059] Upon reception of the scheme indicator signal 74, the resource configuration scheme indicator handler 72 processes the scheme indicator signal 74 and ascertains that resource configuration scheme 5B is to be utilized and can configure and use the plural resources encompassed by the resource configuration scheme indicator according to the received indication. Thus, using the coded, short-hand or abbreviated notation comprising the resource configuration scheme indicator, the donor IAB node 22 avoids the need to describe in more detail, e.g., by row and column/resource block designators, each of the plural resources that are to be configured at IAB node 24.

[0060] Fig. 8 shows example, non-limiting, basic acts or steps that may be performed by an IAB node of the example embodiment and mode of Fig. 4. Act 8-1 comprises receiving an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node. Act 8-2 comprises configuring the radio resources of the IAB node according to the indication. The resource configuration according to the indication may be performed by node processor(s) 66. The node processor(s) 66 may be configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node, as mentioned above. Moreover, the one or more schemes may be characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node. Preferably, the same Resource Configuration Scheme Generator 70 are used for all IAB nodes 24.

[0061] In choosing the resource configuration scheme indicator to send to an IAB node 24, the resource configuration scheme indicator generator 70 may base its selection on various factors or constraints. Among such factors or input for the selection of the resource configuration scheme indicator 70 may be one or more of the following: the overall ratio of backhaul to access node traffic, uplink/downlink traffic ratio, site

planning considerations (i.e., in order to avoid inter-IAB node interference), etc.

[0062] Thus, a resource configuration scheme indicator, also known as an IAB slot format indicator (IAB-SFI), may, e.g., for a given (configured) periodicity, indicate a pattern of DU UL/DL configurations, with the configurations of the IAB node mobile termination (MT) unit 50 following from Table 1 and Table 2. The resource configuration scheme indicator(s) may be particularly applicable to flexible resources. As explained below, the resource configuration scheme indicator may also be useful not only for configuration and/or activation signaling, but also for state transitions or switching in conjunction with other example embodiments and modes described herein.

[0063] C. IAB RESOURCE CONFIGURATION: MOBILE TERMINATION (MT) RESOURCE UTILIZATION OVERRIDE

From Table 1 and Table 2 above, understood in light of the nomenclature of Table 3, that the Mobile-Termination (MT) 50 of an IAB node 24 may be permitted to receive or transmit using a DU resource when a mode of the Distributed Unit (DU) 52 of the IAB node 24 is both "soft" and the DU resource is indicated, either explicitly or implicitly, as not available. For example, with reference to the second row of Table 1, which concerns a soft downlink configuration for the DU, if the DU resource is indicated as unavailable, then the DU does not transmit and does not schedule uplink transmissions from child nodes and UEs using that radio resources. Since the particular DL-S resource is not available to the DU of the IAB node 24, Table 1 gives the Mobile-Termination (MT) 50 of the IAB node 24 an opportunity, when the Mobile-Termination (MT) 50 is configured for downlink, to receive on the downlink using the DL-S resource that otherwise would be configured for the Distributed Unit (DU) 52 [see row 1, second column of Table 1]. Alternatively, when the Mobile-Termination (MT) 50 is configured for uplink, the Mobile-Termination (MT) 50 is given the opportunity to receive on the downlink using the DU resource that otherwise would be configured for the Distributed Unit (DU) 52 in the soft mode [see row 1, third column of Table 1]. As a further alternative, if the Mobile-Termination (MT) 50 is configured flexibly, the Mobile-Termination (MT) 50 is given the opportunity to transmit or receive on the downlink using the resource that otherwise would be configured for the Distributed Unit (DU) 52 [see row 1, fourth column of Table 1]. Similarly, the Mobile-Termination (MT) 50 is provided with opportunities for receiving and/or transmitting using resources otherwise configured for DU when the DU is configured as UL-S but the DU radio resources are not available, as seen in the fourth row of Table 1. Likewise, Table 2 provides opportunities for the Mobile-Termination (MT) 50 to use certain soft, unavailable-to-the-DU resources as shown in the second and fourth rows thereof. Thus, it is seen from Table 1 and Table 2, for example, that a certain class of radio resources configured for the Distributed Unit (DU) 52 as "soft", but unavailable

to the Distributed Unit (DU) 52, are potentially available for use by the Mobile-Termination (MT) 50. Thereby the Mobile-Termination (MT) 50 may advantageously utilize the radio resources of this class, which resources are nominally configured for the Distributed Unit (DU) 52 but, now being unavailable to the DU, would otherwise go unused by the IAB node 24.

[0064] In the example embodiment and mode described herein with reference to Fig. 9 - 12, the IAB resource configuration controller 36, although having configured certain radio resources as being potentially available for a IAB node mobile termination (MT) unit 50 when the IAB node distributed unit (DU) 52 is in a "soft configuration", overrides such potential availability. For this purpose Fig. 9 shows the donor IAB node 22, and IAB resource configuration controller 36 in particular, as comprising IAB resource MT utilization override signal generator 80. The IAB resource MT utilization override signal generator 80 generates an IAB resource MT utilization override signal 82 which signals to the Mobile-Termination (MT) 50 that the IAB node mobile termination (MT) unit 50 should not transmit upon certain radio resources or act upon transmissions which the IAB node mobile termination (MT) unit 50 receives over those radio resources, even though those may otherwise be potentially available according to Table 1 or Table 2, for example.

[0065] The IAB resource configuration controller 36 may choose to override the availability to the Mobile-Termination (MT) 50 of radio resources associated with a soft mode DU configuration for any of several reasons. For example, the central unit (CU) 40 of the donor IAB node 22 may determine or be notified that interference conditions do or may exist in the network, and for that reason may decide to attempt to reduce transmissions that could cause or exacerbate interference by curtailing the potential activity of, e.g., potential transmissions from, the Mobile-Termination (MT) 50 over the potentially available DU radio resources. Alternatively, the central unit (CU) 40 the central unit (CU) 40 of the donor IAB node 22 may determine or be notified that a certain measurement or series of measurements need to be performed, and reduction of traffic or cessation of at least some further activity from Mobile-Termination (MT) 50 may facilitate the measurement(s). Thus, for these or other reasons the central unit (CU) 40 of donor IAB node 22 may direct the IAB resource MT utilization override signal generator 80 to generate the IAB resource MT utilization override signal 82.

[0066] Thus, processor circuitry such as node processor(s) 46 of central unit (CU) 40 may make a determination, or receive an indication of a determination, e.g., from another node or network, of a network condition. In response to the determination or indication, the IAB resource MT utilization override signal generator 80 may generate the IAB resource utilization override signal 82. The IAB resource utilization override signal is configured to preclude a Mobile-Termination (MT) of the IAB node from

using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink. The class of IAB radio resources is radio resources indicated as unavailable to the Distributed Unit (DU) for a soft configured DU.

[0067] In other words, despite the potential availability to the Mobile-Termination (MT) 50 of a certain class radio resources, upon issuance of the IAB resource MT utilization override signal 82 the IAB node 24 of Fig. 9 is precluded from taking advantage of the opportunity to use such radio resources. That class of radio resources comprises radio resources which were configured for use by DU in a soft mode but which are also indicated as unavailable to the DU.

[0068] Fig. 10 shows example, non-limiting representative acts performed by the donor IAB node 22 of Fig. 9. Act 10-1 comprises generating an IAB resource utilization override signal. As explained above, the IAB resource utilization override signal is configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU). Act 10-2 comprises transmitting the IAB resource utilization override signal to the IAB node.

[0069] Fig. 9 further shows IAB node processor(s) 54 of the IAB node 24, and in an example embodiment and mode the IAB resource configuration manager 38 in particular, as comprising IAB resource MT utilization override signal handler 84. The IAB resource MT utilization override signal handler 84 is configured to determine from the IAB resource utilization override signal 82 that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink. As mentioned above, that class of IAB radio resources comprises radio resources indicated as unavailable to the Distributed Unit (DU) when configured as soft. In accordance with such interpretation, the IAB resource configuration manager 38 governs the Mobile-Termination (MT) 50 so that the Mobile-Termination (MT) 50 does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0070] Fig. 11 shows example, non-limiting representative acts performed by the IAB node 24 of Fig. 9. Act 11-1 comprises receiving an IAB resource utilization override signal from the donor IAB node. Act 11-2 comprises determining from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU). Act 11-3 comprises governing the Mobile-Termination (MT) so that the Mobile-Termination

(MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0071] Fig. 12 depicts generation by donor IAB node 22 and use by IAB node 24 of an IAB resource MT utilization override signal 84. Fig. 12 simply shows that a resource pool 85 is configured for IAB node 24, which portions of the resource pool 85 configured for Distributed Unit (DU) 52 overlapping the Distributed Unit (DU) 52 in Fig. 12 and portions of the resource pool 85 configured for Mobile-Termination (MT) 50 overlapping the Mobile-Termination (MT) 50. The "class" of radio resources which were configured for use by DU in a soft mode but which are also indicated as un-available to the DU are shown as "class" resource subset 86 in Fig. 12. Arrow 87 in Fig. 12 indicates that ordinarily, according to Table 1 and Table 2, for example, the resources of "class" resource subset 86 could potentially become available for Mobile-Termination (MT) 50. However, arrow 88 indicates that, upon receipt of the IAB resource MT utilization override signal 82, the "class" resource subset 86 now becomes unavailable to Mobile-Termination (MT) 50, illustrated as arrow 87 being crossed out or Xed. Receipt of the IAB resource MT utilization override signal 82 has the result that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0072] Thus, the example embodiment and mode of Fig. 9 - Fig. 12 introduces and includes a "NA" state for the MT configuration, and appropriate state transitions and "connected" states to IAB nodes on the network. The IAB resource MT utilization override signal 82 described in this example embodiment and mode serves to put the MT, e.g., the Mobile-Termination (MT) 50, in a not available state, with respect to the class of resources depicted as "class" resource subset 86 in Fig. 12. Although the "class" resource subset 86 may be indicated as unavailable to the Distributed Unit (DU) 52, according to the example embodiment and mode of Fig. 9 - Fig. 12 such un-availability for the DU should not necessarily result in Tx or Rx configuration for the Mobile-Termination (MT) 50, for which reason the IAB resource MT utilization override signal 82 may be generated. As indicated above, example reasons for the IAB resource MT utilization override signal 82 may be for cross-link interference management, including reduction of cross-link interference as well as having muting patterns across nodes for measurements. Thus, rather than leaving to implementation the existence of an "NA" state for an MT configuration, the example embodiment and mode of Fig. 9 - Fig. 12 provides the central unit (CU) 40 with the ability to preclude activity of the Mobile-Termination (MT) 50 using the "class" resource subset 86. The IAB resource MT utilization override signal 82 does not affect any radio resources that are needed for maintaining a connection. Thus, in the NA state for the MT resources, except for those used to maintain connected mode, the corresponding behavior for the

MT would be NULL means that the MT does not transmit and does not have to be able to receive any communications. This state would be the default state for resources not associated with receiving an SSB or (at least for a plurality) of RACH resources.

[0073] Thus, in an IAB node 24 comprising at least a Distribution Unit (DU) (which behaves in the manner of a gNB to another IAB node) and a Mobile Terminal (MT), (which behaves in the manner of a User Equipment "Mobile Terminal") there exists, for the Mobile Terminal, a series of designatable (by the CU via a DU in connection with the MT) "Not Assignable" time/frequency/space resources which can be so designated by the CU in order to, among other things, minimize cross-link interference and/or provide measurement opportunity.

[0074] D. IAB RESOURCE CONFIGURATION: RESOURCE CONFIGURATION SWITCHING

Fig. 13 shows another example embodiment and mode wherein the IAB resource configuration controller 36 of donor IAB node 22 expediently performs certain switching with regard to "flexible" resources that may be configured for an IAB node 24. Fig. 13 shows IAB resource configuration controller 36 as comprising IAB resource configuration switch signal generator 90. The IAB resource configuration switch signal generator 90 may comprise or be realized by node processor(s) 46 of central unit (CU) 40. The IAB resource configuration switch signal generator 90 generates an IAB resource configuration switch signal 92 which is transmitted to IAB node 24. The IAB resource configuration switch signal 92 may be transmitted to IAB node 24 by transmitter circuitry 48 of donor IAB node 22. The IAB resource configuration switch signal 92 is processed by IAB resource configuration switch signal handler 94. As explained herein, the IAB resource configuration switch signal 92 is configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0075] Fig. 14A shows a first example of a change of a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource. In the example scenario of Fig. 14A, the utilization attribute comprises link direction for which the radio resource is utilized. Fig. 14A provides two depictions of radio resource configuration change, i.e., a prior art radio resource configuration change on the left side of Fig. 14A and an inventive radio resource configuration change on the right side of Fig. 14A. The same radio resource is shown on both the left side and right side of Fig. 14A as an outer rectangular block, and within the outer rectangular block are inner rectangular blocks whose interior content depicts a change of state of the utilization attribute, link direction, for the radio resource over time. Time as shown by the vertical axis of Fig. 14A, time increasing down the page of Fig. 14A.

[0076] According to the prior art practice shown on the left side of Fig. 14A, the radio

resource begins with state content 96_{PA}-1 shown as ">", which denotes that fact that the link direction attribute for the radio resource is downlink. The radio resource was activated for the downlink direction by a prior art signal S_{PA}-1. Fig. 14A then shows a sequence of further prior art signals that are employed, over time, to change the state content of the resource, e.g., to change the link direction attribute. In order to change the state content from content 96_{PA}-1 to downlink to uplink, a prior art signal S_{PA}-2 must be sent from the donor IAB node to the IAB node to release the radio resource. Fig. 14A shows by an "X" in state content 96_{PA}-2 that the radio resource has had to be released. After release of the radio resource, a prior art signal S_{PA}-3 may be sent to activate use of the radio resource for the uplink direction, which is depicted by with state content 96_{PA}-3 shown as "<". Then, should a further switch of the radio resource be desired, another release signal S_{PA}-4 must be sent, followed by another activation signal S_{PA}-5 to activate use of the radio resource again for the downlink, as depicted by content 96_{PA}-5.

[0077] The right side of Fig. 14A shows, by contrast, that the IAB resource configuration switch signal 92 enables a change of utilization attribute state without having to release the radio resource. The right side of Fig. 14A begins with an IAB resource configuration switch signal 92 which configures the radio resource for downlink use. But when the donor IAB node 22 wants to switch the radio resource to uplink, the donor IAB node 22 need not send a release signal. Rather, the donor IAB node 22 may send another IAB resource configuration switch signal 92 whose reception, by IAB resource configuration switch signal handler 94 of IAB node 24, causes a state change to uplink direction use for the radio resource. Should a further direction change be desired, the donor IAB node 22 may simply again send another IAB resource configuration switch signal 92.

Fig. 14B shows a second example of a change of a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource. In the example scenario of Fig. 14B, the utilization attribute comprises entity type which is to use the radio resource. The entity type may be one of the mobile termination (MT) unit 50 and the distributed unit (DU) 52. The state content in Fig. 14B thus changes or switches between DU and MT. Like Fig. 14A, Fig. 14B also contrasts a prior art signaling for changing resource utilization with the IAB resource configuration switch signal 92 of Fig. 13.

[0078] Fig. 15 shows example, non-limiting, basic acts or steps that may be performed by a donor IAB node of the example embodiment and mode of Fig. 13. Act 15-1 comprises generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource. Act 15-2 comprises transmitting the IAB resource configuration switch

signal to the IAB node.

[0079] Fig. 16 is a flowchart showing example, non-limiting, basic acts or steps that may be performed by an IAB node of the example embodiment and mode of Fig. 13. Act 16-1 comprises receiving an IAB resource configuration switch signal from the donor IAB node. Act 16-2 comprises using the IAB resource configuration switch signal to change a utilization attribute of a radio resource configured for the IAB node.

[0080] In an example embodiment and mode, the IAB resource configuration switch signal 92 may comprises a downlink control indicator (DCI). The downlink control indicator (DCI) used for the IAB resource configuration switch signal 92 comprises a field which specifies the radio resource, e.g., identifies the particular radio resource(s) that is/are being switched. This example implementation of the IAB resource configuration switch signal 92 is similar to a prior art downlink control indicator (DCI) which serves as an activation signal or a release signal, e.g., activation or deactivation of SPS or UL Type 2 Scheduled grants. Such activation or deactivation/release downlink control indicators (DCIs) are detected and distinguished from other downlink control indicators (DCIs) by having certain fields thereof set to predetermined values, e.g., zero(es). Table 4 below shows Special fields for DL SPS and UL grant Type 2 scheduling activation PDCCH validation, while Table 5 shows Special fields for DL SPS and UL grant Type 2 scheduling release PDCCH validation. Table 4 and Table 5 are excerpted from Section 10.2 of 3GPP TS 38.213 V15.3.0 (2018-09), incorporated herein by reference in its entirety, which notes the formats for DCI formats 1_0 and 1_1 for downlink SPS and DCI formats 0_0 and 0_1 for uplink scheduled grants. DCI format 0_0 and 1_0 are used for both activation and release of semi-persistent resources, whereas DCI formats 1_0 and 1_1 for downlink SPS activation and DCI formats 0_0 and 0_1 for uplink scheduled grant activation may be applied. The X_0 (where $X \in \{0,1\}$) DCI formats are meant to be compact "fallback" DCI formats. $

Table 4 Special fields for DL SPS and UL grant Type 2 scheduling activation PDCCH validation

	DCI format 0_0/0_1	DCI format 1_0	DCI format 1_1
HARQ process number	set to all '0's	set to all '0's	set to all '0's
Redundancy version	set to '00'	set to '00'	For the enabled transport block: set to '00'

Table 5: Special fields for DL SPS and UL grant Type 2 scheduling release PDCCH validation

	DCI format 0_0	DCI format 1_0
HARQ process number	set to all '0's	set to all '0's
Redundancy version	set to '00'	set to '00'
Modulation and coding scheme	set to all '1's	set to all '1's
Resource block assignment	set to all '1's	set to all '1's

Thus, in various example implementations described herein, the IAB resource configuration switch signal 92 may also use or comprise one or more downlink control indicator (DCI) formats.

[0081] In one example implementation, the IAB resource configuration switch signal 92 comprises a field which is dedicated to or associated with changing the utilization attribute. For example, the IAB resource configuration switch signal 92 may be a a 1 bit flag included in a PDCCH DCI using the above formats to indicate uplink and/or downlink. The 1 bit flag may be a new field which is added to an otherwise conventional Physical Downlink Control Channel (PDCCH) DCI, or may be an unused field in an existing conventional PDCCH DCI.

[0082] In another example implementation described herein, the IAB resource configuration switch signal 92 comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute. For example, any one of the DCI formats depicted in Table 4 or Table 5 may be suitable for toggling a radio resource between use in the uplink direction and the downlink direction in the manner depicted in the right side of Fig. 14A, or for toggling a radio resource between use by the mobile termination (MT) unit 50 and the distributed unit (DU) 52 in the manner depicted in the right side of Fig. 14B. The specific DCI format chosen to serve as this "same" DCI additionally specifies the identity of the radio resource and comprising one or more fields set to a predetermined value such as the fields set to zeroes in Table 4 and Table 5.

[0083] In other example implementations described herein, the IAB resource configuration switch signal 92 may comprise a downlink control indicator (DCI) format which is selected according to a desired state of the utilization attribute. For example, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined DCI format may be either one of 0_0 and 0_1 for the uplink state, and the predetermined format may be one of 1_0 and 1_1 for the downlink state.

[0084] It is also possible that the IAB resource configuration switch signal generator 90 of donor IAB node 22 may generate plural IAB resource configuration switch signals 92, with differing IAB resource configuration switch signals 92 affecting or concerning differing utilization attributes. For example, the IAB resource configuration switch signal generator 90 may generate a first IAB resource configuration switch signal 92 whose DCI format is indicative of a desired switch in a first utilization attribute, and then a second IAB resource configuration switch signal 92 whose DCI format is indicative of a desired switch in a first utilization attribute. The first IAB resource configuration switch signal 92 could request, for example, an entity change from a distributed unit (DU) 52 to a mobile termination (MT) unit 50. Then, after the requested entity switch has been accomplished, the IAB resource configuration switch signal generator 90 may generate the second IAB resource configuration switch signal 92 to switch the direction attribute of the radio resource, e.g., from downlink to uplink.

[0085] Alternatively, a DCI format used for IAB resource configuration switch signal 92 may be associated with two utilization attributes. For example, with a set of four DCI formats, of two DCI formats associated with a first entity type, one could also be associated with or used for downlink and the other for uplink. Likewise, of the four DCI formats, two other DCI formats may be associated with a second entity type, and of those two one could also be associated with or used for downlink and the other for uplink.

[0086] Thus, in at least some example embodiment and modes, the IAB resource configuration switch signal 92 is carried by Layer 1 signaling, such as in a downlink control indicator (DCI) of a Physical Downlink Control Channel (PDCCH). When the utilization attribute affected by the IAB resource configuration switch signal 92 is link direction, the radio resource is a flexible resource in the manner understood from Table 1 and Table 2. The technology disclosed herein may also be applied to the MT/DU units within an IAB node to avoid violating half duplex constraints when time/frequency/space resources are shared between the MT and DU.

[0087] Thus, in the example embodiment and modes of Fig. 13, the IAB resource configuration controller 36 may generate a resource configuration switch signal which changes an attribute utilization of one or more radio resources configured for the IAB node 24. Advantageously, in the various implementations described herein, a switching between attributes is performed without having to release a radio resource involved in the switch. In sequences of connected IAB nodes the transmission of L1 signaling as described below to facilitate fast L1 switching especially in Flexible time/frequency Space resources between UL and DL or between DU and MT (particularly to avoid half duplex transmission constraint violations). “DL” here may generally apply to DU transmissions, both for transmit and receive and UL may here apply to transmit and

receive functions of the MT.

[0088] Advantageously, the technology disclosed herein introduces state transitions on flexible resources to allow for fast switching between uplink and downlink. It should be further understood that the IAB resource configuration switch signal 92 may not be confined to any particular one radio resource but may instead refer collectively to a group or subset of radio resources. For example, the IAB resource configuration switch signal 92 may also be used to switch between IAB resource configuration schemes, as understood from Fig. 6, for example.

[0089] As yet another aspect of the technology disclosed herein, one or more IAB nodes of the network may be provided with an additional or supplemental identifier to differentiate the node as it serves for non-IAB functions and communications of the IAB node from the node serving for IAB functions and communication. For example, to support configuration and activation, an IAB_RNTI may be assigned to the IAB node to differentiate access network UE-specific SPS from DU activation. This additional IAB_RNTI identity may be assigned by donor IAB node 22 to the IAB nodes 24 served thereby, or by some other entity such as a core network entity.

[0090] Certain units and functionalities of the systems 20 may be implemented by electronic machinery. For example, electronic machinery may refer to the processor circuitry described herein, such as node processor(s) 46, IAB node processor(s) 54, and node processor(s) 66. Moreover, the term "processor circuitry" is not limited to mean one processor, but may include plural processors, with the plural processors operating at one or more sites. Moreover, as used herein the term "server" is not confined to one server unit but may encompasses plural servers and/or other electronic equipment and may be co-located at one site or distributed to different sites. With these understandings, Fig. 17 shows an example of electronic machinery, e.g., processor circuitry, as comprising one or more processors 290, program instruction memory 292; other memory 294 (e.g., RAM, cache, etc.); input/output interfaces 296 and 297, peripheral interfaces 298; support circuits 299; and busses 300 for communication between the aforementioned units. The processor(s) 290 may comprise the processor circuitries described herein, for example, node processor(s) 46, IAB node processor(s) 54, and node processor(s) 66.

[0091] An memory or register described herein may be depicted by memory 294, or any computer-readable medium, may be one or more of readily available memory such as random access memory (RAM), read only memory (ROM), floppy disk, hard disk, flash memory or any other form of digital storage, local or remote, and is preferably of non-volatile nature, as and such may comprise memory. The support circuits 299 are coupled to the processors 290 for supporting the processor in a conventional manner. These circuits include cache, power supplies, clock circuits, input/output circuitry and

subsystems, and the like.

[0092] Although the processes and methods of the disclosed embodiments may be discussed as being implemented as a software routine, some of the method steps that are disclosed therein may be performed in hardware as well as by a processor running software. As such, the embodiments may be implemented in software as executed upon a computer system, in hardware as an application specific integrated circuit or other type of hardware implementation, or a combination of software and hardware. The software routines of the disclosed embodiments are capable of being executed on any computer operating system and is capable of being performed using any CPU architecture.

[0093] The functions of the various elements including functional blocks, including but not limited to those labeled or described as "computer", "processor" or "controller", may be provided through the use of hardware such as circuit hardware and/or hardware capable of executing software in the form of coded instructions stored on computer readable medium. Thus, such functions and illustrated functional blocks are to be understood as being either hardware-implemented and/or computer-implemented, and thus machine-implemented.

[0094] In terms of hardware implementation, the functional blocks may include or encompass, without limitation, digital signal processor (DSP) hardware, reduced instruction set processor, hardware (e.g., digital or analog) circuitry including but not limited to application specific integrated circuit(s) [ASIC], and/or field programmable gate array(s) (FPGA(s)), and (where appropriate) state machines capable of performing such functions.

[0095] In terms of computer implementation, a computer is generally understood to comprise one or more processors or one or more controllers, and the terms computer and processor and controller may be employed interchangeably herein. When provided by a computer or processor or controller, the functions may be provided by a single dedicated computer or processor or controller, by a single shared computer or processor or controller, or by a plurality of individual computers or processors or controllers, some of which may be shared or distributed. Moreover, use of the term "processor" or "controller" may also be construed to refer to other hardware capable of performing such functions and/or executing software, such as the example hardware recited above.

[0096] Nodes that communicate using the air interface also have suitable radio communications circuitry. Moreover, the technology disclosed herein may additionally be considered to be embodied entirely within any form of computer-readable memory, such as solid-state memory, magnetic disk, or optical disk containing an appropriate set of computer instructions that would cause a processor to carry out the techniques

described herein.

[0097] Moreover, each functional block or various features of the wireless terminal 30 and radio access network 24 used in each of the aforementioned embodiments may be implemented or executed by circuitry, which is typically an integrated circuit or a plurality of integrated circuits. The circuitry designed to execute the functions described in the present specification may comprise a general-purpose processor, a digital signal processor (DSP), an application specific or general application integrated circuit (ASIC), a field programmable gate array (FPGA), or other programmable logic devices, discrete gates or transistor logic, or a discrete hardware component, or a combination thereof. The general-purpose processor may be a microprocessor, or alternatively, the processor may be a conventional processor, a controller, a microcontroller or a state machine. The general-purpose processor or each circuit described above may be configured by a digital circuit or may be configured by an analogue circuit. Further, when a technology of making into an integrated circuit superseding integrated circuits at the present time appears due to advancement of a semiconductor technology, the integrated circuit by this technology is also able to be used.

[0098] It will be appreciated that the technology disclosed herein is directed to solving radio communications-centric issues and is necessarily rooted in computer technology and overcomes problems specifically arising in radio communications. Moreover, the technology disclosed herein improves basic function of an IAB network, e.g., methods and procedures to deal with problematic conditions associated with resource configuration and resource switching, for example.

[0099] The technology disclosed herein encompasses one or more of the following non-limiting, non-exclusive example embodiments and modes:

Example Embodiment 1: A donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitter circuitry configured to transmit the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0100] Example Embodiment 2: The node of Example Embodiment 1: wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[0101] Example Embodiment 3: The node of Example Embodiment 1, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how

radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[0102] Example Embodiment 4: A method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method node comprising: using processor circuitry to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitting the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0103] Example Embodiment 5: The method of Example Embodiment 4, wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[0104] Example Embodiment 6: The method of Example Embodiment 4, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[0105] Example Embodiment 7: An Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; processor circuitry arranged to configure radio resources of the IAB node according to the indication.

[0106] Example Embodiment 8: The node of Example Embodiment 7, wherein the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[0107] Example Embodiment 9: The node of Example Embodiment 7, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[0108] Example Embodiment 10: A method in an Integrated Access and Backhaul (IAB)

node which communicates with a donor IAB nodes in an Integrated Access and Backhaul (IAB) network, the method node comprising: receiving an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; using processor circuitry to configure radio resources of the IAB node according to the indication.

[0109] Example Embodiment 11: The method of Example Embodiment 10, further comprising using the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[0110] Example Embodiment 12: The method of Example Embodiment 10, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[0111] Example Embodiment 13: A donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to make or receive a determination of a network condition and, in response to the condition, generate an IAB resource utilization override signal, the IAB resource utilization override signal being configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); transmitter circuitry configured to transmitthe IAB resource utilization override signal to the IAB node.

[0112] Example Embodiment 14: A method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: using processor circuitry to generate an IAB resource utilization override signal, the IAB resource utilization override signal being configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); transmitting the IAB resource utilization override signal to the IAB node.

[0113] Example Embodiment 15: The method of Example Embodiment 14, further comprising making or receiving a determination of a network condition and, in response to the condition, generating the IAB resource utilization override signal.

[0114] Example Embodiment 16: An Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource utilization override signal from the donor IAB node, a Mobile-Termination (MT) unit; a Distributed Unit (DU); processor circuitry configured to: determine from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); govern the Mobile-Termination (MT) 50 so that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0115] Example Embodiment 17: A method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: receiving an IAB resource utilization override signal from the donor IAB node, determining from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); governing the Mobile-Termination (MT) so that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0116] Example Embodiment 18: A donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource; transmitter circuitry configured to transmit the IAB resource configuration switch signal to the IAB node.

[0117] Example Embodiment 19: The node of Example Embodiment 18, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0118] Example Embodiment 20: The node of Example Embodiment 18, wherein the utilization attribute comprises entity type which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0119] Example Embodiment 21: The node of Example Embodiment 18, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a prede-

termined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0120] Example Embodiment 22: The node of Example Embodiment 18, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0121] Example Embodiment 23: The node of Example Embodiment 22, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0122] Example Embodiment 24: The node of Example Embodiment 22, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0123] Example Embodiment 25: The node of Example Embodiment 24, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0124] Example Embodiment 26: The node of Example Embodiment 25, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0125] Example Embodiment 27: The node of Example Embodiment 25, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0126] Example Embodiment 27: The node of Example Embodiment 18, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0127] Example Embodiment 29: The node of Example Embodiment 28, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the

radio resource.

[0128] Example Embodiment 30: A method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: using processor circuitry to generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource; transmitting the IAB resource configuration switch signal to the IAB node.

[0129] Example Embodiment 31: The method of Example Embodiment 30, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0130] Example Embodiment 32: The method of Example Embodiment 30, wherein the utilization attribute comprises entity type which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0131] Example Embodiment 33: The method of Example Embodiment 30, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0132] Example Embodiment 34: The method of Example Embodiment 30, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0133] Example Embodiment 35: The method of Example Embodiment 34, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0134] Example Embodiment 36: The method of Example Embodiment 34, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0135] Example Embodiment 37: The method of Example Embodiment 36, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0136] Example Embodiment 38: The method of Example Embodiment 37, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0137] Example Embodiment 39: The method of Example Embodiment 37, wherein when

the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0138] Example Embodiment 40: The method of Example Embodiment 30, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0139] Example Embodiment 41: The method of Example Embodiment 40, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0140] Example Embodiment 42: An Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource configuration switch signal from the donor IAB node, processor circuitry configured to use the IAB resource configuration switch signal to change a utilization attribute of a radio resource configured for the IAB node.

[0141] Example Embodiment 43: The node of Example Embodiment 42, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0142] Example Embodiment 44: The node of Example Embodiment 42, wherein the utilization attribute comprises entity type of the IAD node which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0143] Example Embodiment 45: The node of Example Embodiment 42, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0144] Example Embodiment 46: The node of Example Embodiment 42, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0145] Example Embodiment 47: The node of Example Embodiment 46, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0146] Example Embodiment 48: The node of Example Embodiment 46, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0147] Example Embodiment 49: The node of Example Embodiment 42, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0148] Example Embodiment 50: The node of Example Embodiment 49, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0149] Example Embodiment 51: The node of Example Embodiment 49, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0150] Example Embodiment 52: The node of Example Embodiment 42, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0151] Example Embodiment 53: The node of Example Embodiment 52, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0152] Example Embodiment 54: A method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: receiving an IAB resource configuration switch signal from the donor IAB node, processor circuitry using the IAB resource configuration switch signal to change a utilization attribute of a radio resource

configured for the IAB node.

[0153] Example Embodiment 55: The method of Example Embodiment 54, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0154] Example Embodiment 56: The method of Example Embodiment 54, wherein the utilization attribute comprises entity type of the IAD node which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0155] Example Embodiment 57: The method of Example Embodiment 54, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0156] Example Embodiment 58: The method of Example Embodiment 54, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0157] Example Embodiment 59: The method of Example Embodiment 58, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0158] Example Embodiment 60: The method of Example Embodiment 58, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0159] Example Embodiment 61: The method of Example Embodiment 60, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0160] Example Embodiment 62: The method of Example Embodiment 61, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0161] Example Embodiment 63: The method of Example Embodiment 61, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0162] Example Embodiment 64: The method of Example Embodiment 54, wherein the processor circuitry is configured to generate a second IAB resource configuration

switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0163] Example Embodiment 65: The method of Example Embodiment 64, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0164] Although the description above contains many specificities, these should not be construed as limiting the scope of the technology disclosed herein but as merely providing illustrations of some of the presently preferred embodiments of the technology disclosed herein. Thus the scope of the technology disclosed herein should be determined by the appended claims and their legal equivalents. Therefore, it will be appreciated that the scope of the technology disclosed herein fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the technology disclosed herein is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." The above-described embodiments could be combined with one another. All structural, chemical, and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the technology disclosed herein, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims.

[0165] <Summary>

In one example, a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitter circuitry configured to transmit the IAB resource configuration scheme

indicator over a radio interface to the IAB node.

[0166] In one example, the node, wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[0167] In one example, the node, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[0168] In one example, a method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method node comprising: using processor circuitry to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network; transmitting the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[0169] In one example, the method, wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[0170] In one example, the method, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[0171] In one example, an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; processor circuitry arranged to configure radio resources of the IAB node according to the indication.

[0172] In one example, the node, wherein the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[0173] In one example, the node, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured

with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[0174] In one example, a method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB nodes in an Integrated Access and Backhaul (IAB) network, the method node comprising: receiving an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node; using processor circuitry to configure radio resources of the IAB node according to the indication.

[0175] In one example, the method, further comprising using the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[0176] In one example, the method, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[0177] In one example, a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to make or receive a determination of a network condition and, in response to the condition, generate an IAB resource utilization override signal, the IAB resource utilization override signal being configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); transmitter circuitry configured to transmit the IAB resource utilization override signal to the IAB node.

[0178] In one example, a method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: using processor circuitry to generate an IAB resource utilization override signal, the IAB resource utilization override signal being configured to preclude a Mobile-Termination (MT) of the IAB node from using a class of IAB radio resources in a situation in which a Distributed Unit (DU) of the IAB node is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); transmitting the

IAB resource utilization override signal to the IAB node.

[0179] In one example, the method, further comprising making or receiving a determination of a network condition and, in response to the condition, generating the IAB resource utilization override signal.

[0180] In one example, an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource utilization override signal from the donor IAB node, a Mobile-Termination (MT) unit; a Distributed Unit (DU); processor circuitry configured to: determine from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); govern the Mobile-Termination (MT) 50 so that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0181] In one example, a method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: receiving an IAB resource utilization override signal from the donor IAB node, determining from the IAB resource utilization override signal that the Mobile-Termination (MT) is precluded from using a class of IAB radio resources in a situation in which the Distributed Unit (DU) is configured for soft uplink or soft downlink, the class of IAB radio resources being radio resources indicated as unavailable to the Distributed Unit (DU); governing the Mobile-Termination (MT) so that the Mobile-Termination (MT) does not transmit on the class of IAB radio resources nor act on any transmission received on the class of radio resources.

[0182] In one example, a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising: processor circuitry configured to generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource; transmitter circuitry configured to transmit the IAB resource configuration switch signal to the IAB node.

[0183] In one example, the node, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0184] In one example, the node, wherein the utilization attribute comprises entity type which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0185] In one example, the node, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0186] In one example, the node, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0187] In one example, the node, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0188] In one example, the node, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0189] In one example, the node, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0190] In one example, the node, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0191] In one example, the node, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0192] In one example, the node, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0193] In one example, the node, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0194] In one example, a method in a donor Integrated Access and Backhaul (IAB) node

which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: using processor circuitry to generate an IAB resource configuration switch signal configured to change a utilization attribute of a radio resource configured for the IAB node without releasing the radio resource; transmitting the IAB resource configuration switch signal to the IAB node.

[0195] In one example, the method, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0196] In one example, the method, wherein the utilization attribute comprises entity type which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0197] In one example, the method, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0198] In one example, the method, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0199] In one example, the method, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0200] In one example, the method, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0201] In one example, the method, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0202] In one example, the method, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0203] In one example, the method, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0204] In one example, the method, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0205] In one example, the method, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0206] In one example, an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising: receiver circuitry configured to receive an IAB resource configuration switch signal from the donor IAB node, processor circuitry configured to use the IAB resource configuration switch signal to change a utilization attribute of a radio resource configured for the IAB node.

[0207] In one example, the node, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0208] In one example, the node, wherein the utilization attribute comprises entity type of the IAD node which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0209] In one example, the node, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0210] In one example, the node, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0211] In one example, the node, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the radio resource between plural states of the utilization attribute.

[0212] In one example, the node, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0213] In one example, the node, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0214] In one example, the node, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1

for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0215] In one example, the node, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0216] In one example, the node, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0217] In one example, the node, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0218] In one example, a method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the method comprising: receiving an IAB resource configuration switch signal from the donor IAB node, processor circuitry using the IAB resource configuration switch signal to change a utilization attribute of a radio resource configured for the IAB node

In one example, the method, wherein the utilization attribute comprises link direction for which the radio resource is utilized.

[0219] In one example, the method, wherein the utilization attribute comprises entity type of the IAD node which is to use the radio resource, the entity type being one of a distributed unit (DU) and a mobile termination (MT) unit.

[0220] In one example, the method, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the downlink control indicator (DCI) comprises a field dedicated to changing the utilization attribute.

[0221] In one example, the method, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0222] In one example, the method, wherein the IAB resource configuration switch signal comprises a same downlink control indicator (DCI) which is utilized to toggle the

radio resource between plural states of the utilization attribute.

[0223] In one example, the method, the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value.

[0224] In one example, the method, wherein the format of the downlink control indicator (DCI) is selected according to a state of the utilization attribute.

[0225] In one example, the method, wherein when the utilization attribute is link direction for which the radio resource is used, and wherein the state of the utilization attribute is one of a downlink state and an uplink state; the predetermined format is one of 0_0 and 0_1 for the uplink state; and the predetermined format is one of 1_0 and 1_1 for the downlink state.

[0226] In one example, the method, wherein when the utilization attribute is entity type which is to use the radio resource, and wherein the state of the entity type is one mobile termination (MT) unit and distributed unit (DU).

[0227] In one example, the method, wherein the processor circuitry is configured to generate a second IAB resource configuration switch signal configured to change a second utilization attribute of a radio resource configured for the IAB node without releasing the radio resource.

[0228] In one example, the method, wherein the IAB resource configuration switch signal comprises a downlink control indicator (DCI) of a predetermined format and which specifies the radio resource and which has one or more fields set to a predetermined value, and wherein the IAB resource configuration switch signal comprises plural downlink control indicators (DCI) which specify the radio resource and which have one or more fields set to a predetermined value; wherein a first of the plural downlink control indicators (DCIs) is configured to change a first utilization attribute of the radio resource and a second of the plural downlink control indicators (DCIs) is configured to change a second utilization attribute of the radio resource.

[0229] <Cross Reference>

This Nonprovisional application claims priority under 35 U.S.C. § 119 on provisional Application No. 62/790,922 on January 10, 2019, the entire contents of which are hereby incorporated by reference.

Claims

[Claim 1] A donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the donor node comprising:
processor circuitry configured to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network;
transmitter circuitry configured to transmit the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[Claim 2] The node of claim 1, wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[Claim 3] The node of claim 1, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[Claim 4] A method in a donor Integrated Access and Backhaul (IAB) node which communicates with an IAB node in an Integrated Access and Backhaul (IAB) network, the method node comprising:
using processor circuitry to generate an IAB resource configuration scheme indicator for providing a coded description of how plural IAB radio resources are to be configured at the at least one other IAB node of the network;
transmitting the IAB resource configuration scheme indicator over a radio interface to the IAB node.

[Claim 5] The method of claim 4, wherein the processor circuitry is configured to generate the IAB resource configuration scheme indicator based on a selection from plural alternative IAB resource configuration schemes.

[Claim 6] The method of claim 4, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the at least one other IAB node and how radio

resources are to be configured with respect to a IAB node mobile termination (MT) unit of the at least one other IAB node.

[Claim 7] An Integrated Access and Backhaul (IAB) node which communicates with a donor IAB node in an Integrated Access and Backhaul (IAB) network, the node comprising:
receiver circuitry configured to receive an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node;
processor circuitry arranged to configure radio resources of the IAB node according to the indication.

[Claim 8] The node of claim 7, wherein the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[Claim 9] The node of claim 7, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[Claim 10] A method in an Integrated Access and Backhaul (IAB) node which communicates with a donor IAB nodes in an Integrated Access and Backhaul (IAB) network, the method node comprising:
receiving an IAB resource configuration scheme indicator which is configured to provide a coded description of how plural IAB radio resources are to be configured at the IAB node;
using processor circuitry to configure radio resources of the IAB node according to the indication.

[Claim 11] The method of claim 10, further comprising using the processor circuitry is configured to interpret the IAB resource configuration scheme indicator in accordance with plural alternative IAB resource configuration schemes configured at the IAB node.

[Claim 12] The method of claim 10, wherein the one or more schemes are characterized by factors including an IAB node entity factor whereby the IAB resource configuration scheme indicator provides an indication of how radio resources are to be configured with respect to a IAB node distributed unit (DU) of the IAB node and how radio resources are to

be configured with respect to a IAB node mobile termination (MT) unit of the IAB node.

[Fig. 1]

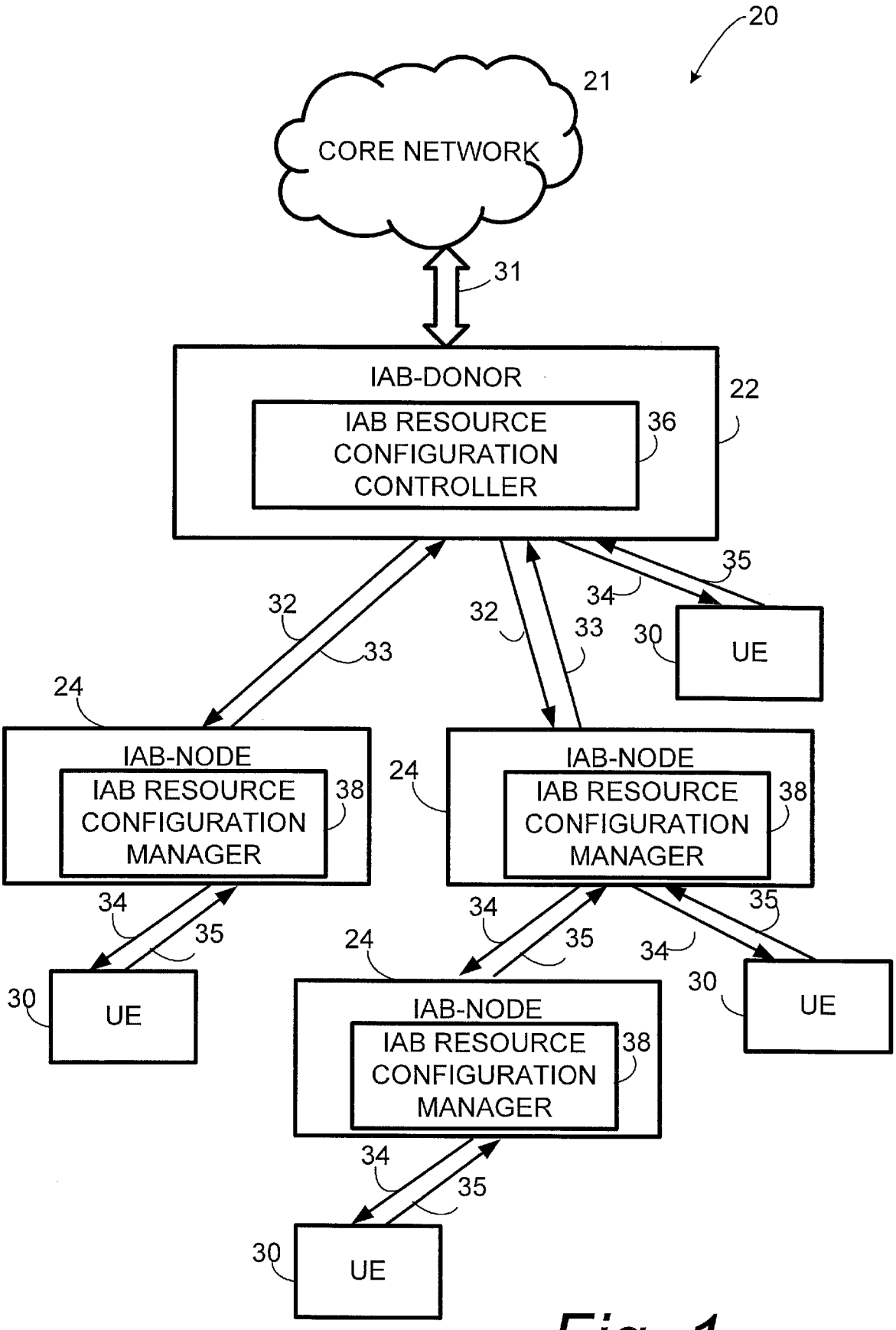

20
21
CORE NETWORK
31
IAB-DONOR
22
IAB RESOURCE CONFIGURATION CONTROLLER
36
32
33
34
35
30
UE
24
IAB-NODE
IAB RESOURCE CONFIGURATION MANAGER
38

Fig. 1

[Fig. 2]

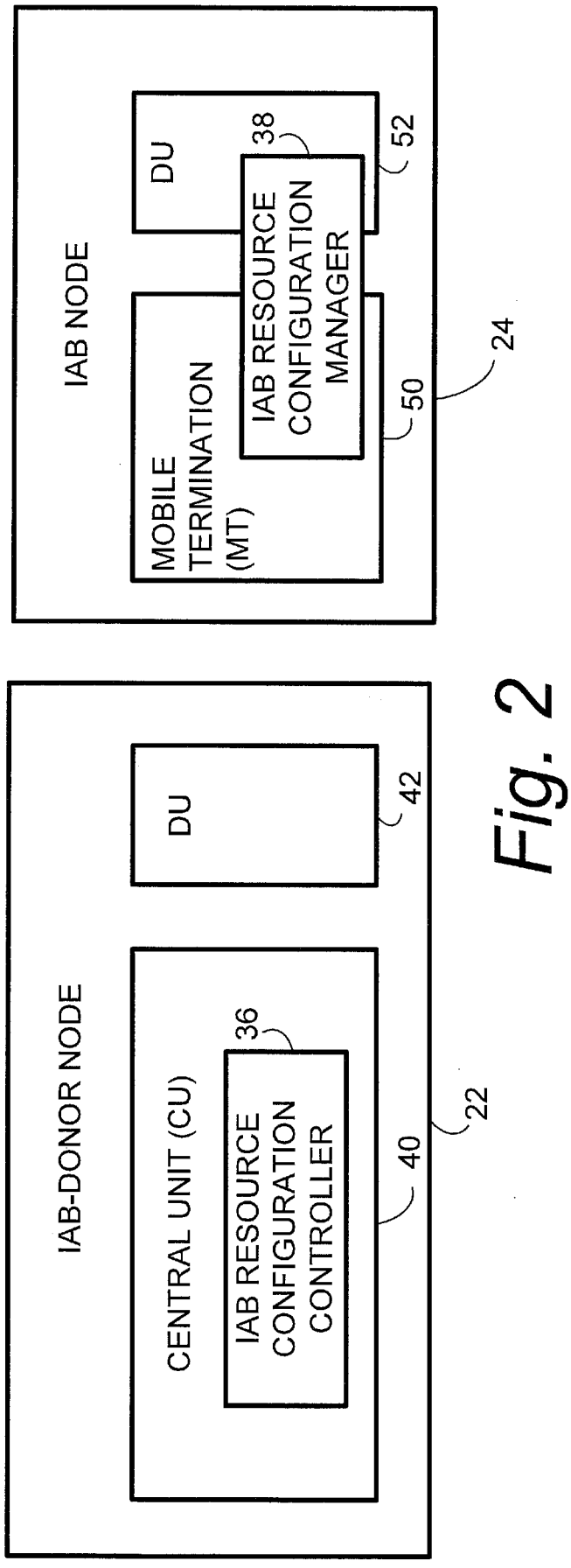

IAB-DONOR NODE
CENTRAL UNIT (CU)
IAB RESOURCE CONFIGURATION CONTROLLER
36
40
22
DU
42
IAB NODE
MOBILE TERMINATION (MT)
IAB RESOURCE CONFIGURATION MANAGER
38
50
DU
52
24

Fig. 2

[Fig. 3]

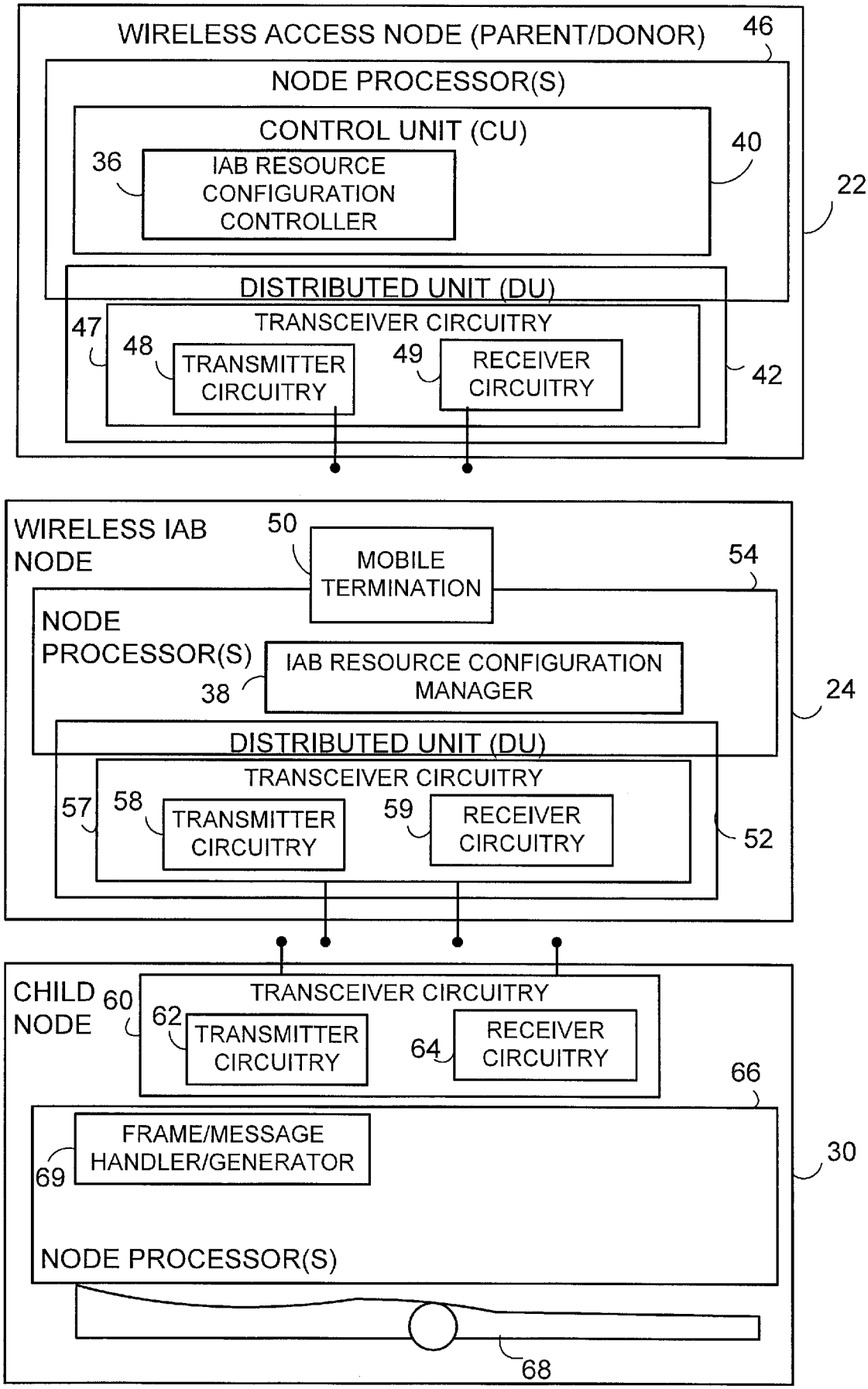
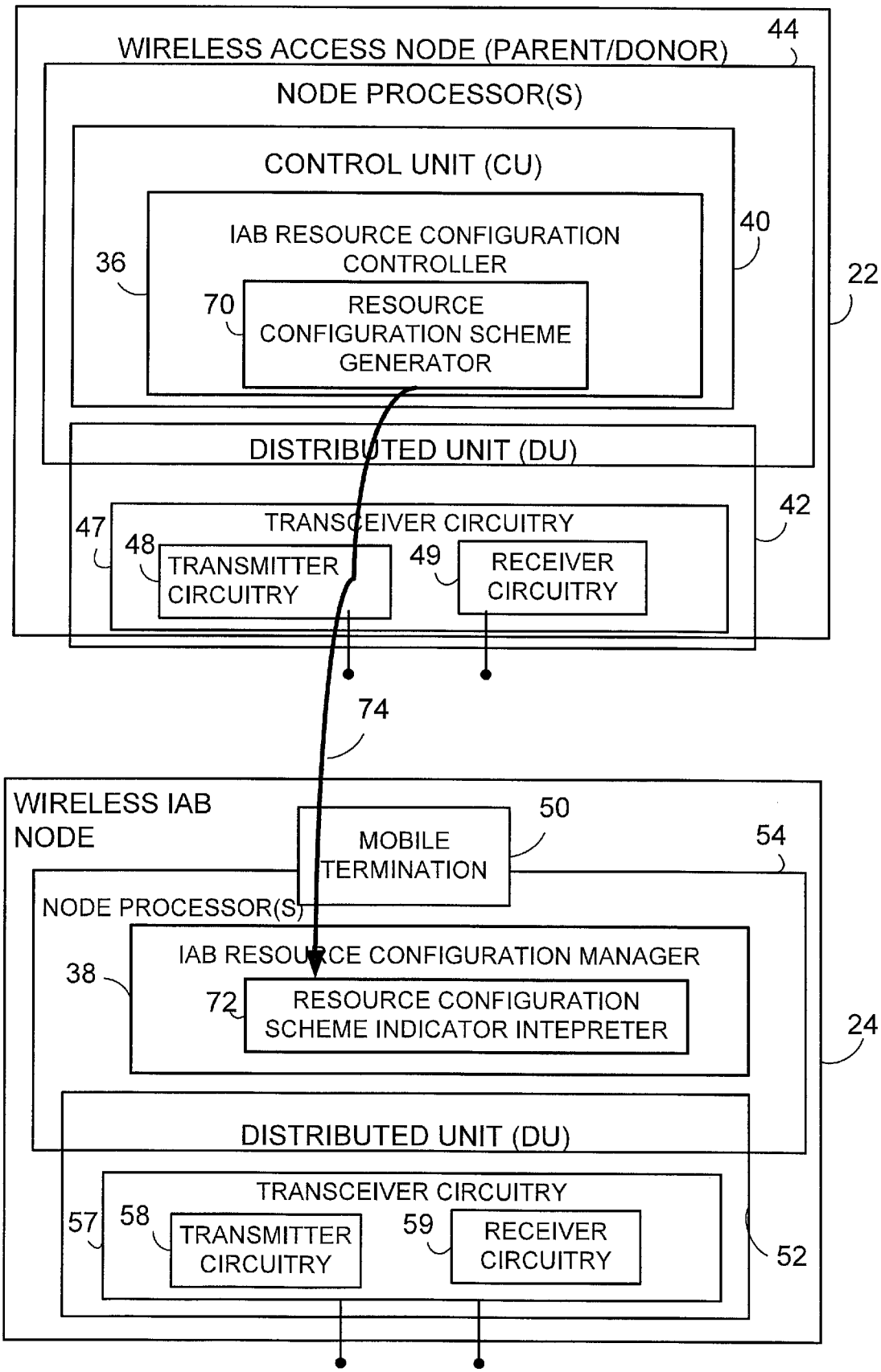

WIRELESS ACCESS NODE (PARENT/DONOR)
46
NODE PROCESSOR(S)
CONTROL UNIT (CU)
40
36
IAB RESOURCE CONFIGURATION CONTROLLER
22
DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
47
48
TRANSMITTER CIRCUITRY
49
RECEIVER CIRCUITRY
42
WIRELESS IAB NODE
50
MOBILE TERMINATION
54
NODE PROCESSOR(S)
38
IAB RESOURCE CONFIGURATION MANAGER
24
DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
57
58
TRANSMITTER CIRCUITRY
59
RECEIVER CIRCUITRY
52
CHILD NODE
60
TRANSCEIVER CIRCUITRY
62
TRANSMITTER CIRCUITRY
64
RECEIVER CIRCUITRY
66
FRAME/MESSAGE HANDLER/GENERATOR
69
30
NODE PROCESSOR(S)
68

Fig. 3

[Fig. 4]


WIRELESS ACCESS NODE (PARENT/DONOR)
44
NODE PROCESSOR(S)
CONTROL UNIT (CU)
IAB RESOURCE CONFIGURATION CONTROLLER
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36
70
RESOURCE CONFIGURATION SCHEME GENERATOR
22
DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
42
47
48
TRANSMITTER CIRCUITRY
49
RECEIVER CIRCUITRY
74
WIRELESS IAB NODE
50
MOBILE TERMINATION
54
NODE PROCESSOR(S)
IAB RESOURCE CONFIGURATION MANAGER
38
72
RESOURCE CONFIGURATION SCHEME INDICATOR INTEPRETER
24
DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
57
58
TRANSMITTER CIRCUITRY
59
RECEIVER CIRCUITRY
52

Fig. 4

[Fig. 5A]

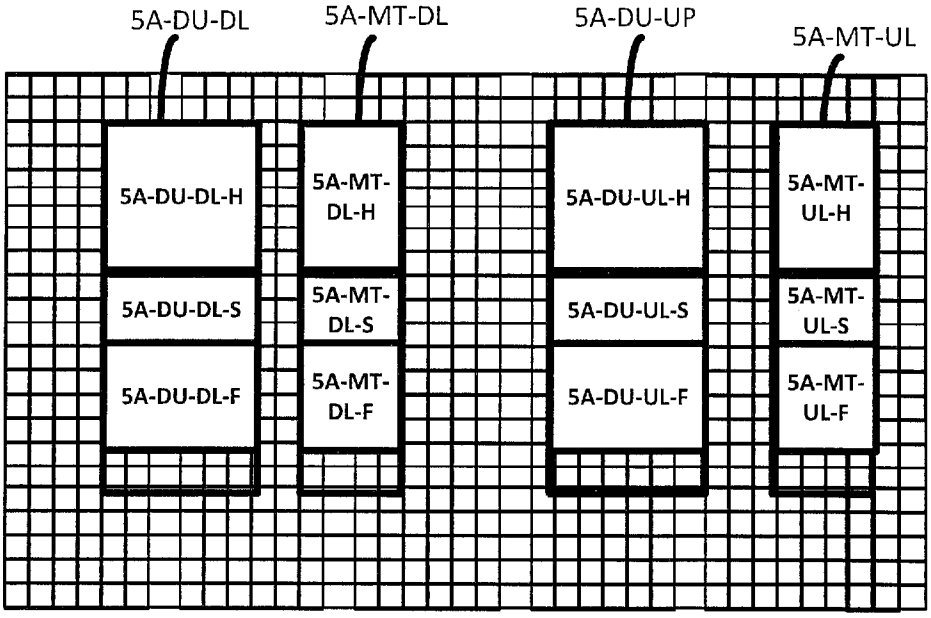


Fig. 5A

[Fig. 5B]

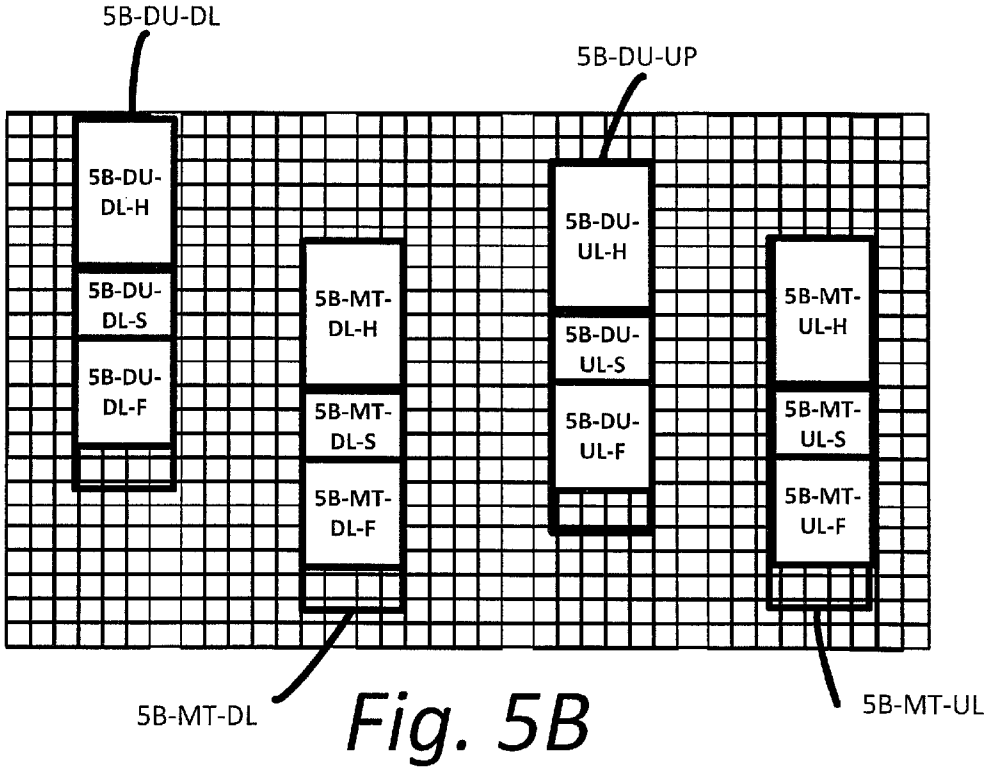


Fig. 5B

[Fig. 6]

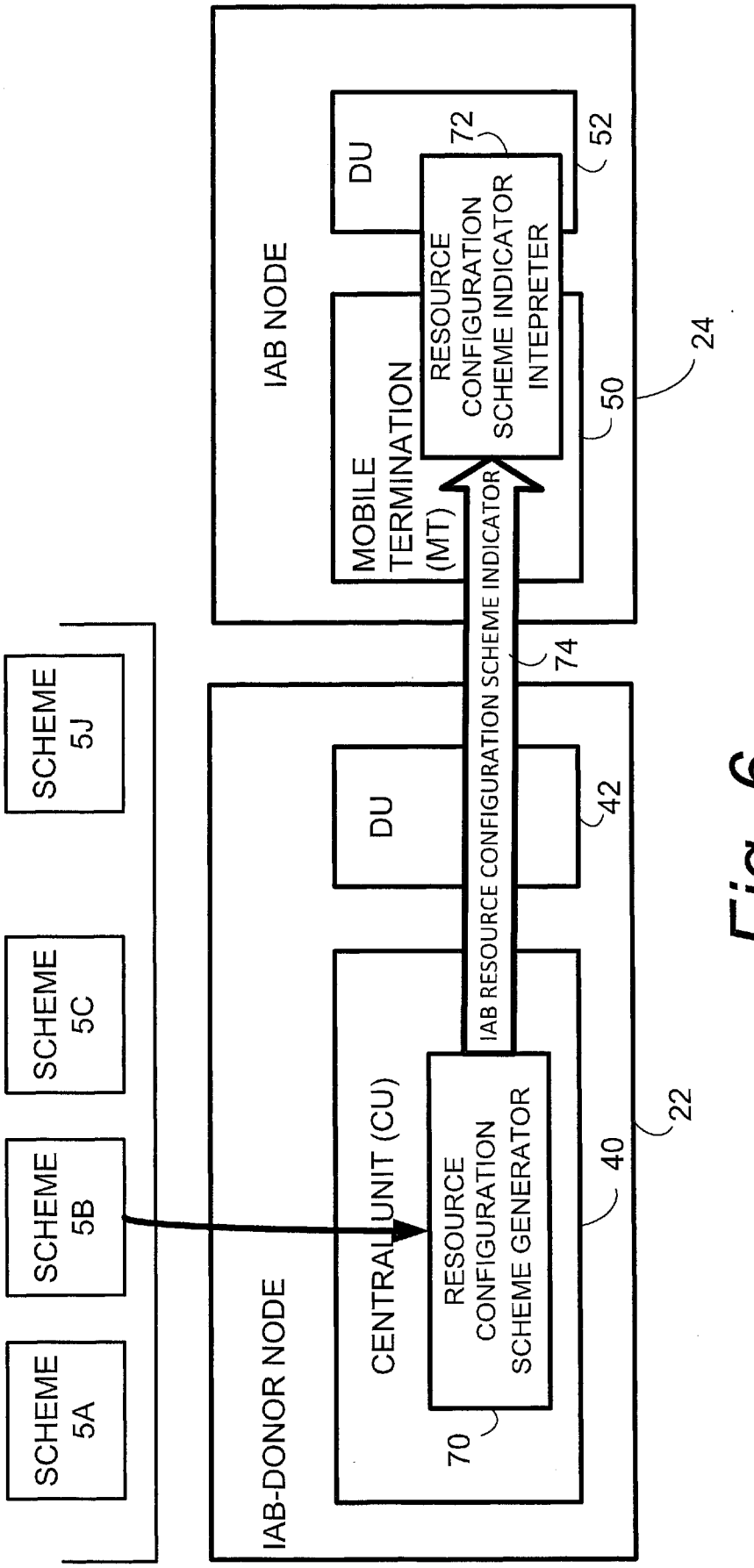

SCHEME 5A
SCHEME 5B
SCHEME 5C
SCHEME 5J
IAB-DONOR NODE
CENTRAL UNIT (CU)
RESOURCE CONFIGURATION SCHEME GENERATOR
70
40
22
DU
42
IAB RESOURCE CONFIGURATION SCHEME INDICATOR
74
IAB NODE
MOBILE TERMINATION (MT)
RESOURCE CONFIGURATION SCHEME INDICATOR INTEPRETER
72
50
DU
52
24

Fig. 6

[Fig. 7]

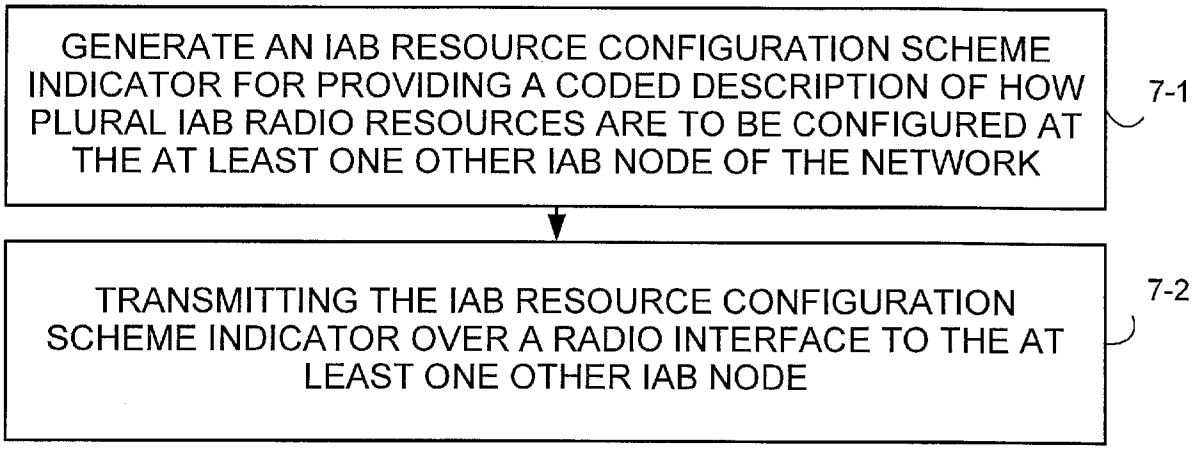


Fig. 7

[Fig. 8]

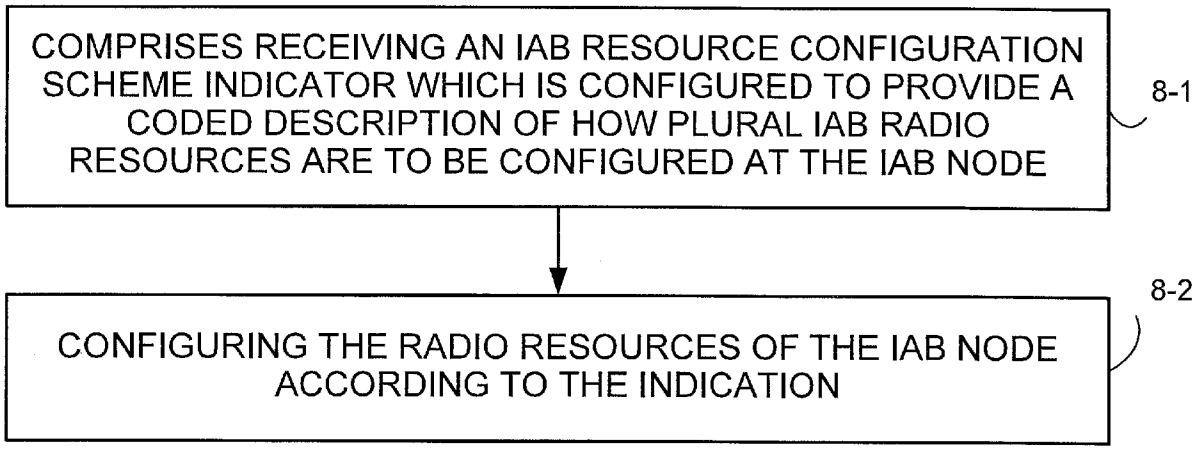
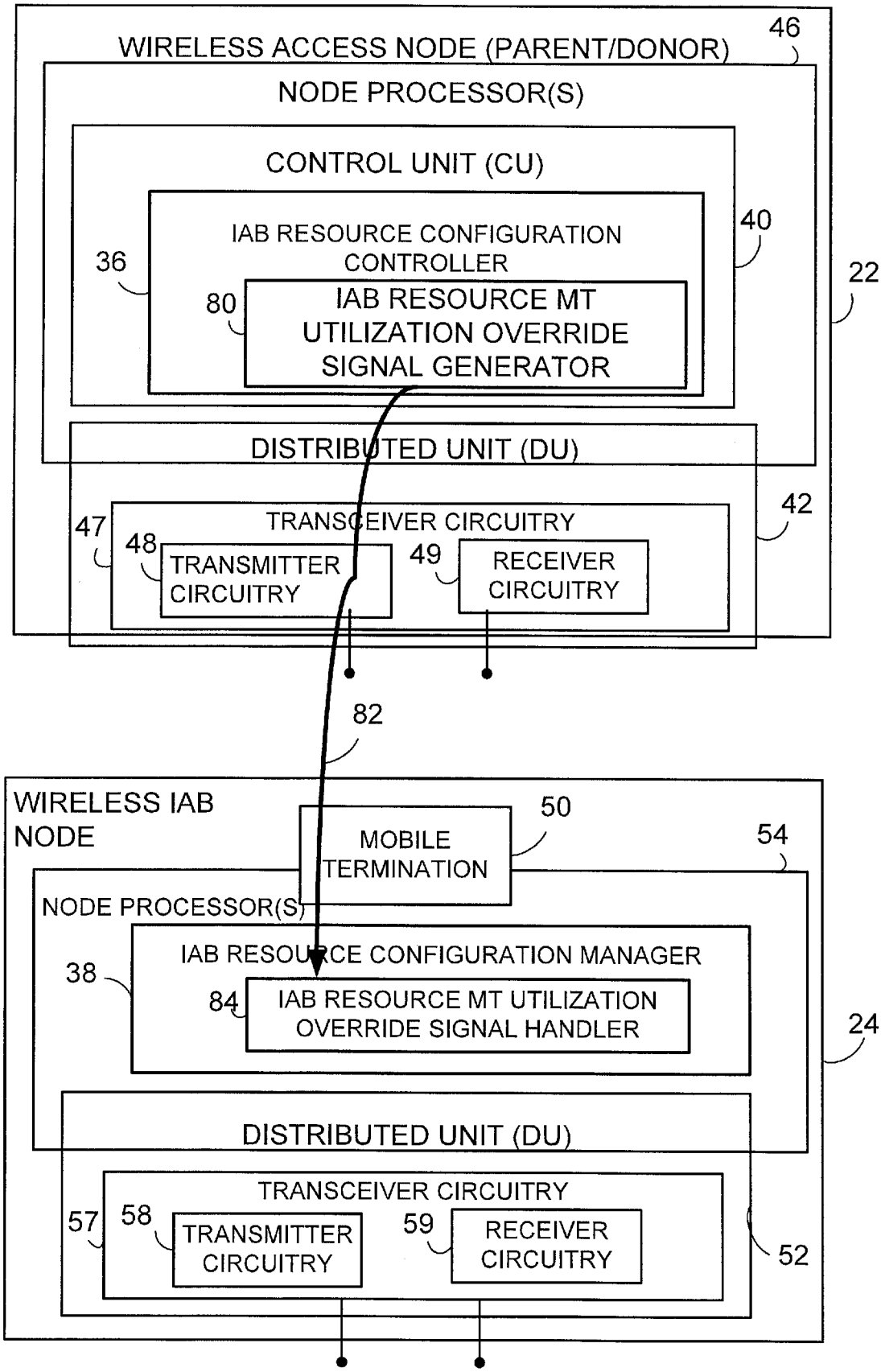


Fig. 8

[Fig. 9]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NODE PROCESSOR(S)
CONTROL UNIT (CU)
IAB RESOURCE CONFIGURATION CONTROLLER
36
40
80
IAB RESOURCE MT UTILIZATION OVERRIDE SIGNAL GENERATOR
22
DISTRIBUTED UNIT (DU)
42
TRANSCEIVER CIRCUITRY
47
48
TRANSMITTER CIRCUITRY
49
RECEIVER CIRCUITRY
82
WIRELESS IAB NODE
50
MOBILE TERMINATION
54
NODE PROCESSOR(S)
IAB RESOURCE CONFIGURATION MANAGER
38
84
IAB RESOURCE MT UTILIZATION OVERRIDE SIGNAL HANDLER
24
DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
57
58
TRANSMITTER CIRCUITRY
59
RECEIVER CIRCUITRY
52

Fig. 9

[Fig. 10]

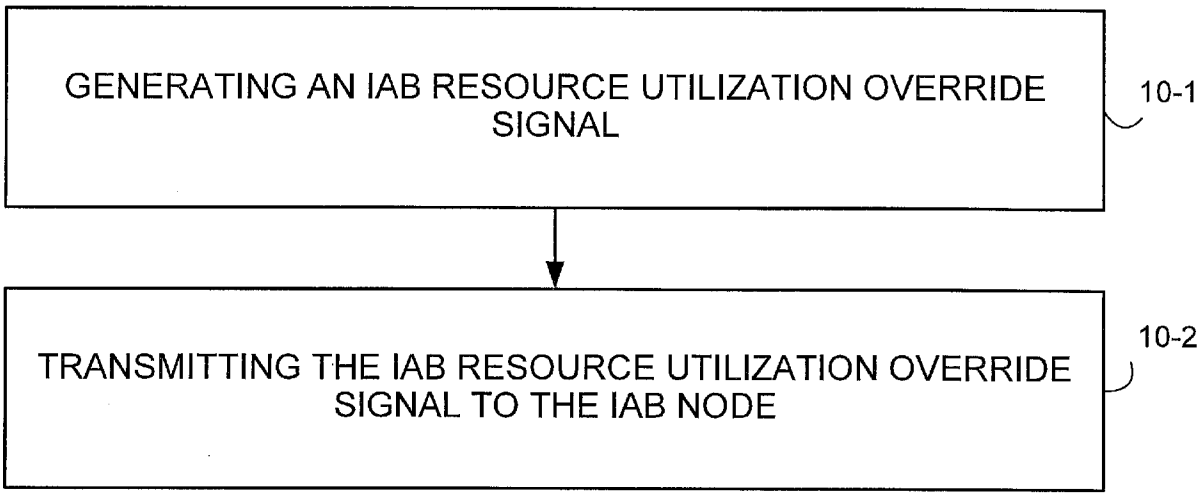


Fig. 10

[Fig. 11]

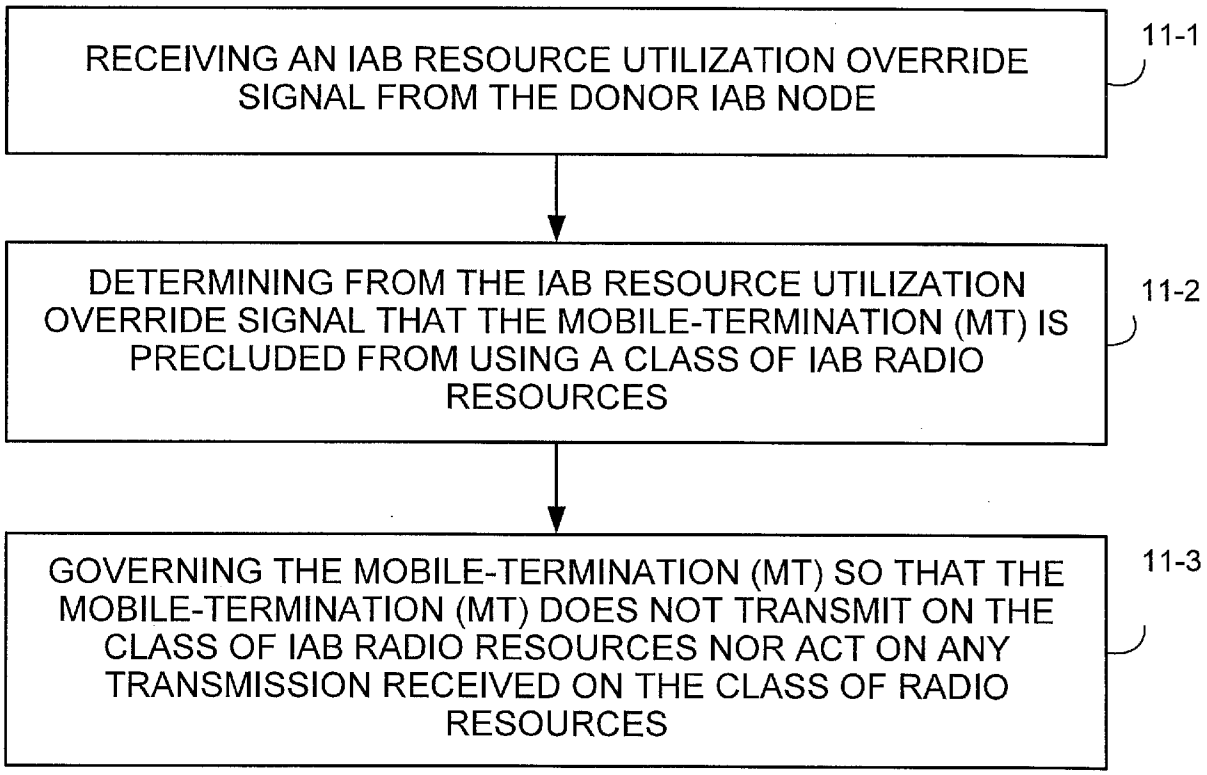
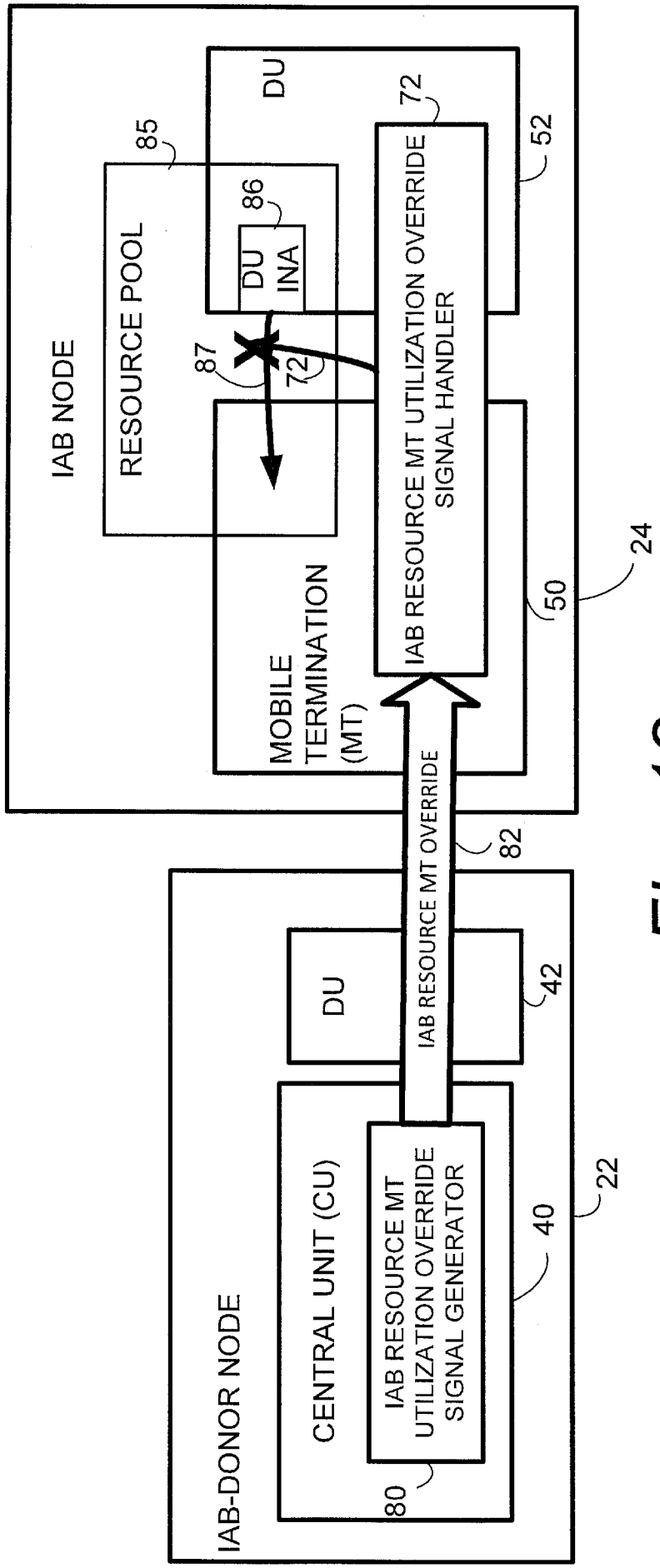


Fig. 11

[Fig. 12]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CENTRAL UNIT (CU)
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DU
42
IAB RESOURCE MT OVERRIDE
82
IAB NODE
RESOURCE POOL
85
DU
86
DU INA
87
72
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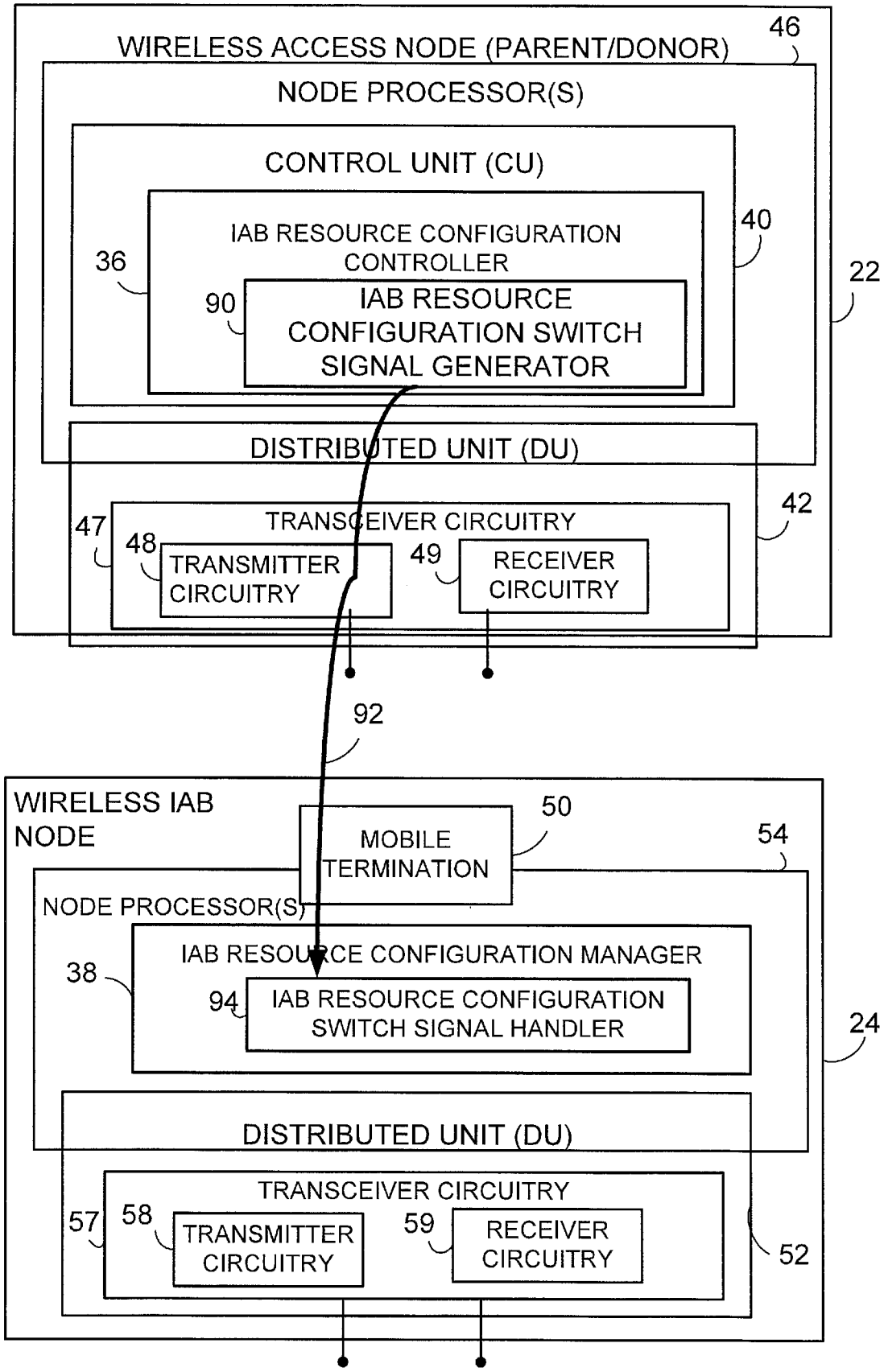
IAB RESOURCE MT UTILIZATION OVERRIDE SIGNAL HANDLER
52
MOBILE TERMINATION (MT)
50
24

Fig. 12

[Fig. 13]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NODE PROCESSOR(S)
CONTROL UNIT (CU)
IAB RESOURCE CONFIGURATION CONTROLLER
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IAB RESOURCE CONFIGURATION SWITCH SIGNAL GENERATOR
22
DISTRIBUTED UNIT (DU)
42
47
TRANSCEIVER CIRCUITRY
48
TRANSMITTER CIRCUITRY
49
RECEIVER CIRCUITRY
92
WIRELESS IAB NODE
50
MOBILE TERMINATION
54
NODE PROCESSOR(S)
IAB RESOURCE CONFIGURATION MANAGER
38
94
IAB RESOURCE CONFIGURATION SWITCH SIGNAL HANDLER
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DISTRIBUTED UNIT (DU)
TRANSCEIVER CIRCUITRY
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TRANSMITTER CIRCUITRY
59
RECEIVER CIRCUITRY
52

Fig. 13

[Fig. 14A]

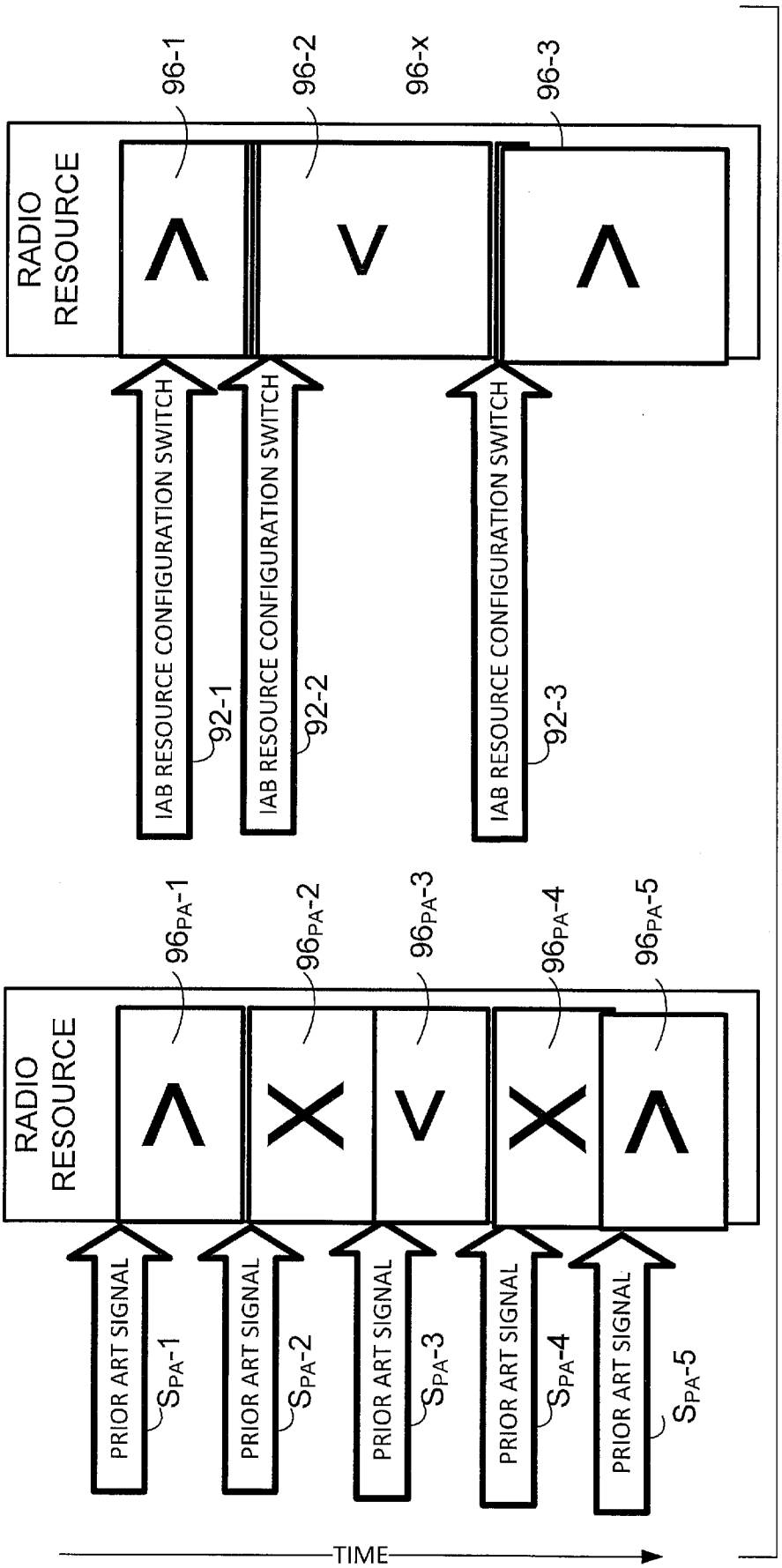


Fig. 14A

[Fig. 14B]

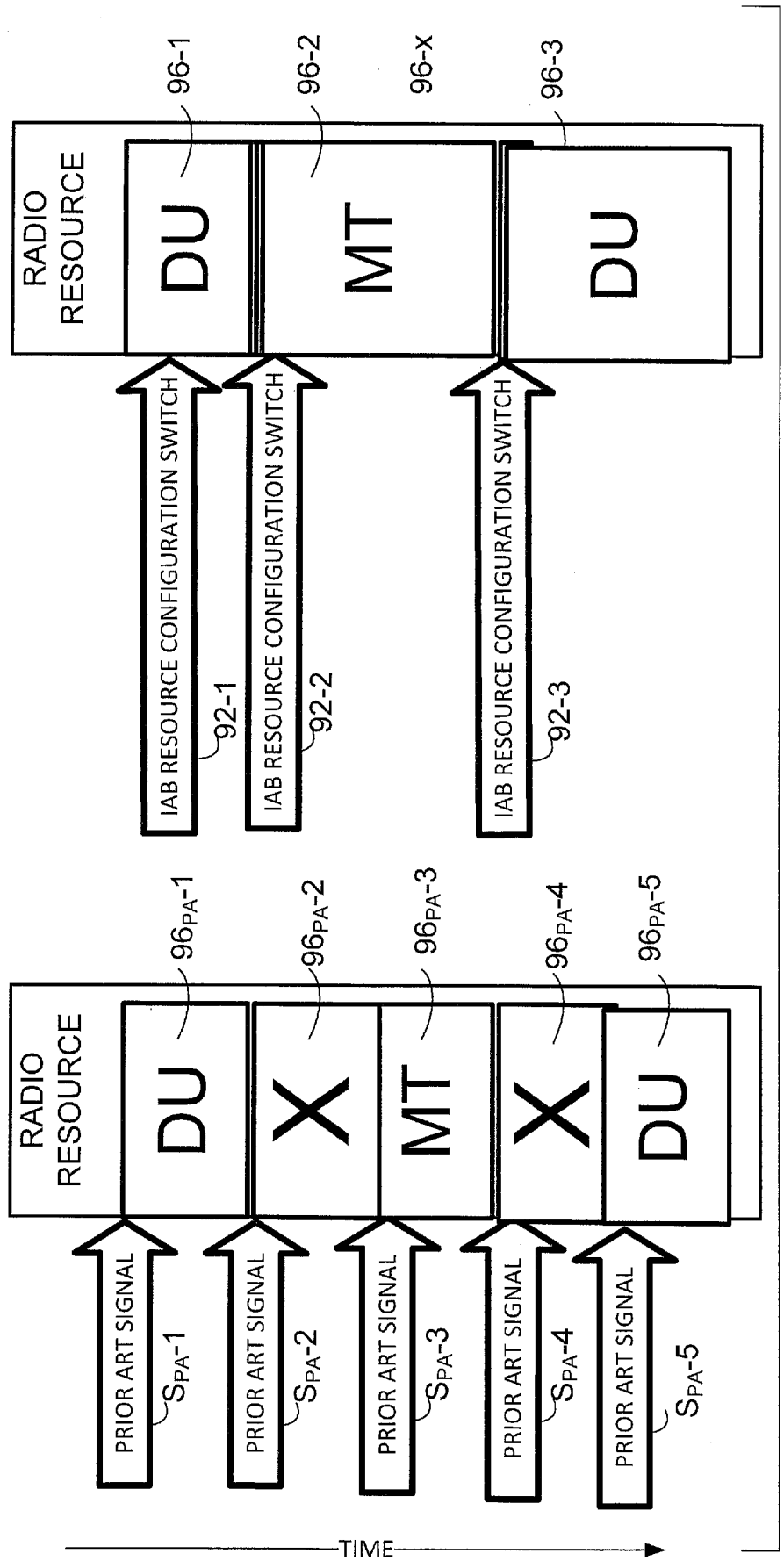


Fig. 14B

[Fig. 15]

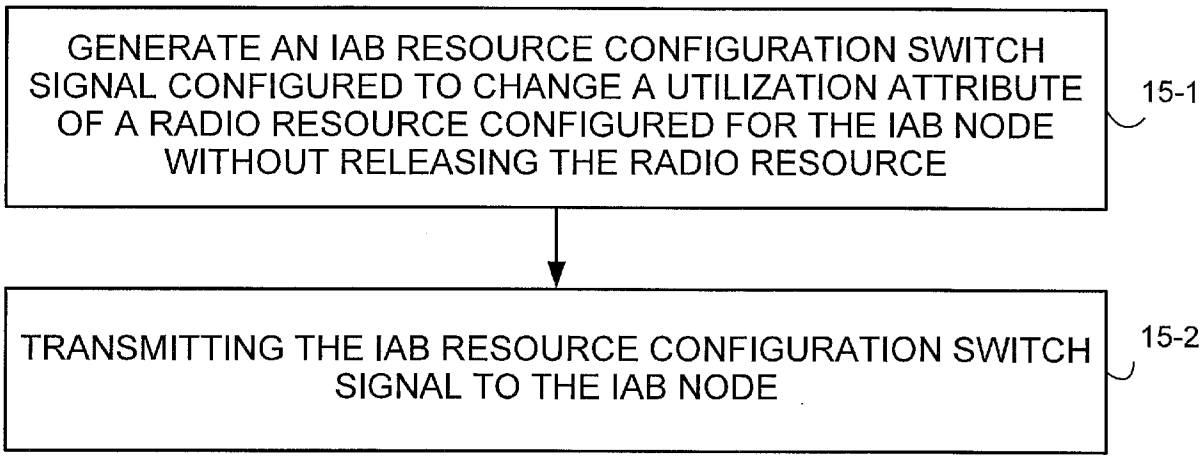


Fig. 15

[Fig. 16]

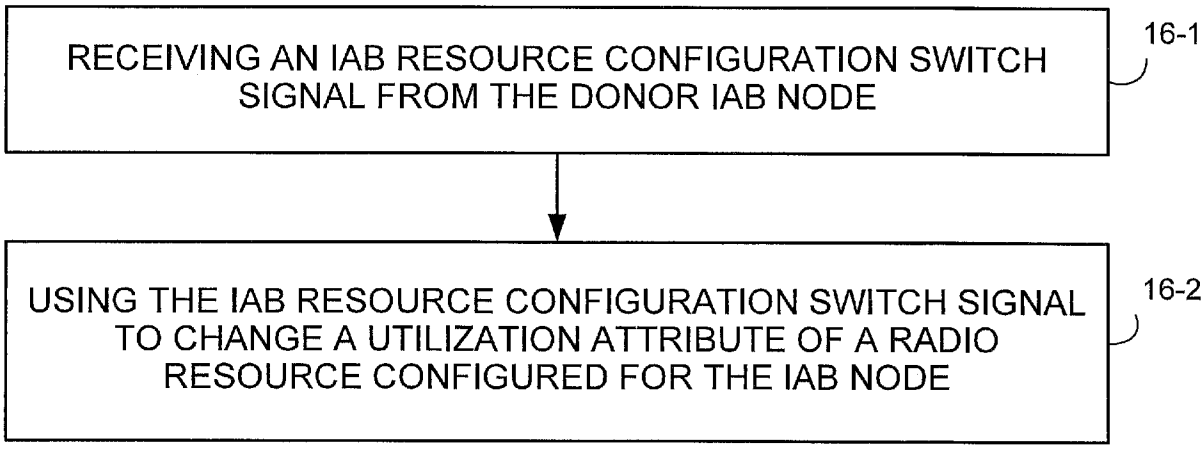


Fig. 16

[Fig. 17]

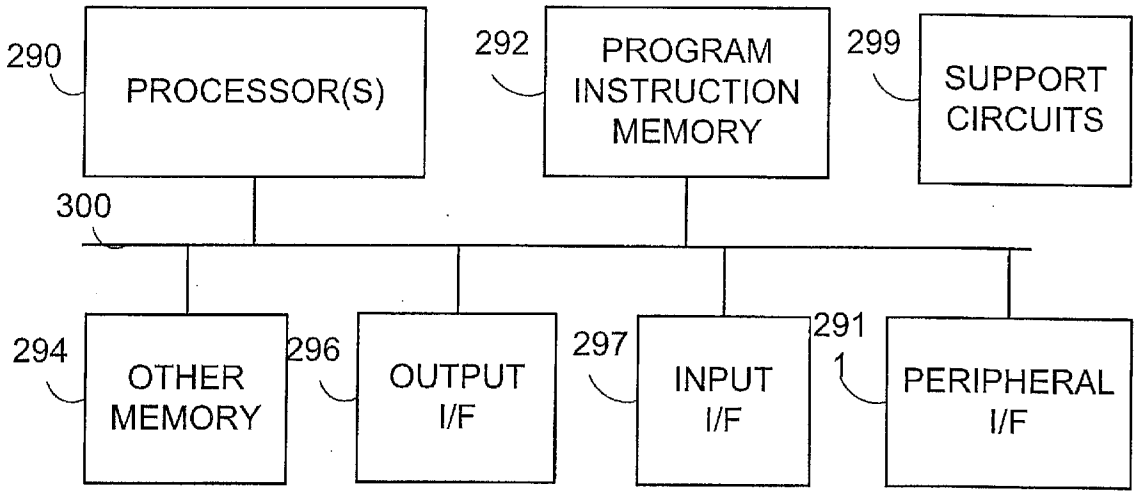
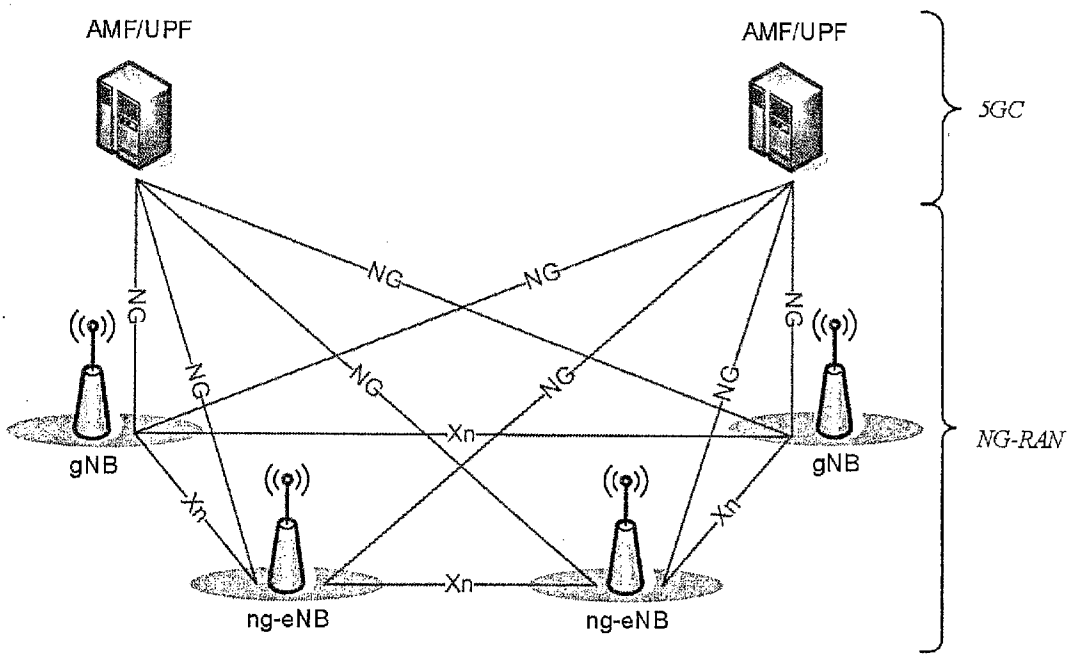


Fig. 17

[Fig. 18]



PRIOR ART

Fig. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/000507

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/00(2009.01)i; ***H04W 92/20***(2009.01)i
FI: H04W92/20 110; H04W72/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B7/24-7/26, H04W4/00-99/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2020
Registered utility model specifications of Japan 1996-2020
Published registered utility model applications of Japan 1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	vivo, Enhancements to support NR backhaul link[online], 3GPP TSG RAN WG1 #95 R1-1812305, 2018.11.03 section 2	1-12
A	AT & T, Summary of 7.2.3.1 Enhancements to support NR backhaul links[online], 3GPP TSG RAN WG1 #95 R1-1814127, 2018.11.19 section 3	1-12
A	Intel Corporation, PHY layer enhancements for NR IAB[online], 3GPP TSG RAN WG1 #95 R1-1812486, 2018.11.03 section 4	1-12
A	Huawei, HiSilicon, On resource coordination and dynamic scheduling in IAB[online], 3GPP TSG RAN WG1 #95 R1-1812201, 2018.11.03 section 2	1-12
P, X	Sharp, L1 signaling supports resource management for IAB![online], 3GPP TSG RAN WG1 adhoc_NR_AH_1901 R1-1900830, 2019.01.11 section 2	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 March 2020	**31 March 2020**
Name and mailing address of the ISA/JP **Japan Patent Office** **3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo** **100-8915, Japan**	Authorized officer **YOSHIMURA, Shinjiro 5J 5885** Telephone No. **+81-3-3581-1101 Ext. 3534**