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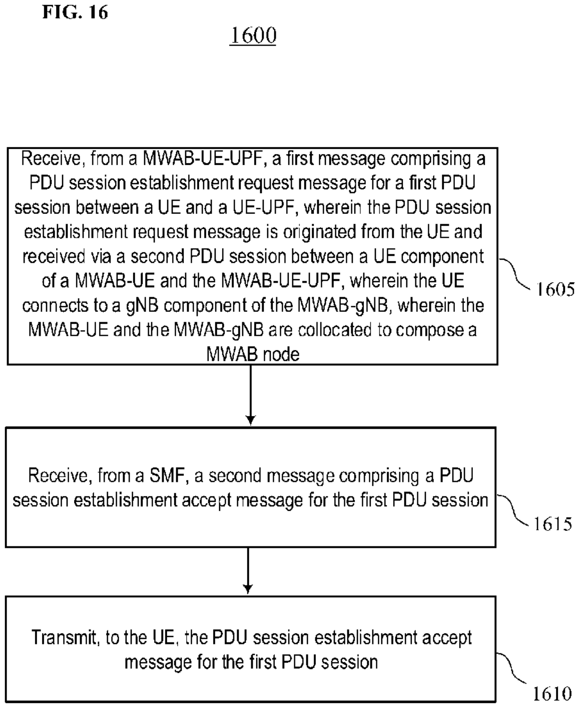
(54) **Title:** PDU SESSION ESTABLISHMENT

FIG. 16



(57) **Abstract:** Various aspects of the present disclosure relate to protocol data unit (PDU) session establishment. In an aspect, an AMF receives a first message comprising a PDU session establishment request message for a first PDU session between a UE and a UE-UPF from a MWAB-UE-UPF. The PDU session establishment request message is originated from the UE and received via a second PDU session between a MWAB-UE and the MWAB-UE-UPF. The UE connects to a MWAB-gNB. The MWAB-UE and the MWAB-gNB are collocated to compose a MWAB node. The AMF receives a second message comprising a PDU session establishme nt accept message for the first PDU session from a SMF. The AMF then transmits the PDU session establishment accept message for the first PDU session to the UE. In this way, the first PDU session establishment is performed between the UE and a UE-UPF.

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PDU SESSION ESTABLISHMENT

[0001] The present disclosure relates to wireless communications, and more specifically to protocol data unit (PDU) session establishment.

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may be otherwise known as an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Each network communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0003] In 3GPP Rel-18, service&system aspects2 (SA2) conducted a study followed by a work item on vehicle-mounted relays (VMR). During the study, it was agreed to limit the scope of the work to the integrated access and backhaul (IAB) architecture, whereby the IAB node consist of an IAB-mobile terminal (MT) and an IAB-distributed unit (DU), with the IAB-DU establishing an F1 interface with a donor centralized unit (CU) over a wireless link. However, there are other architecture options to achieve the functionality of VMR.

SUMMARY

[0004] The present disclosure relates to methods, apparatuses, and systems that support PDU session establishment, especially, PDU session establishment for a mobile gNB with wireless access backhauling (MWAB) node.

[0005] Some implementations of the method and devices described herein include, receiving, from a user plane function (UPF) for a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE-UPF), a first message comprising a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a UPF for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a mobile gNB with wireless access backhauling (MWAB-UE) and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; receiving, from a session management function (SMF), a second message comprising a PDU session establishment accept message for the first PDU session; and transmitting, to the UE, the PDU session establishment accept message for the first PDU session.

[0006] Some implementations of the method and apparatuses described herein may further include determining the MWAB-UE based on an Internet protocol (IP) address of the MWAB-gNB comprised in the first message; determining, based on the MWAB-UE, the SMF for the first PDU session, wherein the SMF for the first PDU session and the SMF for the second PDU session are a same SMF; and preserving a first mapping between the UE and the MWAB-UE.

[0007] Some implementations of the method and apparatuses described herein may further include transmitting, to the SMF, the PDU session establishment request message and an identity of the MWAB-UE.

[0008] Some implementations of the method and apparatuses described herein may further include receiving, from the SMF, a transfer message associated with the first PDU session, wherein the transfer message comprises an identity of the UE; determining, based on the identity of the UE and the first mapping, the MWAB-UE and the MWAB-gNB; determining a MWAB-UE-UPF based on the MWAB-gNB and a second mapping between the MWAB-gNB and the MWAB-UE-UPF; and transmitting, to the MWAB-UE-UPF, the PDU session establishment accept message via a N2 message towards MWAB-gNB.

[0009] Some implementations of the method and devices described herein include, receiving, from an access and mobility management function (AMF), an identity of a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a user plane function (UPF) for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; determining a UE-UPF for the first PDU session; and transmitting, to the UE-UPF, a N4 session establishment request message associated with the first PDU session.

[0010] Some implementations of the method and apparatuses described herein may further include transmitting, to the MWAB-UE, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a UPF for the MWAB-UE (MWAB-UE-UPF), wherein data of the first PDU session is exchanged via the second PDU session; and receiving, from the MWAB-UE, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE.

[0011] Some implementations of the method and apparatuses described herein may further include binding the first PDU session with the second PDU session. In some implementations of the method and apparatuses described herein may include binding the first PDU session with the second PDU session in case of one of the following: receiving the identity of the MWAB-UE and the PDU session establishment request message for the first PDU session from the AMF; or receiving the PDU session establishment request message for the second PDU session from the MWAB-UE, wherein the PDU session establishment request message comprises the identity of the UE.

[0012] Some implementations of the method and apparatuses described herein may further include triggering a N4 session establishment/modification procedure towards the MWAB-UE-UPF by setting a packet filter set with the UE-UPF and an IP address of the UE.

[0013] Some implementations of the method and apparatuses described herein may further include transmitting, to a radio access network (RAN) nod e, the IP address of the UE, the identity of the UE, an identity of the first PDU session, a quality of service (QoS) flow setup request list of the UE, within a message associated with the second PDU session.

[0014] In some implementations of the method and apparatuses described herein, the UE-UPF for the first PDU session and the MWAB-UE-UPF for the second PDU session may be a same UPF. In some implementations of the method and apparatuses described herein, the N4 session establishment request message may comprise an Internet protocol (IP) address of the MWAB-UE-UPF in the case that the UE-UPF is different from the MWAB-UE-UPF.

[0015] Some implementations of the method and devices described herein include, transmitting, to a session management function (SMF), a protocol data unit (PDU) session establishment request message comprising an indication of establishing backhaul (BH) PDU session for a user equipment (UE) behind the MWAB-gNB; and receiving, from the SMF, a PDU session establishment accept message.

[0016] Some implementations of the method and apparatuses described herein may further include receiving, from the SMF, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF); and transmitting, to the SMF, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE.

[0017] Some implementations of the method and apparatuses described herein may further include receiving, from a wireless access and a radio access network (RAN) node, a third mapping between a data radio bear (DRB) of the MWAB-UE and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI.

[0018] Some implementations of the method and apparatuses described herein may further include receiving, from the MWAB-gNB, an uplink (UL) PDU with a general packet radio service tunneling protocol for the user plane (GTP-U) header comprising a QFI.

[0019] Some implementations of the method and apparatuses described herein may further include determining a DRB based on the QFI, the IP address of the UE and the third mapping; and transmitting, to the RAN node via the DRB, the UL PDU.

[0020] Some implementations of the method and apparatuses described herein may further include receiving, from a RAN node, a downlink (DL) PDU with a GTP-U header; determining that a destination IP address of the DL PDU is the IP address of the UE; and transmitting, to the MWAB-gNB, the DL PDU.

[0021] Some implementations of the method and devices described herein include, receiving, from a session management function (SMF), an Internet protocol (IP) address of a user equipment (UE), a quality of service (QoS) flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a user plane function (UPF) for the UE (UE-UPF). determining a third mapping between a data radio bear (DRB) of a UE component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI; and transmitting, to the MWAB-UE, the third mapping.

[0022] Some implementations of the method and apparatuses described herein may further include determining a fourth mapping between the IP address of the UE and the second PDU session.

[0023] Some implementations of the method and apparatuses described herein may further include receiving, from a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF), a downlink (DL) PDU with an IP address of the UE and a general packet radio service (GPRS) tunneling protocol for the user plane (GTP-U) header comprising a QFI; and determining a DRB for the MWAB-UE based on the IP address of the UE and QFI.

[0024] In some implementations of the method and apparatuses described herein, the RAN node may comprise a gNB with wireless access backhauling (MWAB) donor node.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1A illustrates an example of a wireless communications system that supports PDU session establishment in accordance with aspects of the present disclosure.

[0026] FIG. 1B illustrates an example of a MWAB node associated with aspects of the present disclosure.

[0027] FIG. 1C illustrates example connections for MWAB node associated with aspects of the present disclosure.

[0028] FIG. 1D illustrates an example of MWAB network associated with aspects of the present disclosure.

[0029] FIG. 2 illustrates an example signaling chart illustrating an example process in accordance with aspects of the present disclosure.

[0030] FIG. 3 illustrates protocol stacks for a MWAB node and a UE behind the MWAB node in accordance with aspects of the present disclosure.

[0031] FIG. 4 illustrates two examples options for tunnel in tunnel in accordance with aspects of the present disclosure.

[0032] FIG. 5 illustrates an example process in accordance with aspects of the present disclosure.

[0033] FIG. 6 illustrates another example process in accordance with aspects of the present disclosure.

[0034] FIG. 7 illustrates an example of data exchange process in accordance with aspects of the present disclosure.

[0035] FIGS. 8 through 11 illustrates an example of a device that support PDU session establishment in accordance with aspects of the present disclosure.

[0036] FIGS. 12 through 15 illustrates an example of a processor that support PDU session establishment in accordance with aspects of the present disclosure.

[0037] FIG. 16 illustrates a flowchart of a method that supports PDU session establishment in accordance with aspects of the present disclosure.

[0038] FIG. 17 illustrates a flowchart of a method that supports PDU session establishment in accordance with aspects of the present disclosure.

[0039] FIG. 18 illustrates a flowchart of a method that supports PDU session establishment in accordance with aspects of the present disclosure.

[0040] FIG. 19 illustrates a flowchart of a method that supports PDU session establishment in accordance with aspects of the present disclosure.

[0041] Throughout the drawings, the same or similar reference numerals represent the same or similar elements.

DETAILED DESCRIPTION

[0042] Principles of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein may be implemented in various manners other than the ones described below.

[0043] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0044] References in the present disclosure to "one embodiment," "an example embodiment," "an embodiment," "some embodiments," and the like indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0045] It shall be understood that although the terms "first" and "second" or the like may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term "and/or" includes any and all combinations of one or more of the listed terms.

[0046] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises", "comprising", "has", "having", "includes" and/or "including", when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/ or combinations thereof.

[0047] As used herein, the term "communication network" refers to a network following any suitable communication standards, such as, 5G new radio (NR), Long Term Evolution (LTE), LTE-Advanced (LTE-A), Wideband Code Division Multiple Access (WCDMA), High-Speed Packet Access (HSPA), Narrow Band Internet of Things (NB-IoT), and so on. Further, the communications between a user equipment and a network device in the communication network may be performed according to any suitable generation communication protocols, including but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G) communication protocols, and/or any other protocols either currently known or to be developed in the future. Embodiments of the present disclosure may be applied in various communication systems. Given the rapid development in communications, there will also be future type communication technologies and systems in which the present disclosure may be embodied. It should not be seen as limiting the scope of the present disclosure to only the aforementioned systems.

[0048] As used herein, the term "network device" generally refers to a node in a communication network via which a user equipment can access the communication network and receive services therefrom. The network device may refer to a base station (BS) or an access point (AP), for example, a node B (NodeB or NB), a radio access network (RAN) node, an evolved NodeB (eNodeB or eNB), a NR NB (also referred to as a gNB), a Remote Radio Unit (RRU), a radio header (RH), an infrastructure device for a V2X (vehicle-to-everything) communication, a transmission and reception point (TRP), a reception point (RP), a remote radio head (RRH), a relay, an integrated access and backhaul (IAB) node, a low power node such as a femto BS, a pico BS, and so forth, depending on the applied terminology and technology. The network device may further refer to a network function (NF) in the core network, for example, a SMF, an AMF, a PCF, a UPF or devices with same function in future network architectures, and so forth.

[0049] As used herein, the term "user equipment (UE)" generally refers to any end device that may be capable of wireless communications. By way of example rather than a limitation, a user equipment may also be referred to as a mobile termination (MT). Besides, a user equipment may also be referred to as a communication device, a terminal device, an end user device, a subscriber station (SS), an unmanned aerial vehicle (UAV), a portable subscriber station, a mobile station (MS), or an access terminal (AT). The user equipment may include, but is not limited to, a mobile phone, a cellular phone, a smart phone, a voice over IP (VoIP) phone, a wireless local loop phone, a tablet, a wearable user equipment, a personal digital assistant (PDA), a portable computer, a desktop computer, an image capture user equipment such as a digital camera, a gaming user equipment, a music storage and playback appliance, a vehicle-mounted wireless user equipment, a wireless endpoint, a mobile station, laptop-embedded equipment (LEE), laptop-mounted equipment (LME), a USB dongle, a smart device, wireless customer-premises equipment (CPE), an Internet of Things (loT) device, a watch or other wearable, a head-mounted display (HMD), a vehicle, a drone, a medical device (for example, a remote surgery device), an industrial device (for example, a robot and/or other wireless devices operating in an industrial and/or an automated processing chain contexts), a consumer electronics device, a device operating on commercial and/or industrial wireless networks, and the like. In the following description, the terms: "user equipment," "communication device," "terminal," "mobile terminal," "user equipment" and "UE," may be used interchangeably.

[0050] FIG. 1A illustrates an example of a wireless communications system 100 that supports data collection in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a 5G network, such as an NR network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0051] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0052] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0053] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0054] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in FIG. 1A. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the packet data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in FIG. 1A. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100.

[0055] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0056] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities

102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0057] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN Intelligent Controller (RIC) (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) system, or any combination thereof.

[0058] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0059] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaption protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU 160.

[0060] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0061] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-c, F1-u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0062] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0063] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0064] In the wireless communications system 100, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0065] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., μ=0) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., μ=0) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., μ=1) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., μ=2) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., μ=3) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., μ=4) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0066] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0067] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., μ=0, μ=1, μ=2, μ=3, μ=4) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., μ=0) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0068] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0069] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., μ=0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., μ=1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., μ=3), which includes 120 kHz subcarrier spacing.

[0070] There are some architecture options to achieve the functionality of VMR as defined in TS 22.261, for instance the so-called “Velcro” solution whereby the relay node consists of a UE co-located with a full gNB, with the gNB in the relay establishing N2 and N3 interface to an access and mobility management function (AMF) residing in the 5G Core (5GC) over a PDU session. This architecture option which has not yet been studied by SA2 may be better suited to certain deployment scenarios for vehicle-mounted relays, for instance using the VMR where IAB is not widely supported, or the scenario in which the relay process local traffic in the vehicle to provide on board services with low latency.

[0071] It has been defined that the wireless backhaul node comprises a MT part and a full gNB part, which is called as MWAB node instead. The MWAB node can also be called VMR node or WAB node. The MT part can be called UE component of the MWAB (MWAB-UE). In the following description, the terms: “MWAB-UE” “MWAB-MT” and “MT” may be used interchangeably. The full gNB part can be called gNB component of the MWAB (MWAB-gNB). FIG. 1B illustrates an example of a MWAB node associated with aspects of the present disclosure. When the MWAB node connects to its parent node, it can be regarded as the user equipment, that is, the role of the MT. When the MWAB node provides service for its child node (the child node may be another MWAB node, or an ordinary UE), it can be regarded as a network device, that is, it acts as a gNB.

[0072] FIG. 1C illustrates example connections for MWAB node (i.e., MWAB node) associated with aspects of the present disclosure. A UE connects to the gNB of MWAB node and establish an PDU session with the 5GC/NGC serving the UE (e.g., UE-UPF). There's a NG (e.g., N2/N3) interface between MWAB-gNB and the 5GC/NGC serving the UE. There's a backhauling (BH) PDU session between MWAB-UE and BH 5GC (e.g., WMAB-UE-UPF), which is used to support the overlaid N3 interface between MWAB-gNB and UE-UPF, which is used to transmit the data of PDU session between UE and UE-UPF.

[0073] FIG. 1D illustrates an example of an MWAB network 100D associated with aspects of the present disclosure. In the MWAB network, a relay node (RN) or MWAB node or a wireless backhaul node/device can provide wireless access services for UEs. That is, UE can connect to an MWAB-donor relayed by one or more MWAB nodes. It is to be understood that the number of MWAB nodes is only for the purpose of illustration without suggesting any limitations. Although not shown, it would be appreciated that there may be multiple hops between the UE and the MWAB-donor, and one or more MWAB nodes may be located between the UE and the MWAB-donor.

[0074] The MWAB-donor can be an access network element with a complete base station function, or it can be an access network element with a separate form of the CU and the DU. The MWAB-donor is connected to the core network (for example, connects to the 5G core network, 5GC), and provide the wireless backhaul function for the MWAB node. In addition, the CU of the MWAB-donor is referred as MWAB-donor-CU (or directly referred as CU), and the DU of the MWAB-donor is referred as MWAB-donor-DU. The MWAB-donor-CU may also be separated into the control plane (CP) and the user plane (UP). For example, a CU can be composed of one CU-CP and one (or more) CU-UPs. The MWAB-donor may also be called a donor node or a donor base station (Donor gNodeB, DgNB) or a backhaul (BH) gNB or a BH NodeB. In addition, the wireless link between MWAB-donor and MWAB node, or the wireless link between different MWAB nodes is called backhaul link.

[0075] In the 5G standard, considering the small coverage of the high frequency band, in order to ensure the coverage performance of the network, multi-hop networking may be adopted in the MWAB network. Taking into account the requirements of service transmission reliability, MWAB nodes can support dual connectivity (DC) or multiconnectivity to improve the reliability of transmission, so as to deal with abnormal situations that may occur on the backhaul link, such as radio link failure (RLF) or blockage and load fluctuations, etc.

[0076] The MWAB network supports multi-hop and dual-connection networking, so there may be multiple transmission paths between the UE and the MWAB-donor. On a transmission path, it contains multiple nodes, such as UE, one or more MWAB nodes, and MWAB-donor (if the MWAB-donor is in the form of separate CU and DU, it also contains the MWAB-donor-DU and MWAB-donor-CU), each MWAB node treats the neighboring node that provides backhaul services for it as a parent (MWAB) node, and accordingly, each MWAB node can be regarded as a child (MWAB) node of its parent node.

[0077] In addition, a MWAB node may also be a "mobile base station relay", which is a mobile base station acting as a relay between a UE and the 5G network, i.e., providing a NR access link to UEs and connected wirelessly (using NR) through a donor NG-RAN to the 5G Core. Such mobile base station relay is assumed to be mounted on a moving vehicle and serve UEs that can be located inside or outside the vehicle (or entering/leaving the vehicle).

[0078] In view of the above discussions, some embodiments of the present disclosure provide a solution for PDU session establishment between MWAB-UE and MWAB-UE-UPF to work as the backhaul link in order to support N3 interface between MWAB-gNB and UE-UPF, which is used to transmit the data of PDU session between UE and UE-UPF. In one aspect of the solution of the present disclosure, an AMF receives a first message comprising a PDU session establishment request message for a first PDU session between a UE and a UE-UPF from a MWAB-UE-UPF. The PDU session establishment request message is originated from the UE and received via a second PDU session between a MWAB-UE and the MWAB-UE-UPF. The UE connects to a MWAB-gNB. The MWAB-UE and the MWAB-gNB are collocated to compose a MWAB node. The AMF receives a second message comprising a PDU session establishment accept message for the first PDU session from a SMF. The AMF then transmits the PDU session establishment accept message for the first PDU session to the UE via MWAB-UE-UPF. In this way, the first PDU session establishment is performed between the UE and a UE-

UPF. Principles and implementations of embodiments of the present disclosure will be described in detail below with reference to FIGS. 2-19.

[0079] FIG. 2 illustrates a signaling chart illustrating an example process 200 in accordance with aspects of the present disclosure. The process 200 may involve a MWAB node 201, a RAN node 202, a AMF 203, and a SMF 204. A MWAB-UE and a MWAB-gNB are collocated to compose the MWAB node 201. The MWAB node 201 in FIG. 2 may be an example of network entity 102 or UE 104 in FIG. 1A. The RAN node 202 may be a MWAB donor (or BH gNB) connected by the MWAB node 201. The AMF 203 in FIG. 2 may be an example of core network 106 in FIG. 1A. The SMF 204 in FIG. 2 may be an example of core network 106 in FIG. 1A. It would be appreciated that although the process 200 is applied to in the communication environment 100A of FIG. 1A, this process may be likewise applied to other communication scenarios with similar issues.

[0080] In the process 200, the MWAB-UE of the MWAB node 201 transmits 210 a PDU session establishment request message 215 to the SMF 204. The PDU session establishment request message 215 comprises an indication of establishing BH PDU session (i.e., the second PDU session) for a UE behind the MWAB-gNB of the MWAB node 201. The second PDU session is used as the backhaul link to transfer the data of the first PDU session between UE and UE-UPF. Correspondingly, the SMF 204 receives 220 the PDU session establishment request message 215 from the MWAB node 201.

[0081] It is assumed that there's a third PDU session already established between MWAB-UE and MWAB-UE-UPF to support the overlayed N2 interface between MWAB-gNB and AMF. That is, the third PDU session between MWAB-UE and MWAB-UE-UPF is used to exchange the N2 message between MWAB-gNB and AMF. The MWAB-UE of the MWAB node 201 transmits the first message (e.g., N2 message) from MWAB-gNB (which includes the PDU session establishment request message originated by UE) to MWAB-UE-UPF via the RAN node 202. The MWAB-UE-UPF then forwards the PDU session establishment request message to the AMF 203 based on the destination IP address of the first message. The AMF 203 receives 225 a first message (e.g., N2 message) from the MWAB-UE-UPF, and the first message comprises the PDU session establishment request message for a first PDU session between a UE and a UE-UPF. The PDU session establishment request message is originated from the UE and received via a second PDU session between a MWAB-UE of the MWAB node 201 and the MWAB-UE-UPF. The UE connects to a MWAB-gNB of the MWAB node 201. The MWAB-UE and the MWAB-gNB are collocated to compose the MWAB node 201.

[0082] The AMF 203 then may transmit 230 an identity of MWAB-UE (e.g., SUPI) and a PDU session establishment request message for a first PDU session between a UE and a UE-UPF 235 to the SMF 204. Correspondingly, the SMF 204 receives 240 the identity of MWAB-UE and a PDU session establishment request message for a first PDU session between a UE and a UE-UPF 235 from the AMF 203.

[0083] For instance, the UE sends a PDU session establishment request to the MWAB-gNB, which contains an ID of the second PDU session. The MWAB-gNB encapsulates the NAS message of UE (e.g., PDU session establishment request) into a N2 message or a next generation (NG) control plane (NG-C) interface message (e.g., UL NAS transport). The N2 message can be the Uplink NAS message defined in TS 38.413. The MWAB-gNB forwards the uplink (UL) NAS transport message with the PDU session establishment request as the NAS container to the MWAB-UE. The MWAB-UE obtains the source and destination IP address (e.g., IP address of the MWAB-gNB and IP address of the AMF 203) of the UL NAS Transport message. The MWAB-UE determines a quality of service (QoS) flow identifier (QFI) based on the source and destination IP address according to the QoS rule. The MWAB-UE then maps the QFI to a DRB based on the configuration from the RAN node 202. The MWAB-UE forwards the UL NAS transport message towards RAN node 202 via the DRB. The RAN node 202 determines the third PDU session based on the DRB ID. The RAN node 202 forwards the UL NAS transport message to the MWAB-UE-UPF via the third PDU session. The MWAB-UE-UPF receives the UL NAS transport message. The MWAB-UE-UPF forwards the UL NAS transport message towards the AMF 203 based on the destination IP address (i.e., the IP address of the AMF 203).

[0084] FIG. 3 illustrates protocol stacks for MWAB node and a UE behind the MWAB node in accordance with aspects of the present disclosure. As shown in FIG. 4, the BH PDU session#2 between the MWAB-UE and MWAB-UE-UPF is the second PDU session. MWAB-UE-UPF-UPF is the serving UPF for MWAB-UE BH PDU session. The BH PDU session#2 works in GTU-tunnel mode, and it is marked as GTP-U tunnel#2. There's a PDU session established for UE behind the MWAB-gNB between UE-UPF, which is the serving UPF for PDU session of the UE. The PDU session of UE, i.e., the first PDU session, also works in GTP-U tunnel mode, and it marked as GTP-U tunnel#1. GTP-U tunnel#1 is on top of GTP-U tunnel#2, which can be regarded as tunnel in tunnel. The UE PDU session data exchange between the UE and UE-UPF is performed via the BH PDU session#2.

[0085] FIG. 4 illustrates two examples options for tunnel in tunnel in accordance with aspects of the present disclosure. As shown in FIG. 4, there are three UEs connected to MWAB-gNB, and each of the three UEs establishes a PDU session with UE-UPF. In option 1, MWAB-MT establishes one BH PDU session for all the UEs connecting to the MWAB-gNB. That is, UE#1, UE#2 and UE#3 behind MWAB-gNB share the same BH PDU session of the MWAB-MT. In option2, MWAB-MT establishes one BH PDU session for each UE PDU session. That is, UE#1, UE#2 and UE#3 behind MWAB-gNB do not share the same BH PDU session of the MWAB-MT.

[0086] Alternatively or additionally, the AMF 203 may determine the MWAB-UE based on the IP address of the MWAB-gNB comprised in the first message. Based on the MWAB-UE, the AMF 203 may determine the SMF 204 for the first PDU session, and the SMF for the second PDU session (if second PDU session is established before the first PDU session) or third PDU session are the same SMF. Alternatively, if the second PDU session has not been established yet, then the AMF 203 may select the SMF 204 the same as the existing specification. The AMF 203 then may preserve a first mapping between the UE and the MWAB-UE.

[0087] For example, upon receiving the UL NAS transport message from MWAB-UE-UPF, the AMF 203 may obtain the IP address of the MWAB-gNB from the IP header of the UL NAS transport message. It is assumed that the AMF 203 has a mapping relationship between the MWAB-gNB (e.g., the identity of the MWAB-gNB or the IP address of the MWAB-gNB) and the MWAB-UE (e.g., the identity of the MWAB-UE). The AMF 203 determines an ID of the MWAB-UE based on the IP address of the MWAB-gNB or the associated ID of the MWAB-gNB, i.e., the mapping relationship between the MWAB-gNB and the MWAB-UE. The AMF 203 obtains the payload container type contained in UL NAS transport message and identifies it contains a 5G system session management (5GSM) message (i.e., N1 SM information). The AMF 203 may select a same SMF for the UE PDU session (i.e., the first PDU session) as the BH PDU session of the MWAB-UE (i.e., the second PDU session or the third PDU session).

In other words, the AMF 203 preserves the first mapping between UE and MWAB-UE. In this way, the SMF 204 is able to bind MWAB-UE-UPF and UE-UPF if they are not the same one. The AMF 203 may then forward the 5GSM message (i.e., the PDU session establishment request message) towards the selected SMF 204 together with the ID of the MWAB-UE. The ID of the MWAB-UE may be sent in a separate message from AMF 203 to SMF 204 together with an ID of the UE. That is, the AMF 203 may provide the first mapping between the UE and the MWAB-UE to SMF 204 in a separate message.

[0088] Additionally, the identity of the MWAB-UE/UE may comprise the subscription permanent identifier (SUPI), subscription concealed identifier (SUCI), 5G S-temporary mobile subscription identifier (5G-S-TMSI), 5G globally unique temporary identifier (5G-GUTI), generic public subscription identifier (GPSI), etc.

[0089] Reference is made back to FIG. 2, the SMF 204 determines 245 a UE-UPF for the first PDU session. Then the SMF 204 transmits 250 a N4 session establishment request message associated with the first PDU session to the UE-UPF.

[0090] In some embodiments, the UE-UPF for the first PDU session and the MWAB-UE-UPF for the second PDU session may be a same UPF. For example, based on the ID of the MWAB-UE associated with the PDU session establishment request message, the SMF 204 knows that the UE is connecting to the MWAB-gNB associated with the MWAB-UE. Then the SMF 204 may select a UE-UPF which is the same as the MWAB-UE-UPF if possible. In addition, if the UE-UPF is different from the MWAB-UE-UPF, the N4 session establishment request message may comprise an IP address of the MWAB-UE-UPF.

[0091] Alternatively or additionally, the SMF 204 may transmit an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a MWAB-UE-UPF to the MWAB-UE of the MWAB node 201, and the data of the first PDU session is exchanged via the second PDU session. The SMF 204 then may receive a PDU session establishment request message for the second PDU session from the MWAB-UE of the MWAB node 201, and the PDU session establishment request message comprises the identity of the UE.

[0092] On the other side of the communication, the MWAB-UE of the MWAB node 201 may receive an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a MWAB-UE-UPF from the SMF 204. The

MWAB-UE of the MWAB node 201 then may transmit a PDU session establishment request message for the second PDU session from the SMF 204, and the PDU session establishment request message comprises the identity of the UE.

[0093] In addition, the SMF 204 may bind the first PDU session with the second PDU session. In some embodiments, the SMF 204 may bind the first PDU session with the second PDU session after receiving the identity of the MWAB-UE and the PDU session establishment request message for the first PDU session from the AMF. In some embodiments, the SMF 204 may bind the first PDU session with the second PDU session after receiving the PDU session establishment request message for the second PDU session from the MWAB-UE, and the PDU session establishment request message comprises the identity of the UE.

[0094] Additionally, if the UE-UPF is different from the MWAB-UE-UPF, the SMF 204 may set a packet filter set with the UE-UPF and an IP address of the UE to trigger a N4 session establishment/modification procedure towards the MWAB-UE-UPF. For example, the UE-UPF may be set as a source IP address for DL direction and a destination IP address for UL direction. The IP address of the UE may be set as the destination IP address for DL direction and the source IP address for UL direction. Otherwise, if UE-UPF is same as MWAB-UE-UPF, the SMF 204 may trigger N4 session establishment procedures towards the MWAB-UE-UPF (or UE-UPF) by setting packet filter set with the IP address of the application server and the IP address of the UE.

[0095] Continuing with reference to FIG. 2, the RAN node 202 receives 265 an IP address of a UE, a QoS flow setup request list of a first PDU session of the UE 260 within a message associated with the second PDU session from the SMF 204. On the other side of the communication, the SMF 204 transmits 255 the IP address of a UE, a QoS flow setup request list of a first PDU session of the UEs 260 to the RAN node 202. For example, the SMF 204 may provide the NAS message, PDU session ID#2 (i.e., the ID of the second PDU session), the ID of the UE and/or the IP address of the UE (i.e., UE IP address), QoS flow setup request list of UEs to AMF 203 first. The AMF 203 may generate the PDU session resource setup request message and transmits it to the RAN node 202. The PDU session resource setup request message contains the following parameters:

AMF UE NGAP ID (refer to MWAB-UE here)

RAN UE NGAP ID (refer to MWAB-UE here)

PDU Session Resource Setup Request List

>PDU Session Resource Setup Request Item

>> PDU session ID (e.g., BH PDU session ID#2 or the second PDU session)

>> PDU session NAS-PDU (contains the PDU Session Establishment Accept message for MWAB-UE)

>> UE IP address (or other UE ID identified by both RAN node and MWAB-UE)

>> PDU Session Resource Setup Request Transfer (contains the QoS flow setup request list of a first PDU session of the UE)

[0096] In addition, the RAN node 202 may determine a fourth mapping between the IP address of the UE and the second PDU session. For example, the QoS flow setup request list of a first PDU session of the UE contains QFI and the associated QoS parameters for the QoS flow. In this way, the RAN node 202 obtains the mapping#4 of UE IP address and the BH PDU session (i.e., the second PDU session) of MWAB-UE.

[0097] The RAN node 202 determines 270 a third mapping between a DRB of a MWAB-UE and one of: an IP address of the UE, a QFI; or the IP address of the UE and the QFI. The RAN node 202 then transmits 273 the third mapping 275 to the MWAB-UE of the MWAB node 201. Correspondingly, the MWAB-UE of the MWAB node 201 receives 278 the third mapping 275 from the RAN node 202.

[0098] For example, there may be multiple UEs behind MWAB-gNB share the same BH PDU session of the MWAB-UE. UE#1, UE#2 and UE#3 connect to MWAB-gNB and share the same BH PDU session of the MWAB-UE, and the SMF 204 may provide the following parameters in separate message towards the RAN node 202 for the BH PDU session (i.e., the second PDU session) of the MWAB-UE:

UE IP address#1, QoS flow setup request list of a first PDU session of UE#1

UE IP address#2, QoS flow setup request list of a first PDU session of UE#2

UE IP address#3, QoS flow setup request list of a first PDU session of UE#3

[0099] The RAN node 202 may determine the mapping of one of (the IP address of the UE or QFI) and the DRB for the MWAB-UE, i.e., the third mapping.

[0100] Alternatively or additionally, the AMF 203 may receive a transfer message (e.g., Namf_Communication_N1N2MessageTransfer) associated with the first PDU session from the SMF 204, and the transfer message comprises an identity of the UE and PDU session establish accept message for the UE. Based on the identity of the UE and the first mapping between the UE and the MWAB-UE, the AMF 203 may determine the MWAB-UE and then the associated MWAB-gNB. Based on the MWAB-gNB and a second mapping between the MWAB-gNB and the MWAB-UE-UPF, the AMF 203 may determine a MWAB-UE-UPF. The AMF 203 may then transmit the PDU session establishment accept message via a N2 message towards MWAB-gNB to the MWAB-UE-UPF.

[0101] For example, upon receiving the transfer message associated with the first PDU session from the SMF 204, the AMF 203 may determine the MWAB-UE based on the ID of the UE (e.g., SUPI) based on the first mapping. The AMF 203 may further determine MWAB-gNB information based on the MWAB-UE. It is assumed that AMF 203 has the mapping of MWAB-UE-UPF (e.g., the IP address of the MT-UPF) and the MWAB-gNB (e.g., the IP address of the MWAB-gNB or the identity of MWAB-gNB). The AMF 203 then determines the associated MWAB-UE-UPF information based on the MWAB-gNB information and the second mapping.

[0102] Continuing with reference to FIG. 2, the SMF 204 transmits 280 a PDU session establishment accept message 283 for MWAB-UE to the MWAB node 201. The PDU session establishment accept message 283 for MWAB-UE may be contained in a N1 SM container within the Namf_Communication_N1N2MessageTransfer from the SMF 204 to the AMF 203. The PDU session establishment accept message corresponding to the PDU session establishment request transmitted in 215, which is associated with the second PDU session for the MWAB-UE. Correspondingly, the MWAB-UE of the MWAB node 201 receives 285 the PDU session establishment accept message 283 from the SMF 204.

[0103] In an example, the SMF 204 may provide the RAN node 202 with a N1 SM container (e.g., PDU session establishment accept message for the MWAB-UE), PDU session ID#1 (i.e., the ID of the first PDU session), the ID of the UE and/or the IP address of the UE, QoS flow setup request list of UEs. The RAN node 202 may configure MWAB-UE with the third mapping of DRB between the MWAB-UE and RAN node 202 and one of UE IP address or the QFI. Besides, the RAN node 202 forwards PDU session establishment accept message (with UE IP address) to the MWAB-UE. Based on the third mapping, the MWAB-UE is able to map one of the UE IP address or the QFI to the DRB.

[0104] In other words, the SMF 204 transmits 287 a second message (e.g., a Namf_Communication_N1N2MessageTransfer message) comprising a PDU session establishment accept message for the first PDU session 290 to the AMF 203. E.g., Namf_Communication_N1N2MessageTransfer message includes PDU session ID of the first PDU session, N2 SM information and N1 SM container, which contains the PDU session establishment accept message for the first PDU session. After receiving 293 the second message 290 from the SMF 204, the AMF 203 transmits 295 the N1 SM container which contains the PDU session establishment accept message for the first PDU session to the UE. The AMF 203 determines MWAB-UE based on the identity of UE and the first mapping. It then determines MWAB-gNB based on MWAB-UE. Then the AMF 203 determines MWAB-UE-UPF based on MWAB-gNB, and forwards N2 SM information which contains the PDU session establishment accept message for the first PDU session.

[0105] Alternatively or additionally, the MWAB-UE of the MWAB node 201 may receive an UL PDU with a general packet radio service tunnelling protocol for the user plane (GTP-U) header comprising a QFI from the MWAB-gNB. For example, the MWAB-gNB may insert QFI in the GTP-U header#1. Alternatively, the MWAB-gNB forwards the UL PDU with GTP-U header#1 with QFI to the MWAB-UE.

[0106] Additionally, the MWAB-UE of the MWAB node 201 may determine a DRB based on the QFI, the IP address of the UE and the third mapping. The MWAB-UE of the MWAB node 201 may then transmit the UL PDU to the RAN node via the DRB. For instance, the MWAB-UE may obtain the source IP address from the UL PDU. The MWAB-UE obtains the QFI either from GTP-U header#1 or directly from MWAB-gNB. Based on the third mapping, the MWAB-UE may determine the DRB based on the IP address of the UE and the QFI.

[0107] In some embodiments, the RAN node 202 may receive a DL PDU with an IP address of the UE and a GTP-U header comprising a QFI from the MWAB-UE-UPF. Based on the IP address of the UE and QFI, the RAN node 202 may determine a DRB for the MWAB-UE. For example, the RAN node 202 may obtain the IP address of the UE from the DL PDU and QFI#2 from GTP-U header#2. The RAN node 202 may determine the MWAB-UE and DRB based on the IP address of the UE and QFI#2. The RAN node 202 subtracts the GTP-U header#2 and forward the DL PDU with GTP-U header#1 to the MWAB-UE via the DRB.

[0108] In some embodiments, the MWAB-UE of the MWAB node 201 may receive a DL PDU with a GTP-U header from the RAN node 202, and the MWAB-UE may determine that a destination IP address of the DL PDU is the IP address of the UE. The MWAB-UE then may transmit the DL PDU to the MWAB-gNB.

[0109] In an example, upon receiving the DL PDU with GTP-U header#1 from RAN node 202, the MWAB-UE checks the destination IP address (i.e., the IP address of the UE) and knows that the DL PDU with GTP-U header#1 is for the UE. The MWAB-UE then may forward the DL PDU with GTP-U header#1 to the MWAB-gNB.

[0110] FIG. 5 illustrates an example process 500 in accordance with aspects of the present disclosure. The process 500 may involve a UE 501, a gNB 502, a MT 503, a RAN node 504 (e.g., BH gNB or MWAB donor), an AMF 505, a SMF 506, a MT-UPF 507 (e.g., MWAB-UE-UPF) and a UE-UPF 508. The gNB 502 in FIG. 5 may be an example of MWAB-gNB of the MWAB node 201 in FIG. 2. The MT 503 in FIG. 5 may be an example of the MWAB-UE of the MWAB node 201 in FIG. 2. The AMF 505 in FIG. 5 may be an example of the AMF 203 in FIG. 2. The SMF 506 may be an example of SMF 204 in FIG. 2. It is understood that the process 500 can be considered as a more specific example of the process 200 in FIG. 2.

[0111] In the process 500, it is assumed that the UE PDU session (i.e., the first PDU session) establishment triggers the BH PDU session (i.e., the second PDU session) establishment of the MT 503. Steps 512-530 and 548-560 are used to establish GTP-U tunnel#1 for first PDU session, i.e., a GTP-U tunnel between gNB 502 and UE-UPF. Steps 532-546 are used to establish GTP-U tunnel#2 (i.e., a GTP-U tunnel between a MWAB donor or called RAN node and MT-UPF 507) for second PDU session, which realizes GTP-U tunnel#1 in GTP-U tunnel#2.

[0112] At 512, the UE 501 sends PDU session establishment request to gNB 502, which contains PDU session ID#1. At 514, the gNB 502 encapsulates the NAS message of UE (e.g., PDU session establishment request) into a N2/NG-C message (e.g., UL NAS Transport). The gNB 502 forwards the UL NAS transport message with PDU session establishment request as the NAS container to the MT 503. At 516, the MT 503 forwards the UL NAS transport message towards the RAN node 504 (e.g., a MWAB donor which the MWAB node connects to) via the DRB. At 518, the RAN node 504 forwards the UL NAS transport message to the MT-UPF 507 via BH PDU session#2 (i.e., the second PDU session). At 520, the MT-UPF 507 forwards the UL NAS transport message towards AMF 505 based on the destination IP address (i.e., the IP address of the AMF).

[0113] At 522, the AMF 505 determines the ID of the MT 503 (e.g., SUPI) based on the gNB IP address or the associated gNB ID. The AMF 505 then selects a SMF for the first PDU session, which is the same as the SMF for the third PDU session of the MT 503. Alternatively, the AMF 505 selects a SMF based on the existing specification. At 524, the AMF 505 forwards the PDU session establishment request message together with an ID of the MT 503 (e.g., SUPI) towards the selected SMF 506. At 526, SMF 506 selects a UE-UPF for the first PDU session which is the same as the MT-UPF for the third PDU session if possible. Alternatively, the SMF 506 selects a UE-UPF based on the existing specification.

[0114] At 528, the SMF 506 sends a N4 session establishment request or a N4 PDU session modification request to UE-UPF 508. In the case of SMF 506 selecting a UE-UPF for the first PDU session which is the same as MT-UPF for the third PDU session, If the UE-UPF 508 is different from MT-UPF 507, the SMF 506 may provide the associated MT-UPF IP address in the N4 session establishment request. In the case of SMF 506 selecting a UE-UPF based on the existing specification, SMF does not provide the associated MT-UPF IP address in the N4 session establishment request. At 530, the UE-UPF 508 responses SMF 506 with a N4 Session establishment response or N4 PDU session modification response with a UPF side user plane (UP) transport layer information for the UE PDU session (i.e., GTP-U tunnel#1), which includes the endpoint IP address (e.g., UPF IP address) and a TEID. In the case of SMF 506 selecting a UE-UPF for the first PDU session which is the same as MT-UPF for the third PDU session, if the UE-UPF is the same as MT-UPF, steps 528 and 530 can be omitted.

[0115] At 532, the SMF 506 sends an indication of establishing the second PDU session and an ID of the UE (e.g., SUPI) to MT 503 (via AMF 505 and RAN node 504). For example, the indication and the ID of the UE 501 may be contained in a DL NAS message towards MT 503.

[0116] At 534, upon receiving the indication of establishing the second PDU session and the ID of the UE 501, the MT 503 generates the PDU session establishment request for the second PDU session, which contains PDU session ID#2 and the ID of the UE 501. The MT 503 sends the PDU session establishment request to the SMF 506 (via RAN node 504 and AMF 505). In the case of AMF 505 selecting a SMF for the first PDU session based on the existing specification, AMF 505 selects a SMF for the second PDU session which is the same as the SMF for the first PDU session. Upon receiving the PDU session establishment request with the ID of the UE 501 from MT 503, the SMF 506 selects a MT-UPF 507 for the second PDU session which is the same as the UE-UPF for the first PDU session if possible. In this way, the SMF 506 binds UE PDU session (i.e., the first PDU session) with PDU session ID#1 with BH PDU session (i.e., the second PDU session) of the MT 503 with PDU session ID#2.

[0117] At 536, if the UE-UPF is different from the MT-UPF, the SMF 506 triggers a N4 session establishment procedure or a N4 session modification towards MT-UPF by setting packet filter set with UE-UPF and IP address of the UE 501. At 538, the SMF 506 provides the RAN node 504 with a NAS message (e.g., a PDU session establishment accept message for the MT 503), PDU session ID#2, the ID of the UE and/or UE IP address, QoS flow setup request list of UE to RAN node.

[0118] At 540, the RAN node 504 configures the MT 503 with the mapping of DRB between MT 503 and the RAN node 504 and one of UE IP address or QFI. Besides, the RAN node 504 forwards PDU session establishment accept message with UE IP address to the MT 503. The UE IP address may be the IP address allocated for the first PDU session. Based on the mapping, MT 503 is able to map one of UE IP address or the QFI to the DRB ID.

[0119] At 542, the RAN node 504 provides SMF 506 with the N2 SM information via AMF. The N2 SM information contains PDU session ID, AN tunnel information (i.e., RAN node side UP transport layer information), list of accepted/rejected QFI(s).

[0120] At 544, the SMF 506 includes the ID of the UE 501 (e.g., SUPI), PDU session ID#1, N2 SM information (PDU session ID, QFI(s), QoS profile(s), CN tunnel information (i.e., UE-UPF side UP transport layer information)), N1 SM container (PDU Session Establishment Accept for UE) in a Namf_Communication_N1N2Messsage transfer message and sends the Namf_Communication_N1N2Messsage transfer message to AMF 505. The PDU session establishment accept message is for UE, which may contain the IP address of the UE (or called UE IP address). That is, all the N1N2 message is associated with UE PDU session from SMF 506.

[0121] At 546, upon receiving the N1N2 message associated with UE PDU session (i.e., first PDU session) from the SMF 506, the AMF 505 determine MT 503 based on the ID of the UE 501 and the mapping between the UE 501 and the MT 503. AMF further determines gNB information based on the MT 503. It is assumed that AMF 505 has the mapping of MT-UPF 507 (e.g., MT-UPF IP address) and gNB 502(e.g., gNB IP address). AMF 505 then determines the associated MT-UPF information based on gNB information and the mapping between the gNB information and the MT-UPF information.

[0122] At 548, the AMF 505 generates a N2 PDU session request and sends it to MT-UPF 507. The N2 PDU session request includes both N1 message (e.g., PDU session establishment accept message for UE) and other parameters associated with UE PDU session to RAN node.

[0123] Upon receiving the N2 PDU session request message from the AMF 505, the MT-UPF 507 performs IP filtering. For example, MT-UPF 507 determines both the third PDU session and QFI based on the packet filter set, which contains the source IP address (i.e., AMF IP address) and destination IP address (i.e., gNB IP address). At 550, the MT-UPF 507 forwards the N2 PDU session request message towards the RAN node 504 via the third PDU session. That is, the MT-UPF 507 encapsulates the N2 PDU session request message with a GTP-U header, which contains QFI. Besides, the GTP-U header also contains the TEID allocated by the RAN node 504 for the third PDU session. Upon receiving the N2 PDU session request message, the RAN node 504 determines the MT 503 based on the third PDU session and determines the DRB based on QFI contained in the GTP-U header. At 552, the RAN node 504 sends the N2 PDU session request to the MT 503 via the DRB. Upon receiving the N2 PDU session request message, the MT 503 checks the destination IP address. At 554, if the destination IP address is the gNB IP address, the MT 503 forwards the N2 PDU session request message to the gNB 502.

[0124] At 556, upon receiving the N2 PDU session request message with NAS message from AMF 505, the gNB 502 sends the PDU session establishment accept message to UE 501 via DL RRC message. Besides, the gNB 502 also configures UE 501 with the mapping of the QFI and the DRB between the UE 501 and the gNB 502.

[0125] The gNB 502 generates a N2 PDU session response, which contains N2 SM information for SMF 506. At 558, the gNB 502 forwards the N2 PDU session response to the MT 503. At 560, the MT 503 forwards the N2 PDU session response message to MT-UPF 507 via the third PDU session. MT-UPF 507 forwards the N2 PDU session response message towards AMF 505 based on the destination IP address. At 566, upon receiving the N2 PDU session response, the AMF 505 forwards the N2 SM information to the SMF 506.

[0126] At 568, if the UE-UPF is different from the MT-UPF, the SMF 506 triggers a N4 session modification procedure towards UE-UPF by setting a packet filter set with application server IP address and UE IP address. In the case of SMF 506 selecting a UE-UPF based on the existing specification, SMF 506 may also provide MT-UPF IP address at 568. In this way, UE-UPF 508 obtains a mapping of MT-UPF and UE IP address based on 528 and 568.

[0127] In general, upon receiving the UL NAS transport message from MT-UPF 507, AMF 505 determines the ID of the MT 503 (e.g., SUPI) based on the gNB IP address. AMF 505 selects a same SMF for the UE PDU session (i.e., first PDU session) as the SMF for MT PDU session (i.e., third PDU session). AMF 505 preserves the mapping relationship between UE 501 and MT 503. AMF 505 forwards the 5GSM message (i.e., PDU session establishment request message from UE) towards the selected SMF together with the ID of the MT 503. Based on the ID of the MT 503 associated with the PDU session establishment request message from UE 501, SMF 506 selects a UE-UPF for the first PDU session which is the same as MT-UPF for the third PDU session if possible. SMF 506 sends a N4 session establishment request to UE-UPF 508. If UE-UPF 508 is different from MT-UPF 507, SMF 506 provides the associated MT-UPF IP address in the N4 session establishment request for UE PDU session. SMF 506 sends an indication of establishing BH PDU session (i.e., the second PDU session) and the ID of the UE 501 to MT 503 (via AMF 505 and RAN node 504).

[0128] Upon receiving the indication of establishing BH PDU session (i.e., the second PDU session) and the ID of the UE 501, MT 503 generates PDU session establishment request, which contains the ID of the UE 50 (e.g., SUPI). If UE-UPF is different from MT-UPF, SMF 506 triggers a N4 session establishment/modification procedure towards MT-UPF 507 by setting packet filter set with UE-UPF 508 and UE IP address. SMF 506 provides RAN node 504 with a NAS message (e.g., PDU session establishment accept message for UE), PDU session ID#2 (WAB-MT BH PDU session), the ID of the UE 501 and/or UE IP address, QoS flow setup request list of UE to RAN node 504. In this way, RAN node 504 obtains the mapping of UE IP address and the MT BH PDU session (i.e., the second PDU session). RAN node 504 configures MT 503 with the mapping of (UE

IP address, QFI) and a DRB. Upon receiving the N1N2 message associated with UE PDU session from SMF 506, AMF 505 determines the MT based on the ID of the UE 501. AMF 505 further determines gNB information based on MT 503. AMF 505 then determines the associated MT-UPF information based on gNB information. AMF 505 generates a N2 PDU session request and sends it to MT-UPF 507.

[0129] In general in another way, upon receiving the UL NAS transport message from MT-UPF 507, AMF 505 determines the ID of the MT 503 (e.g., SUPI) based on the gNB IP address. AMF 505 selects a SMF based on the existing specification. AMF 505 forwards the 5GSM message (i.e., PDU session establishment request message from UE) towards the selected SMF together with the ID of the MT 503. Based on the ID of the MT 503 associated with the PDU session establishment request message from UE 501, SMF 506 selects a UE-UPF based on the existing specification. SMF 506 sends a N4 session establishment request to UE-UPF 508. SMF 506 sends an indication of establishing BH PDU session (i.e., the second PDU session) and the ID of the UE 501 to MT 503 (via AMF 505 and RAN node 504).

[0130] Upon receiving the indication of establishing BH PDU session (i.e., the second PDU session) and the ID of the UE 501, MT 503 generates PDU session establishment request for the second PDU session, which contains the ID of the UE 50 (e.g., SUPI). MT 503 sends the PDU session establishment request to AMF 505 via RAN node 504. AMF 505 selects SMF 506 for the PDU session which is the same as the SMF for the first PDU session. SMF 506 receives a PDU session establishment request message for second PDU session from MT 503, which contains the ID of the UE 501. SMF 506 selects a MT-UPF for the second PDU session which is the same as UE-UPF for the first PDU session. SMF may further provide MT-UPF IP address for the first PDU session to UE UPF if UE-UPF is different from MT-UPF.

[0131] FIG. 6 illustrates an example process 600 in accordance with aspects of the present disclosure. The process 600 may involve a UE 601, a gNB 602, a MT 603, a RAN node 604 (e.g., BH gNB or MWAB donor), an AMF 605, a SMF 606, a MT-UPF 607 and a UE-UPF 608. The gNB 602 in FIG. 6 may be an example of MWAB-gNB of the MWAB node 201 in FIG. 2. The MT 603 in FIG. 6 may be an example of the MWAB-UE of the MWAB node 201 in FIG. 2. The AMF 605 in FIG. 6 may be an example of the AMF 203 in FIG. 2. The SMF 606 may be an example of SMF 204 in FIG. 2. It is understood that the process 600 can be considered as a more specific example of the process 200 in FIG. 2.

[0132] In the process 600, it is assumed that MT 603 triggers BH PDU session#2 (i.e., second PDU session) establishment of the MT 603. Steps 610-614 are used to establish GTP-U tunnel#2 for second PDU session. Steps 616-656 are used to establish GTP-U tunnel#1 for first PDU session, which realizes GTP-U tunnel#1 in GTP-U tunnel#2.

[0133] At 610, MT 603 triggers BH PDU session (i.e., the second PDU session) establishment, which is used to transfer the data of the first PDU session of UE behind gNB 602. The MT 603 sends a PDU session establishment request to SMF 606, which contains PDU session ID#2 and indication of tunnel in tunnel. The indication of tunnel in tunnel can be called other names, e.g., indication of BH PDU session, indication of BH PDU session for UE behind gNB etc.

[0134] At 612, upon receiving the PDU session establishment request from the MT 603, the SMF 606 triggers a N4 session establishment procedure or a N4 session modification procedure towards the MT-UPF 607. At 614, the SMF 606 sends PDU session establishment accept to the MT 603, which contains PDU session ID#2. It is possible that no IP address is allocated to MT 603 for the PDU session. That is, no IP address is contained in PDU session establishment accept message. In this way, BH PDU session#2 (i.e., the second PDU session) is established, which is the GTP-U tunnel#2 that transfers data of GTP-U tunnel#1 in FIG. 3.

[0135] At 616, the UE 601 sends the PDU session establishment request (for the first PDU session) towards the gNB 602. At 618, the gNB 601 encapsulates the PDU session establishment request message into UL NAS transport message and forward it to MT 603. At 620, the MT 603 sends the UL NAS transport message via the third PDU session to the MT-UPF 607. At 624, the MT-UPF 607 forwards the UL NAS transport message to AMF 605. It is assumed that PDU session establishment request sent by UE 601 includes PDU session ID#1.

[0136] At 626, upon receiving the UL NAS transport message from the MT-UPF 607, the AMF 605 determines the ID of the MT 603 (e.g., SUPI) based on the gNB IP address or the associated gNB ID. The AMF 605 selects a SMF for the UE PDU session (i.e., the first PDU session) which is the same SMF for the PDU session of the MT 603 (i.e., the second PDU session).

[0137] At 628, the AMF 605 sends a PDU session establishment request and the ID of the MT 603 to the SMF 606. At 630, the SMF 606 binds UE PDU session (i.e., the first PDU session with PDU session ID#1) with BH PDU session#2 of the MT 603 (i.e., the second PDU session with PDU session ID#2). The SMF 606 selects a UE-UPF for UE PDU session (i.e., the first PDU session) which is the same as MT-UPF for BH PDU session of the MT 603 (i.e., the second PDU session) if possible.

[0138] Steps 538 and 540 of process 500 may also happen after 630. The SMF 606 provides the RAN node 604 with a NAS message (e.g., PDU session establishment accept message for MT 603), PDU session ID#2, an ID of the UE and/or UE IP address, a QoS flow setup request list of UE to RAN node 604. The RAN node 604 configures the MT 603 with the mapping of UE IP address and a DRB between the MT 603 and the RAN node 604 or the mapping of QFI and the DRB. Besides, the RAN node 604 forwards a PDU session establishment accept message with UE IP address to the MT 603. Based on the mapping, the MT 603 is able to map one of the UE IP address or the QFI to the DRB.

[0139] At 632, if the UE-UPF is different from the MT-UPF, the SMF 605 triggers a N4 session establishment procedure or a N4 session modification procedure to the UE-UPF 608, which contains the IP address of the MT-UPF 607.

[0140] At 634, the SMF 5606 includes the ID of the UE 601, PDU session ID#2, N2 SM information (PDU session ID, QFI(s), QoS profile(s), CN tunnel information (i.e., UE-UPF side UP transport layer information)), N1 SM container (PDU Session Establishment Accept for UE) in a Namf_Communication_N1N2Messsage transfer message and sends the Namf_Communication_N1N2Messsage transfer message and transmit it to the AMF 605.

[0141] At 636, the AMF 605 determine MT 603 based on the ID of the UE 601 and the mapping between the UE 601 and the MT 603. At 638, the AMF 605 generates a N2 PDU session request (contains the PDU Session Establishment Accept message for UE) and sends it to MT-UPF 607. At 640, the MT-UPF 607 forwards the N2 PDU session request message towards the RAN 604 via the third PDU session. The RAN 604 sends the PDU Session Establishment Accept message for UE to the MT 603. The MT 603 forwards the PDU Session Establishment Accept message for UE to the gNB 602 and the gNB 602 sends it to the UE 601.

[0142] At 645, if the UE-UPF is different from the MT-UPF, the SMF 606 triggers a N4 session modification procedure towards the MT-UPF 607 by setting a packet filter set with the IP address of the UE-UPF and the UE IP address. Otherwise, the SMF 606 triggers a N4 session modification procedure towards the MT-UPF 607 by setting a packet filter set with the application server IP address and the UE IP address. Besides, if UE-UPF is different from MT-UPF, the SMF 606 may trigger a N4 session modification procedure towards UE-UPF 608 by setting a packet filter set with the application server IP address and the UE IP address.

[0143] In general, MT 603 sends a PDU session establishment request message to SMF, which contains PDU session ID#2 and indication of tunnel in tunnel. AMF 605 sends the PDU session establishment request message and an ID of the MT 603(e.g., SUPI) to SMF 606. SMF 606 binds a UE PDU session (i.e., the first PDU session with PDU session ID#1) with a BH PDU session#2 of the MT (i.e., the second PDU session with PDU session ID#2). SMF 606 selects UE-UPF 608 for UE PDU session (i.e., the first PDU session) which is the same as the MT-UPF 607 for BH PDU session of the MT (i.e., the second PDU session) if possible.

[0144] FIG. 7 illustrates an example of data exchange process 700 in accordance with aspects of the present disclosure. The process 700 may involve a UE 701, a gNB 702, a MT 703, a RAN node 704 (e.g., BH gNB or MWAB donor), a MT-UPF 705 and a UE-UPF 706. The gNB 702 in FIG. 7 may be an example of MWAB-gNB of the MWAB node 201 in FIG. 2. The MT 703 in FIG. 7 may be an example of the MWAB-UE of the MWAB node 201 in FIG. 2. It is understood that the process 700 can be considered as a more specific example of the process 200 in FIG. 2.

[0145] For the UL PDU transmission, at 710, the UE 701 sends the UL PDU to the gNB 702 via the corresponding DRB (e.g., based on the mapping of the QFI and the DRB). UL PDU is in the format of IP packet, UE IP address is the source IP address and application server IP address is the destination IP address.

[0146] At 715, upon receiving the UL PDU from the UE 701, the gNB 702 determines the QFI based on the DRB. It is assumed that the gNB 702 makes 1:1 mapping between the QFI and the DRB of the UE 701. Alternatively, it is assumed that the UE 701 inserts QFI in the SDAP header when encapsulating UL PDU into the radio protocols. The data format transmitted by the UE 701 is as PHY/MAC/RLC/PDCP/SDAP/IP/UL PDU. The gNB 702 encapsulates the UL PDU with GTP-U header#1. GTP-U header#1 corresponds to GTP-U tunnel#1. The gNB 702 forwards the UL PDU with GTP-U header#1 to the

MT 703. In one option, the gNB 702 inserts QFI in the GTP-U header#1. Alternatively, the gNB 702 forwards the UL PDU with GTP-U header#1 with QFI to the MT 703.

[0147] At 720, the MT 703 obtains the source IP address from the UL PDU. The MT 703 obtains the QFI either from GTP-U header#1 or directly from the gNB 702. Based on the mapping of one of the UE IP address or the QFI and the DRB between the MT 703 and the RAN node 704, the MT 703 determines the DRB based on the UE IP address and the QFI.

[0148] At 725, the MT 703 sends the UL PDU with GTP-U header#1 to RAN node 704 via the DRB. Optionally, the MT 703 may contain QFI in the SDAP header when encapsulating UL PDU with GTP-U header#1 into the radio protocols. At 730, the RAN node 704 determines QFI either based on the DRB or obtains from SDAP header of the UL PDU with GTP-U header#1. The RAN node 704 adds GTP-U header#2 to UL PDU with GTP-U header#1. GTP-U header#2 corresponds to GTP-U tunnel#2. That is, UL PDU with GTP-U header#1 is contained in GTP-U header#2. The RAN node 704 obtains the UE IP address from the UL PDU, it determines the corresponding BH PDU session#2 (i.e., the second PDU session) based on the mapping of UE IP address and the BH PDU session (i.e., the second PDU session) of the MT 703. At 730, the RAN node 704 sends the UL PDU with GTP-U header#1 and GTP-U header#2 to the MT-UPF 705 via BH PDU session#2. At 735, the MT-UPF 705 subtracts the GTP-U header#2 and forward the UL PDU with GTP-U header#1 to UE-UPF 706 based on the destination IP address contained in UL PDU.

[0149] For DL PDU transmission, at 740, the DL PDU arrives in UE-UPF 706, which is in the format of IP packet. At 745, the UE-UPF 706 determines the associated MT-UPF based on UE IP address according to the mapping of the MT-UPF 705 and the UE IP address. The UE-UPF 706 performs IP filtering, identifies the PDU session#1 (i.e., the first PDU session) and QFI#1 for the UE 701 based on the packet filter set.

[0150] At 750, the UE-UPF 706 generates a DL PDU with GTP-U header#1, which contains QFI#1 in the GTP-U header#1. The UE-UPF 706 sends the DL PDU with GTP-U header#1 to the MT-UPF 705 based on 745. At 755, the MT-UPF 705 performs IP filtering and identifies the BH PDU session#2 (i.e., the second PDU session) and QFI#2 for the MT 703 based on the packet filter set.

[0151] At 760, the MT-UPF 705 adds GTP-U header#2 to the DL PDU with GTP-U header#1. The MT-UPF 705 also inserts QFI#2 into GTP-U header#2. The MT-UPF 705 sends the DL PDU with GTP-U header#1 and GTP-U header#2 to the RAN node 704 via the BH PDU session#2. At 765, the RAN node 704 obtains UE IP address from DL PDU and QFI#2 from GTP-U header#2. The RAN node 704 determines the MT 703 and the DRB based on UE IP address and QFI#2. The RAN node 704 subtracts the GTP-U header#2 and forward the DL PDU with GTP-U header#1 to the MT 703 via the DRB.

[0152] At 770, upon receiving the DL PDU with GTP-U header#1 from RAN node, the MT 703 checks the destination IP address (i.e., UE IP address) and knows that the DL PDU with GTP-U header#1 is for the UE 701. At 775, the MT 703 forwards the DL PDU with GTP-U header#1 to the gNB 702. At 780, the gNB 702 obtains UE IP address from DL PDU and QFI#1 from GTP-U header#1. The gNB 702 determines the DRB based on QFI#1. The gNB 702 subtracts the GTP-U header#1 and sends the DL PDU towards the UE 701 via the DRB.

[0153] In general, gNB 702 forwards the UL PDU with GTP-U header#1 with QFI to MT 703. MT 703 determines a DRB between MT 703 and RAN node 704 based on the UE IP address and the QFI. UE-UPF 706 determines the associated MT-UPF 705 provided by the SMF based on UE IP address. UE-UPF 706 generates DL PDU with GTP-U header#1 and forwards it to MT-UPF 705.

[0154] FIG. 8 illustrates an example of a device 800 that supports PDU session establishment in accordance with aspects of the present disclosure. The device 800 may be an example of a core network 106 as described herein. The device 800 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 800 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 802, a memory 804, a transceiver 806, and, optionally, an I/O controller 808. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0155] The processor 802, the memory 804, the transceiver 806, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 802, the memory 804, the transceiver 806, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0156] In some implementations, the processor 802, the memory 804, the transceiver 806, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 802 and the memory 804 coupled with the processor 802 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 802, instructions stored in the memory 804).

[0157] For example, the processor 802 may support wireless communication at the device 800 in accordance with examples as disclosed herein. The processor 802 may be configured to operable to support a means for receiving, from a user plane function (UPF) for a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE-UPF), a first message comprising a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a UPF for the UE (UE-UPF), wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a mobile gNB with wireless access backhauling (MWAB-UE) and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; receiving, from a session management function (SMF), a second message comprising a PDU session establishment accept message for the first PDU session; and transmitting, to the UE, the PDU session establishment accept message for the first PDU session. The processor 802 may be configured to operable to support other means for other implementations of method 1600.

[0158] The processor 802 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 802 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 802. The processor 802 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 804) to cause the device 800 to perform various functions of the present disclosure.

[0159] The memory 804 may include random access memory (RAM) and read-only memory (ROM). The memory 804 may store computer-readable, computer-executable code including instructions that, when executed by the processor 802 cause the device 800 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 802 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 804 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0160] The I/O controller 808 may manage input and output signals for the device 800. The I/O controller 808 may also manage peripherals not integrated into the device M02. In some implementations, the I/O controller 808 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 808 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 808 may be implemented as part of a processor, such as the processor 806. In some implementations, a user may interact with the device 800 via the I/O controller 808 or via hardware components controlled by the I/O controller 808.

[0161] In some implementations, the device 800 may include a single antenna 810. However, in some other implementations, the device 800 may have more than one antenna 810 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 806 may communicate bi-directionally, via the one or more antennas 810, wired, or wireless links as described herein. For example, the transceiver 806 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 806 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 810 for transmission, and to demodulate packets received from the one or more antennas 810. The transceiver 806 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0162] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 810 for transmitting the amplified signal into the air or wireless medium.

[0163] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 810 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0164] FIG. 9 illustrates an example of a device 900 that supports PDU session establishment in accordance with aspects of the present disclosure. The device 900 may be an example of a core network 106 as described herein. The device 900 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 900 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 902, a memory 904, a transceiver 906, and, optionally, an I/O controller 908. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0165] The processor 902, the memory 904, the transceiver 906, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 902, the memory 904, the transceiver 906, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0166] In some implementations, the processor 902, the memory 904, the transceiver 906, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 902 and the memory 904 coupled with the processor 902 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 902, instructions stored in the memory 904).

[0167] For example, the processor 902 may support wireless communication at the device 900 in accordance with examples as disclosed herein. The processor 902 may be configured to operable to support a means for receiving, from an access and mobility management function (AMF), an identity of a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a user plane function (UPF) for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; a means for determining a UE-UPF for the first PDU session; and a means for transmitting, to the UE-UPF, a N4 session establishment request message associated with the first PDU session. The processor 902 may be configured to operable to support other means for other implementations of method 1700.

[0168] The processor 902 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 902 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 902. The processor 902 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 904) to cause the device 900 to perform various functions of the present disclosure.

[0169] The memory 904 may include random access memory (RAM) and read-only memory (ROM). The memory 904 may store computer-readable, computer-executable code including instructions that, when executed by the processor 902 cause the device 900 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 902 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 904 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0170] The I/O controller 908 may manage input and output signals for the device 900. The I/O controller 908 may also manage peripherals not integrated into the device M02. In some implementations, the I/O controller 908 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 908 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 908 may be implemented as part of a processor, such as the processor 906. In some implementations, a user may interact with the device 900 via the I/O controller 908 or via hardware components controlled by the I/O controller 908.

[0171] In some implementations, the device 900 may include a single antenna 910. However, in some other implementations, the device 900 may have more than one antenna 910 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 906 may communicate bi-directionally, via the one or more antennas 910, wired, or wireless links as described herein. For example, the transceiver 906 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 906 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 910 for transmission, and to demodulate packets received from the one or more antennas 910. The transceiver 906 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0172] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 910 for transmitting the amplified signal into the air or wireless medium.

[0173] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 910 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0174] FIG. 10 illustrates an example of a device 1000 that supports PDU session establishment in accordance with aspects of the present disclosure. The device 1000 may be an example of a network entity 102 or a UE 104 as described herein. The device 1000 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 1000 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 1002, a memory 1004, a transceiver 1006, and, optionally, an I/O controller 1008. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0175] The processor 1002, the memory 1004, the transceiver 1006, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 1002, the memory 1004, the transceiver 1006, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0176] In some implementations, the processor 1002, the memory 1004, the transceiver 1006, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 1002 and the memory 1004 coupled with the processor 1002 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 1002, instructions stored in the memory 1004).

[0177] For example, the processor 1002 may support wireless communication at the device 1000 in accordance with examples as disclosed herein. The processor 1002 may be configured to operable to support a means for transmitting, to a session management function (SMF), a protocol data unit (PDU) session establishment request message comprising an indication of establishing backhaul (BH) PDU session for a user equipment

(UE) behind the MWAB-gNB; and a means for receiving, from the SMF, a PDU session establishment accept message. The processor 1002 may be configured to operable to support other means for other implementations of method 1800.

[0178] The processor 1002 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 1002 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 1002. The processor 1002 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 1004) to cause the device 1000 to perform various functions of the present disclosure.

[0179] The memory 1004 may include random access memory (RAM) and read-only memory (ROM). The memory 1004 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1002 cause the device 1000 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 1002 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 1004 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0180] The I/O controller 1008 may manage input and output signals for the device 1000. The I/O controller 1008 may also manage peripherals not integrated into the device M02. In some implementations, the I/O controller 1008 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 1008 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 1008 may be implemented as part of a processor, such as the processor 1006. In some implementations, a user may interact with the device 1000 via the I/O controller 1008 or via hardware components controlled by the I/O controller 1008.

[0181] In some implementations, the device 1000 may include a single antenna 1010. However, in some other implementations, the device 1000 may have more than one antenna 1010 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 1006 may communicate bi-directionally, via the one or more antennas 1010, wired, or wireless links as described herein. For example, the transceiver 1006 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 1006 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 1010 for transmission, and to demodulate packets received from the one or more antennas 1010. The transceiver 1006 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0182] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 1010 for transmitting the amplified signal into the air or wireless medium.

[0183] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 1010 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0184] FIG. 11 illustrates an example of a device 1100 that supports PDU session establishment in accordance with aspects of the present disclosure. The device 1100 may be an example of a network entity 102 as described herein. The device 1100 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 1100 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 1102, a memory 1104, a transceiver 1106, and, optionally, an I/O controller 1108. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0185] The processor 1102, the memory 1104, the transceiver 1106, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 1102, the memory 1104, the transceiver 1106, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0186] In some implementations, the processor 1102, the memory 1104, the transceiver 1106, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 1102 and the memory 1104 coupled with the processor 1102 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 1102, instructions stored in the memory 1104).

[0187] For example, the processor 1102 may support wireless communication at the device 1100 in accordance with examples as disclosed herein. The processor 1102 may be configured to operable to support a means for receiving, via the transceiver from a session management function (SMF), an Internet protocol (IP) address of a user equipment (UE), , a quality of service (QoS) flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a user plane function (UPF) for the UE (UE-UPF); a means for determining a third mapping between a data radio bear (DRB) of a UE component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI; and a means for transmitting, to the MWAB-UE, the third mapping. The processor 1102 may be configured to operable to support other means for other implementations of method 1900.

[0188] The processor 1102 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 1102 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 1102. The processor 1102 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 1104) to cause the device 1100 to perform various functions of the present disclosure.

[0189] The memory 1104 may include random access memory (RAM) and read-only memory (ROM). The memory 1104 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1102 cause the device 1100 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 1102 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 1104 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0190] The I/O controller 1108 may manage input and output signals for the device 1100. The I/O controller 1108 may also manage peripherals not integrated into the device M02. In some implementations, the I/O controller 1108 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 1108 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 1108 may be implemented as part of a processor, such as the processor 1106. In some implementations, a user may interact with the device 1100 via the I/O controller 1108 or via hardware components controlled by the I/O controller 1108.

[0191] In some implementations, the device 1100 may include a single antenna 1110. However, in some other implementations, the device 1100 may have more than one antenna 1110 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 1106 may communicate bi-directionally, via the one or more antennas 1110, wired, or wireless links as described herein. For example, the transceiver 1106 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 1106 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 1110 for transmission, and to demodulate packets received from the one or more antennas 1110. The transceiver 1106 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0192] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 1110 for transmitting the amplified signal into the air or wireless medium.

[0193] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 1110 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0194] FIG. 12 illustrates an example of a processor 1200 that supports PDU session establishment in accordance with aspects of the present disclosure. The processor 1200 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 1200 may include a controller 1202 configured to perform various operations in accordance with examples as described herein. The processor 1200 may optionally include at least one memory 1204. Additionally, or alternatively, the processor 1200 may optionally include one or more arithmetic-logic units (ALUs) 1200. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0195] The processor 1200 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1200) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0196] The controller 1202 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1200 to cause the processor 1200 to support various operations in accordance with examples as described herein. For example, the controller 1202 may operate as a control unit of the processor 1200, generating control signals that manage the operation of various components of the processor 1200. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0197] The controller 1202 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1204 and determine subsequent instruction(s) to be executed to cause the processor 1200 to support various operations in accordance with examples as described herein. The controller 1202 may be configured to track memory address of instructions associated with the memory 1204. The controller 1202 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1202 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1200 to cause the processor 1200 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1202 may be configured to manage flow of data within the processor 1200. The controller 1202 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1200.

[0198] The memory 1204 may include one or more caches (e.g., memory local to or included in the processor 1200 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 1204 may reside within or on a processor chipset (e.g., local to the processor 1200). In some other implementations, the memory 1204 may reside external to the processor chipset (e.g., remote to the processor 1200).

[0199] The memory 1204 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1200, cause the processor 1200 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 1202 and/or the processor 1200 may be configured to execute computer-readable instructions stored in the memory 1204 to cause the processor 1200 to perform various functions (e.g., functions or tasks supporting transmit power prioritization). For example, the processor 1200 and/or the controller 1202 may be coupled with or to the memory 1204, the processor 1200, the controller 1202, and the memory 1204 may be configured to perform various functions described herein. In some examples, the processor 1200 may include multiple processors and the memory 1204 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0200] The one or more ALUs 1200 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 1200 may reside within or on a processor chipset (e.g., the processor 1200). In some other implementations, the one or more ALUs 1200 may reside external to the processor chipset (e.g., the processor 1200). One or more ALUs 1200 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1200 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 1200 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 1200 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1200 to handle conditional operations, comparisons, and bitwise operations.

[0201] The processor 1200 may support wireless communication in accordance with examples as disclosed herein. The processor 1202 may be configured to or operable to support a means for receiving, from a user plane function (UPF) for a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE-UPF), a first message comprising a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a UPF for the UE (UE-UPF), wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a mobile gNB with wireless access backhauling (MWAB-UE) and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; a means for receiving, from a session management function (SMF), a second message comprising a PDU session establishment accept message for the first PDU session; and a means for transmitting, to the UE, the PDU session establishment accept message for the first PDU session.

[0202] FIG. 13 illustrates an example of a processor 1300 that supports PDU session establishment in accordance with aspects of the present disclosure. The processor 1300 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 1300 may include a controller 1302 configured to perform various operations in accordance with examples as described herein. The processor 1300 may optionally include at least one memory 1304. Additionally, or alternatively, the processor 1300 may optionally include one or more arithmetic-logic units (ALUs) 1300. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0203] The processor 1300 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1300) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0204] The controller 1302 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1300 to cause the processor 1300 to support various operations in accordance with examples as described herein. For example, the controller 1302 may operate as a control unit of the processor 1300, generating control signals that manage the operation of various components of the processor 1300. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0205] The controller 1302 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1304 and determine subsequent instruction(s) to be executed to cause the processor 1300 to support various operations in accordance with examples as described herein. The controller 1302 may be configured to track memory address of instructions associated with the memory 1304. The controller 1302 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1302 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1300 to cause the processor 1300 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1302 may be configured to manage flow of data within the processor 1300. The controller 1302 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1300.

[0206] The memory 1304 may include one or more caches (e.g., memory local to or included in the processor 1300 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 1304 may reside within or on a processor chipset (e.g., local to the processor 1300). In some other implementations, the memory 1304 may reside external to the processor chipset (e.g., remote to the processor 1300).

[0207] The memory 1304 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1300, cause the processor 1300 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 1302 and/or the processor 1300 may be configured to execute computer-readable instructions stored in the memory 1304 to cause the processor 1300 to perform various functions (e.g., functions or tasks supporting transmit power prioritization). For example, the processor 1300 and/or the controller 1302 may be coupled with or to the memory 1304, the processor 1300, the controller 1302, and the memory 1304 may be configured to perform various functions described herein. In some examples, the processor 1300 may include multiple processors and the memory 1304 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0208] The one or more ALUs 1300 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 1300 may reside within or on a processor chipset (e.g., the processor 1300). In some other implementations, the one or more ALUs 1300 may reside external to the processor chipset (e.g., the processor 1300). One or more ALUs 1300 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1300 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 1300 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 1300 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1300 to handle conditional operations, comparisons, and bitwise operations.

[0209] The processor 1300 may support wireless communication in accordance with examples as disclosed herein. The processor 1302 may be configured to or operable to support a means for receiving, from an access and mobility management function (AMF), an identity of a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a user plane function (UPF) for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node; a means for determining a UE-UPF for the first PDU session; and a means for transmitting, to the UE-UPF, a N4 session establishment request message associated with the first PDU session.

[0210] FIG. 14 illustrates an example of a processor 1400 that supports PDU session establishment in accordance with aspects of the present disclosure. The processor 1400 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 1400 may include a controller 1402 configured to perform various operations in accordance with examples as described herein. The processor 1400 may optionally include at least one memory 1404. Additionally, or alternatively, the processor 1400 may optionally include one or more arithmetic-logic units (ALUs) 1400. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0211] The processor 1400 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1400) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0212] The controller 1402 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1400 to cause the processor 1400 to support various operations in accordance with examples as described herein. For example, the controller 1402 may operate as a control unit of the processor 1400, generating control signals that manage the operation of various components of the processor 1400. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0213] The controller 1402 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1404 and determine subsequent instruction(s) to be executed to cause the processor 1400 to support various operations in accordance with examples as described herein. The controller 1402 may be configured to track memory address of instructions associated with the memory 1404. The controller 1402 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1402 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1400 to cause the processor 1400 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1402 may be configured to manage flow of data within the processor 1400. The controller 1402 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1400.

[0214] The memory 1404 may include one or more caches (e.g., memory local to or included in the processor 1400 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 1404 may reside within or on a processor chipset (e.g., local to the processor 1400). In some other implementations, the memory 1404 may reside external to the processor chipset (e.g., remote to the processor 1400).

[0215] The memory 1404 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1400, cause the processor 1400 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 1402 and/or the processor 1400 may be configured to execute computer-readable instructions stored in the memory 1404 to cause the processor 1400 to perform various functions (e.g., functions or tasks supporting transmit power prioritization). For example, the processor 1400 and/or the controller 1402 may be coupled with or to the memory 1404, the processor 1400, the controller 1402, and the memory 1404 may be configured to perform various functions described herein. In some examples, the processor 1400 may include multiple processors and the memory 1404 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0216] The one or more ALUs 1400 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 1400 may reside within or on a processor chipset (e.g., the processor 1400). In some other implementations, the one or more ALUs 1400 may reside external to the processor chipset (e.g., the processor 1400). One or more ALUs 1400 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1400 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 1400 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation.

Additionally, or alternatively, the one or more ALUs 1400 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1400 to handle conditional operations, comparisons, and bitwise operations.

[0217] The processor 1400 may support wireless communication in accordance with examples as disclosed herein. The processor 1402 may be configured to or operable to support a means for transmitting, to a session management function (SMF), a protocol data unit (PDU) session establishment request message comprising an indication of establishing backhaul (BH) PDU session for a user equipment (UE) behind the MWAB-gNB; and a means for receiving, from the SMF, a PDU session establishment accept message.

[0218] FIG. 15 illustrates an example of a processor 1500 that supports PDU session establishment in accordance with aspects of the present disclosure. The processor 1500 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 1500 may include a controller 1502 configured to perform various operations in accordance with examples as described herein. The processor 1500 may optionally include at least one memory 1504. Additionally, or alternatively, the processor 1500 may optionally include one or more arithmetic-logic units (ALUs) 1500. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0219] The processor 1500 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1500) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0220] The controller 1502 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1500 to cause the processor 1500 to support various operations in accordance with examples as described herein. For example, the controller 1502 may operate as a control unit of the processor 1500, generating control signals that manage the operation of various components of the processor 1500. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0221] The controller 1502 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1504 and determine subsequent instruction(s) to be executed to cause the processor 1500 to support various operations in accordance with examples as described herein. The controller 1502 may be configured to track memory address of instructions associated with the memory 1504. The controller 1502 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1502 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1500 to cause the processor 1500 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1502 may be configured to manage flow of data within the processor 1500. The controller 1502 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1500.

[0222] The memory 1504 may include one or more caches (e.g., memory local to or included in the processor 1500 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 1504 may reside within or on a processor chipset (e.g., local to the processor 1500). In some other implementations, the memory 1504 may reside external to the processor chipset (e.g., remote to the processor 1500).

[0223] The memory 1504 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1500, cause the processor 1500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory.

The controller 1502 and/or the processor 1500 may be configured to execute computer-readable instructions stored in the memory 1504 to cause the processor 1500 to perform various functions (e.g., functions or tasks supporting transmit power prioritization). For example, the processor 1500 and/or the controller 1502 may be coupled with or to the memory 1504, the processor 1500, the controller 1502, and the memory 1504 may be configured to perform various functions described herein. In some examples, the processor 1500 may include multiple processors and the memory 1504 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0224] The one or more ALUs 1500 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 1500 may reside within or on a processor chipset (e.g., the processor 1500). In some other implementations, the one or more ALUs 1500 may reside external to the processor chipset (e.g., the processor 1500). One or more ALUs 1500 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1500 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 1500 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 1500 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1500 to handle conditional operations, comparisons, and bitwise operations.

[0225] The processor 1500 may support wireless communication in accordance with examples as disclosed herein. The processor 1502 may be configured to or operable to support a means for receiving, from a session management function (SMF), an Internet protocol (IP) address of a user equipment (UE), a quality of service (QoS) flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a user plane function (UPF) for the UE (UE-UPF); a means for determining a third mapping between a data radio bear (DRB) of a UE component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI; and a means for transmitting, to the MWAB-UE, the third mapping.

[0226] FIG. 16 illustrates a flowchart of a method 1600 that supports PDU session establishment in accordance with aspects of the present disclosure. The operations of the method 1600 may be implemented by a device or its components as described herein. For example, the operations of the method 1600 may be performed by a core network 106 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0227] At 1605, the method may include receiving, from a user plane function (UPF) for a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE-UPF), a first message comprising a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a UPF for the UE (UE-UPF), wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a mobile gNB with wireless access backhauling (MWAB-UE) and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node. The operations of 1605 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1605 may be performed by a device as described with reference to FIG. 1A.

[0228] At 1610, the method may include receiving, from a session management function (SMF), a second message comprising a PDU session establishment accept message for the first PDU session. The operations of 1610 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 110 may be performed by a device as described with reference to FIG. 1A.

[0229] At 1615, the method may include transmitting, to the UE, the PDU session establishment accept message for the first PDU session. The operations of 1215 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1615 may be performed by a device as described with reference to FIG. 1A.

[0230] In some embodiment, the method may further include determining the MWAB-UE based on an Internet protocol (IP) address of the MWAB-gNB comprised in the first message; determining, based on the MWAB-UE, the SMF for the first PDU session, wherein the SMF for the first PDU session and the SMF for the second PDU session are a same SMF; and preserving a first mapping between the UE and the MWAB-UE. In some embodiment, the method may further include transmitting, to the SMF, the PDU session establishment request message and an identity of the MWAB-UE.

[0231] In some embodiment, the method may further include receiving, from the SMF, a transfer message associated with the first PDU session, wherein the transfer message comprises an identity of the UE; determining, based on the identity of the UE and the first mapping, the MWAB-UE and the MWAB-gNB; determining a MWAB-UE-UPF based on the MWAB-gNB and a second mapping between the MWAB-gNB and the MWAB-UE-UPF; and transmitting, to the MWAB-UE-UPF, the PDU session establishment accept message via a N2 message towards MWAB-gNB.

[0232] FIG. 17 illustrates a flowchart of a method 1700 that supports PDU session establishment in accordance with aspects of the present disclosure. The operations of the method 1700 may be implemented by a device or its components as described herein. For example, the operations of the method 1700 may be performed by a core network 106 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0233] At 1705, the method may include receiving, from an access and mobility management function (AMF), an identity of a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a user plane function (UPF) for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node. The operations of 1705 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1705 may be performed by a device as described with reference to FIG. 1A.

[0234] At 1710, the method may include determining a UE-UPF for the first PDU session. The operations of 1310 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1710 may be performed by a device as described with reference to FIG. 1A.

[0235] At 1715, the method may include transmitting, to the UE-UPF, a N4 session establishment request message associated with the first PDU session. The operations of 1315 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1715 may be performed by a device as described with reference to FIG. 1A.

[0236] In some embodiment, the method may further include transmitting, to the MWAB-UE, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a UPF for the MWAB-UE (MWAB-UE-UPF), wherein data of the first PDU session is exchanged via the second PDU session; and receiving, from the MWAB-UE, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE. In some embodiment, the method may further include binding the first PDU session with the second PDU session.

[0237] In some embodiment, the method may further include binding the first PDU session with the second PDU session in case of one of receiving the identity of the MWAB-UE and the PDU session establishment request message for the first PDU session from the AMF; or receiving the PDU session establishment request message for the second PDU session from the MWAB-UE, wherein the PDU session establishment request message comprises the identity of the UE.

[0238] In some embodiment, the UE-UPF for the first PDU session and the MWAB-UE-UPF for the second PDU session may be a same UPF. In some embodiment, the N4 session establishment request message may comprise an Internet protocol (IP) address of the MWAB-UE-UPF in the case that the UE-UPF is different from the MWAB-UE-UPF.

[0239] In some embodiment, the method may further include triggering a N4 session establishment/modification procedure towards the MWAB-UE-UPF by setting a packet filter set with the UE-UPF and an IP address of the UE.

[0240] In some embodiment, the method may further include transmitting, to a radio access network (RAN) node, the IP address of the UE, the identity of the UE, an identity of the first PDU session, a quality of service (QoS) flow setup request list of the UE, within a message associated with the second PDU session.

[0241] FIG. 18 illustrates a flowchart of a method 1800 that supports resource allocation for a backscattered communication system in accordance with aspects of the present disclosure. The operations of the method 1800 may be implemented by a device or its components as described herein. For example, the operations of the method 1400 may be performed by a network entity 102 or a UE 104 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0242] At 1805, the method may include transmitting, to a session management function (SMF), a protocol data unit (PDU) session establishment request message comprising an indication of establishing backhaul (BH) PDU session for a user equipment (UE) behind the MWAB-gNB. The operations of 1805 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1805 may be performed by a device as described with reference to FIG. 1A.

[0243] At 1810, the method may include receiving, from the SMF, a PDU session establishment accept message. The operations of 1810 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1810 may be performed by a device as described with reference to FIG. 1A.

[0244] In some embodiment, the method may further include receiving, from the SMF, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF); and transmitting, to the SMF, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE.

[0245] In some embodiment, the method may further include receiving, from a wireless access and a radio access network (RAN) node, a third mapping between a data radio bear (DRB) of the MWAB-UE and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI.

[0246] In some embodiment, the method may further include receiving, from the MWAB-gNB, an uplink (UL) PDU with a general packet radio service tunneling protocol for the user plane (GTP-U) header comprising a QFI.

[0247] In some embodiment, the method may further include determining a DRB based on the QFI, the IP address of the UE and the third mapping; and transmitting, to the RAN node via the DRB, the UL PDU.

[0248] In some embodiment, the method may further include receiving, from a RAN node, a downlink (DL) PDU with a GTP-U header; determining that a destination IP address of the DL PDU is the IP address of the UE; and transmitting, to the MWAB-gNB, the DL PDU.

[0249] FIG. 19 illustrates a flowchart of a method 1900 that supports resource allocation for a backscattered communication system in accordance with aspects of the present disclosure. The operations of the method 1900 may be implemented by a device or its components as described herein. For example, the operations of the method 1900 may be performed by a network entity 102 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0250] At 1905, the method may include receiving, via the transceiver from a session management function (SMF), an Internet protocol (IP) address of a user equipment (UE), a quality of service (QoS) flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a user plane function (UPF) for the UE (UE-UPF). The operations of 1905 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1905 may be performed by a device as described with reference to FIG. 1A.

[0251] At 1910, the method may include determining a third mapping between a data radio bear (DRB) of a UE component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI. The operations of 1910 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1910 may be performed by a device as described with reference to FIG. 1A.

[0252] At 1915, the method may include transmitting, to the MWAB-UE, the third mapping. The operations of 1915 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1915 may be performed by a device as described with reference to FIG. 1A.

[0253] In some embodiment, the method may further include determining a fourth mapping between the IP address of the UE and the second PDU session. In some embodiment, the method may further include receiving, via the transceiver from a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF), a downlink (DL) PDU with an IP address of the UE and a general packet radio service (GPRS) tunneling protocol for the user plane (GTP-U) header comprising a QFI; and determining a DRB for the MWAB-UE based on the IP address of the UE and QFI. In some embodiment, the RAN node may comprise a gNB with wireless access backhauling (MWAB) donor node.

[0254] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0255] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0256] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0257] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[0258] As used herein, including in the claims, an article "a" before an element is unrestricted and understood to refer to "at least one" of those elements or "one or more" of those elements. The terms "a," "at least one," "one or more," and "at least one of one or more" may be interchangeable. As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of" or "one or both of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as "based on condition A" may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on. Further, as used herein, including in the claims, a "set" may include one or more elements.

[0259] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. An apparatus for performing an access and mobility management function (AMF), the apparatus comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the apparatus to:

receive, from a user plane function (UPF) for a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE-UPF), a first message comprising a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a UPF for the UE (UE-UPF), wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a mobile gNB with wireless access backhauling (MWAB-UE) and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node;

receive, from a session management function (SMF), a second message comprising a PDU session establishment accept message for the first PDU session; and

transmit, to the UE, the PDU session establishment accept message for the first PDU session.

2. The apparatus of claim 1, wherein the apparatus is further caused to:

determine the MWAB-UE based on an Internet protocol (IP) address of the MWAB-gNB comprised in the first message;

determine, based on the MWAB-UE, the SMF for the first PDU session, wherein the SMF for the first PDU session and the SMF for the second PDU session are a same SMF; and

preserve a first mapping between the UE and the MWAB-UE.

3. The apparatus of claim 2, wherein the apparatus is further caused to:

transmit, to the SMF, the PDU session establishment request message and an identity of the MWAB-UE.

4. The apparatus of any of claims 1-3, wherein the apparatus is further caused to:

receive, from the SMF, a transfer message associated with the first PDU session, wherein the transfer message comprises an identity of the UE;

determine, based on the identity of the UE and the first mapping, the MWAB-UE and the MWAB-gNB;

determine a MWAB-UE-UPF based on the MWAB-gNB and a second mapping between the MWAB-gNB and the MWAB-UE-UPF; and

transmit, to the MWAB-UE-UPF, the PDU session establishment accept message via a N2 message towards MWAB-gNB.

5. An apparatus for performing a session management function (SMF), the apparatus comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the apparatus to:

receive, from an access and mobility management function (AMF), an identity of a user equipment (UE) component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and a protocol data unit (PDU) session establishment request message for a first PDU session between a user equipment (UE) and a user plane function (UPF) for the UE (UE-UPF) , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the mobile gNB with wireless access backhauling (MWAB-gNB), wherein the MWAB-UE and the MWAB-gNB are collocated to compose a mobile gNB with wireless access backhauling (MWAB) node;

determine a UE-UPF for the first PDU session; and

transmit, to the UE-UPF, a N4 session establishment request message associated with the first PDU session.

6. The apparatus of claim 5, wherein the apparatus is further caused to:

transmit, to the MWAB-UE, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a UPF for the MWAB-UE (MWAB-UE-UPF), wherein data of the first PDU session is exchanged via the second PDU session; and

receive, from the MWAB-UE, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE.

7. The apparatus of claim 6, wherein the apparatus is further caused to:

bind the first PDU session with the second PDU session.

8. The apparatus of claim 7, wherein the apparatus is caused to bind the first PDU session with the second PDU session in case of one of the following:

receiving the identity of the MWAB-UE and the PDU session establishment request message for the first PDU session from the AMF; or

receiving the PDU session establishment request message for the second PDU session from the MWAB-UE, wherein the PDU session establishment request message comprises the identity of the UE.

9. The apparatus of claim 6, wherein the UE-UPF for the first PDU session and the MWAB-UE-UPF for the second PDU session are a same UPF.

10. The apparatus of claim 6, wherein the N4 session establishment request message comprises an Internet protocol (IP) address of the MWAB-UE-UPF in the case that the UE-UPF is different from the MWAB-UE-UPF.

11. The apparatus of claim 10, wherein the apparatus is further caused to:

trigger a N4 session establishment/modification procedure towards the MWAB-UE-UPF by setting a packet filter set with the UE-UPF and an IP address of the UE.

12. The apparatus of any of claims 5-11, wherein the apparatus is further caused to:

transmit, to a radio access network (RAN) node, the IP address of the UE, the identity of the UE, an identity of the first PDU session, a quality of service (QoS) flow setup request list of the UE, within a message associated with the second PDU session.

13. A mobile next generation node B (gNB) with wireless access backhauling (MWAB) node comprising:

a gNB component of MWAB (MWAB-gNB); and

a user equipment (UE) component of the MWAB (MWAB-UE),

wherein the MWAB-UE is configured to:

transmit, to a session management function (SMF), a protocol data unit (PDU) session establishment request message comprising an indication of establishing backhaul (BH) PDU session for a user equipment (UE) behind the MWAB-gNB; and

receive, from the SMF, a PDU session establishment accept message.

14. The MWAB node of claim 13, wherein the MWAB-UE is further configured to:

receive, from the SMF, an identity of the UE and an indication of establishing a second PDU session between the MWAB-UE and a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF); and

transmit, to the SMF, a PDU session establishment request message for the second PDU session, wherein the PDU session establishment request message comprises the identity of the UE.

15. The MWAB node of claim 13, wherein the MWAB-UE is configured to:

receive, from a wireless access and a radio access network (RAN) node, a third mapping between a data radio bear (DRB) of the MWAB-UE and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI.

16. The MWAB node of any of claims 13-15, wherein the MWAB-UE is configured to:

receive, from the MWAB-gNB, an uplink (UL) PDU with a general packet radio service tunnelling protocol for the user plane (GTP-U) header comprising a QFI.

17. The MWAB node of claim 16, wherein the MWAB-UE is configured to:

determine a DRB based on the QFI, the IP address of the UE and the third mapping; and

transmit, to the RAN node via the DRB, the UL PDU.

18. A radio access network (RAN) node comprising:

a processor; and

a transceiver coupled to the processor,

wherein the processor is configured to:

receive, via the transceiver from a session management function (SMF), an Internet protocol (IP) address of a user equipment (UE), a quality of service (QoS) flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a user plane function (UPF) for the UE (UE-UPF);

determine a third mapping between a data radio bear (DRB) of a UE component of a mobile next generation node B (gNB) with wireless access backhauling (MWAB-UE) and one of: an Internet protocol (IP) address of the UE, a quality of service (QoS) flow identifier (QFI); or the IP address of the UE and the QFI; and

transmit, to the MWAB-UE, the third mapping.

19. The RAN node of claim 18, wherein the processor is further configured to:

determine a fourth mapping between the IP address of the UE and the second PDU session.

20. The RAN node of claim 18 or 19, wherein the processor is further configured to:

receive, via the transceiver from a user plane function (UPF) for the MWAB-UE (MWAB-UE-UPF), a downlink (DL) PDU with an IP address of the UE and a general packet radio service (GPRS) tunnelling protocol for the user plane (GTP-U) header comprising a QFI; and

determine a DRB for the MWAB-UE based on the IP address of the UE and QFI.

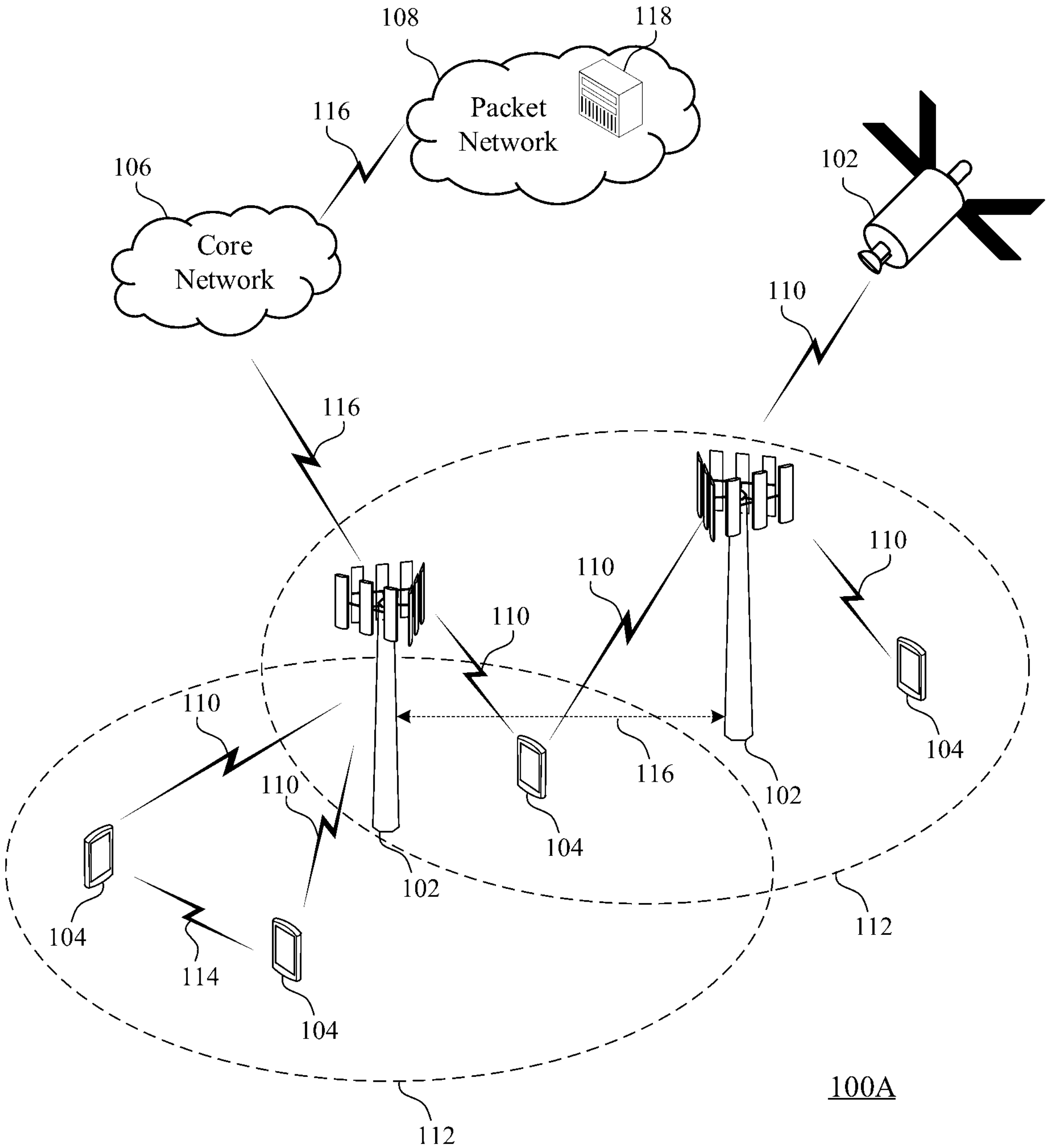
108
118
Packet
Network
116
106
Core
Network
102
110
116
110
110
110
110
110
116
104
102
104
102
104
114
104
112
100A
112

FIG. 1A

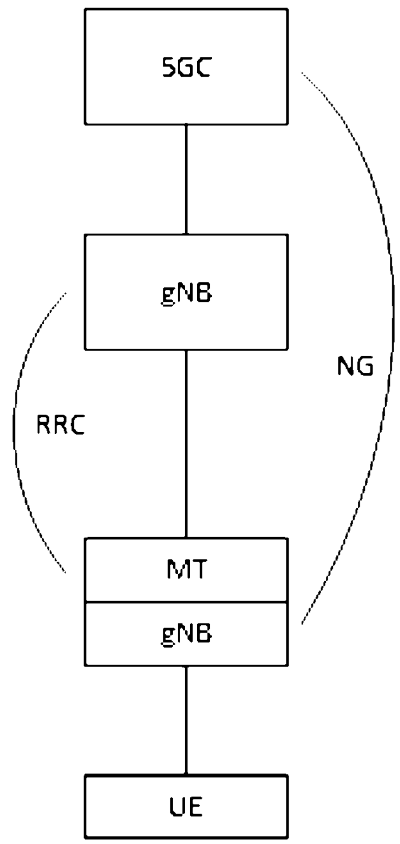
5GC
gNB
NG
RRC
MT
gNB
UE

FIG. 1B

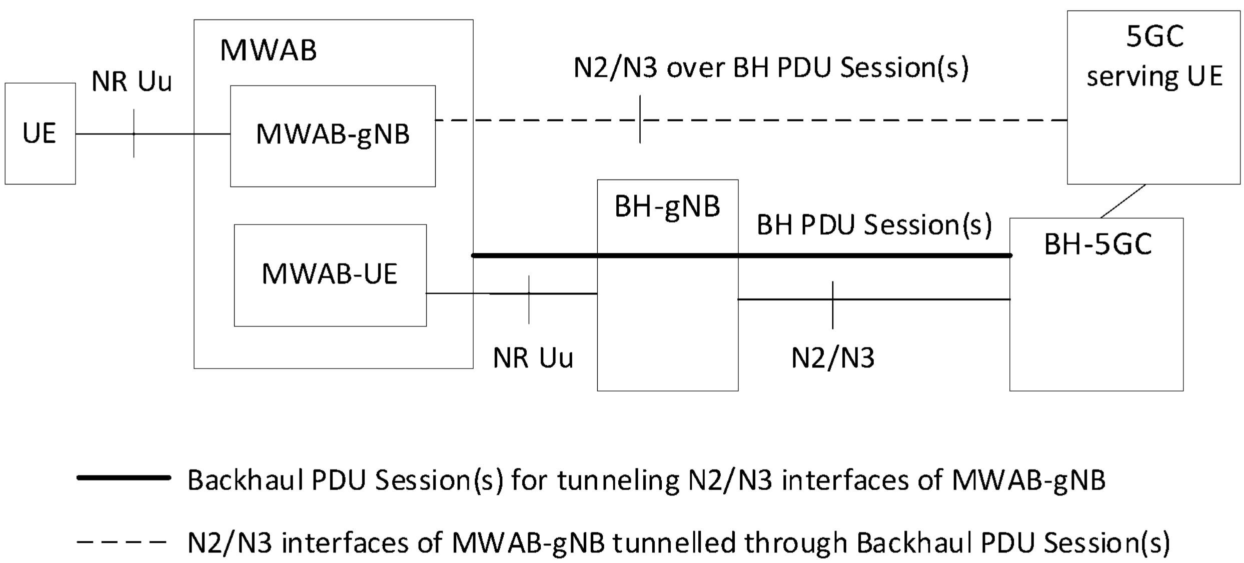
MWAB
NR Uu
UE
MWAB-gNB
N2/N3 over BH PDU Session(s)
5GC
serving UE
MWAB-UE
BH-gNB
BH PDU Session(s)
BH-5GC
NR Uu
N2/N3
Backhaul PDU Session(s) for tunneling N2/N3 interfaces of MWAB-gNB
N2/N3 interfaces of MWAB-gNB tunnelled through Backhaul PDU Session(s)

FIG. 1C

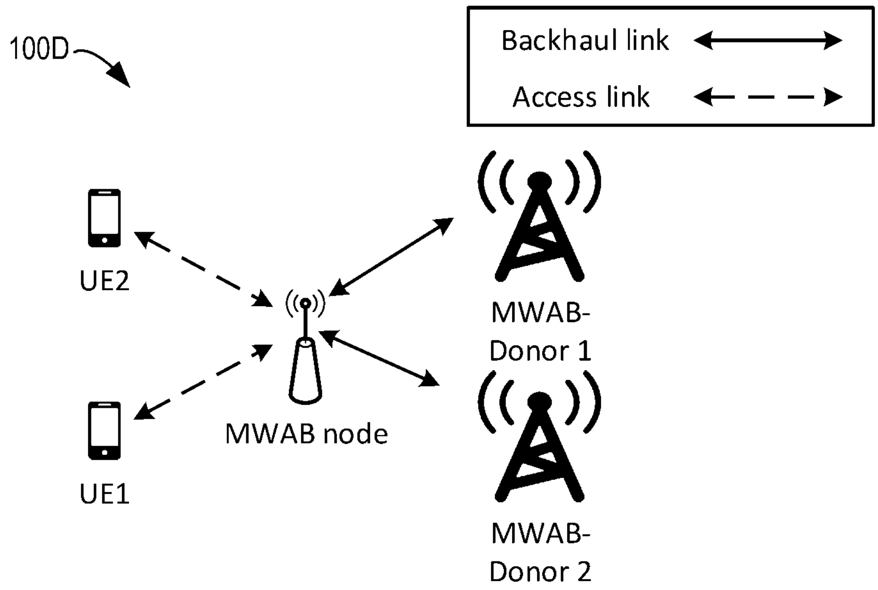
100D
Backhaul link
Access link
UE2
UE1
MWAB node
MWAB-
Donor 1
MWAB-
Donor 2

FIG. 1D

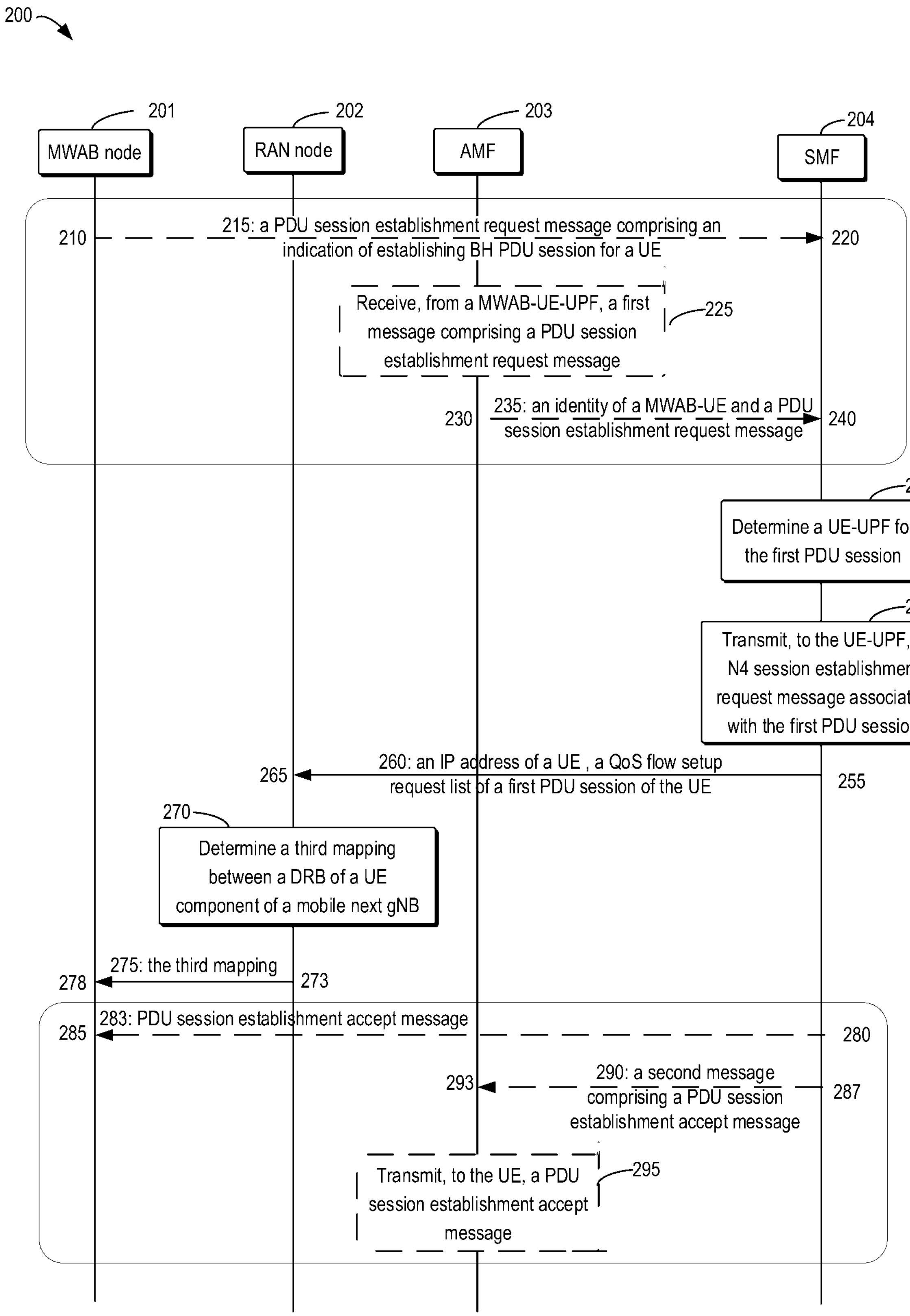
200
201
MWAB node
202
RAN node
203
AMF
204
SMF
210
215: a PDU session establishment request message comprising an indication of establishing BH PDU session for a UE
220
Receive, from a MWAB-UE-UPF, a first message comprising a PDU session establishment request message
225
230
235: an identity of a MWAB-UE and a PDU session establishment request message
240
245
Determine a UE-UPF for the first PDU session
250
Transmit, to the UE-UPF, a N4 session establishment request message associated with the first PDU session
260: an IP address of a UE , a QoS flow setup request list of a first PDU session of the UE
265
255
270
Determine a third mapping between a DRB of a UE component of a mobile next gNB
275: the third mapping
278
273
283: PDU session establishment accept message
285
280
290: a second message comprising a PDU session establishment accept message
293
287
Transmit, to the UE, a PDU session establishment accept message
295

FIG. 2

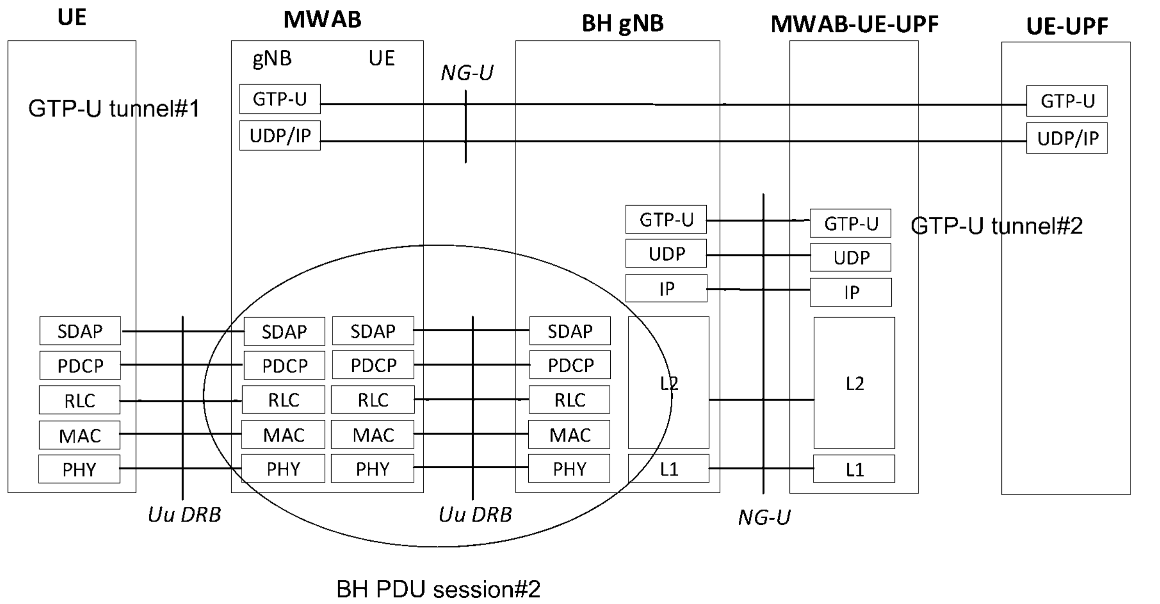
UE
MWAB
BH gNB
MWAB-UE-UPF
UE-UPF
gNB
UE
NG-U
GTP-U tunnel#1
GTP-U
UDP/IP
GTP-U
UDP/IP
GTP-U
UDP
IP
GTP-U
UDP
IP
GTP-U tunnel#2
SDAP
PDCP
RLC
MAC
PHY
SDAP
PDCP
RLC
MAC
PHY
SDAP
PDCP
RLC
MAC
PHY
SDAP
PDCP
RLC
MAC
PHY
L2
L1
L2
L1
Uu DRB
Uu DRB
NG-U
BH PDU session#2

FIG. 3

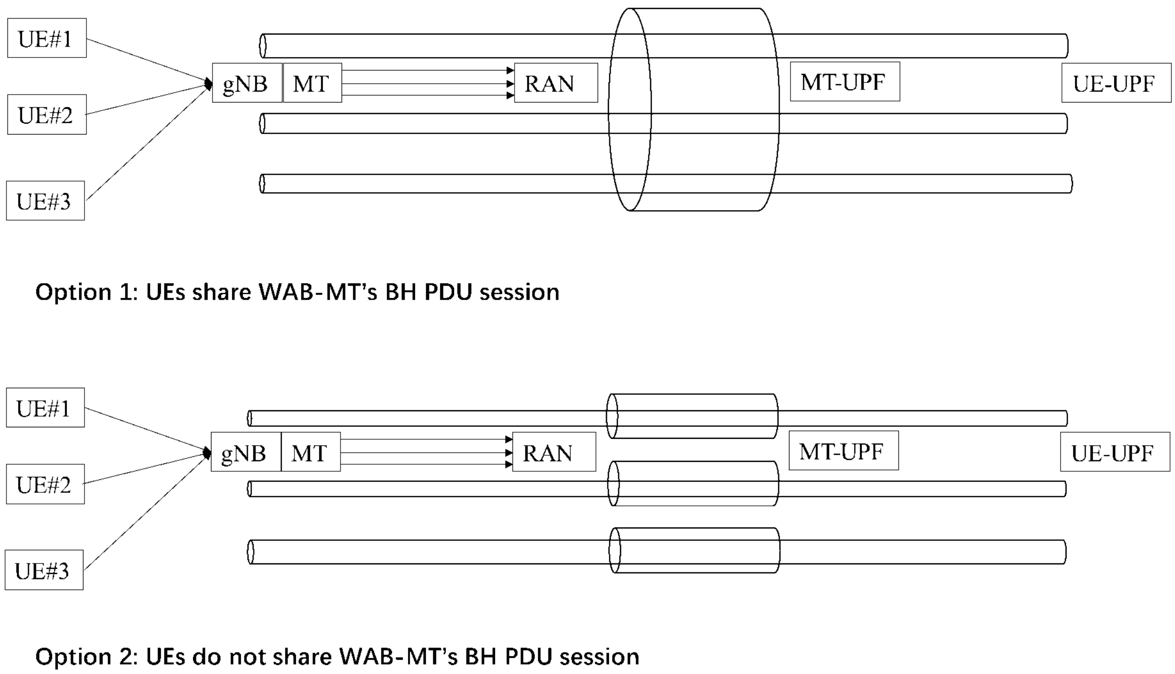
UE#1
UE#2
UE#3
gNB
MT
RAN
MT-UPF
UE-UPF
Option 1: UEs share WAB-MT's BH PDU session
UE#1
UE#2
UE#3
gNB
MT
RAN
MT-UPF
UE-UPF
Option 2: UEs do not share WAB-MT's BH PDU session

FIG. 4

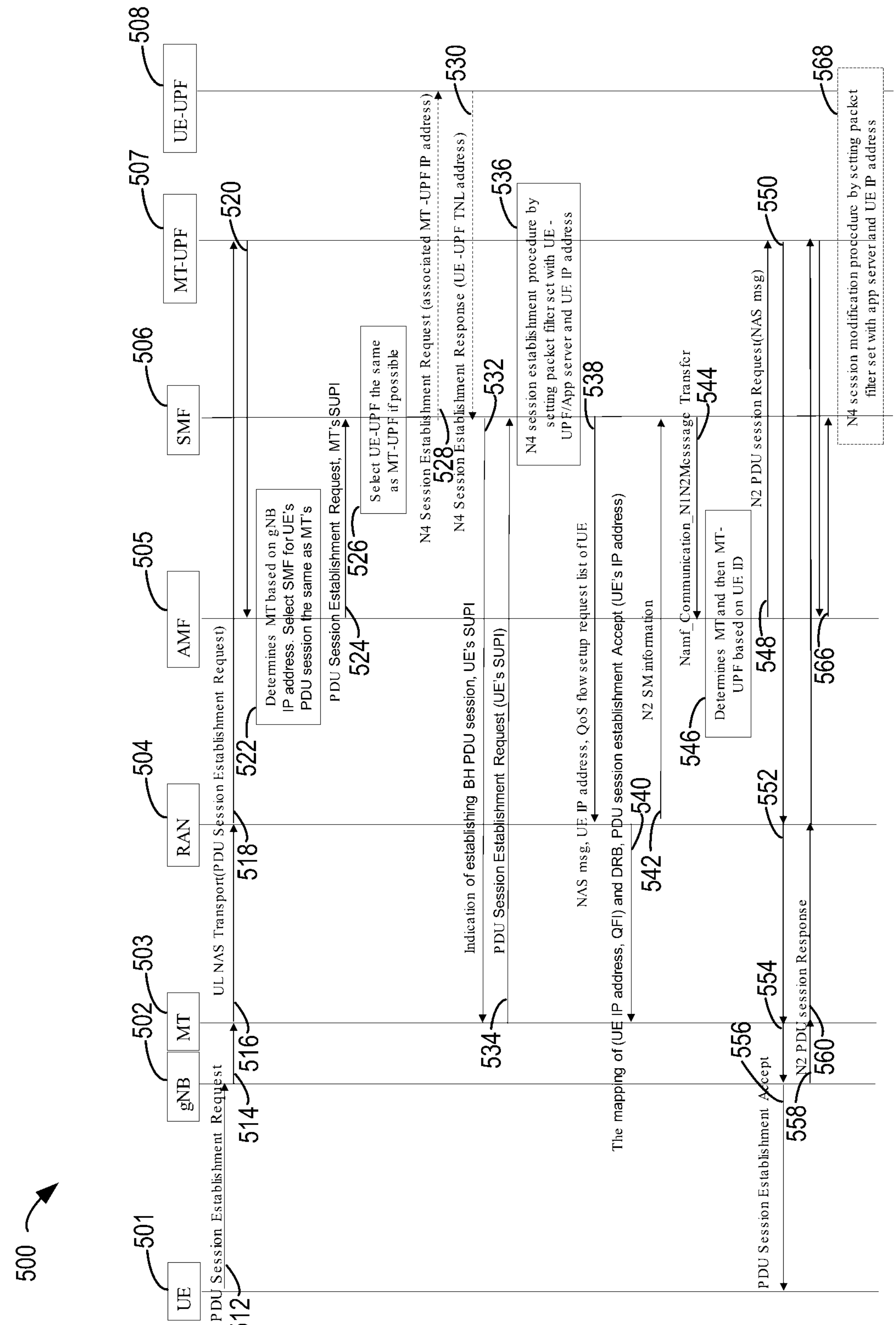
500
UE
501
gNB
502
MT
503
RAN
504
AMF
505
SMF
506
MT-UPF
507
UE-UPF
508
PDU Session Establishment Request
512
514
UL NAS Transport(PDU Session Establishment Request)
516
518
520
Determines MT based on gNB IP address. Select SMF for UE's PDU session the same as MT's
522
PDU Session Establishment Request, MT's SUPI
524
Select UE-UPF the same as MT-UPF if possible
526
N4 Session Establishment Request (associated MT-UPF IP address)
528
N4 Session Establishment Response (UE-UPF TNL address)
530
532
Indication of establishing BH PDU session, UE's SUPI
PDU Session Establishment Request (UE's SUPI)
534
N4 session establishment procedure by setting packet filter set with UE-UPF/App server and UE IP address
536
538
NAS msg, UE IP address, QoS flow setup request list of UE
The mapping of (UE IP address, QFI) and DRB, PDU session establishment Accept (UE's IP address)
540
542
N2 SM information
Namf_Communication_N1N2Message Transfer
544
Determines MT and then MT-UPF based on UE ID
546
N2 PDU session Request(NAS msg)
548
550
552
554
PDU Session Establishment Accept
556
558
N2 PDU session Response
560
566
N4 session modification procedure by setting packet filter set with app server and UE IP address
568

FIG. 5

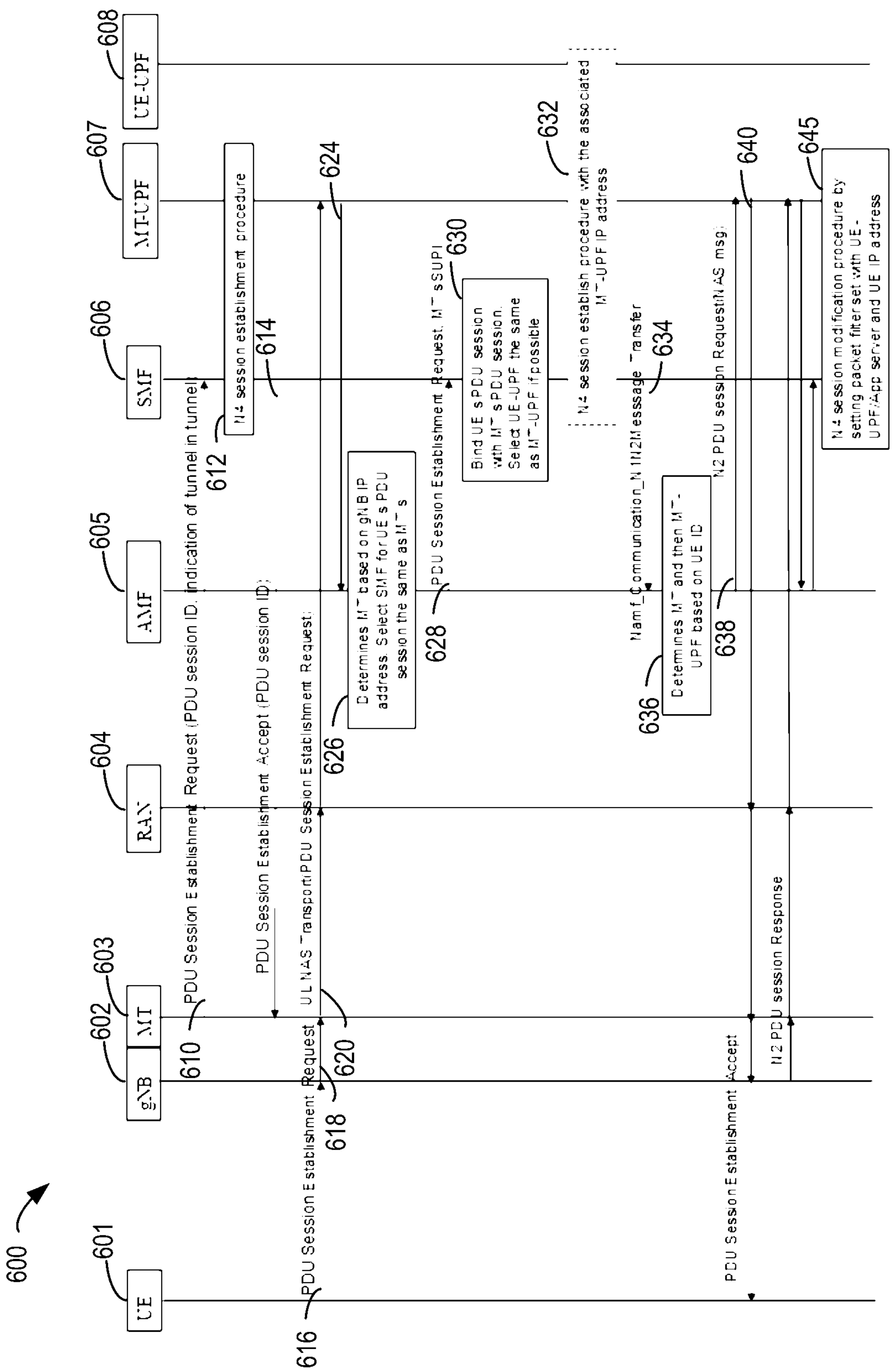
600
UE
601
gNB
602
MT
603
RAN
604
AMF
605
SMF
606
MT-UPF
607
UE-UPF
608
PDU Session Establishment Request (PDU session ID, Indication of tunnel in tunnel)
610
N4 session establishment procedure
612
614
PDU Session Establishment Accept (PDU session ID)
PDU Session Establishment Request
616
618
UL NAS Transport(PDU Session Establishment Request)
620
624
Determines MT based on gNB IP address. Select SMF for UE's PDU session the same as MT's
626
PDU Session Establishment Request, MT's SUPI
628
Bind UE's PDU session with MT's PDU session. Select UE-UPF the same as MT-UPF if possible
630
N4 session establish procedure with the associated MT-UPF IP address
632
Namf_Communication_N1N2Message Transfer
634
Determines MT and then MT-UPF based on UE ID
636
638
N2 PDU session Request(NAS msg)
640
PDU Session Establishment Accept
N2 PDU session Response
N4 session modification procedure by setting packet filter set with UE-UPF/App server and UE IP address
645

FIG. 6

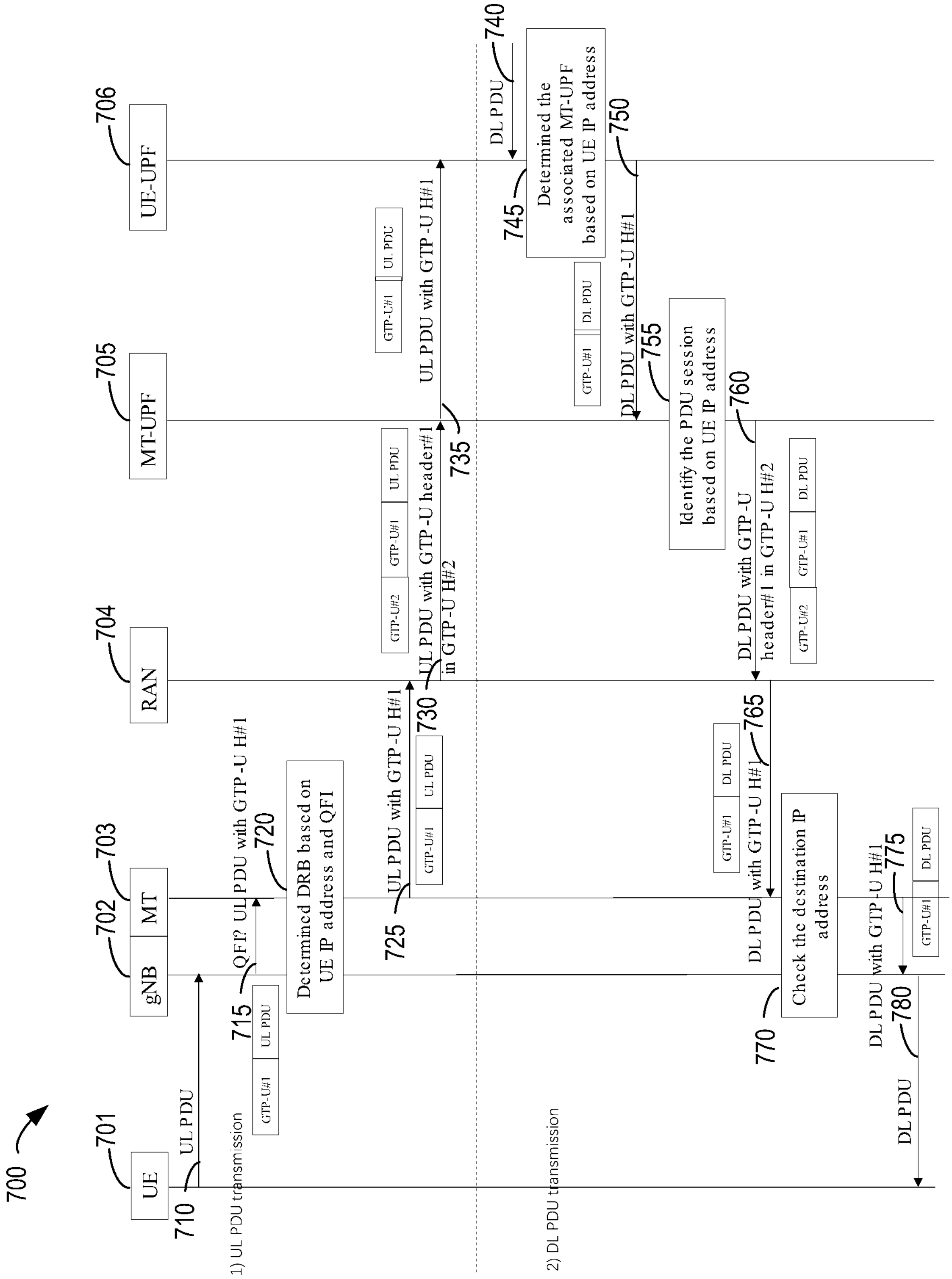
700
UE
701
gNB
702
MT
703
RAN
704
MT-UPF
705
UE-UPF
706
1) UL PDU transmission
2) DL PDU transmission
UL PDU
710
QFI? UL PDU with GTP-U H#1
715
GTP-U#1
UL PDU
Determined DRB based on UE IP address and QFI
720
UL PDU with GTP-U H#1
725
730
UL PDU with GTP-U header#1 in GTP-U H#2
GTP-U#2
735
UL PDU with GTP-U H#1
DL PDU
740
Determined the associated MT-UPF based on UE IP address
745
DL PDU with GTP-U H#1
750
DL PDU
Identify the PDU session based on UE IP address
755
DL PDU with GTP-U header#1 in GTP-U H#2
760
DL PDU with GTP-U H#1
765
Check the destination IP address
770
DL PDU with GTP-U H#1
775
DL PDU
780

FIG. 7

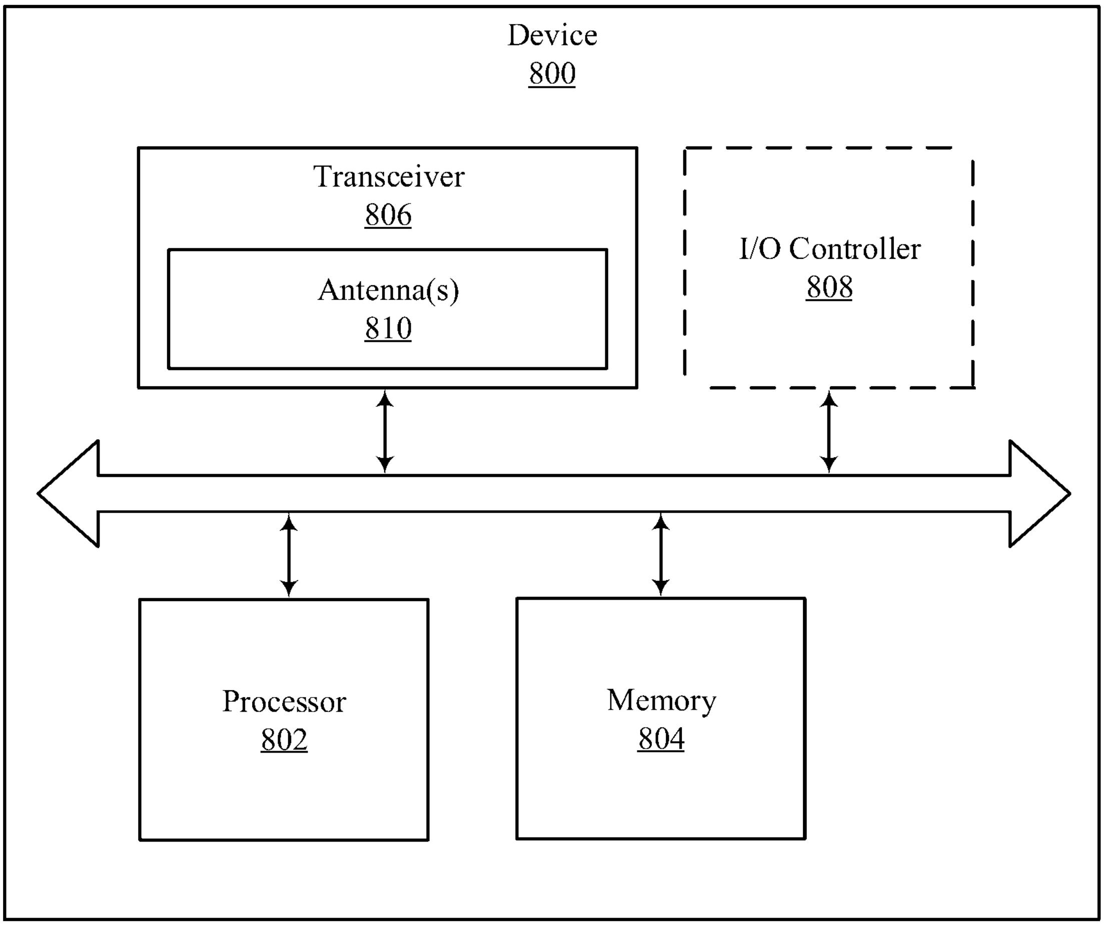
Device
800
Transceiver
806
Antenna(s)
810
I/O Controller
808
Processor
802
Memory
804

FIG. 8

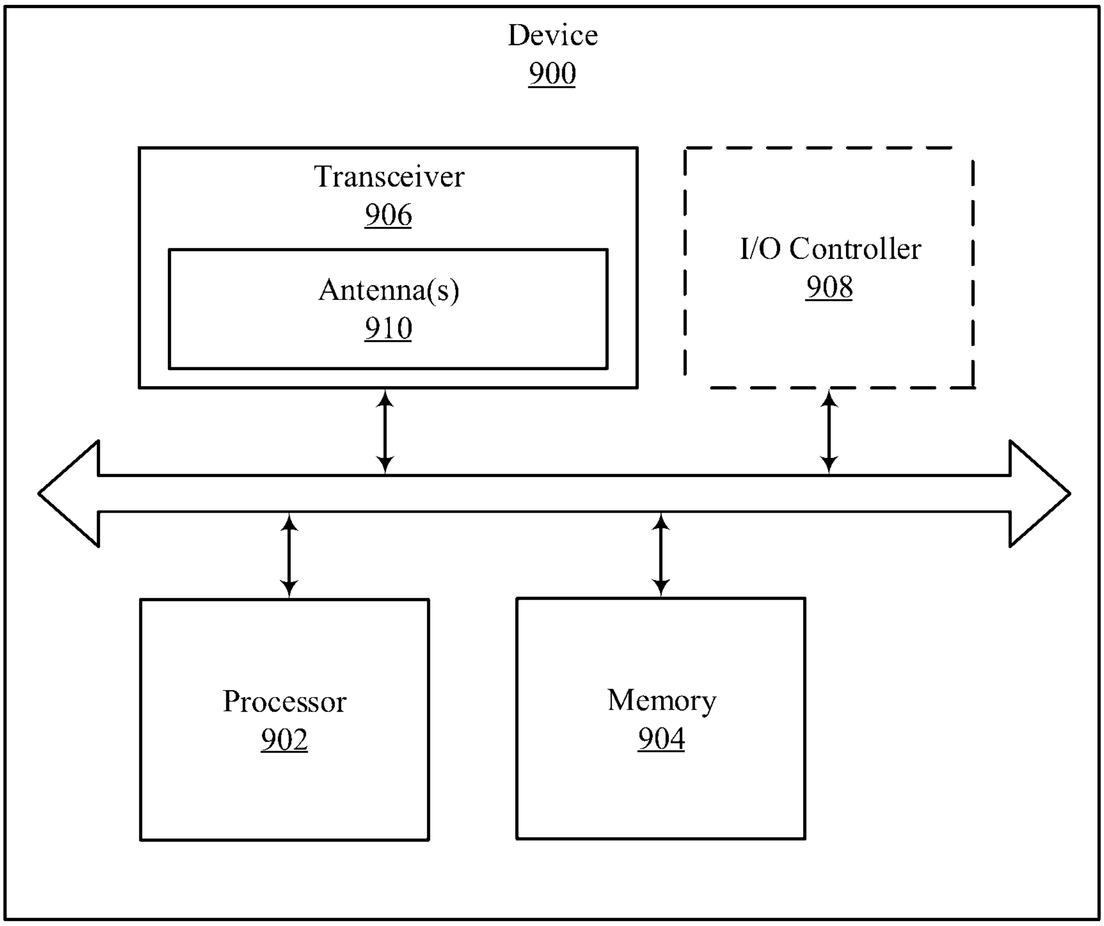
Device
900
Transceiver
906
Antenna(s)
910
I/O Controller
908
Processor
902
Memory
904

FIG. 9

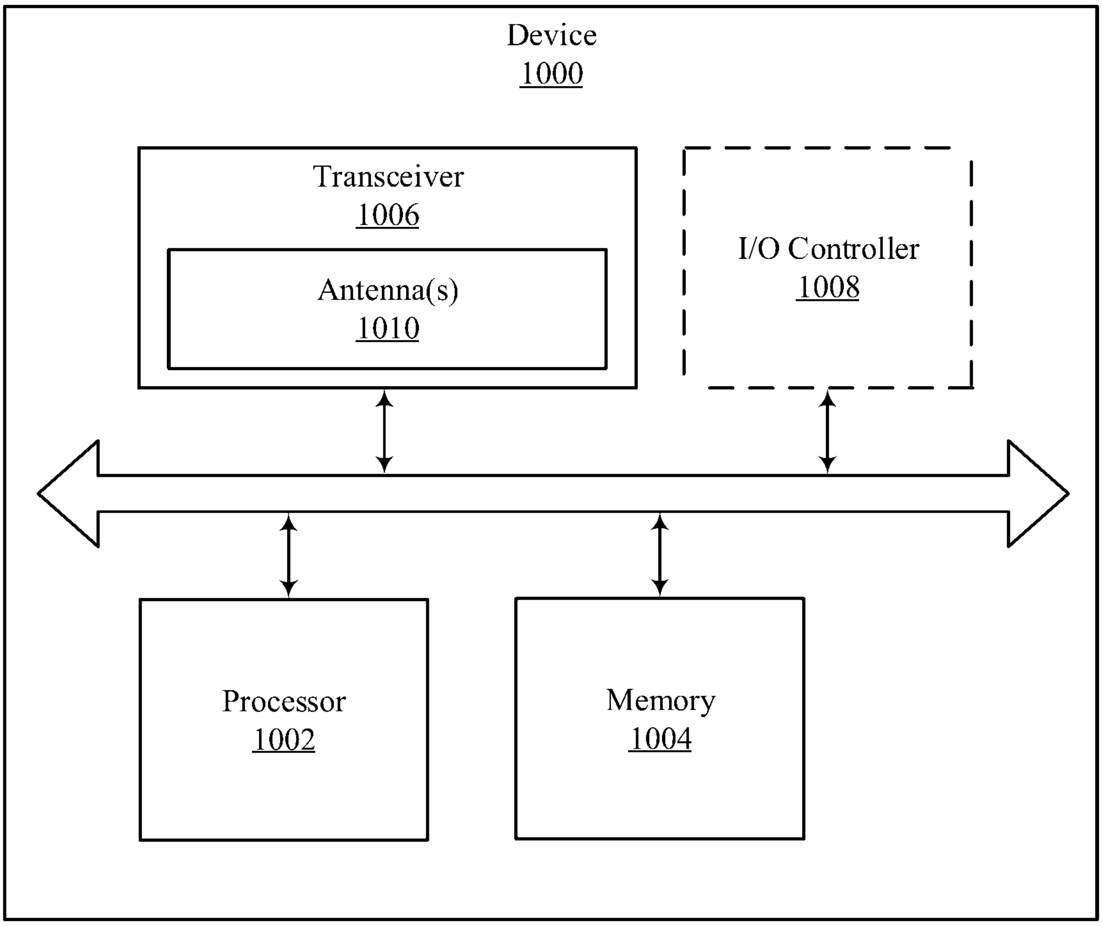
Device
1000
Transceiver
1006
Antenna(s)
1010
I/O Controller
1008
Processor
1002
Memory
1004

FIG. 10

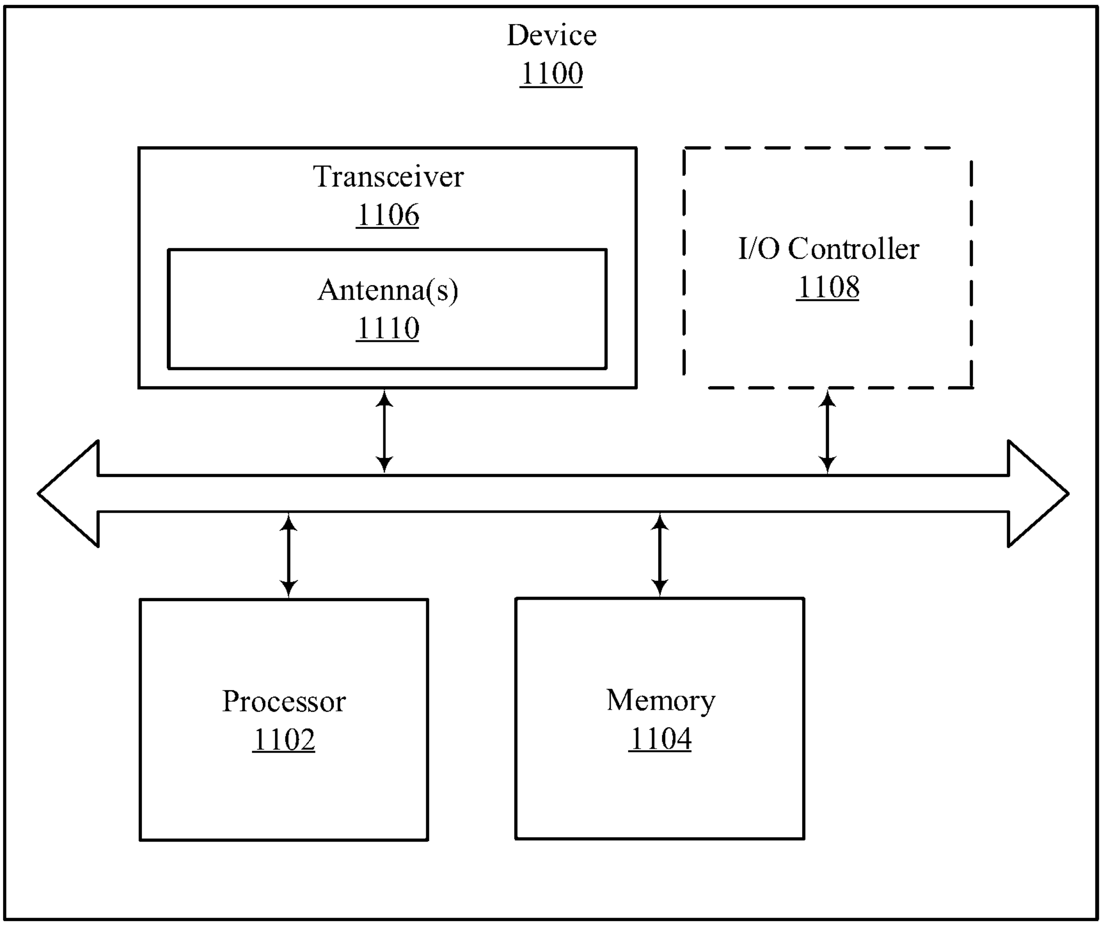
Device
1100
Transceiver
1106
Antenna(s)
1110
I/O Controller
1108
Processor
1102
Memory
1104

FIG. 11

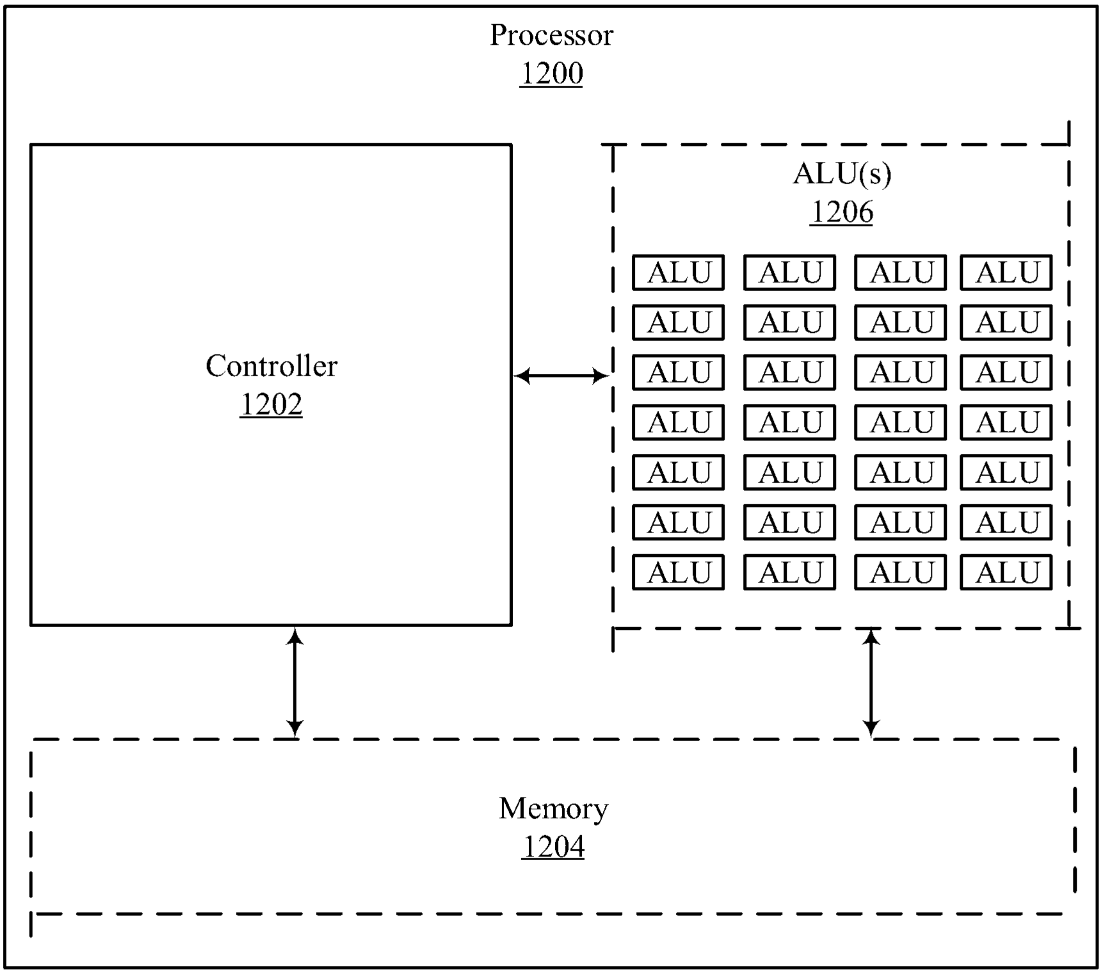

FIG. 12

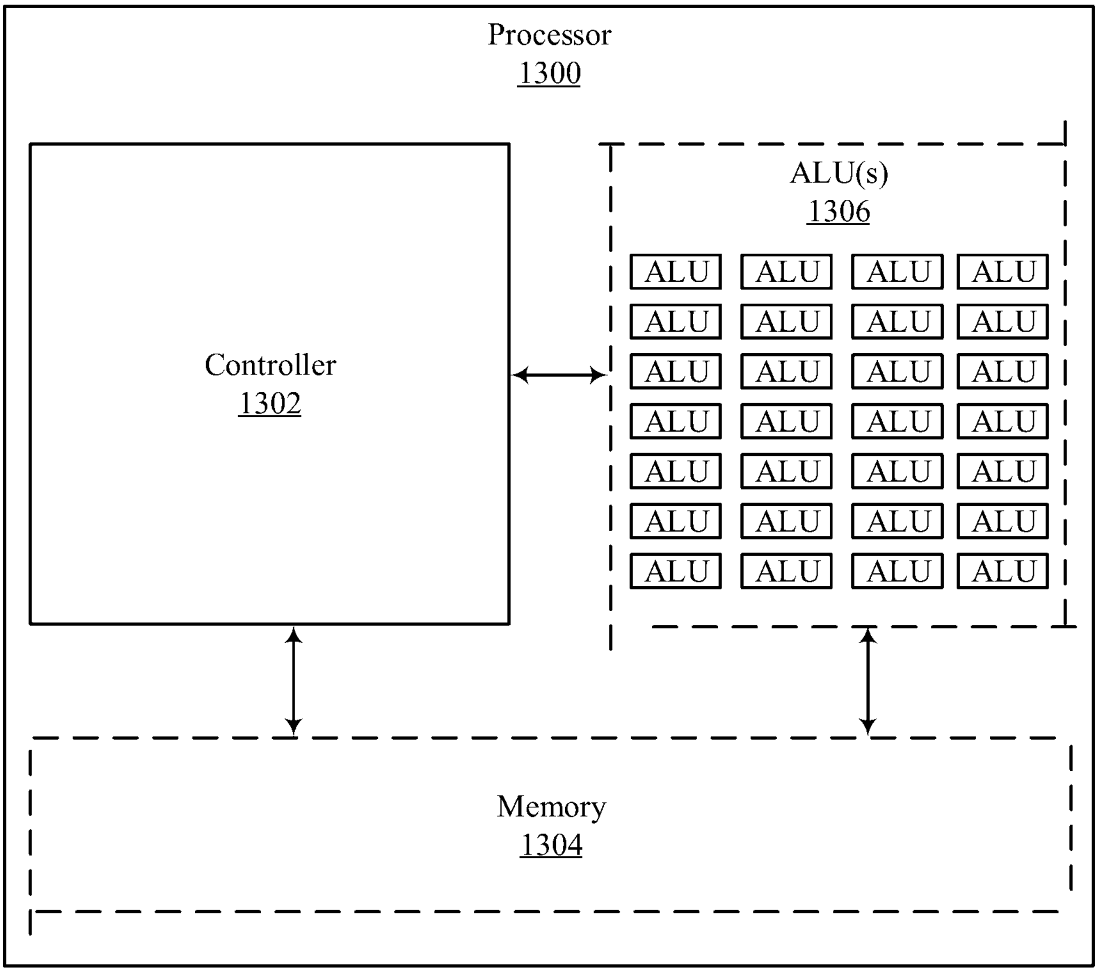

FIG. 13

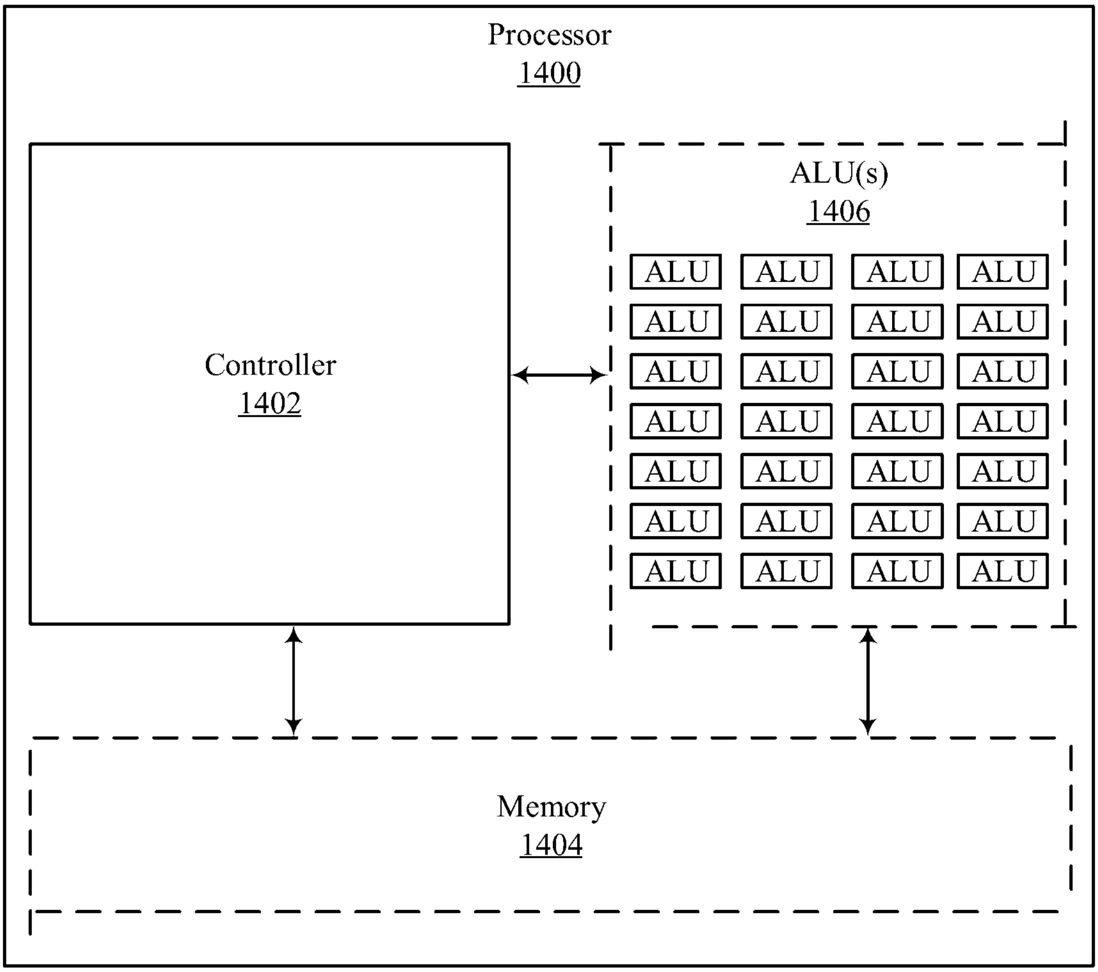

FIG. 14

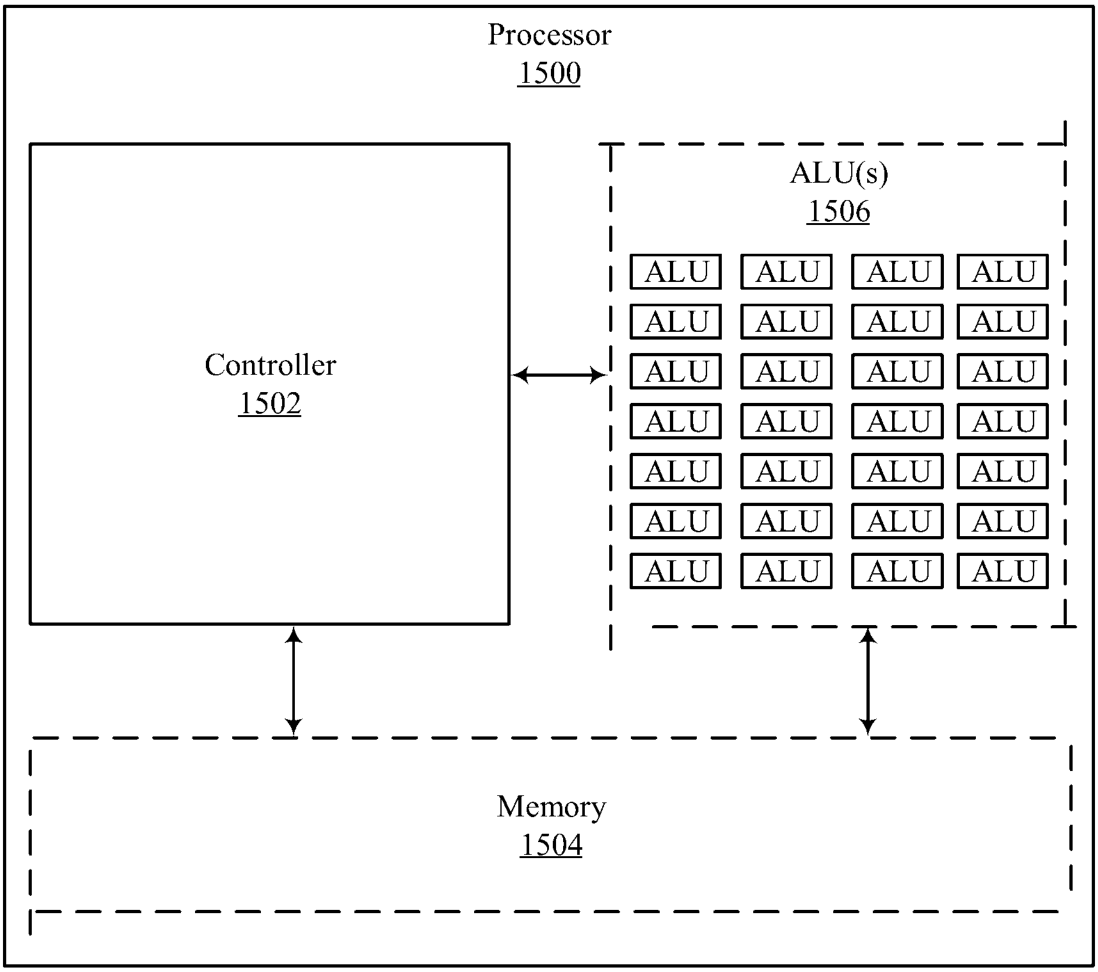

FIG. 15

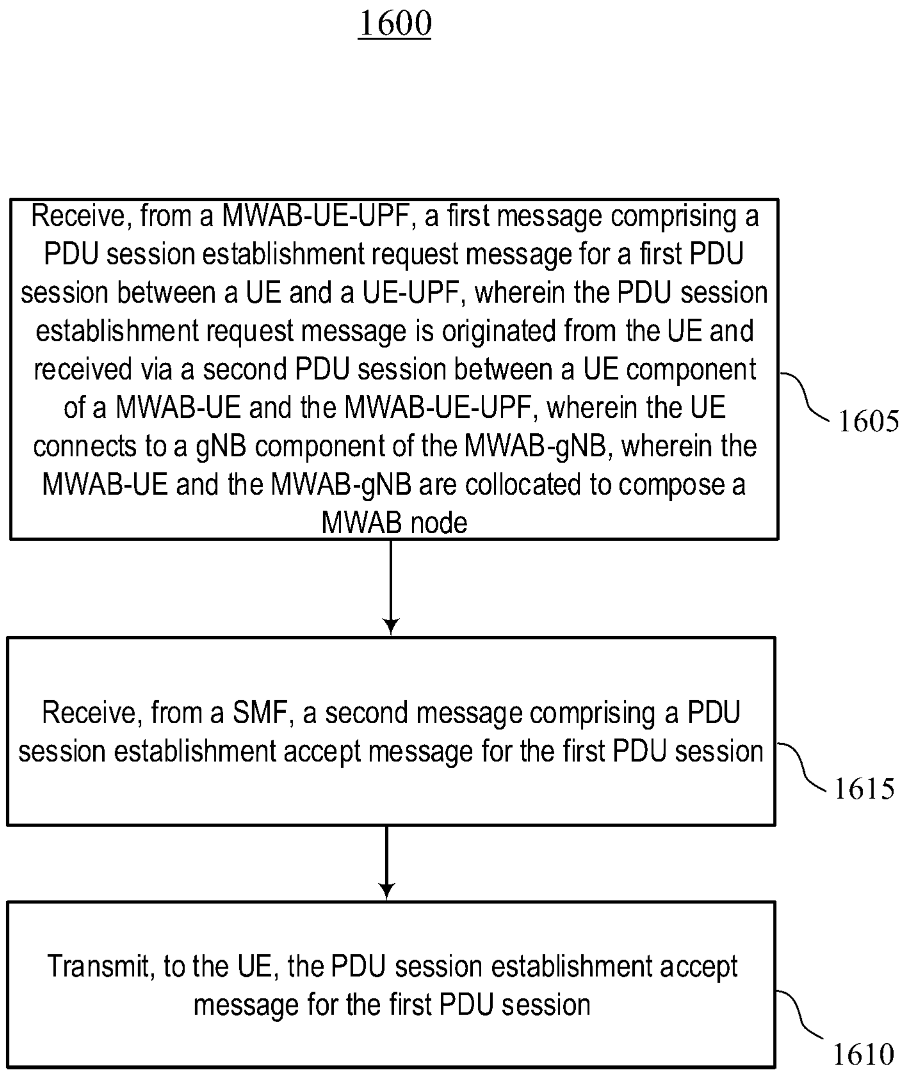
1600
Receive, from a MWAB-UE-UPF, a first message comprising a PDU session establishment request message for a first PDU session between a UE and a UE-UPF, wherein the PDU session establishment request message is originated from the UE and received via a second PDU session between a UE component of a MWAB-UE and the MWAB-UE-UPF, wherein the UE connects to a gNB component of the MWAB-gNB, wherein the MWAB-UE and the MWAB-gNB are collocated to compose a MWAB node
1605
Receive, from a SMF, a second message comprising a PDU session establishment accept message for the first PDU session
1615
Transmit, to the UE, the PDU session establishment accept message for the first PDU session
1610

FIG. 16

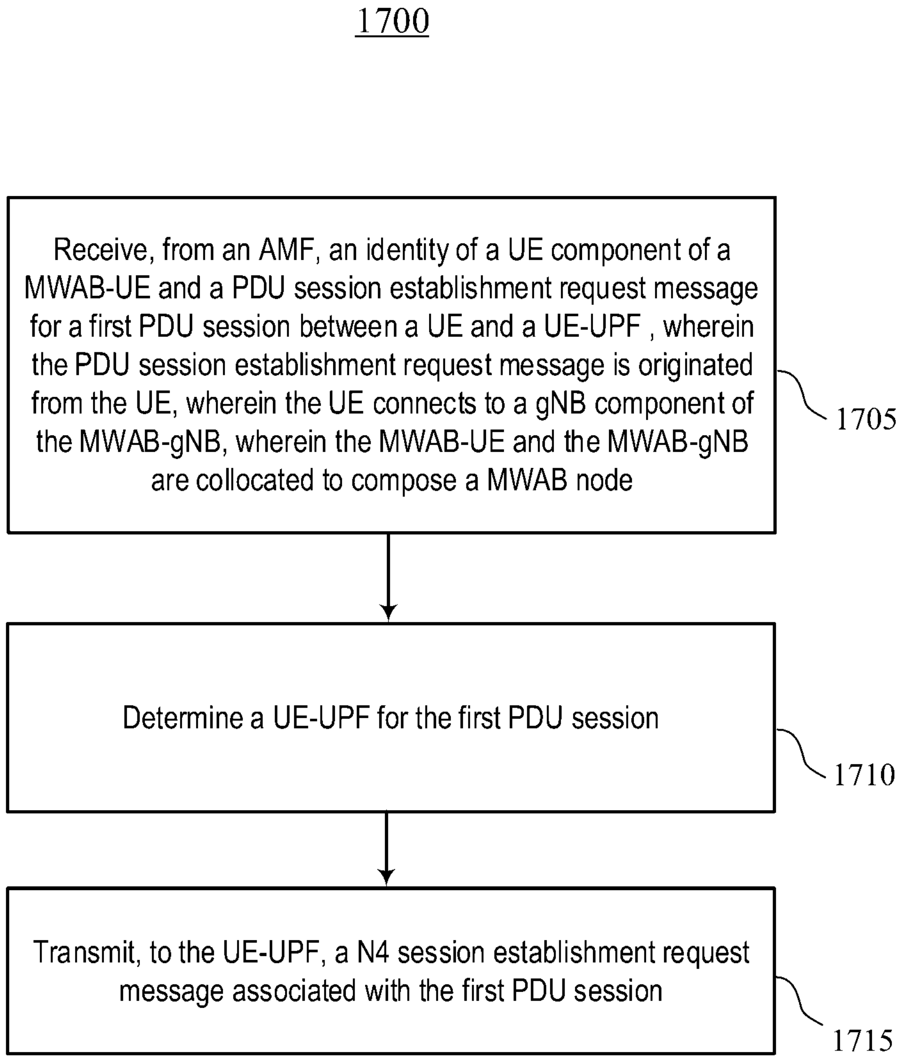
1700
Receive, from an AMF, an identity of a UE component of a MWAB-UE and a PDU session establishment request message for a first PDU session between a UE and a UE-UPF , wherein the PDU session establishment request message is originated from the UE, wherein the UE connects to a gNB component of the MWAB-gNB, wherein the MWAB-UE and the MWAB-gNB are collocated to compose a MWAB node
1705
Determine a UE-UPF for the first PDU session
1710
Transmit, to the UE-UPF, a N4 session establishment request message associated with the first PDU session
1715

FIG. 17

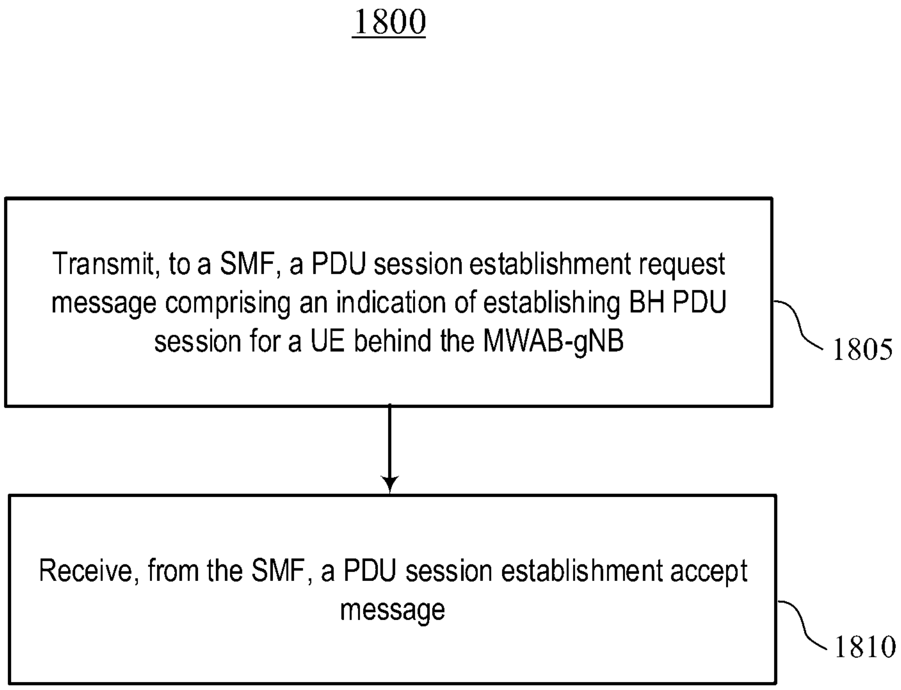
1800
Transmit, to a SMF, a PDU session establishment request message comprising an indication of establishing BH PDU session for a UE behind the MWAB-gNB
1805
Receive, from the SMF, a PDU session establishment accept message
1810

FIG. 18

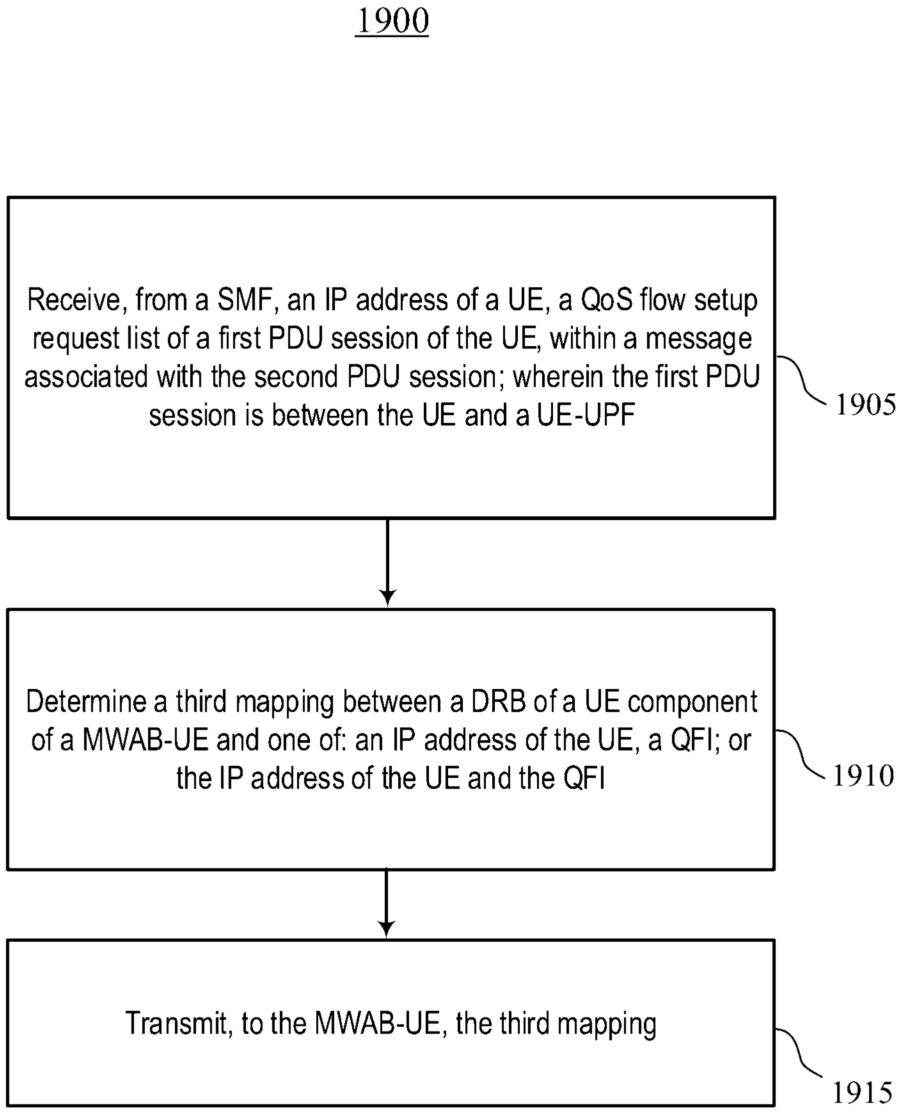
1900
Receive, from a SMF, an IP address of a UE, a QoS flow setup request list of a first PDU session of the UE, within a message associated with the second PDU session; wherein the first PDU session is between the UE and a UE-UPF
1905
Determine a third mapping between a DRB of a UE component of a MWAB-UE and one of: an IP address of the UE, a QFI; or the IP address of the UE and the QFI
1910
Transmit, to the MWAB-UE, the third mapping
1915

FIG. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/076446

A. CLASSIFICATION OF SUBJECT MATTER

H04W 76/10(2018.01)i

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)

IPC:H04W,H04L

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

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

3GPP,CNTXT,ENTXT,WPABS,VEN,CNKI:PDU,session,gNB,IAB,MWAB,UE,SMF,AMF,request, wireless access backhauling,VMR

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2023032529 A1 (NEC CORP) 09 March 2023 (2023-03-09) the whole document	1-20
A	US 2023018399 A1 (CISCO TECH INC) 19 January 2023 (2023-01-19) the whole document	1-20
A	WO 2019212546 A1 (NOKIA TECHNOLOGIES OY et al.) 07 November 2019 (2019-11-07) the whole document	1-20

☐ 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
- "D" document cited by the applicant in the international application
- "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
04 June 2024	**11 June 2024**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/076446

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2023032529 A1	09 March 2023	None	
US 2023018399 A1	19 January 2023	US 2023354017 A1	02 November 2023
		WO 2023288082 A1	19 January 2023
		US 11706614 B2	18 July 2023
WO 2019212546 A1	07 November 2019	None	