(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 June 2025 (19.06.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/123726 A1

(51) International Patent Classification:
H04W 28/24 (2009.01)

(21) International Application Number:
PCT/CN2024/111067

(22) International Filing Date:
09 August 2024 (09.08.2024)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA,

(54) Title: METHODS AND APPARATUSES FOR QOS MAPPING AND QOS ADJUSTMENT FOR MWAB NODE

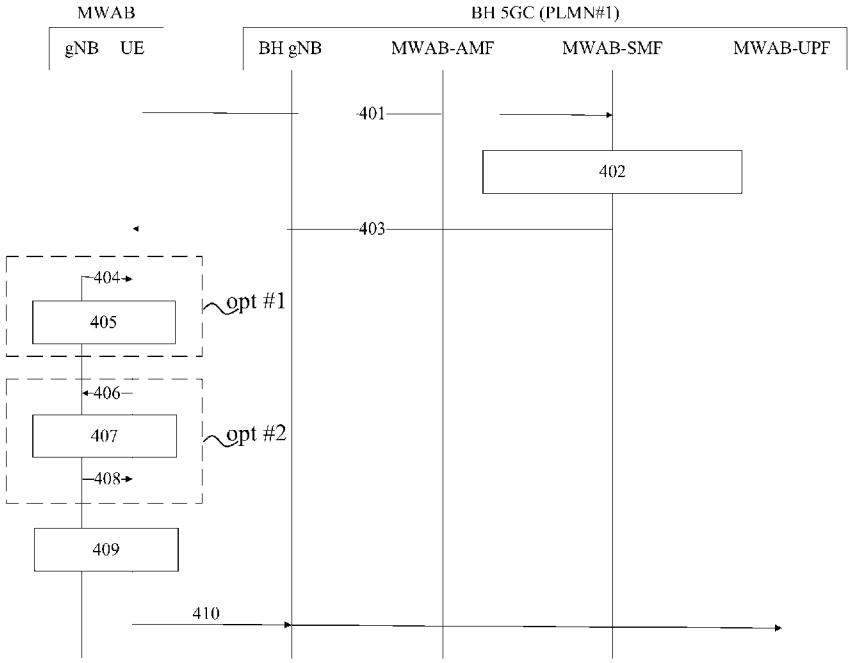

Figure 4

(57) Abstract: Various aspects of the present disclosure relate to methods and apparatuses for QoS mapping and QoS adjustment for an MWAB node. Some implementations of the methods and apparatuses described herein may include a mobile next-generation node-B (gNB) with wireless access backhauling (MWAB) for wireless communication, comprising: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the MWAB to: obtain uplink (UL) data; and determine a first quality of service (QoS) flow associated with a first protocol data unit (PDU) session established between a MWAB-user equipment (MWAB-UE) of the MWAB and a first 5G Core (5GC) network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QoS flow identifier (QFI) of the first QoS flow associated with the UL data; and send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

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[Continued on next page]

NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
— *upon request of the applicant, before the expiration of the time limit referred to in Article 21(2)(a)*

METHODS AND APPARATUSES FOR QOS MAPPING AND QOS ADJUSTMENT FOR MWAB NODE

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to methods and apparatuses for quality of service (QoS) mapping and QoS adjustment for an MWAB node.

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which 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, or the like). 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)).

SUMMARY

[0003] 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.

[0004] Some implementations of the methods and apparatuses described herein may include a mobile next-generation node-B (gNB) with wireless access backhauling (MWAB) for wireless communication, comprising: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the MWAB to: obtain uplink (UL) data; and determine a first QoS flow associated with a first protocol data unit (PDU) session established between a MWAB-user equipment (MWAB-UE) of the MWAB and a first 5G Core (5GC) network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QoS flow identifier (QFI) of the first QoS flow associated with the UL data; and send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

[0005] In some embodiments of the MWAB described herein, the UL data includes one of the following: an operations administration and maintenance (OAM) message; an N2 message; or an UL PDU of a second QoS flow, wherein the second QoS flow is associated with a second PDU session established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network.

[0006] In some embodiments of the MWAB described herein, the first QoS flow is a default QoS flow.

[0007] In some embodiments of the MWAB described herein, the first QoS flow is one of the following: an existing QoS flow which satisfies the QoS requirement for the UL data; a QoS flow established which satisfies the QoS requirement for the UL data; or an existing QoS flow which is modified to satisfy the QoS requirement for the UL data.

[0008] In some embodiments of the MWAB described herein, the at least one processor is further configured to cause the MWAB-UE to: receive, from a first session management function (SMF) of the first 5GC network, first mapping information between the first QFI and the message type of the UL data.

[0009] In some embodiments of the MWAB described herein, the MWAB further includes a MWAB-gNB, wherein the at least one processor is further configured to cause the MWAB-gNB to either: transmit, to the MWAB-UE, the UL data and the message type of the UL data; or receive, from the MWAB-UE, the first mapping information, so as to determine the first QFI based on the first mapping information and the message type of the UL data, and transmit the UL data and the first QFI to the MWAB-UE.

[0010] In some embodiments of the MWAB described herein, the MWAB further includes a MWAB-gNB, wherein the at least one processor is further configured to cause the MWAB-UE to either: receive, from the MWAB-gNB, the UL data and the message type of the UL data, and determine the first QFI based on the message type and the first mapping information; or transmit the first mapping information to the MWAB-gNB and receive the UL data and the first QFI from the MWAB-gNB.

[0011] In some embodiments of the MWAB described herein, the MWAB further includes a MWAB-gNB, and wherein the at least one processor is further configured to cause the MWAB-gNB to: receive, from a UE, the UL data including an UL PDU; determine a second QFI and the QoS requirement associated with the UL data, wherein the second QFI indicates an identifier of a second QoS flow associated with a second PDU session established between the UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and determine the first QoS flow with the first QFI for the UL data based on the QoS requirement.

[0012] In some embodiments of the MWAB described herein, the at least one processor is further configured to cause the MWAB-gNB to: transmit the UL data and the first QFI to the MWAB-UE.

[0013] In some embodiments of the MWAB described herein, the at least one processor is further configured to cause the MWAB-gNB to: determine the marking information associated with the first QFI; and transmit, through the MWAB-UE to a second SMF of the second 5GC network, session management (SM) information including an index of the second PDU session and second mapping information between the second QFI and the marking information associated with the first QFI.

[0014] In some embodiments of the MWAB described herein, the marking information associated with the first QFI includes one of the following: a value of differentiated service codepoint (DSCP); a port number; a flow label; or an IP address.

[0015] In some embodiments of the MWAB described herein, the MWAB further includes a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-gNB to: receive, from an OAM of the second 5GC network, a third mapping information between a QoS requirement associated with the second QoS flow and marking information associated with the first QoS flow; and transmit, to a second SMF of the second 5GC network, the third mapping information between the QoS requirement associated with the second QoS flow and the marking information associated with the first QoS flow.

[0016] In some embodiments of the MWAB described herein, the UL data includes an UL PDU of a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to: transmit a PDU session modification request to a first SMF of the first 5GC network, wherein the PDU session modification request includes a second PDU session aggregate maximum bit rate (AMBR) and a mapping list of the first QFI and a second maximum data burst volume (MDBV) associated with the second QoS flow

[0017] In some embodiments of the MWAB described herein, the MWAB further includes a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow established between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to: receive, from the MWAB-gNB, a second PDU session AMBR and a mapping list of the first QFI and a second MDBV associated with the second QoS flow; and transmit a PDU session modification request to the first SMF of the first 5GC network, which includes the second PDU session AMBR and the mapping list associated with the second QoS flow.

[0018] Some implementations of the methods and apparatuses described herein may further include a network equipment performing a second SMF of a second 5GC network for wireless communication, comprising: at least one memory; and at least one processor coupled

with the at least one memory and configured to cause the second SMF to: receive SM information from a gNB with wireless access backhauling (MWAB); and transmit a session modification request to a second user plane function (UPF) of the second 5GC network, which includes mapping information of marking information associated with a first QFI and a second QFI, wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network, and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

[0019] In some embodiments of the network equipment described herein, the SM information includes an index of the second PDU session and mapping information between the second QFI and the marking information associated with the first QFI.

[0020] In some embodiments of the network equipment described herein, the marking information associated with the first QFI includes one of the following: a value of DSCP; a port number; a flow label; or an IP address.

[0021] Some implementations of the methods and apparatuses described herein may include a network equipment performing a first SMF of a first 5GC network for wireless communication, comprising: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the first SMF to: receive, from a gNB with wireless access backhauling-user equipment (MWAB-UE), a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of a first QFI and a second MDBV associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and the first 5GC network, and the second QoS flow is established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and transmit, to the a gNB of the first 5GC network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

[0022] In some embodiments of the network equipment described herein, the first SMF is preconfigured with the mapping information between a dedicated data network name

(DNN) or single network slicing selection assistance information (S-NSSAI) and a corresponding dedicated MDBV or dedicated PDU session AMBR.

[0023] Some implementations of the methods and apparatuses described herein may include a processor for wireless communication, comprising: at least one controller coupled with at least one memory and configured to cause the processor to: obtain UL data; and determine a first QoS flow associated with a first PDU session established between a MWAB-UE of a MWAB and a first 5GC network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QFI of the first QoS flow associated with the UL data; and send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

[0024] Some implementations of the methods and apparatuses described herein may include a method performed by a MWAB, the method comprising: obtaining UL data; and determining a first QoS flow associated with a first PDU session established between a MWAB-UE of the MWAB and a first 5GC network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QFI of the first QoS flow associated with the UL data; and sending the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

[0025] Some implementations of the methods and apparatuses described herein may include a processor for wireless communication, comprising: at least one controller coupled with at least one memory and configured to cause the processor to: receive SM information from a MWAB; and transmit a session modification request to a second UPF of a second 5GC network, which includes mapping information of marking information associated with a first QFI and a second QFI, wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

[0026] Some implementations of the methods and apparatuses described herein may include a method performed by a second SMF of a second 5GC network, the method comprising: receiving SM information from a MWAB; and transmitting a session modification request to a second UPF of the second 5GC network, which includes mapping

information of marking information associated with a first QFI and of a second QFI, wherein the first QFI indicates a first QoS flow established between a MWAB- user equipment (MWAB-UE) of the MWAB and a first 5GC network, and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

[0027] Some implementations of the methods and apparatuses described herein may include a processor for wireless communication, comprising: at least one memory; and at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a MWAB-UE, a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of a first QFI and a second MDBV associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network, and the and the second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and transmit, to a gNB of the first 5GC network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

[0028] Some implementations of the methods and apparatuses described herein may include a method performed by a first SMF of a first 5GC network, comprising: receiving, from a MWAB-UE, a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of the first QFI and a second MDBV, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and the first 5GC network, and the second QoS flow is established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and transmitting, to a gNB of the first 5GC network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Figure 1 illustrates an example of a wireless communications system in accordance with aspects of the present disclosure.

[0030] Figure 2A illustrates an example of a non-roaming MWAB architecture for 5G systems (5GS) in accordance with aspects of the present disclosure.

[0031] Figure 2B illustrates an example of an architecture for MWAB operation support-non-roaming in accordance with aspects of the present disclosure.

[0032] Figure 3A illustrates protocol stacks of a backhaul link to support the N2 interface for the MWAB node in accordance with aspects of the present disclosure.

[0033] Figure 3B illustrates protocol stacks of a backhaul link to support the N3 interface for the MWAB node in accordance with aspects of the present disclosure.

[0034] Figure 4 illustrates an exemplary QoS flow mapping for a message in accordance with aspects of the present disclosure.

[0035] Figure 5 illustrates an exemplary QoS flow mapping for the DL data or UL data of the UE PDU session in accordance with aspects of the present disclosure.

[0036] Figure 6 illustrates an exemplary QoS parameter adjustment in accordance with aspects of the present disclosure.

[0037] Figure 7 illustrates an example of a user equipment (UE) in accordance with aspects of the present disclosure.

[0038] Figure 8 illustrates an example of a processor in accordance with aspects of the present disclosure.

[0039] Figure 9 illustrates an example of a network equipment (NE) in accordance with aspects of the present disclosure.

[0040] Figure 10 illustrate a flowchart of an exemplary method performed by a UE in accordance with aspects of the present disclosure.

[0041] Figure 11 illustrate a flowchart of an exemplary method performed by an NE in accordance with aspects of the present disclosure.

[0042] Figure 12 illustrate a flowchart of another exemplary method performed by an NE in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0043] Aspects of the present disclosure are described in the context of a wireless communications system.

[0044] Figure 1 illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more NEs 102, one or more UEs 104, and a core network (CN) 106. 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 a long-term evolution (LTE) network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a new radio (NR) network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) 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, for example, 6G. 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.

[0045] The one or more NEs 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a network function, a network entity, a radio access network (RAN), a NodeB, an eNodeB (eNB), a gNB, or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0046] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. For example, an NE 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, an NE 102 may be moveable, for example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NEs 102.

[0047] 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 remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver 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.

[0048] A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. 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 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.

[0049] An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g., S1, N2, N3, or another network interface). In some implementations, the NEs 102 may communicate with each other directly. In some other implementations, the NEs 102 may communicate with each other indirectly (e.g., via the CN 106. In some implementations, one or more NEs 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 radio heads, smart radio heads, or transmission-reception points (TRPs).

[0050] The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 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 function (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 UPF). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as registration management, mobility management, connection management, access authentication/authorization etc. for the one or more UEs 104 served by the one or more NEs 102 associated with the CN 106.

[0051] The CN 106 may communicate with a packet data network over one or more backhaul links (e.g., via an S1, N2, N3, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g., a PDU session, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 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 CN 106 (e.g., one or more network functions of the CN 106).

[0052] In the wireless communications system 100, the NEs 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 NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the NEs 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 NEs 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures).

The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0053] 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.

[0054] 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.

[0055] 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., orthogonal frequency division multiplexing (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.

[0056] 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 NEs 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 NEs 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 NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0057] 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.

[0058] Figure 2A illustrates an example of a non-roaming MWAB architecture for 5GS in accordance with aspects of the present disclosure.

[0059] Figure 2A includes five components, i.e., the UE, the MWAB (including the MWAB-gNB and the MWAB-UE), the BH-gNB, the BH 5GC and the 5GC serving UE.

[0060] The UE connects to the gNB of the MWAB node (i.e., the MWAB-gNB) and establishes a PDU session with the UE's 5GC or next generation core (NGC). There is an NG interface between the MWAB-gNB and the UE's 5GC or NGC. There is a BH PDU session(s) between the MWAB-UE and the BH 5GC, which may be used for transferring messages, such as OAM messages between the MWAB-gNB and the OAM server, an N2 message between the MWAB-gNB and the UE-AMF of UE's 5GC or NGC, etc. The BH PDU session(s) may also be used for transferring data of the UE's PDU session (i.e., the N3 data between the MWAB-gNB and the UE-UPF of UE's 5GC or NGC).

[0061] The MWAB, which may also be referred to as a WAB node or vehicle-mounted relay (VMR) node interchangeably, includes a UE component (i.e., the MWAB-UE) and a gNB component (i.e., the MWAB-gNB), wherein the two components are collocated. The MWAB may be mounted on a moving vehicle and serve UEs that can be located inside or outside the vehicle (or entering or leaving the vehicle). The MWAB-gNB may connect to the AMF residing in the 5GC over a backhaul (BH) PDU session of the MWAB-UE. The MWAB-gNB may be based on gNB functionality specified in 3GPP documents, such as 3GPP TS 38.300 and TS 38.401.

[0062] The MWAB may act as a gNB for other UEs and provide access to 5G networks, i.e., providing an NR access link to UEs and connected wirelessly to the 5GC (using NR) through IP connectivity provided by a BH PDU session established via a BH-gNB cell that the MWAB-UE can camp on. The PDU session is provided either by a Terrestrial Network (TN) or by an NTN.

[0063] Figure 2B illustrates an example of an architecture for MWAB operation support-non-roaming in accordance with aspects of the present disclosure.

[0064] Figure 2B includes four parts, i.e., the UE, the MWAB (including the MWAB-gNB and the MWAB-UE), public land mobile network (PLMN) #1 (including the NG-RAN, MWAB-AMF, MWAB-SMF, MWAB-UPF, etc.) and PLMN #2 (including UE-AMF, UE-SMF, UE-UPF, etc.). The UE connects to the MWAB via the NR Uu interface, the MWAB-

gNB connects to the UE-UPF via the N3 interface and connects to the UE-AMF via the N2 interface and the MWAB-UE connects to the NG-RAN via the NR Uu interface, wherein the NG-RAN may be a BH gNB. The NG-RAN connects to the MWAB-UPF via the N3 interface and connects to the MWAB-AMF via the N2 interface. The detailed structure of Figure 2B may be explained in 3GPP documents, such as 3GPP TR 23.700-06, therefore details are omitted here.

[0065] Based on the aforementioned non-roaming MWAB architecture for 5GS, the BH PDU sessions may be established between the MWAB-UE and the UPF for the MWAB-UE (i.e., MWAB-UPF) within BH-5GC to transfer an OAM message, N2 or N3 signalling or data, wherein the N2 interface is between the MWAB-gNB and the UE-AMF within the 5GC serving UE and the N3 interface is between the MWAB-gNB and the UPF for the UE (i.e., UE-UPF) within the 5GC serving UE. Besides, the OAM message is exchanged between the MWAB-gNB and the OAM server of PLMN #2. Protocol stacks for wireless backhauling of an N2 or an N3 interface of an MWAB via IP connectivity provided by PDU sessions are described in the following figures.

[0066] Figure 3A illustrates protocol stacks of a backhaul link to support the N2 interface for the MWAB node in accordance with aspects of the present disclosure.

[0067] The MWAB-UE connects to the BH gNB via the N2 interface. A PDU session between the MWAB-UE and the MWAB-UPF is established as a backhaul link to support the overlaid N2 interface. The N2 interface terminates at the MWAB-gNB and the UE-AMF respectively, which includes next generation application protocol (NGAP), stream control transmission protocol (SCTP) and internet protocol (IP) layer protocols between them.

[0068] Figure 3B illustrates protocol stacks of a backhaul link to support the N3 interface for the MWAB node in accordance with aspects of the present disclosure.

[0069] A PDU session between the MWAB-UE and the MWAB-UPF is established as a backhaul link to support the overlaid N3 interface.

[0070] The N3 interface terminates at the MWAB-gNB and the UE-UPF respectively, which includes GPRS tunneling protocol user plane (GTP-U), user datagram protocol (UDP) and IP layer protocols between them. The UE connects to the MWAB-gNB. A PDU session

between a UE and a UE-UPF is realized by: 1) the Uu interface between the UE and the MWAB-gNB and 2) the NG-U between the MWAB-gNB and the UE-UPF on top of the backhauling PDU session between an MWAB-UE and an MWAB-UPF.

[0071] A UE PDU session may be established between a UE connecting to an MWAB-gNB of the MWAB and the UE-UPF, and is used to accommodate the UE QoS flow indicated with identifier QFI #2. A BH PDU session may be established between an MWAB-UE of the MWAB and the MWAB-UPF, and is used to accommodate the MWAB-UE QoS flow indicated with identifier QFI #1.

[0072] The detailed structure of protocol stacks of a backhaul link to support the N2 or N3 interface for the MWAB node may be explained in 3GPP documents, therefore details are omitted here.

[0073] However, there may be the following issues for the data transmission need to be solved.

[0074] Issue 1:

[0075] For UL data, the UE may determine the QoS flow of the UL data based on a QoS rule provided by the SMF, which includes mapping information of the QFI and UL packet filter. Then, the UE determines the DRB of the UL data based on the configuration by the gNB, which includes the mapping information of the QFI and DRB ID.

[0076] However, as shown in Figure 3A, regarding the protocol stacks of the backhaul link to support the N2 interface for the MWAB node, for an N2 message, which is generated and forwarded by the MWAB-gNB to the MWAB-UE, the UE-SMF does not provide the QoS rule for the N2 message. Then, the UE does not know how to determine the QoS flow of the N2 message. As shown in Figure 3B, regarding the protocol stacks of the backhaul link to support the N3 interface for the MWAB node, for the UL data of the UE PDU session, which is forwarded by the MWAB-gNB to the MWAB-UE, the UE-SMF does not provide the QoS rule, either. Furthermore, the MWAB-gNB may establish a connection with an OAM server, while the UE-SMF does not provide the QoS rule for the UL data of the OAM message (i.e., message to the OAM server or from the OAM server) generated and forwarded by the MWAB-gNB to the MWAB-UE.

[0077] Therefore, the MWAB-UE may not know how to determine the QoS flow of the UL data (e.g., OAM message between an MWAB-gNB and an OAM server, an N2 message between the MWAB-gNB and the UE-AMF, or the UL data of the UE PDU session, etc.), or how to map it to the corresponding QoS flow of the BH PDU session.

[0078] Issue 2:

[0079] There may be hundreds or thousands of UE PDU sessions transmitted via an MWAB-UE's BH PDU session. For delay-critical GBR QoS flow, MDBV is provided by the SMF to the gNB. Furthermore, the SMF also provides the gNB with a PDU session AMBR upon PDU session establishment. Upon BH PDU session establishment, the MWAB-SMF does not know how many UE PDU sessions will be transmitted via an MWAB-UE's BH PDU session, thus it is not able to set an appropriate value of the MDBV and PDU session AMBR for the BH PDU session and inform the BH gNB.

[0080] The MWAB-SMF may not know how to adjust the PDU session AMBR, whereby an MDBV value for the BH PDU session as a new UE PDU session is added into the BH PDU session.

[0081] The present disclosure proposes solutions for solving the above issues as follows:

[0082] After BH PDU session establishment, the MWAB-gNB may trigger a connection to the OAM server via a BH PDU session to obtain the MWAB-gNB configuration information, e.g., the UE-AMF IP address, Cell ID, gNB ID, etc. After that, the MWAB-gNB may trigger N2 interface establishment towards the UE-AMF via the same BH PDU session or another BH PDU session.

[0083] Solution 1 aims to solve the issue of how the MWAB maps the QoS flow of the UL data of the UE PDU session to the corresponding QoS flow of the BH PDU session. The UL data may include an N2 message between the MWAB-gNB and the UE-AMF or an OAM message between the MWAB-gNB and the OAM server, or other messages, wherein the UL data may also include the UL PDU of the UE QoS flow. In other words, how the MWAB determines the QoS flow of the BH PDU session for the transmission of the UL data.

[0084] Solution 1-1:

[0085] The MWAB may determine a default QoS flow of the BH PDU session for the message (e.g., an N2 message between the MWAB-gNB and the UE-AMF or an OAM message between the MWAB-gNB and the OAM server, or other messages).

[0086] In particular, the MWAB-gNB, the MWAB-UE, or the WMAB may map or bind the message to the default QoS flow of the BH PDU session. In some embodiments, the WMAB-gNB may map the message to the default QoS flow of the BH PDU session, the WMAB-gNB may then send the message and the default QoS flow indication to the MWAB-UE. In some other embodiments, the MWAB-UE may perform the mapping. The WMAB-gNB may send the message and the message indication (e.g., an OAM message indication, an N2 message indication, or an OAM/N2 message indication) to the MWAB-UE, and the MWAB-UE may map (or bind) the message to the default QoS flow of the BH PDU session. For example, assuming the default QoS flow of the BH PDU session is with the identifier QFI #0, the message is then mapped to the QoS flow with QFI #0.

[0087] Solution 1-2:

[0088] The MWAB may determine a QoS flow of the BH PDU session for the message (e.g., an N2 message between the MWAB-gNB and the UE-AMF or an OAM message between the MWAB-gNB and the OAM server, or other messages) based on a pre-configuration map, i.e., map or bind the message to the QoS flow of the BH PDU session.

[0089] In this solution, the MWAB, e.g., the MWAB-gNB or the MWAB-UE, may be pre-configured with the QoS requirement for the message. In addition, the MWAB may also obtain the QoS requirement of the QoS flow of the BH PDU session. For example, the QoS requirement of the QoS flow may be obtained from the MWAB-SMF. The MWAB-SMF may provide the QoS rule (which may include the QoS requirement of the QoS flow) and the related QoS flow level QoS parameters to the MWAB-UE. The MWAB-UE may forward the aforementioned information to the MWAB-gNB, i.e., the QoS rule and the related QoS flow level QoS parameters.

[0090] In some embodiments, the MWAB-gNB may determine the QoS flow of the BH PDU session, i.e., perform the mapping. In particular, the MWAB-gNB may map (or bind) the message to the MWAB-UE QoS flow of the BH PDU session based on the QoS

requirement for the message. The MWAB-gNB then sends the message and QFI of the MWAB-UE QoS flow to the MWAB-UE.

[0091] In some other embodiments, the MWAB-UE may determine the QoS flow of the BH PDU session, i.e., perform the mapping. In particular, the MWAB-gNB may send the message and the message indication (e.g., an OAM message indication, an N2 message indication, or an OAM/N2 message indication) to the MWAB-UE. The MWAB-UE then maps or binds the message to the MWAB-UE QoS flow of the BH PDU session based on the pre-configured QoS requirement for the message.

[0092] In general, the MWAB (either the MWAB-gNB or the MWAB-UE) may match the QoS requirement of the message and the QoS requirement of the QoS flow of the BH PDU session. That is, the MWAB may determine a QoS flow of the BH PDU session which may satisfy the QoS requirement of the message, and map the message to the QoS flow of the BH PDU session.

[0093] There may be different QoS flows that can meet different QoS requirements. In some cases, there may be an existing QoS flow of the BH PDU session which is suitable to support the QoS requirement of the message, wherein this existing QoS flow of the BH PDU session is determined or selected, and the message is mapped (or bound) to this QoS flow of the BH PDU session. In some other cases, there may be multiple QoS flows that meet the QoS requirement of the message, the first QoS flow or any QoS flow may then be determined or selected.

[0094] In some other cases, there may be no QoS flow of the BH PDU session that can satisfy the QoS requirement of the message, therefore a new BH PDU session may be established based on the QoS requirement of the message, and the new BH PDU session is used to accommodate a new QoS flow for the transmission of the message. Alternatively, an existing BH PDU session is modified to accommodate a new QoS flow for the transmission of the message.

[0095] It should be noted that the QoS requirement includes QoS parameters and QoS characteristics. QoS parameters may include at least one of a 5G QoS identifier (5QI), allocation and retention priority (ARP), reflective QoS attribute (RQA), guaranteed flow bit

rate (GFBR), maximum flow bit rate (MFBR), etc. QoS characteristics include resource type, priority level, PDB, PER, averaging window, MDBV, etc.

[0096] Solution 1-3: The MWAB may map (or bind) the message (including the OAM message or the N2 message, etc.) based on a QoS rule, in particular, based on a received QFI of the QoS flow of the BH PDU session associated with the message.

[0097] Figure 4 illustrates an exemplary QoS flow mapping for a message in accordance with aspects of the present disclosure.

[0098] In Figure 4, two components are included, i.e., the MWAB (including the MWAB-gNB and the MWAB-UE), and the BH 5GC, which may also be referred to as PLMN #1 (including the BH gNB, MWAB-AMF, MWAB-SMF and MWAB-UPF).

[0099] In operation 401, the MWAB-UE sends a PDU session establishment request, the DNN and the S-NSSAI via the MWAB-AMF to the MWAB-SMF.

[0100] In particular, the MWAB-UE may be triggered to establish the BH PDU session, which is established between the MWAB-UE and the MWAB-UPF. The MWAB-UE provides a UE requested DNN, while the MWAB-AMF may request a MWAB-policy control function (PCF) to perform a DNN replacement from the UE requested DNN to a selected DNN. The MWAB-AMF then forwards the PDU session establishment request, the UE requested DNN, the selected DNN and the S-NSSAI(s) to the MWAB-SMF. The MWAB-UE may be configured with a dedicated DNN or an S-NSSAI for the PDU session for backhaul link to the OAM server (e.g., local configuration or UE route selection policy (URSP) rules) or a network serving the MWAB-UE may determine a default DNN or S-NSSAI for it based on a subscription. It should be noted that any one of the following: (UE requested DNN, S-NSSAI), (selected DNN, S-NSSAI), (DNN, S-NSSAI) can be referred to as a combination of DNN and S-NSSAI, and stands for "S-NSSAI" or "DNN and S-NSSAI".

[0101] In operation 402, the MWAB-SMF may identify the BH PDU session based on the combination of (DNN, S-NSSAI), wherein the parameter DNN may either be a UE requested DNN or a selected DNN. The MWAB-SMF may be pre-configured with the dedicated (DNN, S-NSSAI) used for the BH PDU session. Alternatively, the MWAB-SMF may obtain the UE's subscription data which indicates the dedicated (DNN, S-NSSAI) is used

for the BH PDU session. E.g., the MWAB-unified data management (UDM), may provide the MWAB-SMF with the session management subscription data associated with the DNN and the S-NSSAI, which may include a BH PDU session indication.

[0102] In operation 403, for the BH PDU session, the MWAB-SMF may send a PDU session establishment accept message to the MWAB-UE, which includes the mapping information of the QFI of the BH PDU session and the message (including the OAM message or the N2 message, etc.). In some embodiments, the mapping information may include the QFI of the BH PDU session and the message type of the message. In other words, the PDU session establishment accept message includes the QoS rule (or QoS flow level QoS parameters, or a QFI, etc.), which includes the mapping information of the QFI and the message, or the mapping information between the QFI and the message type. For instance, the OAM message maps to QFI #00, the N2 message maps to QFI #01, or the OAM/N2 message maps to QFI#02 etc.

[0103] After receiving the QoS rule, i.e., the QFI, or the mapping information of the QFI to the message, the MWAB may perform QoS flow mapping for the message, i.e., map the message to a QoS flow with the indicated QFI with the following options.

[0104] Option #1 (including operations 404 and 405): The MWAB-UE performs QoS flow mapping.

[0105] In operation 404, the MWAB-gNB generates the message and provides the MWAB-UE with the message and a message indication. In operation 405, the MWAB-UE determines the QFI based on the message indication and the mapping information of the QFI and the message (or the mapping information of the QFI and message type of the message). For instance, the OAM message maps to QFI #00, and the message indication indicates an OAM message, thus the MWAB-UE determines the QoS flow QFI #00 for the OAM message.

[0106] Option #2 (including operations 406-408): The MWAB-gNB performs QoS flow mapping.

[0107] In operation 406, the MWAB-UE provides the MWAB-gNB the mapping information of the QFI and the message (or the mapping information of the QFI and message type of the message). In operation 407, the MWAB-gNB generates the message and

determines the QFI based on the mapping information of the QFI and the message (or the mapping information of the QFI and message type of the message). In operation 408, the MWAB-gNB sends the message and the QFI to the MWAB-UE.

[0108] It should be noted that the MWAB may either perform operations 404 and 405, or perform operations 406-408.

[0109] In operation 409, the MWAB-UE maps the QFI to the DRB based on the configuration provided by the BH gNB.

[0110] In operation 410, the MWAB-UE sends the message via the DRB to the BH gNB, and the BH gNB forwards it to the MWAB-UPF. For an OAM message, the MWAB-UPF further forwards it to an OAM server, and for an N2 message, the MWAB-UPF further forwards it to a UE-AMF. For other messages, the MWAB-UPF may forward them to corresponding destinations based on the target IP address.

[0111] Solution 2:

[0112] Solution 2 relates to QoS flow mapping for DL data or UL data of the UE PDU session established between the UE connecting to an MWAB-gNB of the MWAB and the UE-UPF.

[0113] For a UL data transmission, the MWAB-UE may receive a UL data, which may include: an IP header, the UDP header, the GTP-U header and the PDU, etc. Hereinafter in the present disclosure, QFI #1 represents the identifier of the QoS flow of a BH PDU session, which is established between the MWAB-UE and the MWAB-UPF, GTP-U#1 represents the GTP-U tunnel between a BH gNB and an MWAB-UPF established for the BH PDU session, QFI #2 represents the identifier of the QoS flow of a UE PDU session, which is established between the UE and the UE-UPF, and GTP-U #2 represents the GTP-U tunnel between an MWAB-gNB and a UE-UPF established for the UE PDU session.

[0114] For a UL data transmission (e.g., a UL PDU session associated with QoS flow QFI #2), the MWAB-gNB may map or bind the UE QoS flow QFI #2 to the MWAB-UE QoS flow QFI #1 of the BH PDU session based on the QoS requirement of the UE QoS flow. Upon receiving the UL data of the UE QoS flow QFI #2, the MWAB-gNB may mark the

outer IP header of the UL data (i.e., IP/UDP/GTP-U#2/PDU) with the marking information associated with QFI #1, i.e., IP address#1 or DSCP#1/port number#1/flow label#1. By doing so, the MWAB-UE is able to determine QFI #1 based on the outer IP header of the received UL data (i.e., IP/UDP/GTP-U#2/PDU) and the UL packet filter.

[0115] For a DL data transmission (e.g., QoS flow QFI #2 of a DL PDU session), the UE-UPF maps the DL PDU to the UE QoS flow and marks it with QFI #2 based on the DL packet filter. When encapsulating the DL data, the UE-UPF marks the outer IP header of the DL data (i.e., IP/UDP/GTP-U#2/PDU) with the marking information associated with QFI #1, i.e., IP address#1 or DSCP#1/port number#1/flow label#1, based on the mapping information provided by the UE-SMF (which is the same as the mapping information provided by the MWAB-SMF). In this way, the MWAB-UPF is able to determine QFI #1 based on the outer IP header of the received DL data (i.e., IP/UDP/GTP-U#2/PDU) and the DL packet filter.

[0116] The detailed operations for the transmission are explained in the following solutions.

[0117] Solution 2-1: The MWAB-gNB may map (or bind) the UL data of the UE PDU session based on a QoS rule. Specifically, this solution is performed with the following operations:

[0118] Operation 1: The MWAB-UE may provide the MWAB-gNB the mapping information of a QFI (e.g., QFI #1) of a QoS flow and QoS parameter(s) (or a QoS requirement) for the BH PDU session.

[0119] Operation 2: The MWAB-gNB receives the UL data (e.g., the UL PDU) from the UE via a Uu interface, and may determine the QFI (e.g., QFI #2) of a QoS flow and the corresponding QoS requirement for the UL data. Referring to Figure 3B, QFI #2 indicates the identifier of the QoS flow of the UE PDU session, which is established between the UE and UE-UPF. During the UE PDU session establishment procedure, the UE-SMF provides the MWAB-gNB with the PDU session ID of the UE PDU session, a list of QFI #2 and the corresponding QoS requirement. The MWAB-gNB may map the UE QoS flow QFI #2 to MWAB-UE QoS flow QFI #1 of the BH PDU session based on the QoS requirement of the UE QoS flow.

[0120] Operation 3: The MWAB-gNB then sends the UL data, which may be encapsulated with the IP header, the UDP header, and GTP-U #2 header etc., and QFI #1 to the MWAB-UE.

[0121] Operation 4: The MWAB-UE then maps QFI #1 to the DRB based on the configuration provided by the BH gNB, that is, determines the DRB for QoS flow QFI #1

[0122] Solution 2-2: The MWAB-UE may map (or bind) the UL data (e.g., UL PDU) of the UE PDU session based on a QoS rule. For instance, the UL data of the UE PDU session may be mapped based on the QoS requirement of the UE QoS flow of the UE PDU session. At the network side, the UE-UPF may map the DL data (e.g., DL PDU) to the UE QoS flow based on the DL packet filter.

[0123] Specifically, this solution is performed with the following operations in Figure 5.

[0124] Figure 5 illustrates an exemplary QoS flow mapping for the DL data or UL data of the UE PDU session in accordance with aspects of the present disclosure.

[0125] In Figure 5, four components are included, i.e., the UE, the MWAB (including the MWAB-gNB and the MWAB-UE), the BH 5GC, which may also be referred to as PLMN #1 (including the BH gNB, MWAB-AMF, MWAB-SMF and MWAB-UPF), and PLMN #2 (including the OAM, UE-AMF, UE-SMF and UE-UPF).

[0126] In operation 501, a BH PDU session is established for the MWAB-UE.

[0127] In operation 502, the MWAB (or the MWAB-gNB, the MWAB-UE) may obtain the mapping list of (QFI #1, UL packet filter #1, QoS parameters) of the BH PDU session. In some embodiments, the MWAB-UE may provide the mapping list of (QFI #1, UL packet filter #1, QoS parameters) of the BH PDU session to the MWAB-gNB. This may depend on MWAB implementation.

[0128] In operation 503, the UE may send a PDU session establishment request (including a PDU session ID) to the UE-SMF, which is transmitted via the MWAB-gNB, the MWAB-UE, the BH gNB, the MWAB-UPF and the UE-AMF.

[0129] In operation 504, a PDU session establishment procedure may be performed.

[0130] In operation 505, the UE-AMF sends a N2 PDU session request to the MWAB-gNB, which includes a PDU session ID of the UE PDU session, SM information, a NAS message (PDU Session ID, N1 SM container (PDU session establishment accept)) etc. The N2 PDU session request is transmitted via the MWAB-UPF, the BH gNB and the MWAB-UE. The SM information may include a list of QFI #2 and the corresponding QoS requirement.

[0131] In operation 506, the MWAB (or MWAB-gNB or the MWAB-UE) may map or bind the UE QoS flow QFI #2 of the UE PDU session to the MWAB-UE QoS flow QFI #1 of the BH PDU session based on the QoS requirement of the UE QoS flow. For example, there may be three UE QoS flows with the identifier QFI #2-1, QFI #2-2 and QFI #2-3, respectively, and there may be three MWAB-UE QoS flows with the identifier QFI #1-1, QFI #1-2 and QFI #1-3, respectively. The MWAB may map UE QoS flow QFI #2-1 to MWAB-UE QoS flow QFI #1-1, map UE QoS flow QFI #2-2 to MWAB-UE QoS flow QFI #1-2 and map UE QoS flow QFI #2-3 to MWAB-UE QoS flow QFI #1-3.

[0132] In operation 507, the MWAB-gNB may transmit the SM information (e.g., N2 SM information) to the UE-SMF, which includes the PDU session ID of the UE PDU session, the mapping information of QFI #2 (of UE QoS flow) and marking information associated with QFI #1 (of MWAB-UE QoS flow).

[0133] In some embodiments, the MWAB-UE may use a single IP address for the PDU session, and may utilize other parameters (e.g., a DSCP, a port number, a flow label, etc.) to distinguish the QoS flows. For example, the parameters may include at least one of the following: a value of the DSCP, a port number or a flow label. In this case, the marking information associated with QoS flow QFI #1 may include at least one of the following: DSCP#1, port number#1, or flow label#1. Furthermore, the MWAB-gNB also provides access network (AN) tunnel information, which may include the IP address of the BH PDU session (or called an MWAB-UE IP address) and a tunnel endpoint identifier (TEID). Since the IP address of the BH PDU session is within the IP range of the MWAB-UPF, the DL data with the target IP address of the BH PDU session can be routed to the MWAB-UPF accordingly.

[0134] In some other embodiments, the MWAB-UE may use multiple IP addresses (e.g., one single IPv6 prefix corresponding to multiple IPv6 addresses) to distinguish QoS flows for one PDU session. In this case, the marking information may only include an IP address. For example, the marking information associated with QFI #1 may only include IP address #1. Nevertheless, the marking information associated with QFI #1 may still include other parameters, such as a value of the DSCP, a port number or a flow label, etc. The marking information may be in the format of the AN Tunnel information, or a new defined IE.

[0135] In operation 508, the UE-SMF may send a session modification request to the UE-UPF, which includes the mapping information of QFI #2 (of UE QoS flow) and the marking information associated with QFI #1 (of the MWAB-UE QoS flow).

[0136] In operation 509, the UE-UPF may send a session modification response to the MWAB-SMF.

[0137] In operation 510, the remaining steps of a PDU session establishment procedure may be performed.

[0138] Solution 2-3:

[0139] In this solution, the OAM configures the mapping information of the QoS requirement (e.g., 5QI) for the UE PDU session and the marking information (e.g., a DSCP, a port number, a flow label, etc.) for the BH PDU session.

[0140] After the MWAB-gNB connects to the OAM server, the OAM server may configure the first mapping information of the QoS requirement (e.g., 5QI) for the UE PDU session and the marking information (e.g., a DSCP, a port number, a flow label, etc.) for the MWAB-UE PDU session, and may transmit the first mapping information to the MWAB-gNB. The first mapping information may be denoted as mapping #1 for simplicity. Then, the MWAB-gNB may transmit the first mapping information to the UE-SMF, and the UE-SMF may configure the UE-UPF with the first mapping information.

[0141] For UL data (e.g., a UL PDU), the MWAB-gNB may mark the outer IP header of the UL data with the corresponding marking information based on the first mapping information. For DL data (e.g., a DL PDU), the UE-UPF may mark the outer IP header of

the DL data with the corresponding marking information based on the first mapping information.

[0142] During BH PDU session establishment, the MWAB-SMF knows it is a BH PDU session based on the received dedicated DNN or S-NSSAI associated with the BH PDU session. The MWAB-SMF may be preconfigured with the second mapping information of the QFI #1 and UL packet filter (denoted as mapping #2 for simplicity), which includes the same marking information as the first mapping information. The MWAB-SMF may configure the MWAB-UE with the second mapping information of QFI #1 and the UL packet filter.

[0143] Solution 3

[0144] In some other embodiments, the QoS parameters may be adjusted, and the present disclosure proposes detailed operations for doing so.

[0145] Figure 6 illustrates an exemplary QoS parameter adjustment in accordance with aspects of the present disclosure.

[0146] In Figure 6, four components are included, i.e., the UE, the MWAB (including the MWAB-gNB and the MWAB-UE), the BH 5GC, which may also be referred to as PLMN #1 (including the BH gNB, MWAB-AMF, MWAB-SMF and MWAB-UPF), and PLMN #2 (including the OAM, UE-AMF, UE-SMF and UE-UPF).

[0147] In operation 601, a BH PDU session is established between the MWAB-UE and the MWAB-UPF for the MWAB-UE. The BH PDU session is established for the transmission of the MWAB-UE QoS flow with the identifier QFI #1. The MWAB-UE QoS flow may be configured with an MDBV, which is denoted as MDBV #1 for simplicity. The AMBR for the BH PDU session is denoted as AMBR #1 for simplicity.

[0148] In operation 602, a UE PDU session is established between the UE and the UE-UPF for the UE. The UE PDU session is established for the transmission of the UE QoS flow with the identifier QFI #2. During the UE PDU session establishment procedure, the MWAB-gNB may obtain the identifier of the UE QoS flow, i.e., QFI #2, and the corresponding QoS requirement from the UE-SMF. The QoS requirement may include at least one of the

following parameters: an MDBV, a PDU session AMBR, and other QoS parameters, which may be denoted as MDBV #2, PDU session AMBR #2, etc.

[0149] In operation 603, the MWAB-gNB provides at least one of the following parameters to the MWAB-UE:

1) the mapping list of the identifier of the MWAB-UE QoS flow (i.e., QFI #1) and the MDBV (i.e., MDBV #2);

2) the PDU session AMBR (i.e., AMBR#2); or

3) one or more other QoS parameters of the UE QoS flow.

[0150] The MWAB-gNB may match the QoS requirement of UE QoS flow of the UE PDU session and the QoS requirement of the MWAB-UE QoS flow of the BH PDU session. The MWAB-gNB also maps (or binds) the UE QoS flow of the UE PDU session, i.e., QFI #2, with the UE QoS flow of the BH PDU session, i.e., QFI #1. The MWAB-gNB obtains QFI #2 and the corresponding QoS requirement (e.g., MDBV#2, PDU session AMBR#2, etc.) from the UE-SMF during the UE PDU session establishment procedure.

[0151] In operation 604, the MWAB-UE sends a PDU session modification request to the MWAB-SMF, which includes the following: 1) the mapping list of QFI #1 and MDBV #2, 2) PDU session AMBR #2, and 3) other QoS parameters, which are received from the MWAB-gNB in operation 603.

[0152] After receiving the above parameters, the MWAB-SMF may update MDBV #1 by considering MDBV #2. For example, the updated MDBV may have the value of a sum of the original MDBV and the value of MDBV #2, i.e., the updated MDBV #1 = the original MDBV #1 + MDBV #2. In some other embodiments, the updated MDBV may have a value larger than the sum. Similarly, the MWAB-SMF may also update PDU session AMBR#1 by considering PDU session AMBR #2. For example, the updated PDU session AMBR may have the value of a sum of the original PDU session AMBR and the value of PDU session AMBR #2, i.e., the updated PDU session AMBR #1 = the original PDU session AMBR #1 + PDU session AMBR #2. In some other embodiments, the updated PDU session AMBR may have a value larger than the sum.

[0153] In operation 605, the MWAB-SMF sends the SM information to the BH gNB, which includes at least one of the following parameters:

1) the mapping list of the identifier of the MWAB-UE QoS flow (i.e., QFI #1) and the associated updated MDBV (denoted as updated MDBV#1 for simplicity);

2) the updated PDU session AMBR (denoted as updated PDU session AMBR#1 for simplicity);

3) one or more other updated QoS parameters of the UE QoS flow; or

4) a PDU session modification ACK message.

[0154] In operation 606, the BH gNB may send the PDU session modification ACK to the MWAB-UE.

[0155] Alternatively, the MWAB-SMF may be preconfigured with the mapping information of a dedicated DNN or S-NSSAI and the corresponding dedicated MDBV or a dedicated PDU session AMBR etc. For example, the dedicated MDBV (or PDU session AMBR) may have a value which is much larger than that of a normal MDBV (or PDU session AMBR). During BH PDU session establishment, upon receiving the PDU session establishment request, the selected DNN, the UE requested DNN, S-NSSAI(s) from the MWAB-AMF and the MWAB-SMF determines the MDBV and PDU session AMBR based on the DNN or S-NSSAI and the mapping information.

[0156] Figure 7 illustrates an example of a UE 700 in accordance with aspects of the present disclosure. The UE 700 may include a processor 702, a memory 704, a controller 706, and a transceiver 708. The processor 702, the memory 704, the controller 706, or the transceiver 708, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0157] The processor 702, the memory 704, the controller 706, or the transceiver 708, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an

application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0158] The processor 702 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 702 may be configured to operate the memory 704. In some other implementations, the memory 704 may be integrated into the processor 702. The processor 702 may be configured to execute computer-readable instructions stored in the memory 704 to cause the UE 700 to perform various functions of the present disclosure.

[0159] The memory 704 may include volatile or non-volatile memory. The memory 704 may store computer-readable, computer-executable code including instructions when executed by the processor 702 cause the UE 700 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 704 or another type of memory. 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.

[0160] In some implementations, the processor 702 and the memory 704 coupled with the processor 702 may be configured to cause the UE 700 to perform one or more of the functions described herein (e.g., executing, by the processor 702, instructions stored in the memory 704). For example, the processor 702 may support wireless communication at the UE 700 in accordance with examples as disclosed herein. The UE 700 may be configured to support a means for performing the operations of the methods described in the embodiments of the present disclosure.

[0161] In an embodiment, the processor 702 may be configured to cause the UE 700 to: obtain UL data; and determine a first QoS flow associated with a first PDU session established between a MWAB-UE of the MWAB and a first 5GC network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QFI of the first QoS flow associated with

the UL data; and send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

[0162] The controller 706 may manage input and output signals for the UE 700. The controller 706 may also manage peripherals not integrated into the UE 700. In some implementations, the controller 706 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 706 may be implemented as part of the processor 702.

[0163] In some implementations, the UE 700 may include at least one transceiver 708. In some other implementations, the UE 700 may have more than one transceiver 708. The transceiver 708 may represent a wireless transceiver. The transceiver 708 may include one or more receiver chains 710, one or more transmitter chains 712, or a combination thereof.

[0164] A receiver chain 710 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 710 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 710 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 710 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 receiver chain 710 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0165] A transmitter chain 712 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 712 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 transmitter chain 712 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 transmitter chain 712 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0166] Figure 8 illustrates an example of a processor 800 in accordance with aspects of the present disclosure. The processor 800 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 800 may include a controller 802 configured to perform various operations in accordance with examples as described herein. The processor 800 may optionally include at least one memory 804, which may be, for example, an L1/L2/L3 cache. Additionally, or alternatively, the processor 800 may optionally include one or more arithmetic-logic units (ALUs) 806. 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).

[0167] The processor 800 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 800) 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).

[0168] The controller 802 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 800 to cause the processor 800 to support various operations in accordance with examples as described herein. For example, the controller 802 may operate as a control unit of the processor 800, generating control signals that manage the operation of various components of the processor 800. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0169] The controller 802 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 804 and determine subsequent instruction(s) to be executed to

cause the processor 800 to support various operations in accordance with examples as described herein. The controller 802 may be configured to track memory address of instructions associated with the memory 804. The controller 802 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 802 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 800 to cause the processor 800 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 802 may be configured to manage flow of data within the processor 800. The controller 802 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 800.

[0170] The memory 804 may include one or more caches (e.g., memory local to or included in the processor 800 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 804 may reside within or on a processor chipset (e.g., local to the processor 800). In some other implementations, the memory 804 may reside external to the processor chipset (e.g., remote to the processor 800).

[0171] The memory 804 may store computer-readable, computer-executable code including instructions that, when executed by the processor 800, cause the processor 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. The controller 802 and/or the processor 800 may be configured to execute computer-readable instructions stored in the memory 804 to cause the processor 800 to perform various functions. For example, the processor 800 and/or the controller 802 may be coupled with or to the memory 804, the processor 800, the controller 802, and the memory 804 may be configured to perform various functions described herein. In some examples, the processor 800 may include multiple processors and the memory 804 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.

[0172] The one or more ALUs 806 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more

ALUs 806 may reside within or on a processor chipset (e.g., the processor 800). In some other implementations, the one or more ALUs 806 may reside external to the processor chipset (e.g., the processor 800). One or more ALUs 806 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 806 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 806 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 806 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 806 to handle conditional operations, comparisons, and bitwise operations.

[0173] The processor 800 may support wireless communication in accordance with examples as disclosed herein. The processor 800 may be configured to or operable to support a means for performing the operations of the methods described in the embodiments of the present disclosure.

[0174] In an embodiment, the processor 800 may be applicable for a UE or a device with similar functions. The controller 802 may be configured to cause the processor 800 to: obtain UL data; and determine a first QoS flow associated with a first PDU session established between a MWAB-UE of the MWAB and a first 5GC network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QFI of the first QoS flow associated with the UL data; and send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

[0175] In an embodiment, the processor 800 may be applicable for a NE (e.g., a base station) or a device with similar functions. The controller 802 may be configured to cause the processor 800 to: receive SM information from a MWAB; and transmit a session modification request to a second UPF of a second 5GC network, which includes mapping information of marking information associated with a first QFI and a second QFI, wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

[0176] In an embodiment, the processor 800 may be applicable for a NE (e.g., a base station) or a device with similar functions. The controller 802 may be configured to cause the processor 800 to: receive, from a MWAB-UE, a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of a first QFI and a second MDBV associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network, and the and the second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and transmit, to a gNB of the first 5GC network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

[0177] Figure 9 illustrates an example of a NE 900 in accordance with aspects of the present disclosure. The NE 900 may include a processor 902, a memory 904, a controller 906, and a transceiver 908. The processor 902, the memory 904, the controller 906, or the transceiver 908, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0178] The processor 902, the memory 904, the controller 906, or the transceiver 908, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0179] The processor 902 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 902 may be configured to operate the memory 904. In some other implementations, the memory 904 may be integrated into the processor 902. The processor 902 may be configured to execute computer-readable instructions stored in the memory 904 to cause the NE 900 to perform various functions of the present disclosure.

[0180] The memory 904 may include volatile or non-volatile memory. The memory 904 may store computer-readable, computer-executable code including instructions when executed by the processor 902 cause the NE 900 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 904 or another type of memory. 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.

[0181] In some implementations, the processor 902 and the memory 904 coupled with the processor 902 may be configured to cause the NE 900 to perform one or more of the functions described herein (e.g., executing, by the processor 902, instructions stored in the memory 904). For example, the processor 902 may support wireless communication at the NE 900 in accordance with examples as disclosed herein. The NE 900 may be configured to support a means for performing the operations of the methods described in the embodiments of the present disclosure.

[0182] In an embodiment, the processor 902 may be configured to cause the NE 900 to: receive SM information from a MWAB; and transmit a session modification request to a second UPF of a second 5GC network, which includes mapping information of marking information associated with a first QFI and a second QFI, wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

[0183] In another embodiment, the processor 902 may be configured to cause the NE 900 to: receive, from a MWAB-UE, a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of a first QFI and a second MDBV associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and a first 5GC network, and the and the second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and transmit, to a gNB of the first 5GC

network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

[0184] The controller 906 may manage input and output signals for the NE 900. The controller 906 may also manage peripherals not integrated into the NE 900. In some implementations, the controller 906 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 906 may be implemented as part of the processor 902.

[0185] In some implementations, the NE 900 may include at least one transceiver 908. In some other implementations, the NE 900 may have more than one transceiver 908. The transceiver 908 may represent a wireless transceiver. The transceiver 908 may include one or more receiver chains 910, one or more transmitter chains 912, or a combination thereof.

[0186] A receiver chain 910 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 910 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 910 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 910 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 receiver chain 910 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0187] A transmitter chain 912 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 912 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 transmitter chain 912 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 transmitter chain 912 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0188] Figure 10 illustrates a flowchart of an exemplary method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a UE as described herein. In some implementations, the UE may execute a set of instructions to control the function elements of the UE to perform the described functions.

[0189] At 1002, the method may include obtaining UL data. The operations of 1002 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1002 may be performed by a UE as described with reference to Figure 7.

[0190] At 1004, the method may include determining a first QoS flow associated with a first PDU session established between a MWAB-UE of the MWAB and a first 5GC network, based on at least one of the following characteristics of the UL data: a QoS requirement associated with the UL data; a message type of the UL data; or a first QFI of the first QoS flow associated with the UL data. The operations of 1004 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1004 may be performed by a UE as described with reference to Figure 7.

[0191] At 1006, the method may include sending the UL data from the MWAB-UE to the first 5GC network via the first QoS flow. The operations of 1006 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1006 may be performed a UE as described with reference to Figure 7.

[0192] In some embodiments, the UL data includes one of the following: an OAM message; an N2 message; or an UL PDU of a second QoS flow, wherein the second QoS flow is associated with a second PDU session established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network.

[0193] In some embodiments, the first QoS flow is a default QoS flow.

[0194] In some embodiments, the first QoS flow is one of the following: an existing QoS flow which satisfies the QoS requirement for the UL data; a QoS flow established which satisfies the QoS requirement for the UL data; or an existing QoS flow which is modified to satisfy the QoS requirement for the UL data.

[0195] In some embodiments, the method further includes: receiving, from a first SMF of the first 5GC network, first mapping information between the first QFI and the message type of the UL data.

[0196] In some embodiments, the MWAB further includes a MWAB-gNB, and the method further includes: either transmitting, to the MWAB-UE, the UL data and the message type of the UL data; or receiving, from the MWAB-UE, the first mapping information, so as to determine the first QFI based on the first mapping information and the message type of the UL data, and transmitting the UL data and the first QFI to the MWAB-UE.

[0197] In some embodiments, the MWAB further includes a MWAB-gNB, and the method further includes: either receiving, from the MWAB-gNB, the UL data and the message type of the UL data, and determining the first QFI based on the message type and the first mapping information; or transmitting the first mapping information to the MWAB-gNB and receiving the UL data and the first QFI from the MWAB-gNB.

[0198] In some embodiments, the MWAB further includes a MWAB-gNB, and the method further includes: receiving, from a UE, the UL data including an UL PDU; determining a second QFI and the QoS requirement associated with the UL data, wherein the second QFI indicates an identifier of a second QoS flow associated with a second PDU session established between the UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and determining the first QoS flow with the first QFI for the UL data based on the QoS requirement.

[0199] In some embodiments, the method further includes: transmitting the UL data and the first QFI to the MWAB-UE.

[0200] In some embodiments, the method further includes: determining the marking information associated with the first QFI; and transmitting, through the MWAB-UE to a second SMF of the second 5GC network, SM information including an index of the second PDU session and second mapping information between the second QFI and the marking information associated with the first QFI.

[0201] In some embodiments, the marking information associated with the first QFI includes one of the following: a value of DSCP; a port number; a flow label; or an IP address.

[0202] In some embodiments, the MWAB further includes a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-gNB to: receive, from an OAM of the second 5GC network, a third mapping information between a QoS requirement associated with the second QoS flow and marking information associated with the first QoS flow; and transmit, to a second SMF of the second 5GC network, the third mapping information between the QoS requirement associated with the second QoS flow and the marking information associated with the first QoS flow.

[0203] In some embodiments, the UL data includes an UL PDU of a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to: transmit a PDU session modification request to a first SMF of the first 5GC network, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of the first QFI and a second MDBV associated with the second QoS flow

[0204] In some embodiments, the MWAB further includes a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow established between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to: receive, from the MWAB-gNB, a second PDU session AMBR and a mapping list of the first QFI and a second MDBV associated with the second QoS flow; and transmit a PDU session modification request to the first SMF of the first 5GC network, which includes the second PDU session AMBR and the mapping list associated with the second QoS flow.

[0205] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0206] Figure 11 illustrates a flowchart of an exemplary method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a NE as described herein. In some implementations, the NE may execute a set of instructions to control the function elements of the NE to perform the described functions.

[0207] At 1102, the method may include receiving SM information from a MWAB. The operations of 1102 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1102 may be performed by a NE as described with reference to Figure 9.

[0208] At 1104, the method may include transmitting a session modification request to a second UPF of the second 5GC network, which includes mapping information of marking information associated with a first QFI and a second QFI. The operations of 1104 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1104 may be performed by a NE as described with reference to Figure 9.

[0209] In some embodiments of the network equipment described herein, the SM information includes an index of the second PDU session and mapping information between the second QFI and the marking information associated with the first QFI.

[0210] In some embodiments of the network equipment described herein, the marking information associated with the first QFI includes one of the following: a value of DSCP; a port number; a flow label; or an IP address.

[0211] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0212] Figure 12 illustrates a flowchart of an exemplary method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a NE as described herein. In some implementations, the NE may execute a set of instructions to control the function elements of the NE to perform the described functions.

[0213] At 1202, the method may include receiving, from a MWAB-UE, a PDU session modification request, wherein the PDU session modification request includes a second PDU session AMBR and a mapping list of a first QFI and a second MDBV associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and the first 5GC network, and the second QoS flow is established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network. The

operations of 1202 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1202 may be performed by a NE as described with reference to Figure 9.

[0214] At 1204, the method may include transmitting, to the a gNB of the first 5GC network, SM information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow. The operations of 1204 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1204 may be performed by a NE as described with reference to Figure 9.

[0215] In some embodiments of the network equipment described herein, the first SMF is preconfigured with the mapping information between a dedicated DNN or S-NSSAI and a corresponding dedicated MDBV or dedicated PDU session AMBR.

[0216] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0217] 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. A mobile next-generation node-B (gNB) with wireless access backhauling (MWAB) for wireless communication, comprising:

at least one memory; and

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

obtain uplink (UL) data; and

determine a first quality of service (QoS) flow associated with a first protocol data unit (PDU) session established between a MWAB-user equipment (MWAB-UE) of the MWAB and a first 5G Core (5GC) network, based on at least one of the following characteristics of the UL data:

a QoS requirement associated with the UL data;

a message type of the UL data; or

a first QoS flow identifier (QFI) of the first QoS flow associated with the UL data; and

send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

2. The MWAB of claim 1, wherein the UL data includes one of the following:

an operations administration and maintenance (OAM) message;

an N2 message; or

an UL PDU of a second QoS flow, wherein the second QoS flow is associated with a second PDU session established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network.

3. The MWAB of claim 1, wherein the first QoS flow is a default QoS flow.

4. The MWAB of claim 1, wherein the first QoS flow is one of the following:

an existing QoS flow which satisfies the QoS requirement for the UL data;

a QoS flow established which satisfies the QoS requirement for the UL data; or

an existing QoS flow which is modified to satisfy the QoS requirement for the UL data.

5. The MWAB of claim 1, wherein the at least one processor is further configured to cause the MWAB-UE to:

receive, from a first session management function (SMF) of the first 5GC network, first mapping information between the first QFI and the message type of the UL data.

6. The MWAB of claim 5, further including a MWAB-gNB, wherein the at least one processor is further configured to cause the MWAB-gNB to either:

transmit, to the MWAB-UE, the UL data and the message type of the UL data; or

receive, from the MWAB-UE, the first mapping information, so as to determine the first QFI based on the first mapping information and the message type of the UL data, and transmit the UL data and the first QFI to the MWAB-UE.

7. The MWAB of claim 5, further including a MWAB-gNB, wherein the at least one processor is further configured to cause the MWAB-UE to either:

receive, from the MWAB-gNB, the UL data and the message type of the UL data, and determine the first QFI based on the message type and the first mapping information; or

transmit the first mapping information to the MWAB-gNB and receive the UL data and the first QFI from the MWAB-gNB.

8. The MWAB of claim 1, further including a MWAB-gNB, and wherein the at least one processor is further configured to cause the MWAB-gNB to:

receive, from a UE, the UL data including an UL PDU;

determine a second QFI and the QoS requirement associated with the UL data, wherein the second QFI indicates an identifier of a second QoS flow associated with a second PDU session established between the UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and

determine the first QoS flow with the first QFI for the UL data based on the QoS requirement.

9. The MWAB of claim 8, wherein the at least one processor is further configured to cause the MWAB-gNB to:

transmit the UL data and the first QFI to the MWAB-UE.

10. The MWAB of claim 8, wherein the at least one processor is further configured to cause the MWAB-gNB to:

determine the marking information associated with the first QFI; and

transmit, through the MWAB-UE to a second SMF of the second 5GC network, session management (SM) information including an index of the second PDU session and second mapping information between the second QFI and the marking information associated with the first QFI.

11. The MWAB of claim 10, wherein the marking information associated with the first QFI includes one of the following:

a value of differentiated service codepoint (DSCP);

a port number;

a flow label; or

an IP address.

12. The MWAB of claim 1, further including a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-gNB to:

receive, from an OAM of the second 5GC network, a third mapping information between a QoS requirement associated with the second QoS flow and marking information associated with the first QoS flow; and

transmit, to a second SMF of the second 5GC network, the third mapping information between the QoS requirement associated with the second QoS flow and the marking information associated with the first QoS flow.

13. The MWAB of claim 1, wherein the UL data includes an UL PDU of a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to:

transmit a PDU session modification request to a first SMF of the first 5GC network, wherein the PDU session modification request includes a second PDU session aggregate maximum bit rate (AMBR) and a mapping list of the first QFI and a second maximum data burst volume (MDBV) associated with the second QoS flow

14. The MWAB of claim 1, further including a MWAB-gNB, and wherein the UL data includes an UL PDU of a second QoS flow established between a UE connecting to the MWAB-gNB of the MWAB and a second 5GC network, and the at least one processor is further configured to cause the MWAB-UE to:

receive, from the MWAB-gNB, a second PDU session aggregate maximum bit rate (AMBR) and a mapping list of the first QFI and a second MDBV associated with the second QoS flow; and

transmit a PDU session modification request to the first SMF of the first 5GC network, which includes the second PDU session AMBR and the mapping list associated with the second QoS flow.

15. A network equipment performing a second session management function (SMF) of a second 5G Core (5GC) network for wireless communication, comprising:

at least one memory; and

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

receive session management (SM) information from a mobile next-generation node-B (gNB) with wireless access backhauling (MWAB); and

transmit a session modification request to a second user plane function (UPF) of the second 5GC network, which includes mapping information of marking information associated with a first quality of service (QoS) flow identifier (QFI) and a second QFI,

wherein the first QFI indicates a first QoS flow established between a MWAB-user equipment (MWAB-UE) of the MWAB and a first 5GC network, and the second QFI indicates a second QoS flow established between a UE connecting to a MWAB-gNB of the MWAB and the second 5GC network.

16. The network equipment of claim 15, wherein the SM information includes an index of the second PDU session and mapping information between the second QFI and the marking information associated with the first QFI.

17. The network equipment of claim 16, wherein the marking information associated with the first QFI includes one of the following:

a value of differentiated service codepoint (DSCP);

a port number;

a flow label; or

an IP address.

18. A network equipment performing a first session management function (SMF) of a first 5G Core (5GC) network for wireless communication, comprising:

at least one memory; and

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

receive, from a mobile next-generation node-B (gNB) with wireless access backhauling-user equipment (MWAB-UE), a protocol data unit (PDU) session modification request, wherein the PDU session modification request includes a second PDU session aggregate maximum bit rate (AMBR) and a mapping list of a first QoS flow identifier (QFI) and a second maximum data burst volume (MDBV) associated with a second QoS flow, and wherein the first QFI indicates a first QoS flow established between a MWAB-UE of the MWAB and the first 5GC network, and the second QoS flow is established between a UE connecting to a MWAB-gNB of the MWAB and a second 5GC network; and

transmit, to the a gNB of the first 5GC network, session management (SM) information including an updated PDU session AMBR and a list of the first QFI and an associated updated MDBV associated with the second QoS flow.

19. The network equipment of claim 18, wherein the first SMF is preconfigured with the mapping information between a dedicated data network name (DNN) or single network slicing selection assistance information (S-NSSAI) and a corresponding dedicated MDBV or dedicated PDU session AMBR.

20. A processor for wireless communication, comprising:

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

obtain uplink (UL) data; and

determine a first quality of service (QoS) flow associated with a first protocol data unit (PDU) session established between a mobile next-generation node-B (gNB) with wireless access backhauling-user equipment (MWAB-UE) of a MWAB and a first 5G Core (5GC) network, based on at least one of the following characteristics of the UL data:

a QoS requirement associated with the UL data;

a message type of the UL data; or

a first QoS flow identifier (QFI) of the first QoS flow associated with the UL data; and

send the UL data from the MWAB-UE to the first 5GC network via the first QoS flow.

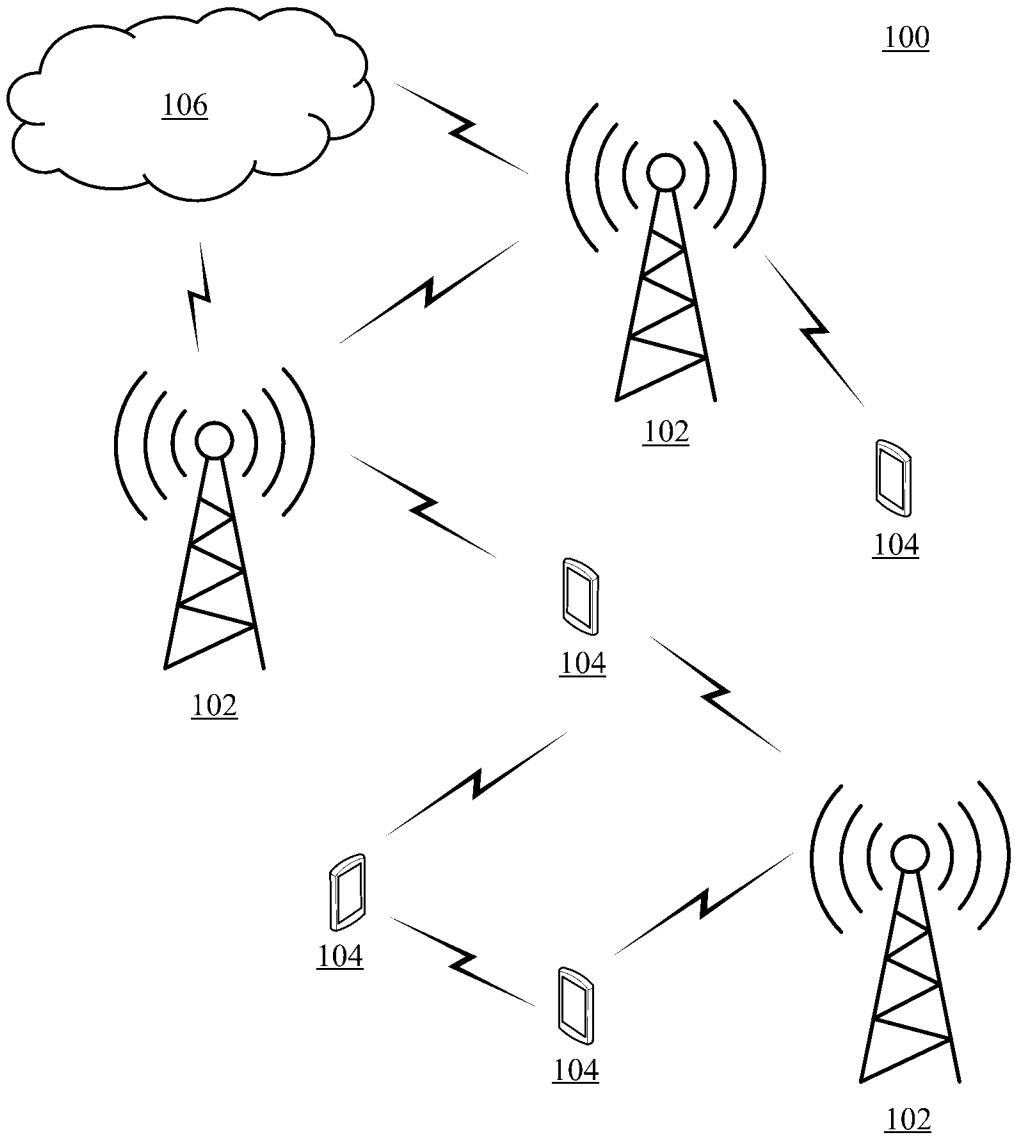


Figure 1

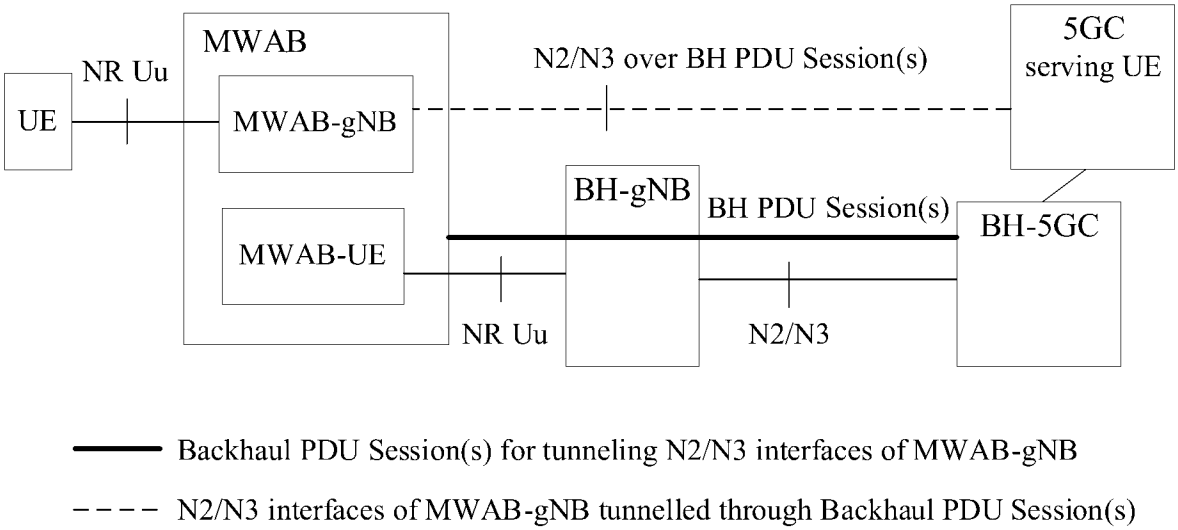


Figure 2A

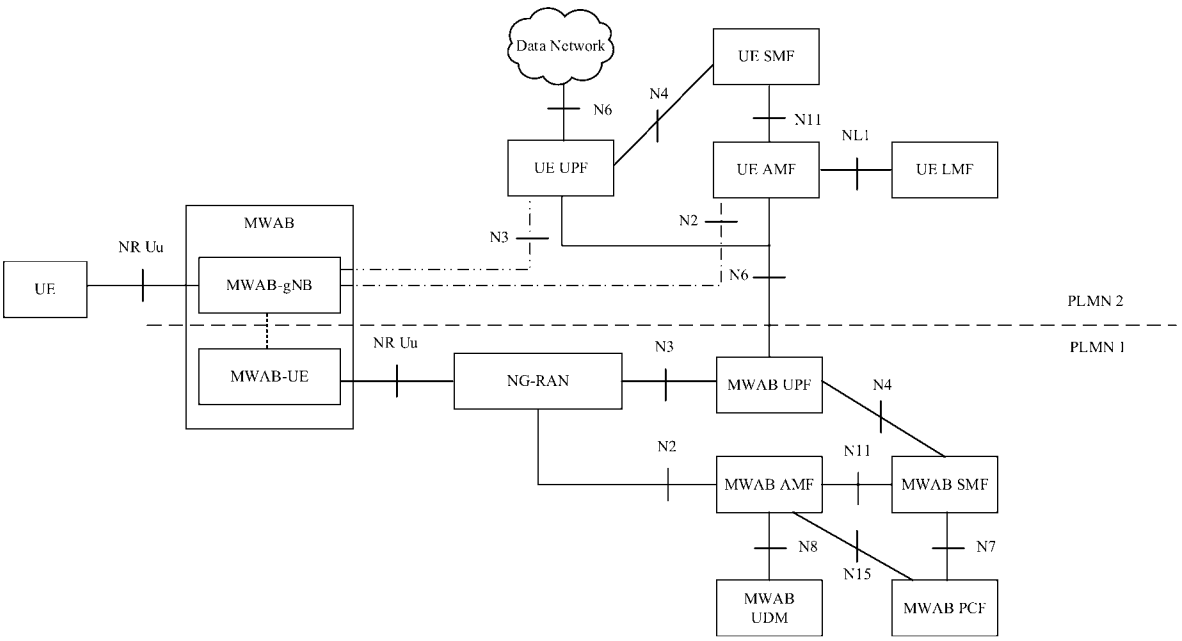


Figure 2B

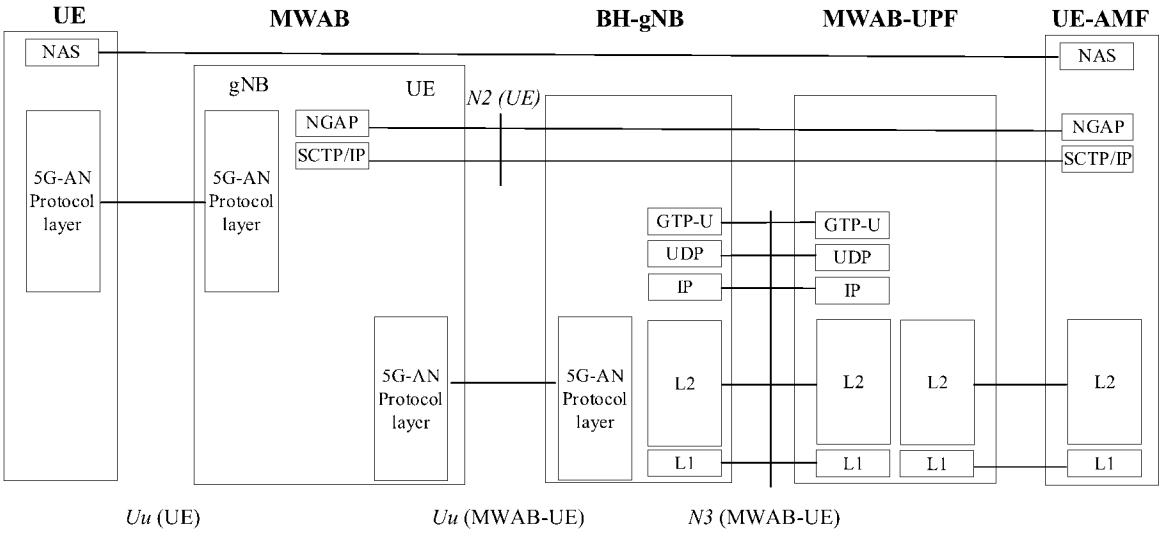


Figure 3A

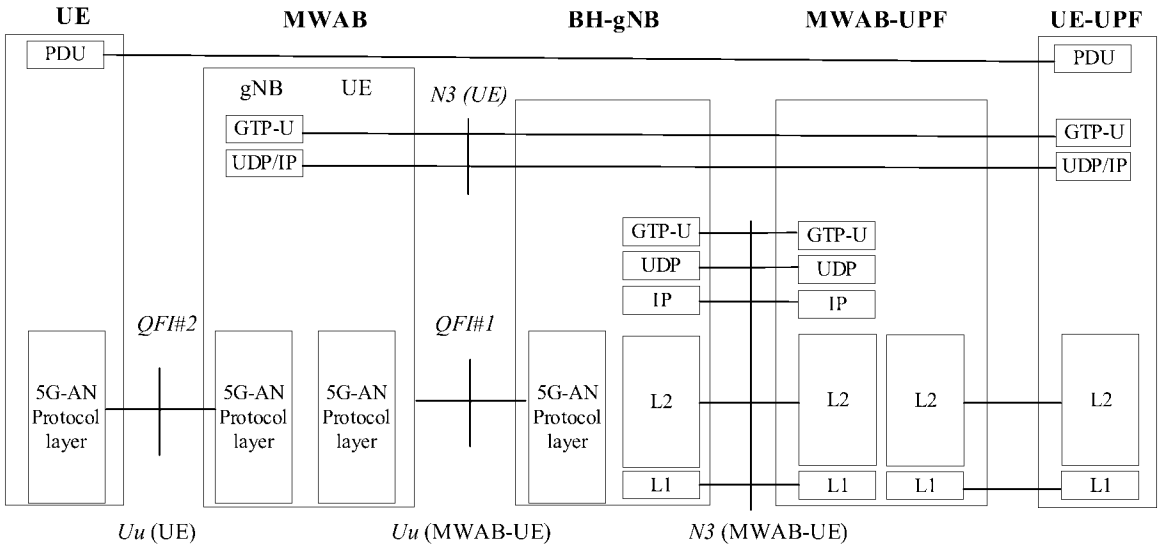


Figure 3B

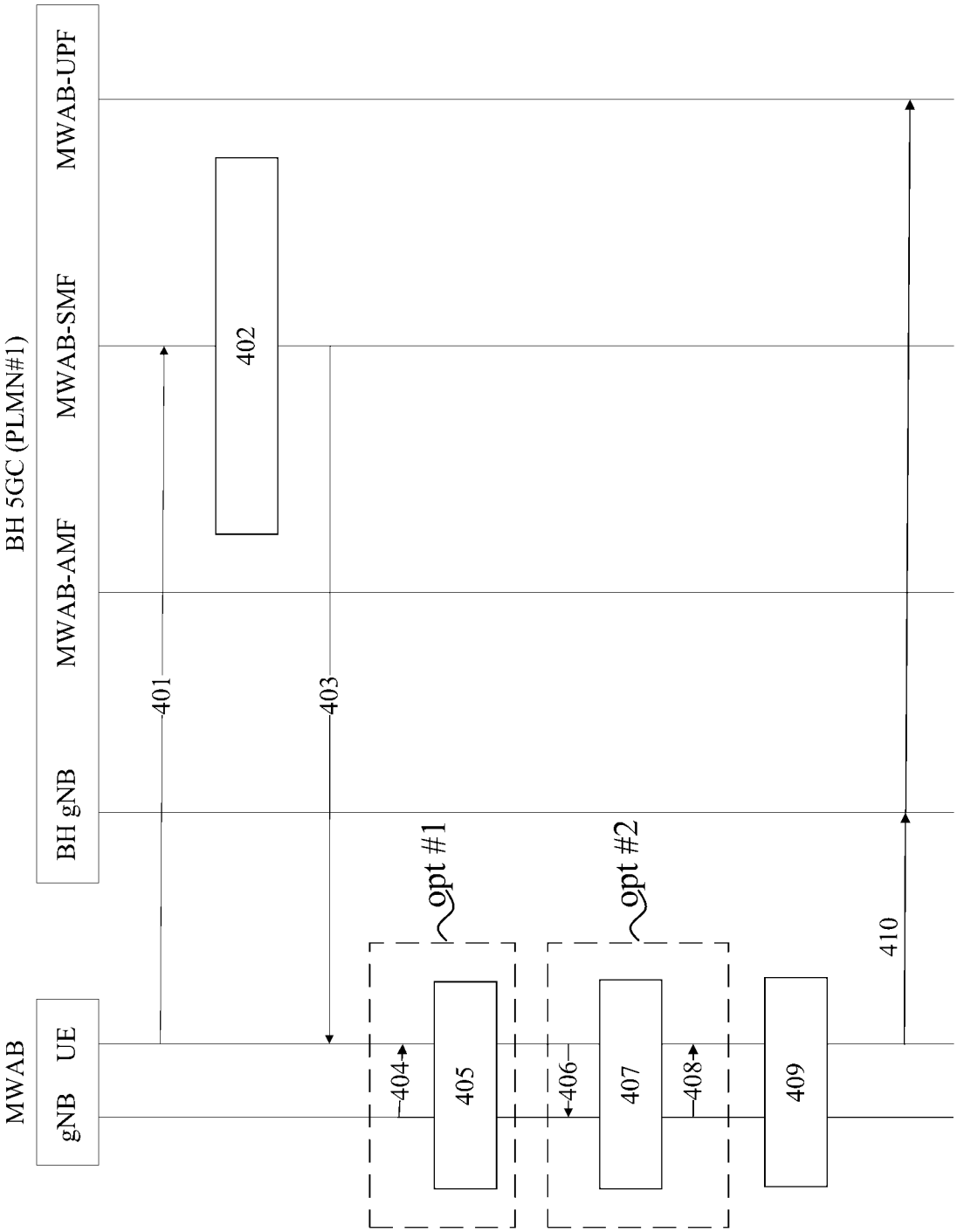

MWAB
gNB
UE
BH gNB
MWAB-AMF
MWAB-SMF
MWAB-UPF
BH 5GC (PLMN#1)
401
402
403
404
405
406
407
408
409
410
opt #1
opt #2

Figure 4

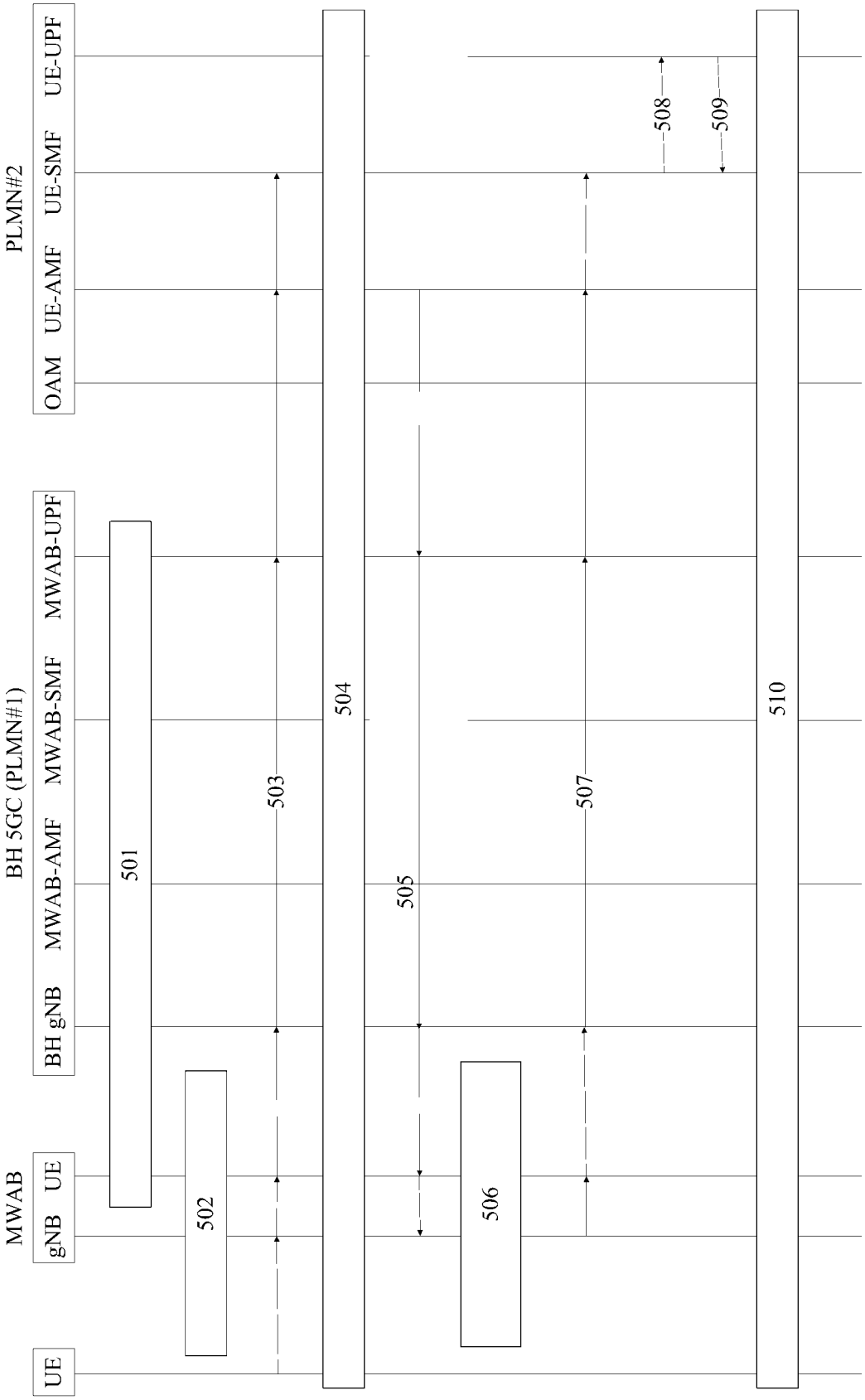

UE
MWAB gNB
MWAB UE
BH 5GC (PLMN#1)
BH gNB
MWAB-AMF
MWAB-SMF
MWAB-UPF
PLMN#2
OAM
UE-AMF
UE-SMF
UE-UPF
501
502
503
504
505
506
507
508
509
510

Figure 5

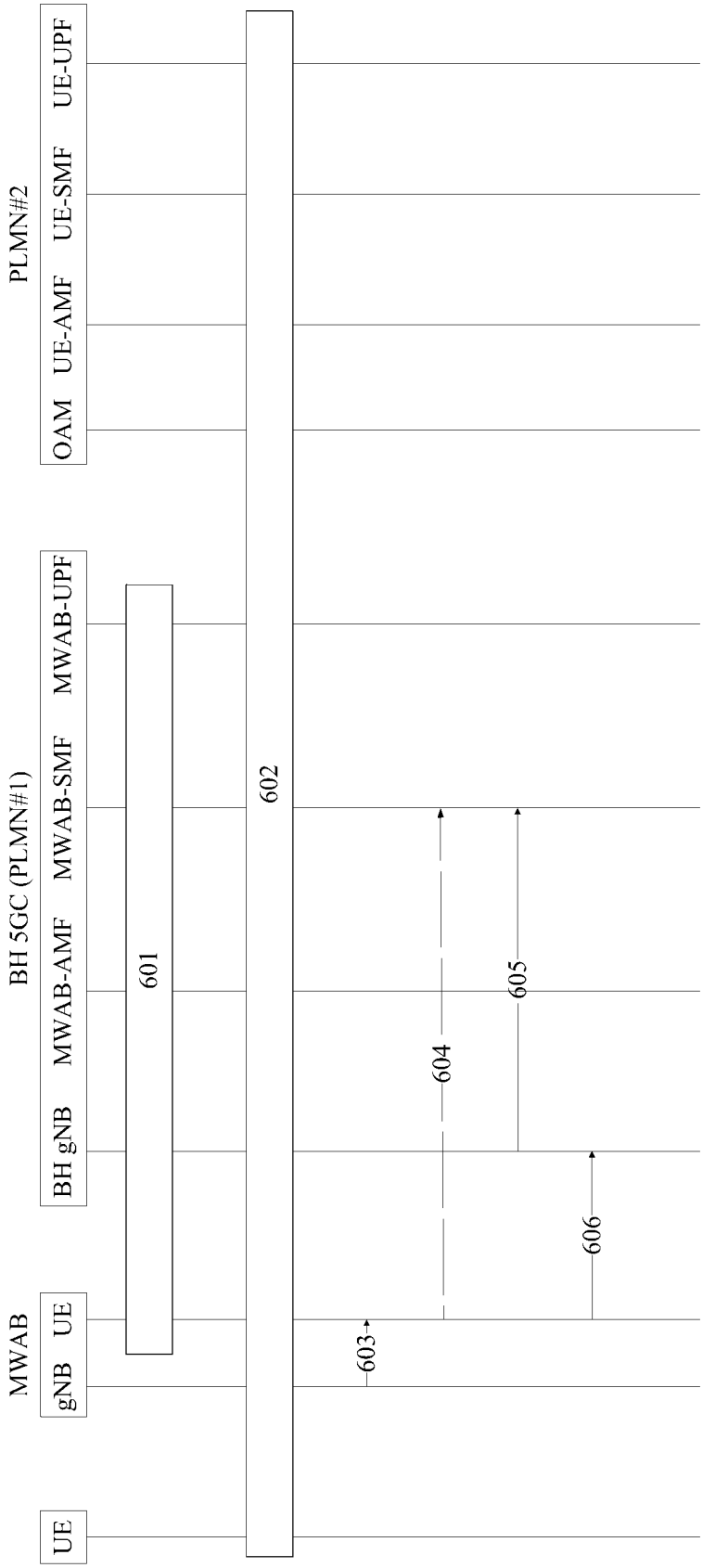

UE
MWAB
gNB
UE
BH 5GC (PLMN#1)
BH gNB
MWAB-AMF
MWAB-SMF
MWAB-UPF
PLMN#2
OAM
UE-AMF
UE-SMF
UE-UPF
601
602
603
604
605
606

Figure 6

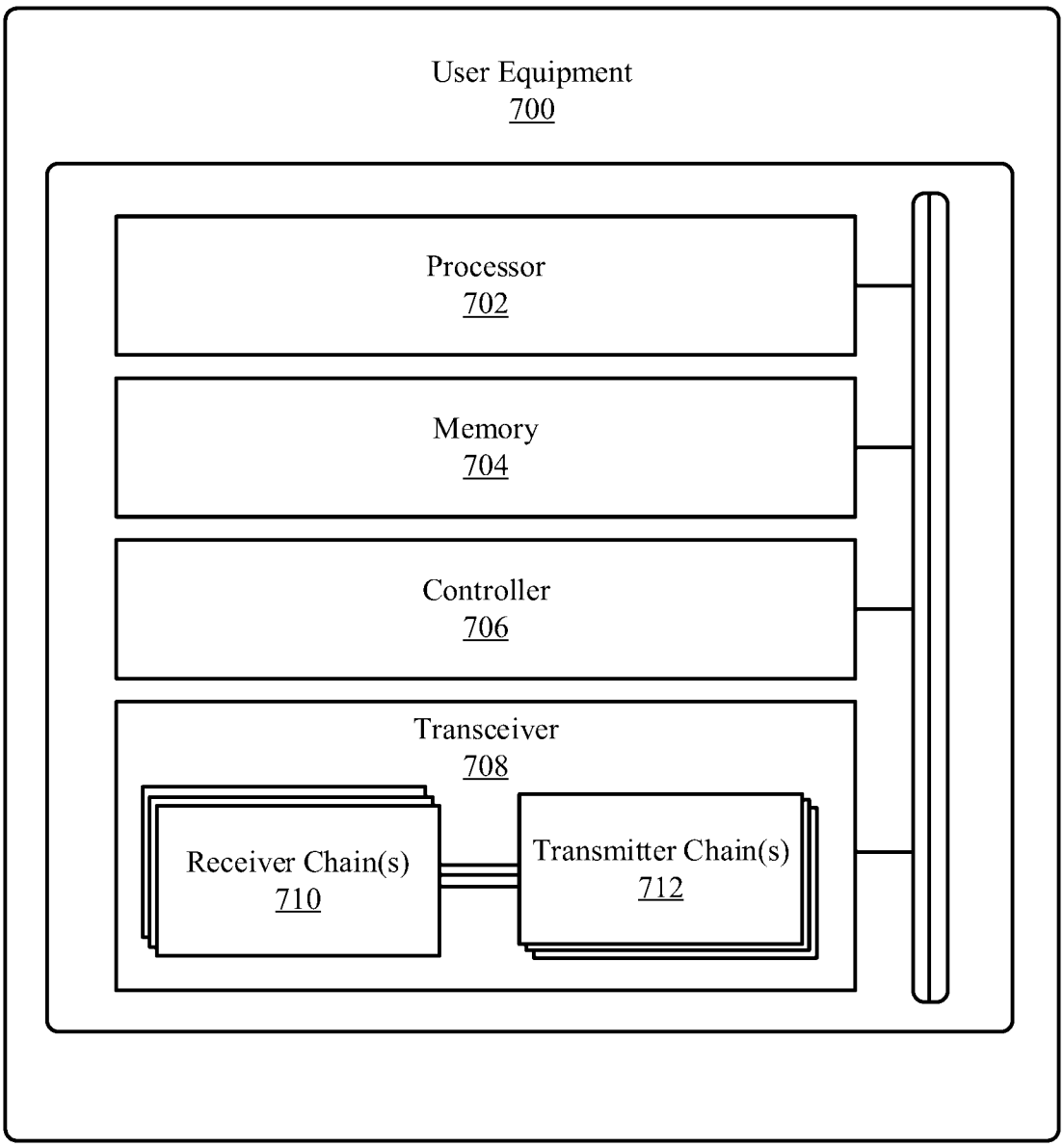
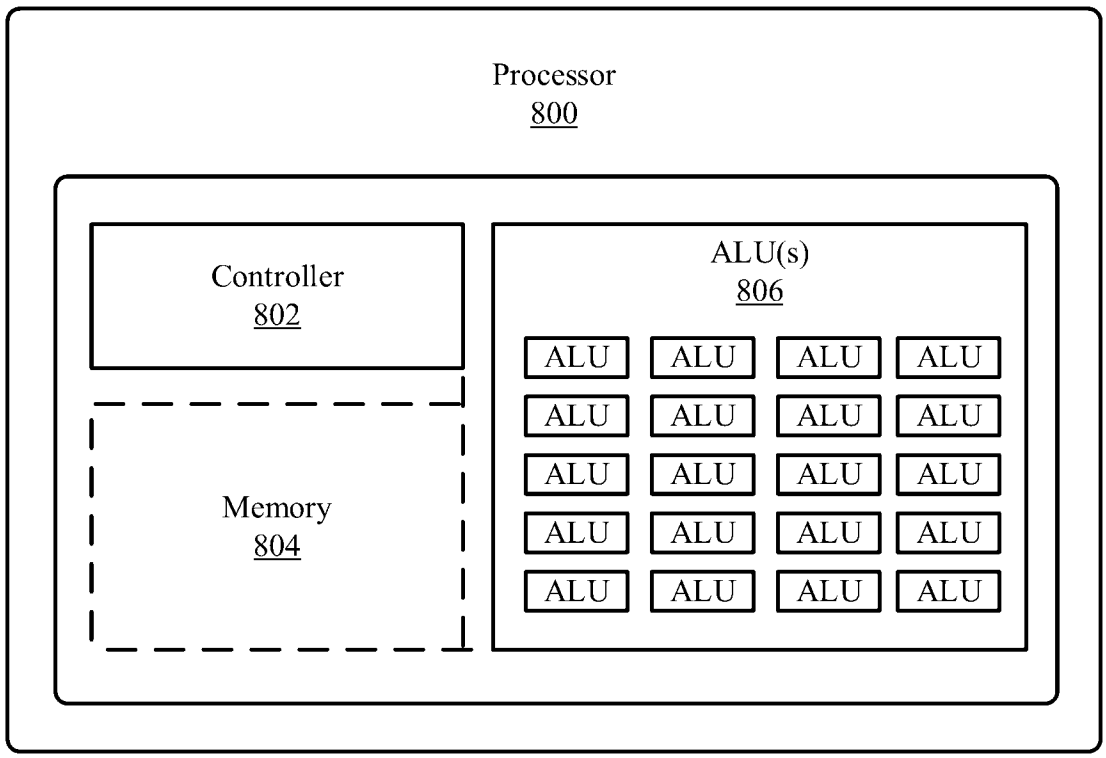

User Equipment
700
Processor
702
Memory
704
Controller
706
Transceiver
708
Receiver Chain(s)
710
Transmitter Chain(s)
712

Figure 7


Processor
800
Controller
802
Memory
804
ALU(s)
806
ALU
ALU
ALU
ALU
ALU
ALU
ALU
ALU
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ALU
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ALU
ALU
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ALU
ALU
ALU

Figure 8

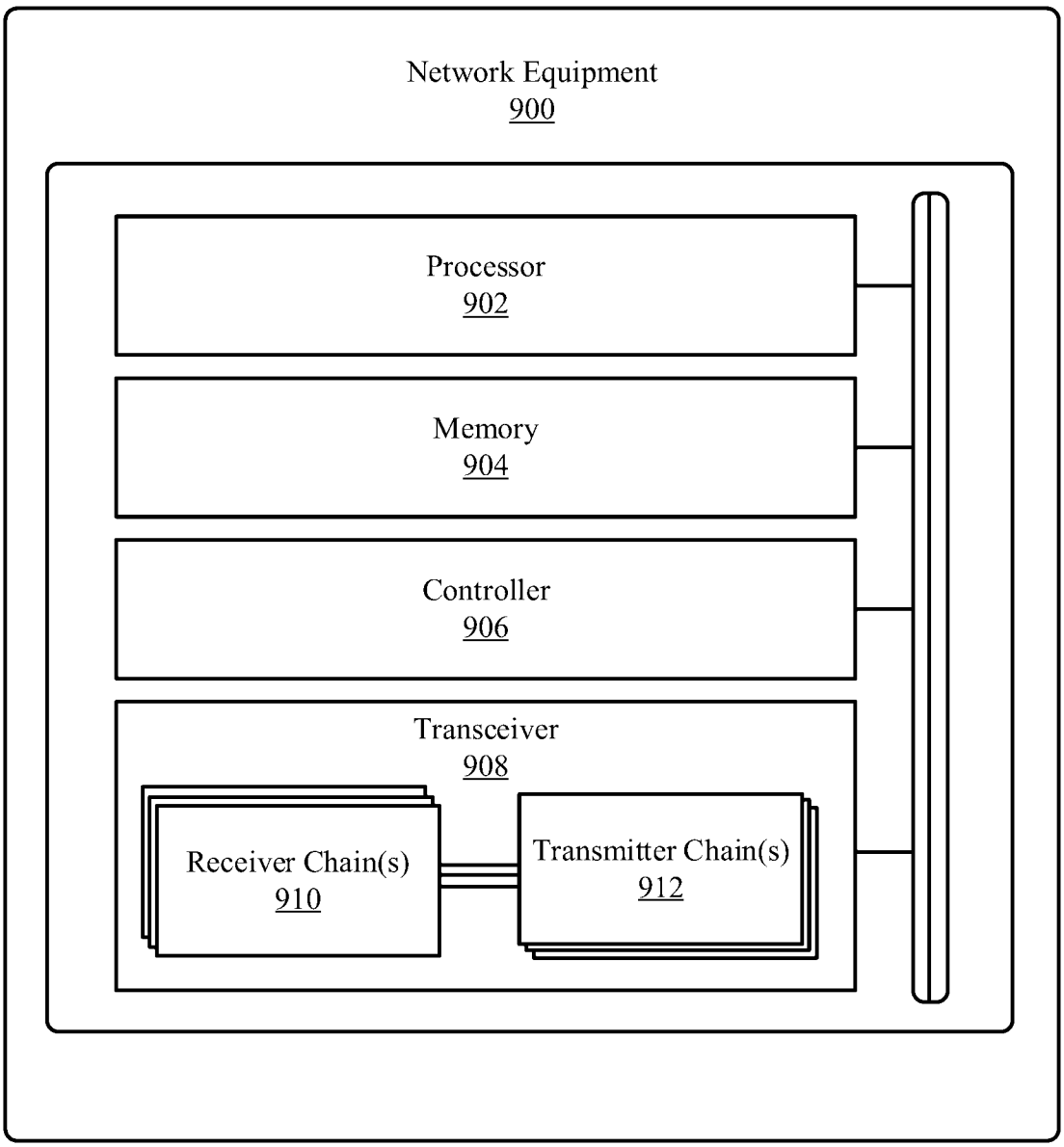
Network Equipment
900
Processor
902
Memory
904
Controller
906
Transceiver
908
Receiver Chain(s)
910
Transmitter Chain(s)
912

Figure 9

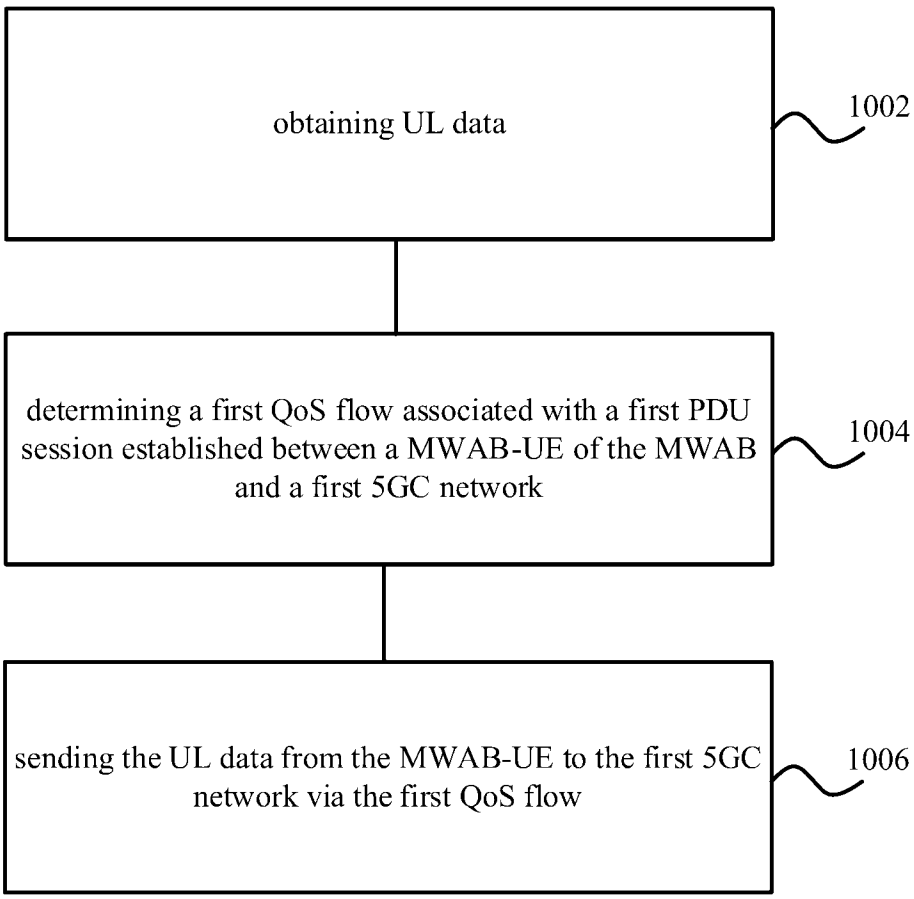
obtaining UL data
1002
determining a first QoS flow associated with a first PDU session established between a MWAB-UE of the MWAB and a first 5GC network
1004
sending the UL data from the MWAB-UE to the first 5GC network via the first QoS flow
1006

Figure 10

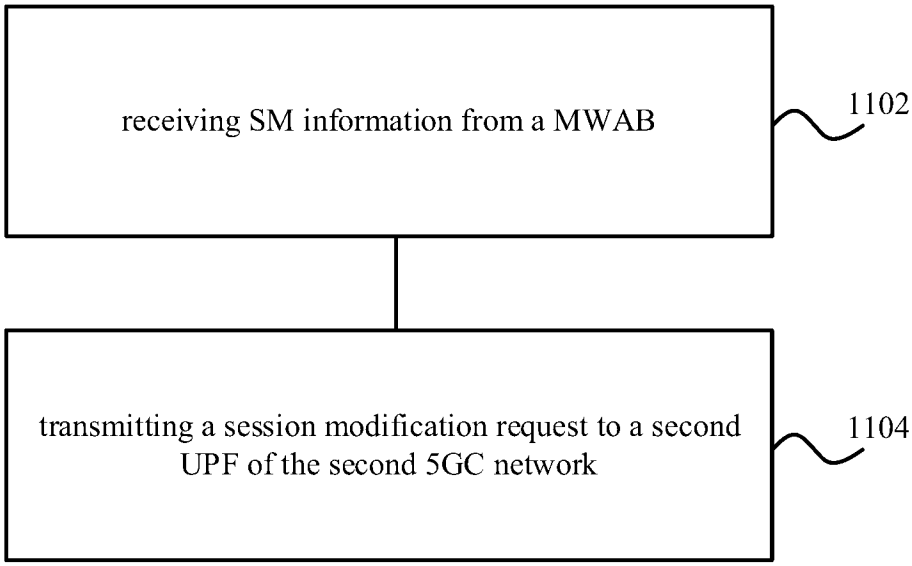

Figure 11

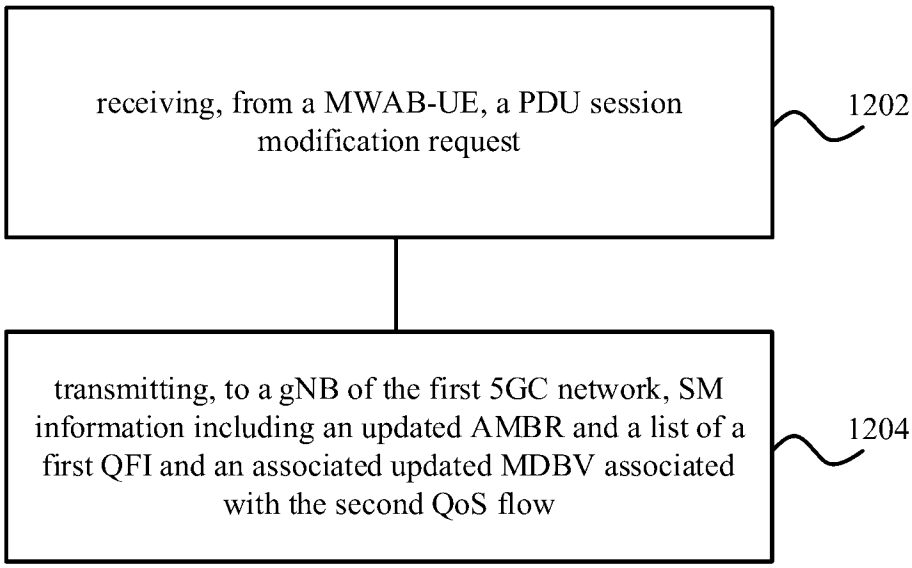

Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/111067

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/24(2009.01)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 H04Q

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)

CNTXT,ENTXT,DWPI,CNKI,3GPP:MWAB,session,QoS,flow,UL,UE,gnb,SMF,mapping,modif+,QFI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NOKIA. "KI#1: Updated solution 3 on N3 backhaul PDU session management" *SA WG2 Meeting #163 S2-2406255,* 31 May 2024 (2024-05-31), section 6.3	1-20
X	WO 2024160293 A1 (LENOVO (BEIJING) LIMITED) 08 August 2024 (2024-08-08) paragraphs 78-257 in description	1-20
A	WO 2023245648 A1 (ZTE CORPORATION) 28 December 2023 (2023-12-28) the whole document	1-20
A	WO 2023240523 A1 (NOKIA SHANGHAI BELL CO., LTD. et al.) 21 December 2023 (2023-12-21) the whole document	1-20
A	WO 2024107097 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)) 23 May 2024 (2024-05-23) 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
23 April 2025	**27 April 2025**

Name and mailing address of the ISA/CN	Authorized officer
CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China**	**YAN,Yue** Telephone No. **(+86) 010-53961643**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/111067

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2024160293 A1	08 August 2024	None	
WO 2023245648 A1	28 December 2023	KR 20240168348 A	29 November 2024
		EP 4505792 A1	12 February 2025
		US 2025024316 A1	16 January 2025
		CN 119422406 A	11 February 2025
WO 2023240523 A1	21 December 2023	IN 202447098911 A	20 December 2024
		CN 119366221 A	24 January 2025
WO 2024107097 A1	23 May 2024	None	