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(54) **OPERATION METHOD RELATED TO SIDELINK TRANSMISSION AND RECEPTION OF UE IN WIRELESS COMMUNICATION SYSTEM, AND DEVICE THEREFOR**

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(57) **ABSTRACT**

An operation method of first user equipment (UE) in a wireless communication system, according to one embodiment, comprises: a step in which the first UE establishes a PC5 unicast link with a second UE; and a step in which the first UE transmits user traffic to the second UE, wherein the method comprises determining, on the basis of addition or elimination of a first PC5 QoS flow, whether to include a service data adaptation protocol (SDAP) header in the PC5 unicast link with respect to second PC5 QoS flow(s) used in the transmission of the user traffic.

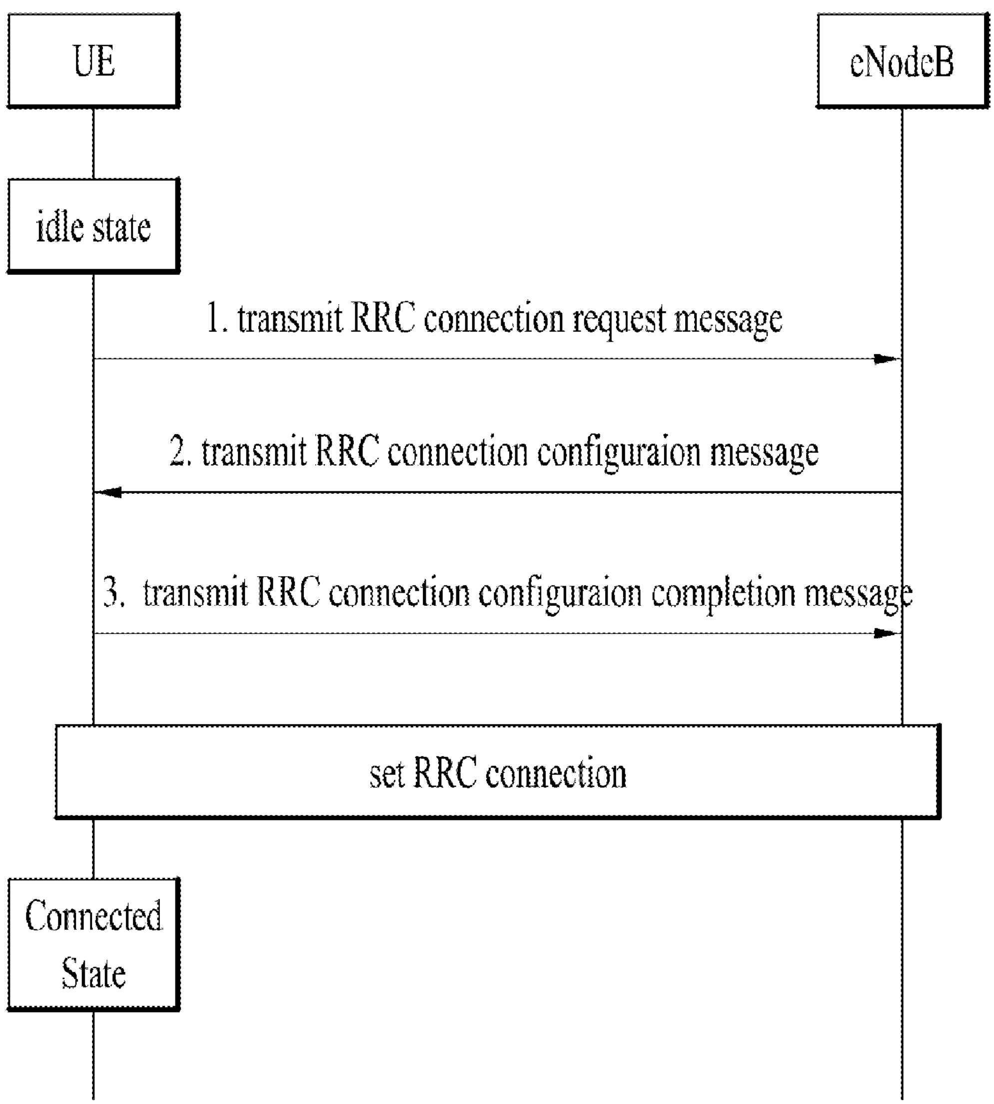


FIG. 1

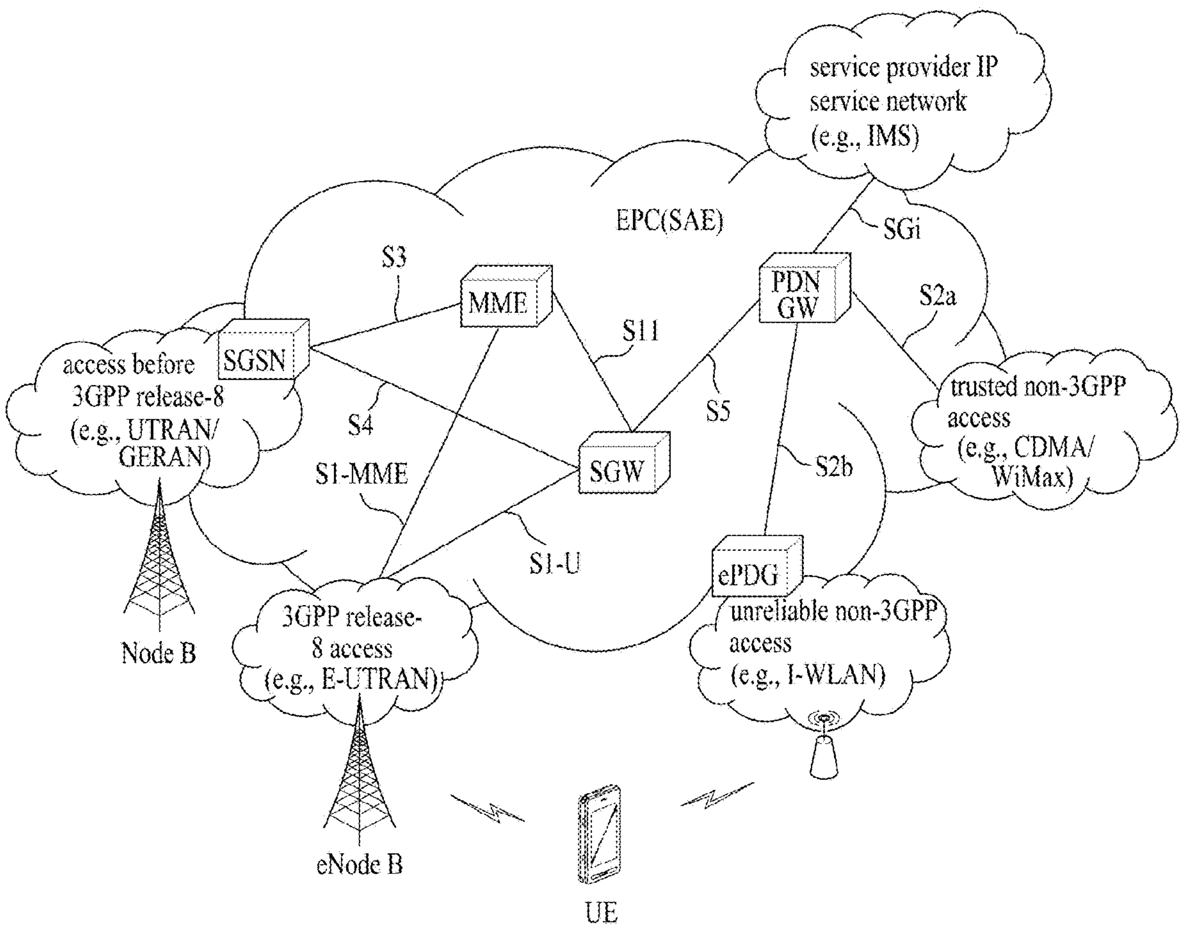

service provider IP
service network
(e.g., IMS)
EPC(SAE)
SGi
S3
MME
PDN
GW
S2a
S11
SGSN
access before
3GPP release-8
(e.g., UTRAN/
GERAN)
S4
S5
trusted non-3GPP
access
(e.g., CDMA/
WiMax)
SGW
S2b
S1-MME
S1-U
ePDG
unreliable non-3GPP
access
(e.g., I-WLAN)
Node B
3GPP release-
8 access
(e.g., E-UTRAN)
eNode B
UE

FIG. 2

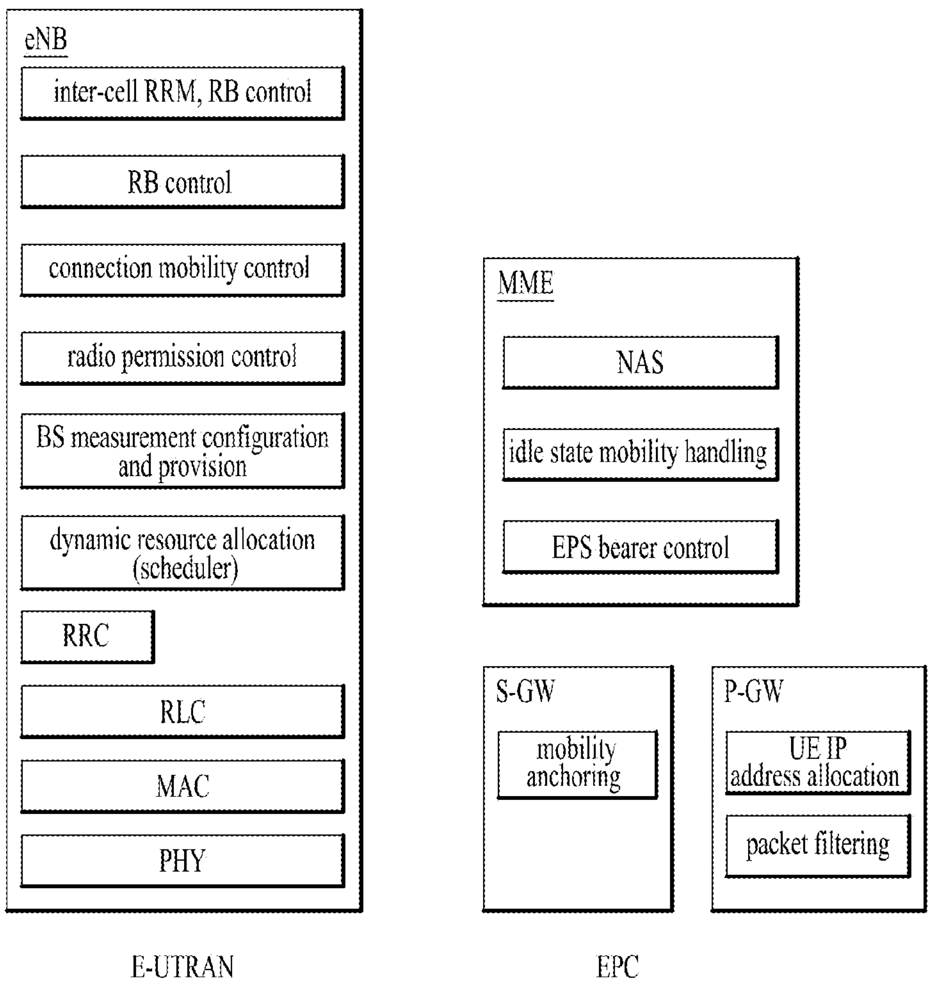

eNB
inter-cell RRM, RB control
RB control
connection mobility control
radio permission control
BS measurement configuration and provision
dynamic resource allocation (scheduler)
RRC
RLC
MAC
PHY
MME
NAS
idle state mobility handling
EPS bearer control
S-GW
mobility anchoring
P-GW
UE IP address allocation
packet filtering
E-UTRAN
EPC

FIG. 3

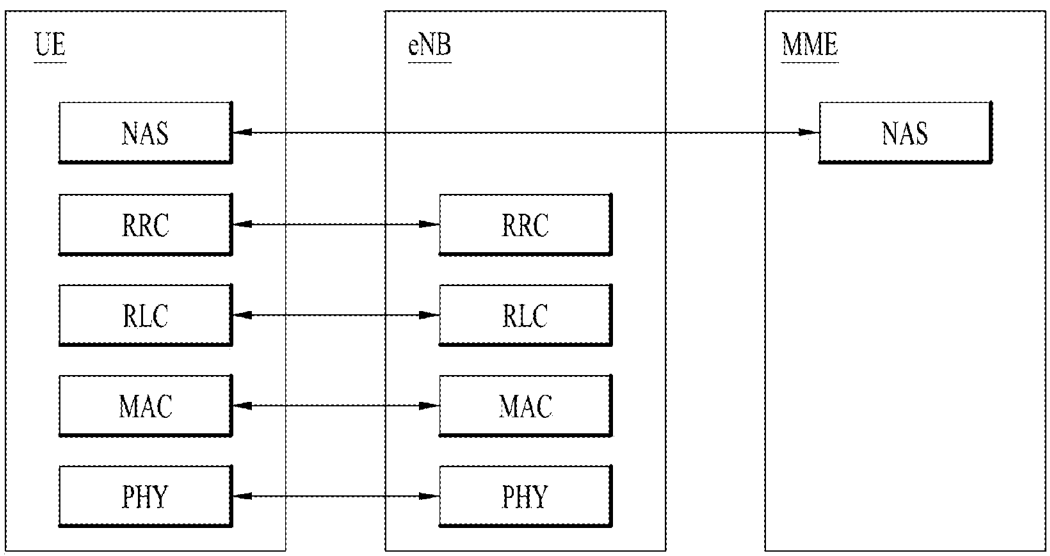


FIG. 4

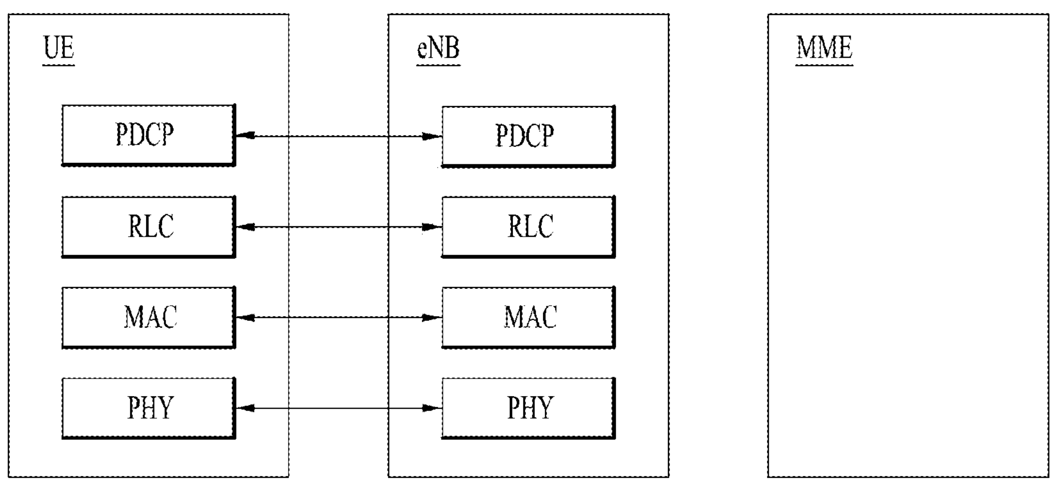


FIG. 5

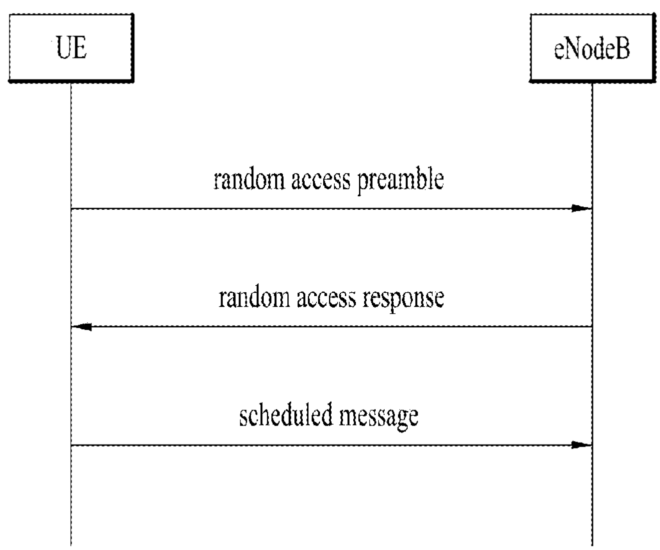

UE
eNodeB
random access preamble
random access response
scheduled message

FIG. 6

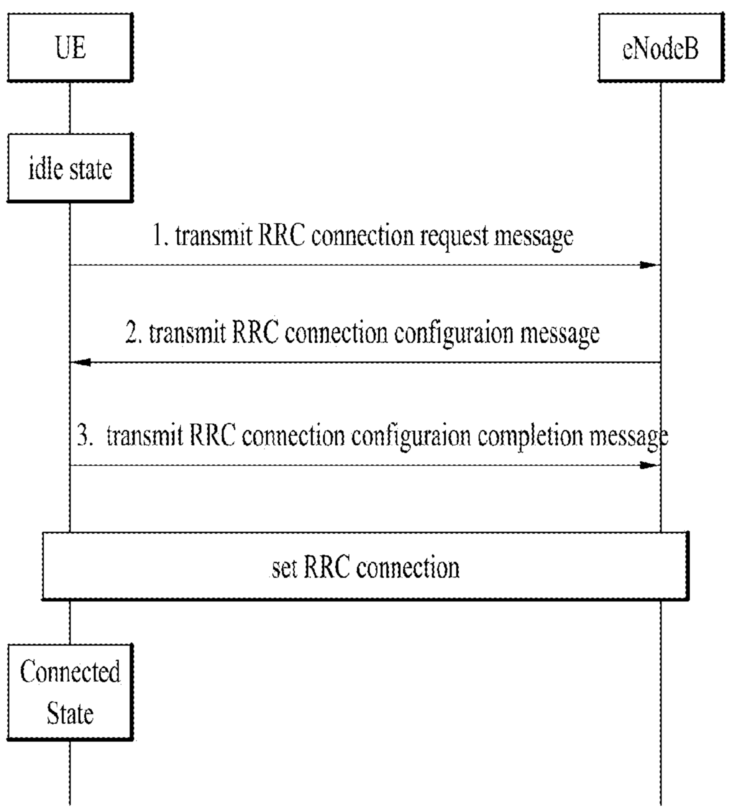

UE
eNodeB
idle state
1. transmit RRC connection request message
2. transmit RRC connection configuraion message
3. transmit RRC connection configuraion completion message
set RRC connection
Connected State

FIG. 7

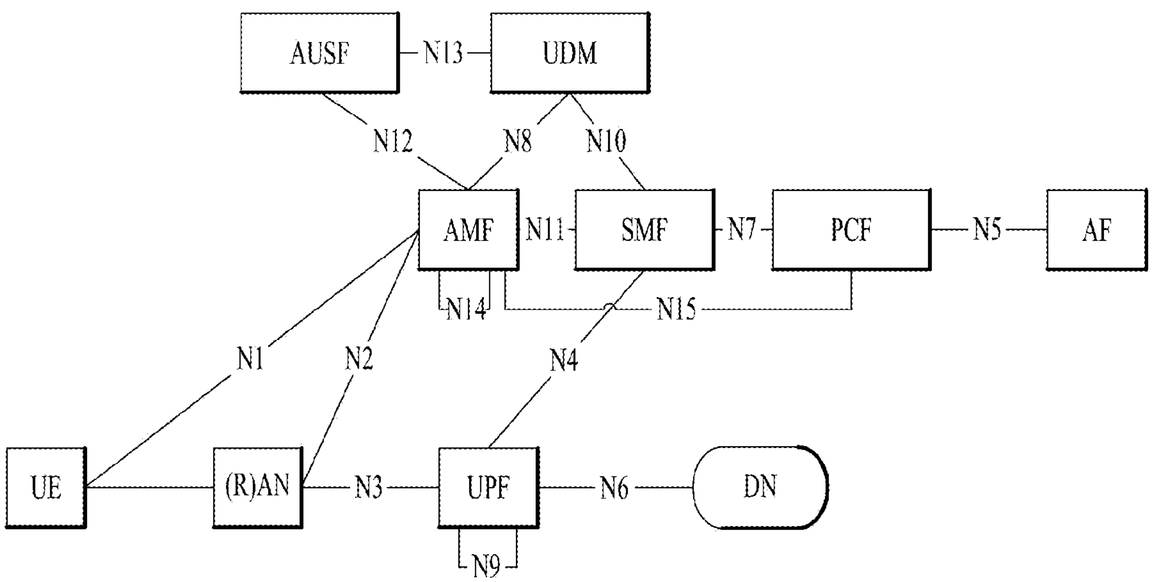

AUSF
N13
UDM
N12
N8
N10
AMF
N11
SMF
N7
PCF
N5
AF
N14
N15
N1
N2
N4
UE
(R)AN
N3
UPF
N6
DN
N9

FIG. 8

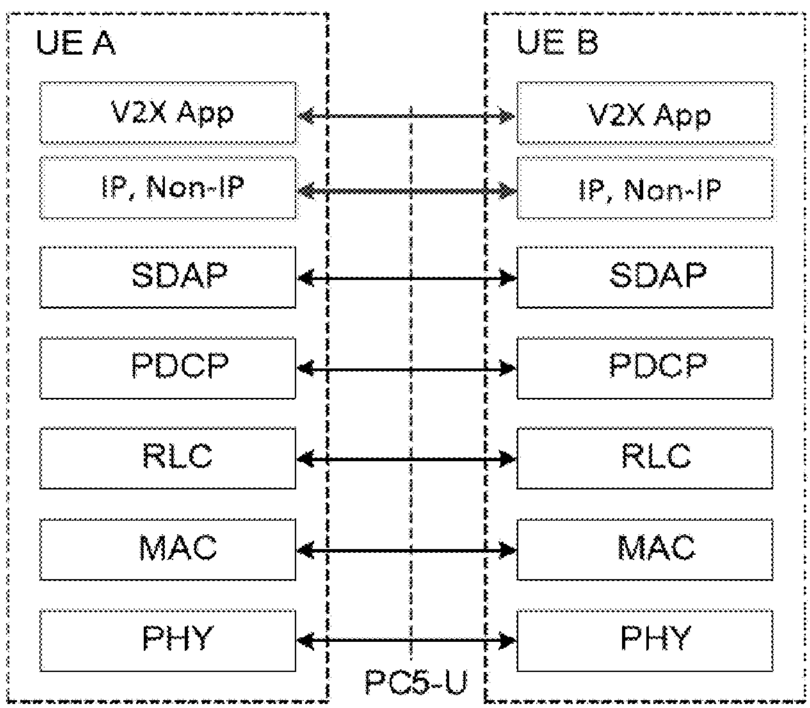

UE A
V2X App
IP, Non-IP
SDAP
PDCP
RLC
MAC
PHY
UE B
V2X App
IP, Non-IP
SDAP
PDCP
RLC
MAC
PHY
PC5-U

FIG. 9

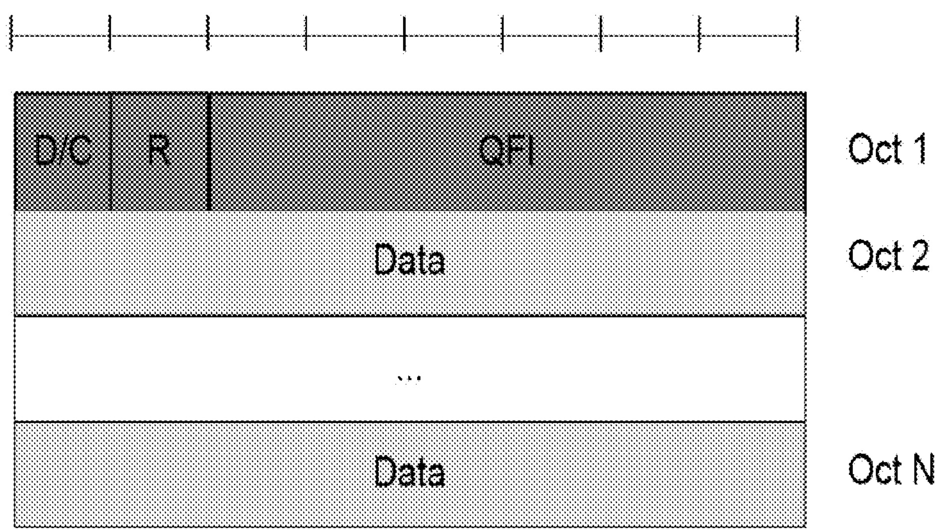


FIG. 10

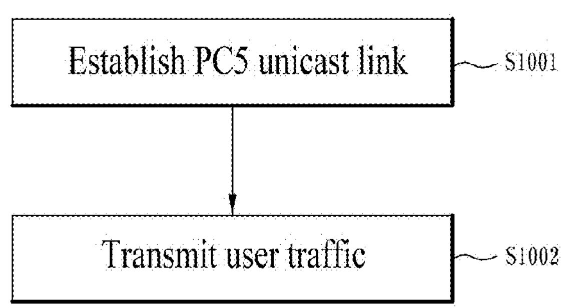

Establish PC5 unicast link
S1001
Transmit user traffic
S1002

FIG. 11

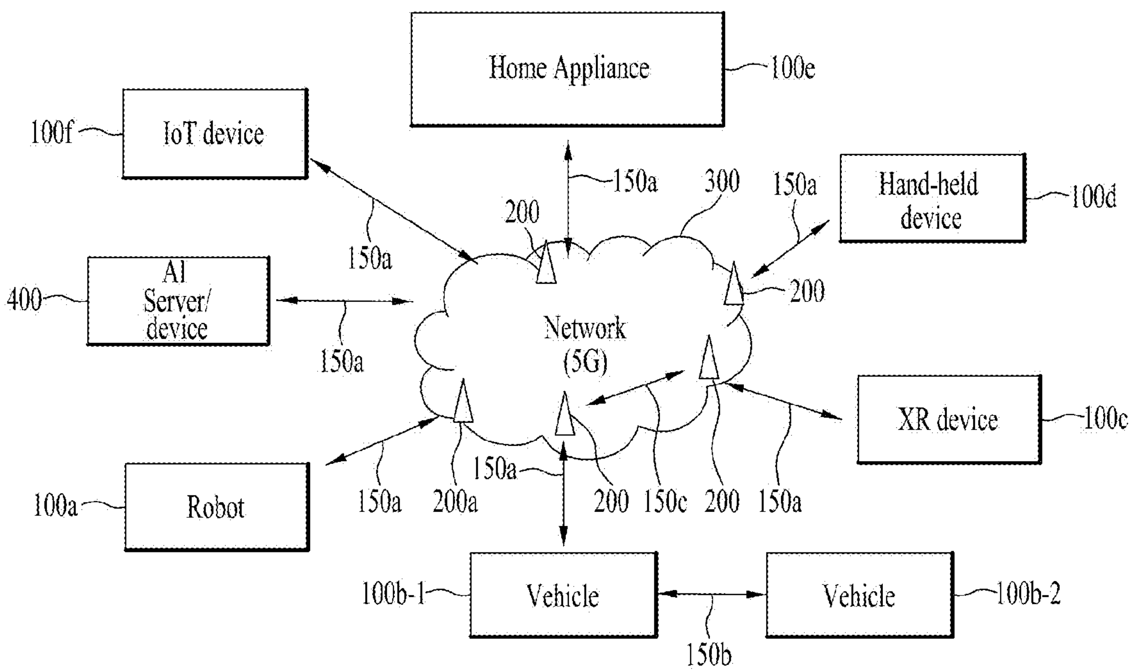

Home Appliance
100e
IoT device
100f
150a
300
150a
Hand-held device
100d
200
150a
AI Server/ device
400
200
Network (5G)
150a
XR device
100c
Robot
100a
150a
200a
150a
200
150c
200
150a
Vehicle
100b-1
Vehicle
100b-2
150b

FIG. 12

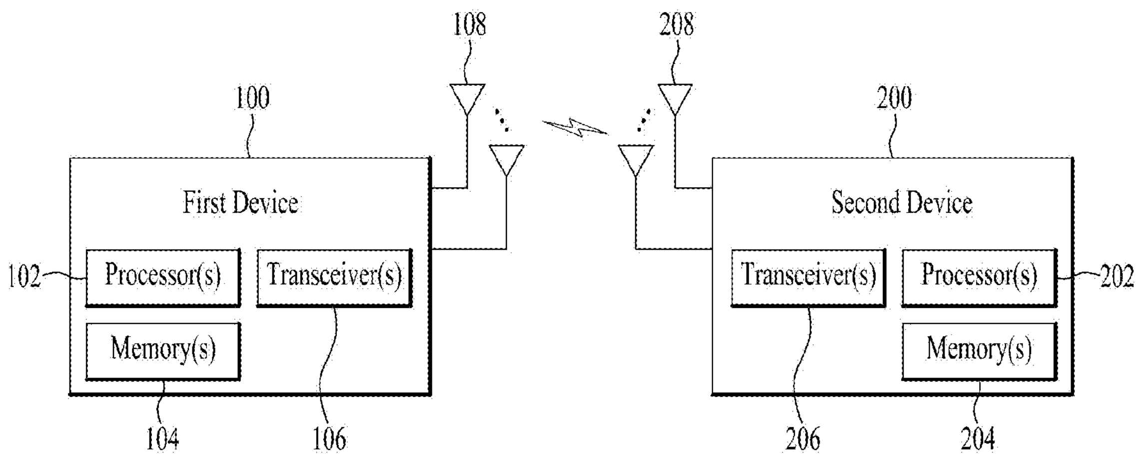

108
208
100
200
First Device
Second Device
102
Processor(s)
Transceiver(s)
Transceiver(s)
Processor(s)
202
Memory(s)
Memory(s)
104
106
206
204

FIG. 13

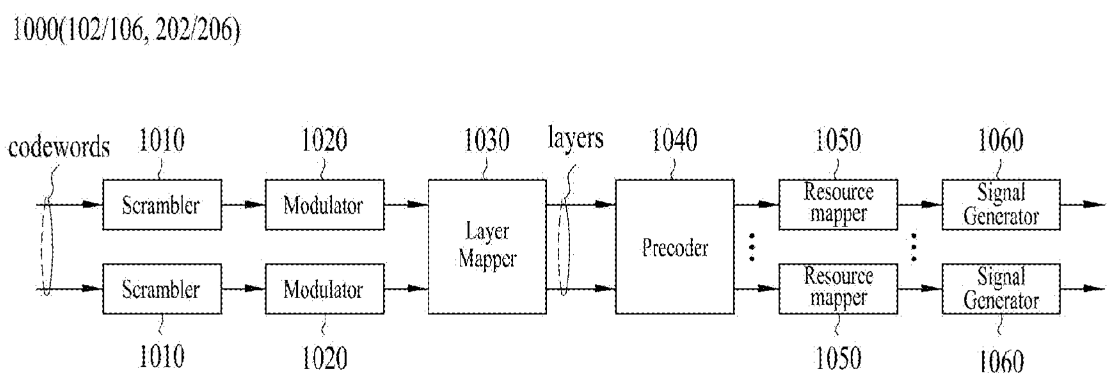

1000(102/106, 202/206)
codewords
1010
1020
1030
layers
1040
1050
1060
Scrambler
Modulator
Layer Mapper
Precoder
Resource mapper
Signal Generator
Scrambler
Modulator
Resource mapper
Signal Generator
1010
1020
1050
1060

FIG. 14

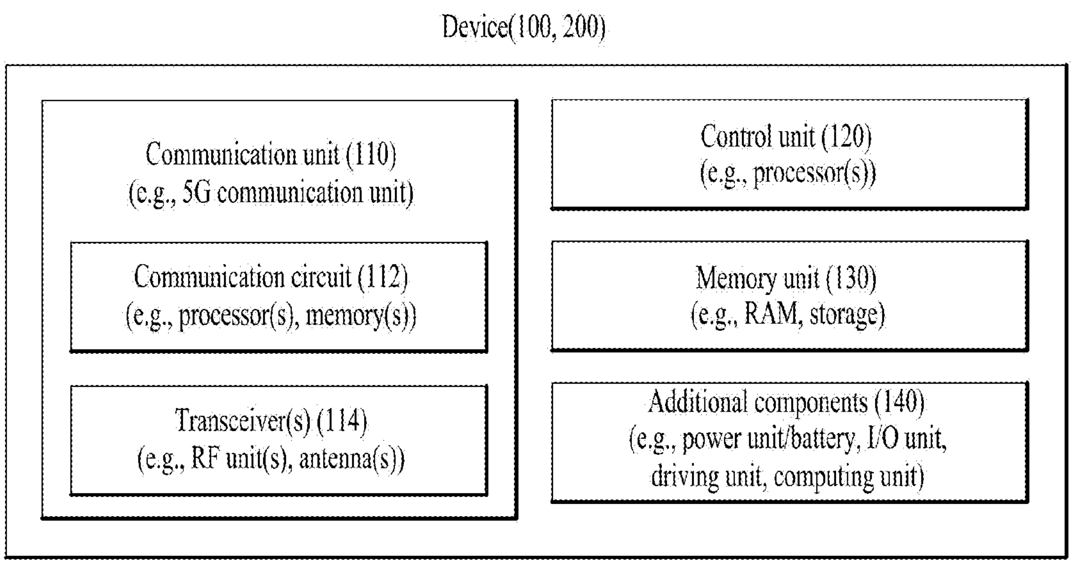

Device(100, 200)
Communication unit (110)
(e.g., 5G communication unit)
Communication circuit (112)
(e.g., processor(s), memory(s))
Transceiver(s) (114)
(e.g., RF unit(s), antenna(s))
Control unit (120)
(e.g., processor(s))
Memory unit (130)
(e.g., RAM, storage)
Additional components (140)
(e.g., power unit/battery, I/O unit,
driving unit, computing unit)

FIG. 15

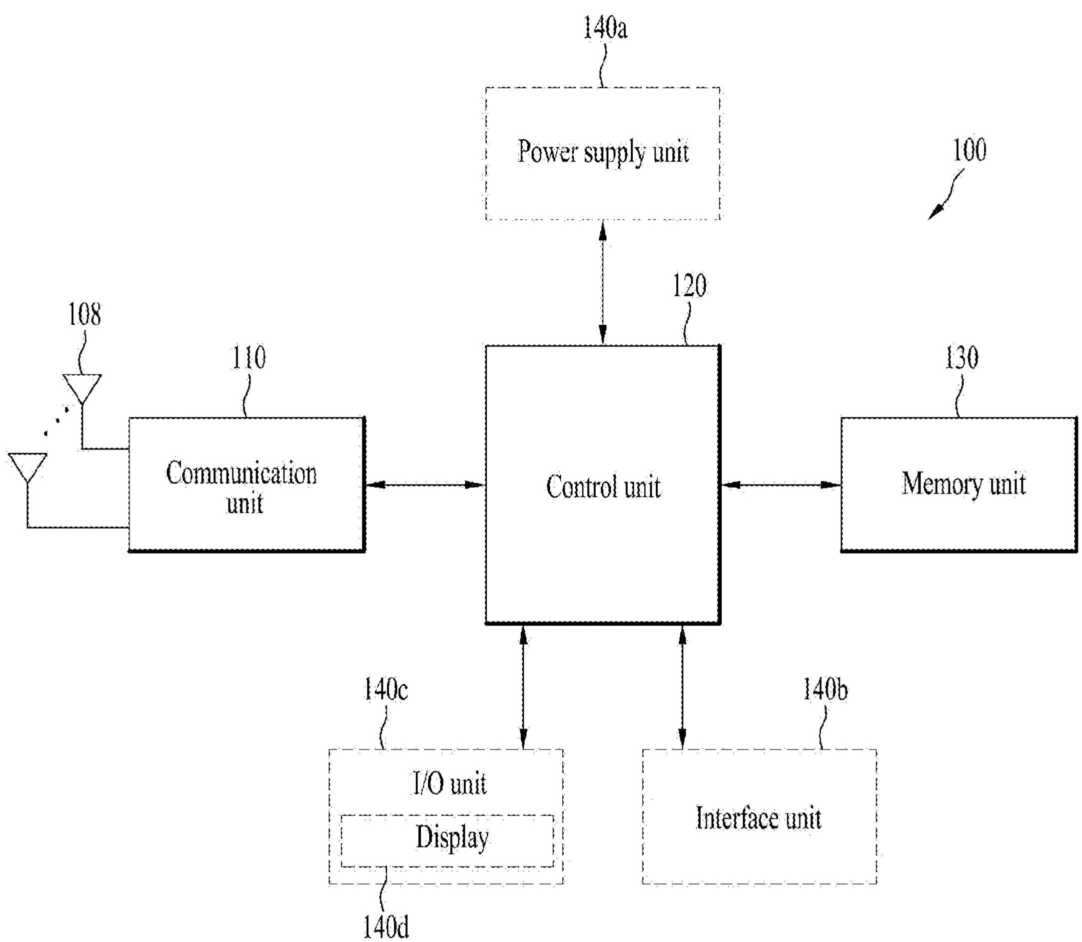

140a
Power supply unit
100
120
108
110
130
Communication unit
Control unit
Memory unit
140c
140b
I/O unit
Display
Interface unit
140d

FIG. 16

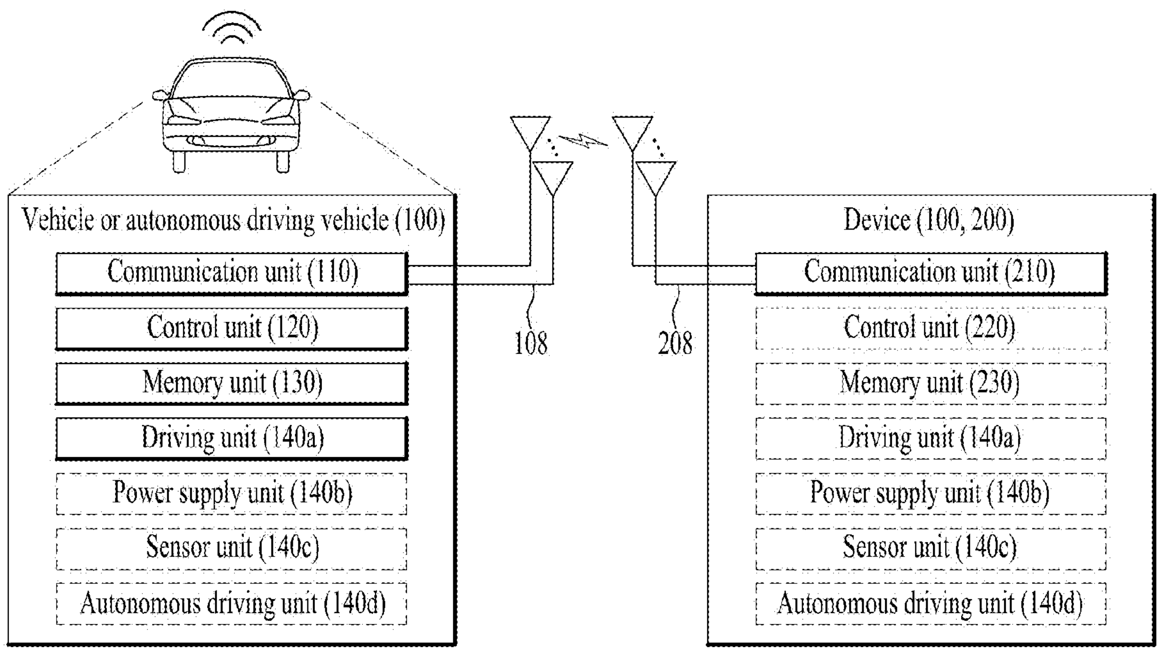

Vehicle or autonomous driving vehicle (100)
Communication unit (110)
Control unit (120)
Memory unit (130)
Driving unit (140a)
Power supply unit (140b)
Sensor unit (140c)
Autonomous driving unit (140d)
108
208
Device (100, 200)
Communication unit (210)
Control unit (220)
Memory unit (230)
Driving unit (140a)
Power supply unit (140b)
Sensor unit (140c)
Autonomous driving unit (140d)

FIG. 17

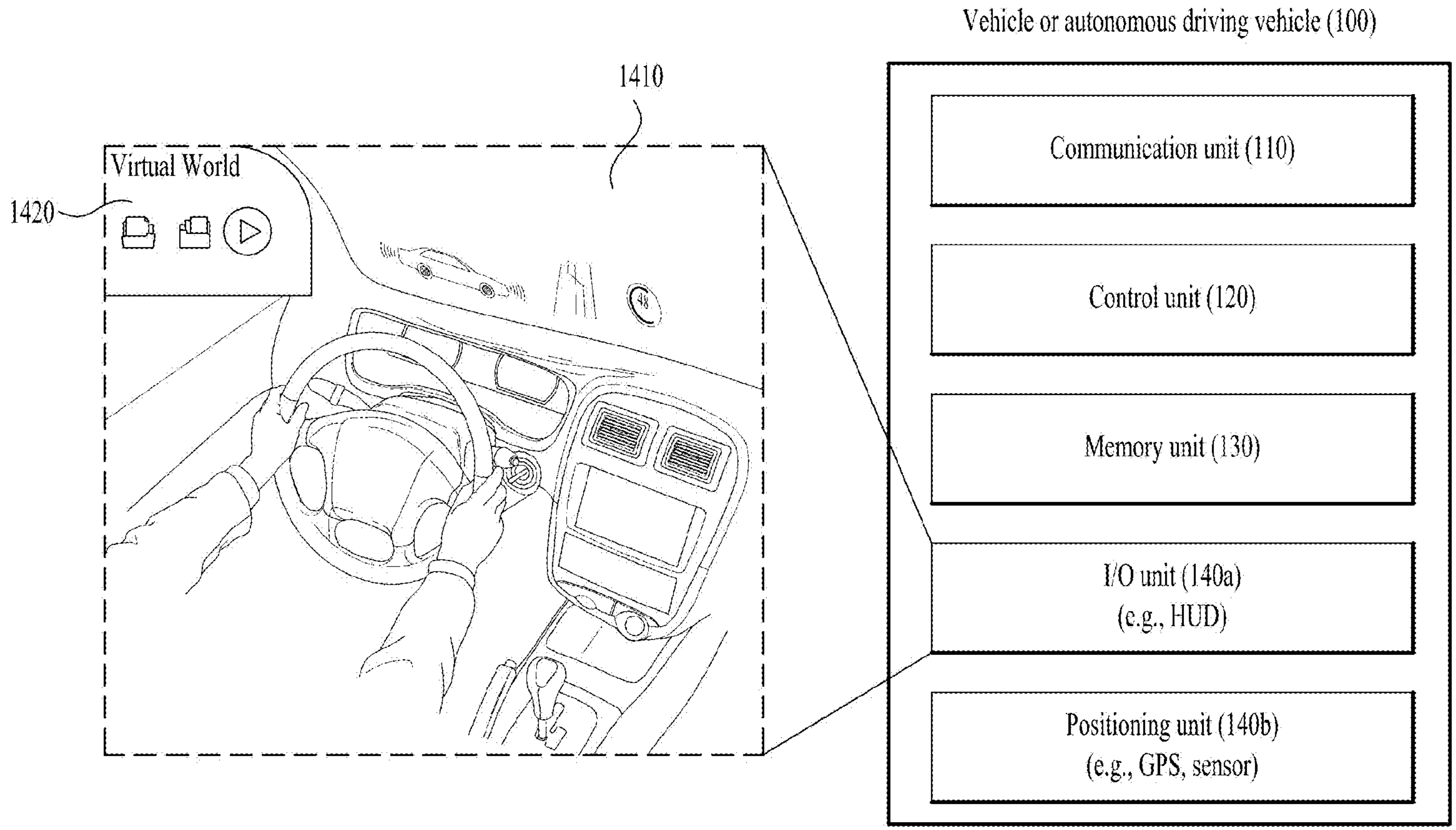

1420
1410
Virtual World
Vehicle or autonomous driving vehicle (100)
Communication unit (110)
Control unit (120)
Memory unit (130)
I/O unit (140a)
(e.g., HUD)
Positioning unit (140b)
(e.g., GPS, sensor)

FIG. 18

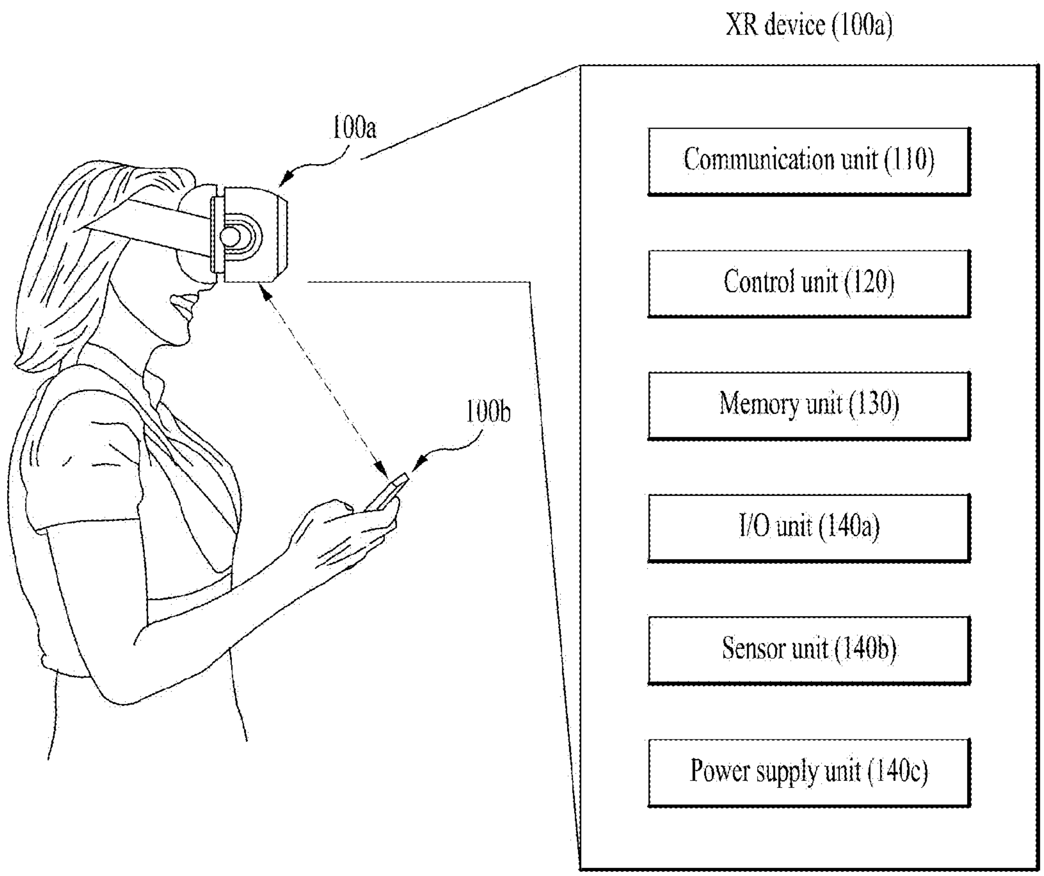

XR device (100a)
100a
100b
Communication unit (110)
Control unit (120)
Memory unit (130)
I/O unit (140a)
Sensor unit (140b)
Power supply unit (140c)

FIG. 19

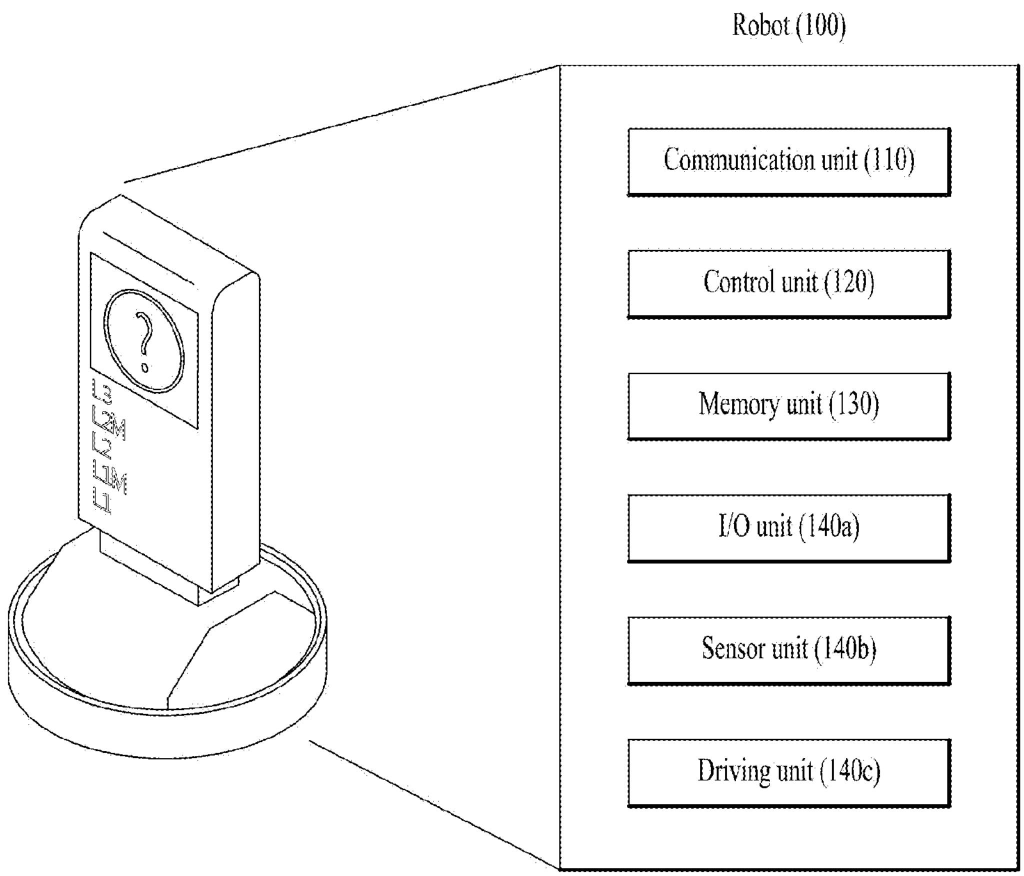
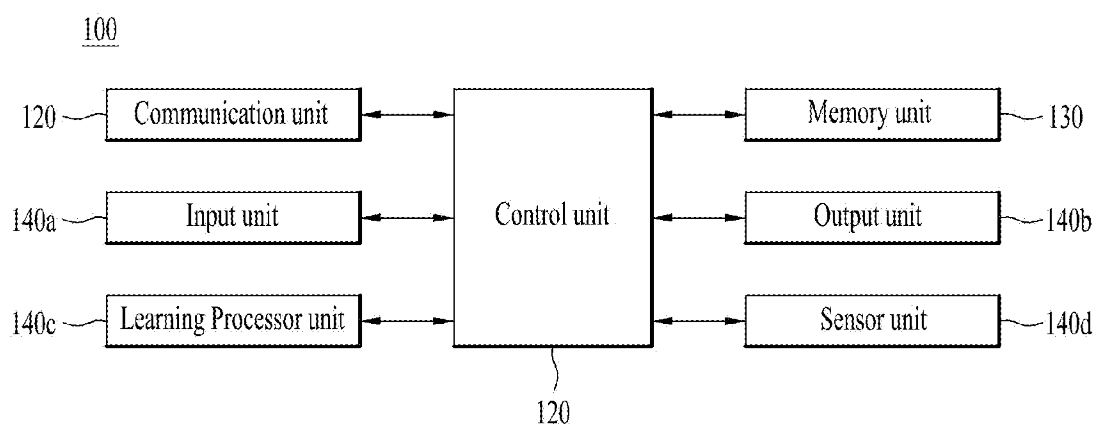

Robot (100)
Communication unit (110)
Control unit (120)
Memory unit (130)
I/O unit (140a)
Sensor unit (140b)
Driving unit (140c)

FIG. 20


100
120
Communication unit
140a
Input unit
140c
Learning Processor unit
Control unit
120
Memory unit
130
Output unit
140b
Sensor unit
140d

OPERATION METHOD RELATED TO SIDELINK TRANSMISSION AND RECEPTION OF UE IN WIRELESS COMMUNICATION SYSTEM, AND DEVICE THEREFOR

TECHNICAL FIELD

[0001] The following description relates to a wireless communication system and, more particularly, to an operation method and an apparatus, associated with sidelink transmission and reception of a user equipment (UE) in relation to a PC5 quality of service (QoS) flow and a service data adaptation protocol (SDAP).

BACKGROUND ART

[0002] Wireless communication systems have been widely deployed to provide various types of communication services such as voice or data. In general, a wireless communication system is a multiple access system that supports communication of multiple users by sharing available system resources (a bandwidth, transmission power, etc.) among them. For example, multiple access systems include a code division multiple access (CDMA) system, a frequency division multiple access (FDMA) system, a time division multiple access (TDMA) system, an orthogonal frequency division multiple access (OFDMA) system, a single carrier frequency division multiple access (SC-FDMA) system, and a multi-carrier frequency division multiple access (MC-FDMA) system.

[0003] Wireless communication systems adopt various radio access technologies (RATs) such as long term evolution (LTE), LTE-advanced (LTE-A), and wireless fidelity (WiFi). 5^{th} generation (5G) is one of them. Three key requirement areas of 5G include (1) enhanced mobile broadband (eMBB), (2) massive machine type communication (mMTC), and (3) ultra-reliable and low latency communications (URLLC). Some use cases may require multiple dimensions for optimization, while others may focus only on one key performance indicator (KPI). 5G supports such diverse use cases in a flexible and reliable way.

[0004] eMBB goes far beyond basic mobile Internet access and covers rich interactive work, and media and entertainment applications in the cloud or augmented reality (AR). Data is one of the key drivers for 5G and in the 5G era, we may see no dedicated voice service for the first time. In 5G, voice is expected to be handled as an application program, simply using data connectivity provided by a communication system. The main drivers for an increased traffic volume are the increase in the size of content and the number of applications requiring high data rates. Streaming services (audio and video), interactive video, and mobile Internet connectivity will continue to be used more broadly as more devices connect to the Internet. Many of these applications require always-on connectivity to push real time information and notifications to users. Cloud storage and applications are rapidly increasing for mobile communication platforms. This is applicable for both work and entertainment. Cloud storage is one particular use case driving the growth of uplink data rates. 5G will also be used for remote work in the cloud which, when done with tactile interfaces, requires much lower end-to-end latencies in order to maintain a good user experience. Entertainment, for example, cloud gaming and video streaming, is another key driver for the increasing need for mobile broadband capacity. Entertainment will be very essential on smart phones and tablets everywhere, including high mobility environments such as trains, cars and airplanes. Another use case is augmented reality (AR) for entertainment and information search, which requires very low latencies and significant instant data volumes.

[0005] One of the most expected 5G use cases is the functionality of actively connecting embedded sensors in every field, that is, mMTC. It is expected that there will be 20.4 billion potential Internet of things (IoT) devices by 2020. In industrial IoT, 5G is one of areas that play key roles in enabling smart city, asset tracking, smart utility, agriculture, and security infrastructure.

[0006] URLLC includes services which will transform industries with ultra-reliable/available, low latency links such as remote control of critical infrastructure and self-driving vehicles. The level of reliability and latency are vital to smart-grid control, industrial automation, robotics, drone control and coordination, and so on.

[0007] Now, multiple use cases will be described in greater detail.

[0008] 5G may complement fiber-to-the home (FTTH) and cable-based broadband (or data-over-cable service interface specifications (DOCSIS)) as a means of providing streams at data rates of hundreds of megabits per second to giga bits per second. Such a high speed is required for TV broadcasts at or above a resolution of 4K (6K, 8K, and higher) as well as virtual reality (VR) and AR. VR and AR applications mostly include immersive sport games. A special network configuration may be required for a specific application program. For VR games, for example, game companies may have to integrate a core server with an edge network server of a network operator in order to minimize latency.

[0009] The automotive sector is expected to be a very important new driver for 5G, with many use cases for mobile communications for vehicles. For example, entertainment for passengers requires simultaneous high capacity and high mobility mobile broadband, because future users will expect to continue their good quality connection independent of their location and speed. Other use cases for the automotive sector are AR dashboards. These display overlay information on top of what a driver is seeing through the front window, identifying objects in the dark and telling the driver about the distances and movements of the objects. In the future, wireless modules will enable communication between vehicles themselves, information exchange between vehicles and supporting infrastructure and between vehicles and other connected devices (e.g., those carried by pedestrians). Safety systems may guide drivers on alternative courses of action to allow them to drive more safely and lower the risks of accidents. The next stage will be remote-controlled or self-driving vehicles. These require very reliable, very fast communication between different self-driving vehicles and between vehicles and infrastructure. In the future, self-driving vehicles will execute all driving activities, while drivers are focusing on traffic abnormality elusive to the vehicles themselves. The technical requirements for self-driving vehicles call for ultra-low latencies and ultra-high reliability, increasing traffic safety to levels humans cannot achieve.

[0010] Smart cities and smart homes, often referred to as smart society, will be embedded with dense wireless sensor networks. Distributed networks of intelligent sensors will identify conditions for cost- and energy-efficient maintenance of the city or home. A similar setup can be done for each home, where temperature sensors, window and heating controllers, burglar alarms, and home appliances are all connected wirelessly. Many of these sensors are typically characterized by low data rate, low power, and low cost, but for example, real time high definition (HD) video may be required in some types of devices for surveillance.

[0011] The consumption and distribution of energy, including heat or gas, is becoming highly decentralized, creating the need for automated control of a very distributed sensor network. A smart grid interconnects such sensors, using digital information and communications technology to gather and act on information. This information may include information about the behaviors of suppliers and consumers, allowing the smart grid to improve the efficiency, reliability, economics and sustainability of the production and distribution of fuels such as electricity in an automated fashion. A smart grid may be seen as another sensor network with low delays.

[0012] The health sector has many applications that may benefit from mobile communications. Communications systems enable telemedicine, which provides clinical health care at a distance. It helps eliminate distance barriers and may improve access to medical services that would often not be consistently available in distant rural communities. It is also used to save lives in critical care and emergency situations. Wireless sensor networks based on mobile communication may provide remote monitoring and sensors for parameters such as heart rate and blood pressure.

[0013] Wireless and mobile communications are becoming increasingly important for industrial applications. Wires are expensive to install and maintain, and the possibility of replacing cables with reconfigurable wireless links is a tempting opportunity for many industries. However, achieving this requires that the wireless connection works with a similar delay, reliability and capacity as cables and that its management is simplified. Low delays and very low error probabilities are new requirements that need to be addressed with 5G.

[0014] Finally, logistics and freight tracking are important use cases for mobile communications that enable the tracking of inventory and packages wherever they are by using location-based information systems. The logistics and freight tracking use cases typically require lower data rates but need wide coverage and reliable location information.

DETAILED DESCRIPTION OF THE DISCLOSURE

Technical Problems

[0015] An object of embodiments is to provide determination of whether to include an SDAP header for a PC5 QoS flow, and operations related thereto.

[0016] The objects that are achievable with the present disclosure are not limited to what has been particularly described hereinabove and other objects not described herein will be more clearly understood by persons skilled in the art from the following detailed description.

Technical Solutions

[0017] According to an embodiment, provided herein is an operation method of a first user equipment (UE) in a wireless communication system, including establishing a PC5 unicast link with a second UE; and transmitting user traffic to the second UE. Whether to include a service data adaptation protocol (SDAP) header for second PC5 quality of service (QoS) flow(s) used to transmit the user traffic is determined, based on addition or elimination of a first PC5 QoS flow to or from the PC5 unicast link.

[0018] In an embodiment, provided herein is a first user equipment (UE) in a wireless communication system, including at least one processor; and at least one computer memory operably connected to the at least one processor and configured to store instructions for causing the at least one processor to perform operations based on execution of the instructions. The operations include: establishing a PC5 unicast link with a second UE; and transmitting user traffic to the second UE. Whether to include a service data adaptation protocol (SDAP) header for second PC5 quality of service (QoS) flow(s) used to transmit the user traffic is determined based on addition or elimination of a first PC5 QoS flow to or from the PC5 unicast link.

[0019] The second PC5 QoS flow(s) may be all PC5 QoS flows using a same PC5 unicast link as the first PC5 QoS flow.

[0020] A vehicle-to everything (V2X) layer of the UE may provide an access stratum (AS) layer with information about whether to include the SDAP header for the second PC5 QoS flow(s).

[0021] The SDAP header may be included based on inclusion of two or more services in the PC5 unicast link.

[0022] The SDAP header may not be included based on inclusion of one service in the PC5 unicast link.

[0023] The first UE and the second UE may have one or more PC5 unicast links.

[0024] The determination of whether to include the SDAP header for the second PC5 QoS flow(s) used to transmit the user traffic may be made even in at least one of a case in which the PC5 unicast link is established, a case in which a new service is added to the PC5 unicast link, or a case in which an existing service is eliminated from the PC5 unicast link.

[0025] The information about whether to include the SDAP header may be provided only upon occurrence of a change in inclusion or exclusion of the SDAP header.

[0026] The first UE may store the information about whether to include the SDAP header in a context managed according to each PC5 unicast link.

[0027] The SDAP header may include a PC5 QoS flow identifier (PFI).

[0028] The AS layer may store the information about whether to include the SDAP header for the second PC5 QoS flow(s).

[0029] The first UE may include the SDAP header in the user traffic based on the information about whether to include the SDAP header for the second PC5 QoS flow(s).

[0030] Upon receiving the SDAP header, the second UE may provide the user traffic using a service corresponding to the PFI.

[0031] The first UE may exclude the SDAP header from the user traffic based on the information about whether to include the SDAP header for the second PC5 QoS flow(s).

[0032] Upon failing to receive the SDAP header, the second UE may provide the user traffic using a service identified by a destination layer-2 identifier (ID) of the user traffic.

Advantageous Effects

[0033] According to an embodiment, transmission efficiency may be obtained by determining whether to include an SDAP header according to a PC5 unicast link, and a receiver may identify to which service received user traffic is related.

[0034] The effects that are achievable with embodiment(s) are not limited to what has been particularly described hereinabove and other effects not described herein will be more clearly understood by persons skilled in the art to which embodiment(s) belong from the following description.

DESCRIPTION OF DRAWINGS

[0035] The accompanying drawings, which are included to provide a further understanding of the disclosure, illustrate embodiments of the disclosure and together with the description serve to explain the principle of the disclosure. In the drawings:

[0036] FIG. **1** is a schematic diagram illustrating the structure of an evolved packet system (EPS) including an evolved packet core (EPC);

[0037] FIG. **2** is a diagram illustrating the general architectures of an E-UTRAN and an EPC;

[0038] FIG. **3** is a diagram illustrating the structure of a radio interface protocol in a control plane;

[0039] FIG. **4** is a diagram illustrating the structure of a radio interface protocol in a user plane;

[0040] FIG. **5** is a flowchart illustrating a random access procedure;

[0041] FIG. **6** is a diagram illustrating a connection process in a radio resource control (RRC) layer;

[0042] FIG. **7** is a diagram illustrating a 5th generation (5G) system;

[0043] FIG. **8** illustrates a protocol stack of a user plane in V2X communication;

[0044] FIG. **9** illustrates an SDAP header;

[0045] FIG. **10** is a flowchart according to an embodiment;

[0046] FIG. **11** illustrates a communication system 1 applied to an embodiment;

[0047] FIG. **12** illustrates wireless devices applicable to an embodiment;

[0048] FIG. **13** illustrates a signal process circuit for a transmission signal;

[0049] FIG. **14** illustrates another example of a wireless device applied to an embodiment;

[0050] FIG. **15** illustrates a hand-held device applied to an embodiment;

[0051] FIG. **16** illustrates a vehicle or an autonomous driving vehicle applied to an embodiment;

[0052] FIG. **17** illustrates a vehicle applied to an embodiment;

[0053] FIG. **18** illustrates an XR device applied to an embodiment;

[0054] FIG. **19** illustrates a robot applied to an embodiment; and

[0055] FIG. **20** illustrates an AI device applied to an embodiment.

BEST MODE FOR CARRYING OUT THE DISCLOSURE

[0056] The embodiments below are combinations of components and features of the present disclosure in a prescribed form. Each component or feature may be considered as selective unless explicitly mentioned as otherwise. Each component or feature may be executed in a form that is not combined with other components and features. Further, some components and/or features may be combined to configure an embodiment of the present disclosure. The order of operations described in the embodiments of the present disclosure may be changed. Some components or features of an embodiment may be included in another embodiment or may be substituted with a corresponding component or feature of the present disclosure.

[0057] Specific terms used in the description below are provided to help an understanding of the present disclosure, and the use of such specific terms may be changed to another form within the scope of the technical concept of the present disclosure.

[0058] In some cases, in order to avoid obscurity of the concept of the present disclosure, a known structure and apparatus may be omitted, or a block diagram centering on core functions of each structure or apparatus may be used. Moreover, the same reference numerals are used for the same components throughout the present specification.

[0059] The embodiments of the present disclosure may be supported by standard documents disclosed with respect to at least one of IEEE (Institute of Electrical and Electronics Engineers) 802 group system, 3GPP system, 3GPP LTE & LTE-A system and 3GPP2 system. Namely, the steps or portions having not been described in order to clarify the technical concept of the present disclosure in the embodiments of the present disclosure may be supported by the above documents. Furthermore, all terms disclosed in the present document may be described according to the above standard documents.

[0060] The technology below may be used for various wireless communication systems. For clarity, the description below centers on 3GPP LTE and 3GPP LTE-A, by which the technical idea of the present disclosure is non-limited.

[0061] Terms used in the present document are defined as follows.

- **[0062]** UMTS (Universal Mobile Telecommunications System): a GSM (Global System for Mobile Communication) based third generation mobile communication technology developed by the 3GPP.
- **[0063]** EPS (Evolved Packet System): a network system that includes an EPC (Evolved Packet Core) which is an IP (Internet Protocol) based packet switched core network and an access network such as LTE and UTRAN. This system is the network of an evolved version of the UMTS.
- **[0064]** NodeB: a base station of GERAN/UTRAN. This base station is installed outdoor and its coverage has a scale of a macro cell.
- **[0065]** eNodeB: a base station of LTE. This base station is installed outdoor and its coverage has a scale of a macro cell.
- **[0066]** UE (User Equipment): the UE may be referred to as terminal, ME (Mobile Equipment), MS (Mobile Station), etc. Also, the UE may be a portable device such as a notebook computer, a cellular phone, a PDA (Personal Digital Assistant), a smart phone, and a multimedia device. Alternatively, the UE may be a non-portable device such as a PC (Personal Computer) and a vehicle mounted device. The term "UE", as used in relation to MTC, can refer to an MTC device.

[0067] HNB (Home NodeB): a base station of UMTS network. This base station is installed indoor and its coverage has a scale of a micro cell.

[0068] HeNB (Home eNodeB): a base station of an EPS network. This base station is installed indoor and its coverage has a scale of a micro cell.

[0069] MME (Mobility Management Entity): a network node of an EPS network, which performs mobility management (MM) and session management (SM).

[0070] PDN-GW (Packet Data Network-Gateway)/PGW: a network node of an EPS network, which performs UE IP address allocation, packet screening and filtering, charging data collection, etc.

[0071] SGW (Serving Gateway): a network node of an EPS network, which performs mobility anchor, packet routing, idle-mode packet buffering, and triggering of an MME's UE paging.

[0072] NAS (Non-Access Stratum): an upper stratum of a control plane between a UE and an MME. This is a functional layer for transmitting and receiving a signaling and traffic message between a UE and a core network in an LTE/UMTS protocol stack, and supports mobility of a UE, and supports a session management procedure of establishing and maintaining IP connection between a UE and a PDN GW.

[0073] PDN (Packet Data Network): a network in which a server supporting a specific service (e.g., a Multimedia Messaging Service (MMS) server, a Wireless Application Protocol (WAP) server, etc.) is located.

[0074] PDN connection: a logical connection between a UE and a PDN, represented as one IP address (one IPv4 address and/or one IPv6 prefix).

[0075] RAN (Radio Access Network): a unit including a Node B, an eNode B, and a Radio Network Controller (RNC) for controlling the Node B and the eNode B in a 3GPP network, which is present between UEs and provides a connection to a core network.

[0076] HLR (Home Location Register)/HSS (Home Subscriber Server): a database having subscriber information in a 3GPP network. The HSS can perform functions such as configuration storage, identity management, and user state storage.

[0077] PLMN (Public Land Mobile Network): a network configured for the purpose of providing mobile communication services to individuals. This network can be configured per operator.

[0078] Proximity Services (or ProSe Service or Proximity-based Service): a service that enables discovery between physically proximate devices, and mutual direct communication/communication through a base station/communication through the third party. At this time, user plane data is exchanged through a direct data path without passing through a 3GPP core network (e.g., EPC).

EPC (Evolved Packet Core)

[0079] FIG. **1** is a schematic diagram showing the structure of an evolved packet system (EPS) including an evolved packet core (EPC).

[0080] The EPC is a core element of system architecture evolution (SAE) for improving performance of 3GPP technology. SAE corresponds to a research project for determining a network structure supporting mobility between various types of networks. For example, SAE aims to provide an optimized packet-based system for supporting various radio access technologies and providing an enhanced data transmission capability.

[0081] Specifically, the EPC is a core network of an IP mobile communication system for 3GPP LTE and can support real-time and non-real-time packet-based services. In conventional mobile communication systems (i.e. second-generation or third-generation mobile communication systems), functions of a core network are implemented through a circuit-switched (CS) sub-domain for voice and a packet-switched (PS) sub-domain for data. However, in a 3GPP LTE system which is evolved from the third generation communication system, CS and PS sub-domains are unified into one IP domain. That is, In 3GPP LTE, connection of terminals having IP capability can be established through an IP-based business station (e.g., an eNodeB (evolved Node B)), EPC, and an application domain (e.g., IMS). That is, the EPC is an essential structure for end-to-end IP services.

[0082] The EPC may include various components. FIG. **1** shows some of the components, namely, a serving gateway (SGW), a packet data network gateway (PDN GW), a mobility management entity (MME), a serving GPRS (general packet radio service) supporting node (SGSN) and an enhanced packet data gateway (ePDG).

[0083] SGW (or S-GW) operates as a boundary point between a radio access network (RAN) and a core network and maintains a data path between an eNodeB and the PDN GW. When. When a terminal moves over an area served by an eNodeB, the SGW functions as a local mobility anchor point. That is, packets. That is, packets may be routed through the SGW for mobility in an evolved UMTS terrestrial radio access network (E-UTRAN) defined after 3GPP release-8. In addition, the SGW may serve as an anchor point for mobility of another 3GPP network (a RAN defined before 3GPP release-8, e.g., UTRAN or GERAN (global system for mobile communication (GSM)/enhanced data rates for global evolution (EDGE) radio access network).

[0084] The PDN GW (or P-GW) corresponds to a termination point of a data interface for a packet data network. The PDN GW may support policy enforcement features, packet filtering and charging support. In addition, the PDN GW may serve as an anchor point for mobility management with a 3GPP network and a non-3GPP network (e.g., an unreliable network such as an interworking wireless local area network (I-WLAN) and a reliable network such as a code division multiple access (CDMA) or WiMax network).

[0085] Although the SGW and the PDN GW are configured as separate gateways in the example of the network structure of FIG. **1**, the two gateways may be implemented according to a single gateway configuration option.

[0086] The MME performs signaling and control functions for supporting access of a UE for network connection, network resource allocation, tracking, paging, roaming and handover. The MME controls control plane functions associated with subscriber and session management. The MME manages numerous eNodeBs and signaling for selection of a conventional gateway for handover to other 2G/3G networks. In addition, the MME performs security procedures, terminal-to-network session handling, idle terminal location management, etc.

[0087] The SGSN handles all packet data such as mobility management and authentication of a user for other 3GPP networks (e.g., a GPRS network).

[0088] The ePDG serves as a security node for a non-3GPP network (e.g., an I-WLAN, a Wi-Fi hotspot, etc.).

[0089] As described above with reference to FIG. **1**, a terminal having IP capabilities may access an IP service network (e.g., an IMS) provided by an operator via various elements in the EPC not only based on 3GPP access but also based on non-3GPP access.

[0090] Additionally, FIG. **1** shows various reference points (e.g. S**1**-U, S**1**-MME, etc.). In 3GPP, a conceptual link connecting two functions of different functional entities of an E-UTRAN and an EPC is defined as a reference point. Table 1 is a list of the reference points shown in FIG. **1**. Various reference points may be present in addition to the reference points in Table 1 according to network structures.

TABLE 1

Reference point	Description
S1-MME	Reference point for the control plane protocol between E-UTRAN and MME
S1-U	Reference point between E-UTRAN and Serving GW for the per bearer user plane tunneling and inter eNodeB path switching during handover
S3	It enables user and bearer information exchange for inter 3GPP access network mobility in idle and/or active state. This reference point can be used intra-PLMN or inter-PLMN (e.g. in the case of Inter-PLMN HO).
S4	It provides related control and mobility support between GPRS Core and the 3GPP Anchor function of Serving GW. In addition, if Direct Tunnel is not established, it provides the user plane tunneling.
S5	It provides user plane tunneling and tunnel management between Serving GW and PDN GW. It is used for Serving GW relocation due to UE mobility and if the Serving GW needs to connect to a non-collocated PDN GW for the required PDN connectivity.
S11	Reference point between an MME and an SGW
SGi	It is the reference point between the PDN GW and the packet data network. Packet data network may be an operator external public or private packet data network or an intra operator packet data network, e.g. for provision of IMS services. This reference point corresponds to Gi for 3GPP accesses.

[0091] Among the reference points shown in FIG. **1**, S2a and S2b correspond to non-3GPP interfaces. S2a is a reference point which provides reliable non-3GPP access and related control and mobility support between PDN GWs to a user plane. S2b is a reference point which provides related control and mobility support between the ePDG and the PDN GW to the user plane.

[0092] FIG. **2** is a diagram exemplarily illustrating architectures of a typical E-UTRAN and EPC.

[0093] As shown in the figure, while radio resource control (RRC) connection is activated, an eNodeB may perform routing to a gateway, scheduling transmission of a paging message, scheduling and transmission of a broadcast channel (BCH), dynamic allocation of resources to a UE on uplink and downlink, configuration and provision of eNodeB measurement, radio bearer control, radio admission control, and connection mobility control. In the EPC, paging generation, LTE_IDLE state management, ciphering of the user plane, SAE bearer control, and ciphering and integrity protection of NAS signaling.

[0094] FIG. **3** is a diagram exemplarily illustrating the structure of a radio interface protocol in a control plane between a UE and a base station, and FIG. **4** is a diagram exemplarily illustrating the structure of a radio interface protocol in a user plane between the UE and the base station.

[0095] The radio interface protocol is based on the 3GPP wireless access network standard. The radio interface protocol horizontally includes a physical layer, a data link layer, and a networking layer. The radio interface protocol is divided into a user plane for transmission of data information and a control plane for delivering control signaling which are arranged vertically.

[0096] The protocol layers may be classified into a first layer (L1), a second layer (L2), and a third layer (L3) based on the three sublayers of the open system interconnection (OSI) model that is well known in the communication system.

[0097] Hereinafter, description will be given of a radio protocol in the control plane shown in FIG. **3** and a radio protocol in the user plane shown in FIG. **4**.

[0098] The physical layer, which is the first layer, provides an information transfer service using a physical channel. The physical channel layer is connected to a medium access control (MAC) layer, which is a higher layer of the physical layer, through a transport channel. Data is transferred between the physical layer and the MAC layer through the transport channel. Transfer of data between different physical layers, i.e., a physical layer of a transmitter and a physical layer of a receiver is performed through the physical channel.

[0099] The physical channel consists of a plurality of subframes in the time domain and a plurality of subcarriers in the frequency domain. One subframe consists of a plurality of symbols in the time domain and a plurality of subcarriers. One subframe consists of a plurality of resource blocks. One resource block consists of a plurality of symbols and a plurality of subcarriers. A Transmission Time Interval (TTI), a unit time for data transmission, is 1 ms, which corresponds to one subframe.

[0100] According to 3GPP LTE, the physical channels present in the physical layers of the transmitter and the receiver may be divided into data channels corresponding to Physical Downlink Shared Channel (PDSCH) and Physical Uplink Shared Channel (PUSCH) and control channels corresponding to Physical Downlink Control Channel (PDCCH), Physical Control Format Indicator Channel (PCFICH), Physical Hybrid-ARQ Indicator Channel (PHICH) and Physical Uplink Control Channel (PUCCH).

[0101] The second layer includes various layers.

[0102] First, the MAC layer in the second layer serves to map various logical channels to various transport channels and also serves to map various logical channels to one transport channel. The MAC layer is connected with an RLC layer, which is a higher layer, through a logical channel. The logical channel is broadly divided into a control channel for transmission of information of the control plane and a traffic channel for transmission of information of the user plane according to the types of transmitted information.

[0103] The radio link control (RLC) layer in the second layer serves to segment and concatenate data received from a higher layer to adjust the size of data such that the size is suitable for a lower layer to transmit the data in a radio interval.

[0104] The Packet Data Convergence Protocol (PDCP) layer in the second layer performs a header compression function of reducing the size of an IP packet header which has a relatively large size and contains unnecessary control information, in order to efficiently transmit an IP packet such as an IPv4 or IPv6 packet in a radio interval having a narrow bandwidth. In addition, in LTE, the PDCP layer also performs a security function, which consists of ciphering for preventing a third party from monitoring data and integrity protection for preventing data manipulation by a third party.

[0105] The Radio Resource Control (RRC) layer, which is located at the uppermost part of the third layer, is defined only in the control plane, and serves to configure radio bearers (RBs) and control a logical channel, a transport channel, and a physical channel in relation to reconfiguration and release operations. The RB represents a service provided by the second layer to ensure data transfer between a UE and the E-UTRAN.

[0106] If an RRC connection is established between the RRC layer of the UE and the RRC layer of a wireless network, the UE is in the RRC Connected mode. Otherwise, the UE is in the RRC Idle mode.

[0107] Hereinafter, description will be given of the RRC state of the UE and an RRC connection method. The RRC state refers to a state in which the RRC of the UE is or is not logically connected with the RRC of the E-UTRAN. The RRC state of the UE having logical connection with the RRC of the E-UTRAN is referred to as an RRC_CONNECTED state. The RRC state of the UE which does not have logical connection with the RRC of the E-UTRAN is referred to as an RRC_IDLE state. A UE in the RRC_CONNECTED state has RRC connection, and thus the E-UTRAN may recognize presence of the UE in a cell unit. Accordingly, the UE may be efficiently controlled. On the other hand, the E-UTRAN cannot recognize presence of a UE which is in the RRC_IDLE state. The UE in the RRC_IDLE state is managed by a core network in a tracking area (TA) which is an area unit larger than the cell. That is, for the UE in the RRC_IDLE state, only presence or absence of the UE is recognized in an area unit larger than the cell. In order for the UE in the RRC_IDLE state to be provided with a usual mobile communication service such as a voice service and a data service, the UE should transition to the RRC_CONNECTED state. A TA is distinguished from another TA by a tracking area identity (TAI) thereof. A UE may configure the TAI through a tracking area code (TAC), which is information broadcast from a cell.

[0108] When the user initially turns on the UE, the UE searches for a proper cell first. Then, the UE establishes RRC connection in the cell and registers information thereabout in the core network. Thereafter, the UE stays in the RRC_IDLE state. When necessary, the UE staying in the RRC_IDLE state selects a cell (again) and checks system information or paging information. This operation is called camping on a cell. Only when the UE staying in the RRC_IDLE state needs to establish RRC connection, does the UE establish RRC connection with the RRC layer of the E-UTRAN through the RRC connection procedure and transition to the RRC_CONNECTED state. The UE staying in the RRC_IDLE state needs to establish RRC connection in many cases. For example, the cases may include an attempt of a user to make a phone call, an attempt to transmit data, or transmission of a response message after reception of a paging message from the E-UTRAN.

[0109] The non-access stratum (NAS) layer positioned over the RRC layer performs functions such as session management and mobility management.

[0110] Hereinafter, the NAS layer shown in FIG. **3** will be described in detail.

[0111] The eSM (evolved Session Management) belonging to the NAS layer performs functions such as default bearer management and dedicated bearer management to control a UE to use a PS service from a network. The UE is assigned a default bearer resource by a specific packet data network (PDN) when the UE initially accesses the PDN. In this case, the network allocates an available IP to the UE to allow the UE to use a data service. The network also allocates QoS of a default bearer to the UE. LTE supports two kinds of bearers. One bearer is a bearer having characteristics of guaranteed bit rate (GBR) QoS for guaranteeing a specific bandwidth for transmission and reception of data, and the other bearer is a non-GBR bearer which has characteristics of best effort QoS without guaranteeing a bandwidth. The default bearer is assigned to a non-GBR bearer. The dedicated bearer may be assigned a bearer having QoS characteristics of GBR or non-GBR.

[0112] A bearer allocated to the UE by the network is referred to as an evolved packet service (EPS) bearer. When the EPS bearer is allocated to the UE, the network assigns one identifier (ID). This ID is called an EPS bearer ID. One EPS bearer has QoS characteristics of a maximum bit rate (MBR) and/or a guaranteed bit rate (GBR).

[0113] FIG. **5** is a flowchart illustrating a random access procedure in 3GPP LTE.

[0114] The random access procedure is used for a UE to obtain UL synchronization with an eNB or to be assigned a UL radio resource.

[0115] The UE receives a root index and a physical random access channel (PRACH) configuration index from an eNodeB. Each cell has 64 candidate random access preambles defined by a Zadoff-Chu (ZC) sequence. The root index is a logical index used for the UE to generate 64 candidate random access preambles.

[0116] Transmission of a random access preamble is limited to a specific time and frequency resources for each cell. The PRACH configuration index indicates a specific subframe and preamble format in which transmission of the random access preamble is possible.

[0117] The UE transmits a randomly selected random access preamble to the eNodeB. The UE selects a random access preamble from among 64 candidate random access preambles and the UE selects a subframe corresponding to the PRACH configuration index. The UE transmits the selected random access preamble in the selected subframe.

[0118] Upon receiving the random access preamble, the eNodeB sends a random access response (RAR) to the UE. The RAR is detected in two steps. First, the UE detects a PDCCH masked with a random access (RA)-RNTI. The UE receives an RAR in a MAC (medium access control) PDU (protocol data unit) on a PDSCH indicated by the detected PDCCH.

[0119] FIG. **6** illustrates a connection procedure in a radio resource control (RRC) layer.

[0120] As shown in FIG. **6**, the RRC state is configured according to whether or not RRC connection is established. An RRC state indicates whether or not an entity of the RRC layer of a UE has logical connection with an entity of the RRC layer of an eNodeB. An RRC state in which the entity of the RRC layer of the UE is logically connected with the entity of the RRC layer of the eNodeB is called an RRC connected state. An RRC state in which the entity of the

RRC layer of the UE is not logically connected with the entity of the RRC layer of the eNodeB is called an RRC idle state.

[0121] A UE in the Connected state has RRC connection, and thus the E-UTRAN may recognize presence of the UE in a cell unit. Accordingly, the UE may be efficiently controlled. On the other hand, the E-UTRAN cannot recognize presence of a UE which is in the idle state. The UE in the idle state is managed by the core network in a tracking area unit which is an area unit larger than the cell. The tracking area is a unit of a set of cells. That is, for the UE which is in the idle state, only presence or absence of the UE is recognized in a larger area unit. In order for the UE in the idle state to be provided with a usual mobile communication service such as a voice service and a data service, the UE should transition to the connected state.

[0122] When the user initially turns on the UE, the UE searches for a proper cell first, and then stays in the idle state. Only when the UE staying in the idle state needs to establish RRC connection, the UE establishes RRC connection with the RRC layer of the eNodeB through the RRC connection procedure and then performs transition to the RRC connected state.

[0123] The UE staying in the idle state needs to establish RRC connection in many cases. For example, the cases may include an attempt of a user to make a phone call, an attempt to transmit data, or transmission of a response message after reception of a paging message from the E-UTRAN.

[0124] In order for the UE in the idle state to establish RRC connection with the eNodeB, the RRC connection procedure needs to be performed as described above. The RRC connection procedure is broadly divided into transmission of an RRC connection request message from the UE to the eNodeB, transmission of an RRC connection setup message from the eNodeB to the UE, and transmission of an RRC connection setup complete message from the UE to eNodeB, which are described in detail below with reference to FIG. **6**.

[0125] 1) When the UE in the idle state desires to establish RRC connection for reasons such as an attempt to make a call, a data transmission attempt, or a response of the eNodeB to paging, the UE transmits an RRC connection request message to the eNodeB first.

[0126] 2) Upon receiving the RRC connection request message from the UE, the ENB accepts the RRC connection request of the UE when the radio resources are sufficient, and then transmits an RRC connection setup message, which is a response message, to the UE.

[0127] 3) Upon receiving the RRC connection setup message, the UE transmits an RRC connection setup complete message to the eNodeB. Only when the UE successfully transmits the RRC connection setup message, does the UE establish RRC connection with the eNode B and transition to the RRC connected mode.

[0128] The functionality of the MME in the legacy EPC is decomposed into the access and mobility management function (AMF) and the session management function (SMF) in the next generation system (or 5G core network (CN)). The AMF carries out NAS interaction with a UE and mobility management (MM), whereas the SMF carries out session management (SM). The SMF also manages a gateway, user plane function (UPF), which has the user-plane functionality, that is, routes user traffic. It may be considered that the SMF and the UPF implement the control-plane part and user-plane part of the S-GW and the P-GW of the legacy EPC, respectively. To route user traffic, one or more UPFs may exist between a RAN and a data network (DN). That is, for 5G implementation, the legacy EPC may have the configuration illustrated in FIG. **7**. In the 5G system, a protocol data unit (PDU) session has been defined as a counterpart to a PDN connection of the legacy EPS. A PDU session refers to association between a UE and a DN, which provides a PDU connectivity service of an Ethernet type or an unstructured type as well as an IP type. The unified data management (UDM) performs the same functionality as the HSS of the EPC, and the policy control function (PCF) performs the same functionality as the policy and charging rules function (PCRF) of the EPC. Obviously, the functionalities may be extended to satisfy the requirements of the 5G system. For details of the architecture, functions, and interfaces of a 5G system, TS 23.501 is conformed to.

[0129] The 5G system is being worked on in TS 23.501 and TS 23.502. Accordingly, the technical specifications are conformed to for the 5G system in the present disclosure. Further, TS 38.300 is conformed to for details of NG-RAN-related architecture and contents. As the 5G system also supports non-3GPP access, section 4.2.8 of TS 23.501 describes architecture and network elements for supporting non-3GPP access, and section 4.12 of TS 23.502 describes procedures for supporting non-3GPP access. A representative example of non-3GPP access is WLAN access, which may include both a trusted WLAN and an untrusted WLAN. The AMF of the 5G system performs registration management (RM) and connection management (CM) for non-3GPP access as well as 3GPP access. As such, the same AMF serves a UE for 3GPP access and non-3GPP access belonging to the same PLMN, so that one network function may integrally and efficiently support authentication, mobility management, and session management for UEs registered through two different accesses.

[0130] **[text missing or illegible when filed]**

[0131] A protocol stack of a user plane in V2X communication using a PC5 reference point is defined as illustrated in FIG. **8**. In relation to FIG. **8**, IP and non-IP PDCP SDU types are supported for V2X communication over PCS. For the IP PDCP SDU type, only IPv6 is supported. IP address allocation and configuration are as defined in Clause 5.6.1.1 of TS 23.287v1.0.0. The non-IP PDCP SDU includes a non-IP type header which indicates a V2X message family used by an application layer (e.g., IEEE 1609 family's WSMP, ISO defined FNTP).

[0132] As can be seen from the PC5 user plane stack, when user traffic is transmitted over the PC5 reference point, the user traffic is transmitted through a sidelink radio bearer (SLRB) via a service data adaptation protocol (SDAP) sublayer. In this case, a method of determining whether to transmit the user traffic by including an SDAP header or excluding the SDAP header is needed. That is, presence/absence of the SDAP header needs to be determined.

[0133] In communication via a Uu reference point, RadioBearerConfig that an NG-RAN provides to a UE includes SDAP-Config. In this case, SDAP-Config may indicate whether the SDAP header is included. For RadioBearerConfig, reference is made to an information element (IE) described in TS 38.331v15.6.0 and a description related to RadioBearerConfig is disclosed in Table 2 below.

TABLE 2

SDAP-Config field descriptions
defaultDRB Indicates whether or not this is the default DRB for this PDU session. Among all configured instances of SDAP-Config with the same value of pdu-Session, this field shall be set to true in at most one instance of SDAP-Config and to false in all other instances.
mappedQoS-FlowsToAdd Indicates the list of QFIs of UL QoS flows of the PDU session to be additionally mapped to this DRB. A QFI value can be included at most once in all configured instances of SDAP-Config with the same value of pdu-Session. For QoS flow remapping, the QFI value of the remapped QoS flow is only included in mappedQoS-FlowsToAdd in sdap-Config corresponding to the new DRB and not included in mappedQoS-FlowsToRelease in sdap-Config corresponding to the old DRB.
mappedQoS-FlowsToRelease Indicates the list of QFIs of QoS flows of the PDU session to be released from existing QoS flow to DRB mapping of this DRB.
pdu-Session Identity of the PDU session whose QoS flows are mapped to the DRB.
sdap-HeaderUL Indicates whether or not a SDAP header is present for UL data on this DRB. The field cannot be changed after a DRB is established. The network sets this field to present if the field defaultDRB is set to true.
sdap-HeaderDL Indicates whether or not a SDAP header is present for DL data on this DRB. The field cannot be changed after a DRB is established.

[0134] A method of determining whether to include the SDAP header during transmission of user traffic via a PC5 reference point is needed. In particular, in the case of PC5 communication, which is direct communication between UEs, it is important to reduce packet size as much as possible. For efficient transmission, it is necessary to search for a method of not including the SDAP header if possible. For reference, in communication via the Uu reference point, major information provided by the SDAP header is a quality of service (QoS) flow ID (QFI). A UL SDAP data PDU format with the SDAP header, extracted from TS 37.324v15.1.0, is illustrated in FIG. **9** in relation to the major information provided by the SDAP header.

[0135] **[text missing or illegible when filed]**

[0136] A PC5 SDAP header processing method proposed in an embodiment includes a combination of one or more operations/configurations/steps. Particularly, the method proposed in an embodiment is useful for a V2X service. However, the method does not need to be limitedly used only for the V2X service and may be applied to various services using PC5. In an embodiment, a PC5 operation may be interpreted as including one or more of PC5 discovery, PC5 communication, direct discovery, direct communication, V2X communication over PC5, V2X communication over LTE PC5, and V2X communication over NR PC5. In an embodiment, unicast connection is interchangeably used with PC5 unicast connection or a layer-2. In an embodiment, a V2X service is interchangeably used with a V2X service type and complies with definitions and examples (e.g., a provider service ID (PSID) or an ITS application ID (ITS-AID)) of TS 23.287. The SDAP header in PC5 is regarded as including a PC5 QoS flow identifier (PFI) as major information. A QoS operation of PC5 complies with TS 23.287. In particular, reference may be made to Clause 5.4.1 of TS 23.287 (QoS handling for V2X communication over PC5 reference point) and S2-1908227, S2-1908214, and S2-1908215, which are meeting documents of SA2#134.

[0137] **[text missing or illegible when filed]**

[0138] An embodiment relates to a method in which a UE (specifically, the UE may be a V2X layer. This is applicable throughout all embodiments) provides an access stratum (AS) layer (i.e., an AS layer of the UE) with information about whether the SDAP header is included for all PC5 QoS flows corresponding to/associated with each PC5 unicast link. A first UE according to an embodiment may establish a PC5 unicast link with a second UE (S**1001** of FIG. **5**) and transmit user traffic to the second UE (S**1002** of FIG. **10**).

[0139] Here, whether to include the SDAP header for second PC5 QoS flow(s) used to transmit the user traffic may be determined based on addition or elimination of a first PC5 QoS flow to or from the PC5 unicast link. When the first PC5 QoS flow is added, it may be determined whether to include the SDAP header even for the first PC5 QoS flow. That is, it may be determined whether to include the SDAP header for all PC5 QoS flows belonging to a PC5 unicast link based on addition or elimination of the first PC5 QoS flow to and from the PC5 unicast link. The second PC5 QoS flow(s) may be all PC5 QoS flows using the same PC5 unicast link as the first PC5 QoS flow, and a V2X layer of the UE may provide information as to whether to include the SDAP header for the second PC5 QoS flow(s) to the AS layer. That is, when a new PC5 QoS flow is added to the PC5 unicast link or an existing PC5 QoS flow is eliminated from the PC5 unicast link, the UE provides the AS layer with information as to whether to include the SDAP header upon transmitting all PC5 QoS flows included in an SDAP configuration associated with a corresponding PC5 QoS flow. All PC5 QoS flows included in the SDAP configuration associated with the corresponding PC5 QoS flow may be interpreted as all PC5 QoS flows using the same PC5 unicast link as the corresponding PC5 QoS flow.

[0140] The determination of whether to include the SDAP header for the second PC5 QoS flow(s) used to transmit the user traffic may be performed even in at least one of the case in which the PC5 unicast link is established, the case in which a new service is added to the PC5 unicast link, or the case in which the existing service is eliminated from the PC5 unicast link. In other words, adding a new PC5 QoS flow to the PC5 unicast link may be performed when the PC5 unicast link is established or the PC5 unicast link is modified, and eliminating an existing PC5 QoS flow from the PC5 unicast link may be performed when the PC5 unicast link is modified.

[0141] **[text missing or illegible when filed]**

[0142] Subsequently, the SDAP header may be included based on the fact that two or more services are included in the PC5 unicast link. That is, when a plurality of (two or more) services are included in (or associated with) or become included in (or associated with) the PC5 unicast link associated with a corresponding PC5 QoS flow (this may be interpreted as the case in which the same PC5 unicast link is used for user traffic transmission for a plurality of services), information indicating that the SDAP header will be included may be provided.

[0143] In addition, the SDAP header may not be included based on the fact that one service is included in the PC5 unicast link. That is, when only one service is included in (or associated with) or becomes included in (or associated with) the PC5 unicast link associated with a corresponding PC5

QoS flow (this may be interpreted as the case in which the PC5 unicast link is used for user traffic transmission for one service), information indicating that the SDAP header should not be included may be provided.

[0144] The information indicating that the SDAP header should not be included upon transmitting the PC5 QoS flow, provided to the AS layer, means that other information (i.e., a PFI) necessary for a QoS operation described in TS 23.287 is also provided. This may be applied throughout embodiments.

[0145] The information indicating that the SDAP header should not be included may be implicitly indicated, for example, by not including an IE indicating the information. This may be applied throughout embodiments.

[0146] While the information about whether to include the SDAP header and related information have been provided to the AS layer when the new PC5 QoS flow is added to the PC5 unicast link or when the existing PC5 QoS flow is removed from the PC5 unicast link, the information about whether to include the SDAP header and the related information may be provided to the AS layer when the PC5 unicast link is established, when a new service is added to the PC5 unicast link, or when an existing service is removed from the PC5 unicast link. Alternatively, these conditions may be applied together in a combined form. This may be applied throughout embodiments.

[0147] The information indicating whether to include the SDAP header may be provided only when a change in whether to include the SDAP header occurs. That is, in the above description, providing the information indicating whether to include the SDAP header by the UE to the AS layer may be performed only when a change occurs.

[0148] The UE may store the information as to whether to include the SDAP header in a context managed according to each destination or each PC5 unicast link.

[0149] **[text missing or illegible when filed]**

[0150] The SDAP header may include a PFI. The AS layer may store the information indicating whether to include the SDAP header for the second PC5 QoS flow(s). The AS layer transmits user traffic by including or not including the SDAP header for the PC5 QoS flow used for user traffic transmission based on the information as to whether to include the SDAP header, provided from the V2X layer. That is, the AS layer stores the information as to whether to include the SDAP header, provided from the V2X layer and, when the user traffic should actually be transmitted, the AS layer transmits the user traffic by including or excluding the SDAP header for the corresponding PC5 QoS flow.

[0151] Specifically, the first UE may include the SDAP header in the user traffic based on the information indicating whether to include the SDAP header for the second PC5 QoS flow(s). Upon receiving the SDAP header, the second UE may provide the user traffic using a service corresponding to the PFI. That is, when the UE receives the user traffic via PC5, if the SDAP header is included, the UE may provide the traffic using a service corresponding to the PFI included in the SDAP header.

[0152] Alternatively, the first UE may not include the SDAP header in the user traffic based on the information indicating whether to include the SDAP header for the second PC5 QoS flow(s). Upon failing to receive the SDAP header, the second UE may provide the user traffic using a service identified by a destination layer-2 ID of the user traffic. That is, the case in which the SDAP header is not included considers that the corresponding traffic may be provided using the service identified by the destination layer-2 ID of the user traffic.

[0153] **[text missing or illegible when filed]**

[0154] According to the above configuration, when user traffic for a plurality of services is transmitted using the same destination layer-2 ID or the same PC5 unicast link, a receiver may identify to which service received user traffic is related by providing the PFI including the SDAP header. Then, the received user traffic may be provided using the corresponding service. When user traffic only for one service is transmitted using one destination layer-2 ID or one PC5 unicast link, transmission efficiency may be achieved by not including the SDAP header.

[0155] **[text missing or illegible when filed]**

[0156] According to an embodiment, the UE may provide the AS layer with the information as to whether to include the SDAP header for each PC5 QoS flow. Specifically, when a new PC5 QoS flow is added or an existing PC5 QoS flow is eliminated, the UE provides the AS layer with the information indicating whether to include the SDAP header as follows upon transmitting each flow for a corresponding PC5 QoS flow (when the PC5 QoS flow is added) and for all other PC5 QoS flows included in an SDAP configuration associated with the corresponding PC5 QoS flow. This may be understood as providing each PFI and the information indicating whether to include the SDAP header for the PFI. All other PC5 QoS flows included in the SDAP configuration associated with the corresponding PC5 QoS flow may be interpreted as all PC5 QoS flows using the same destination (or a combination of the same source/destination) as the corresponding PC5 QoS flow or may be interpreted as all PC5 QoS flows in a PC5 QoS context managed according to each destination to which the corresponding PC5 QoS flow belongs. The SDAP configuration, the logical link, and the PC5 QoS context may be additionally configured/managed according to each communication mode (i.e., broadcast, groupcast, or unicast).

[0157] 1) When a plurality of V2X services is included in (or associated with) or becomes included in (or associated with) a destination associated with the PC5 QoS flow (this may be interpreted as the case in which the same destination layer-2 ID is used for user traffic transmission for the plural V2X services), information indicating that the SDAP header will be included is provided.

[0158] 2) When a plurality of V2X services is included in (or associated with) or becomes included in (or associated with) a combination of a source (this may be a transmitter identified by a source layer-2 ID) and a destination, associated with a corresponding PC5 QoS flow, (this may be interpreted as the case in which a combination of the same source layer-2 ID and the same destination layer-2 ID is used for user traffic transmission for the plural V2X services), information indicating that the SDAP header will be included is provided.

[0159] 3) When only one V2X service is included in (or associated with) or becomes included in (or associated with) a destination associated with a corresponding PC5 QoS flow (this may be interpreted as the case in which the destination layer-2 ID is used for user traffic transmission for one V2X service), information indicating that the SDAP header should not be included is provided.

[0160] 4) When only one V2X service is included in (or associated with) or becomes included in (or associated with) a combination of a source and a destination, associated with a corresponding PC5 QoS flow, (this may be interpreted as the case in which a combination of the source layer-2 ID and the destination layer-2 ID is used for user traffic transmission for one V2X service), information indicating that the SDAP header should not be included is provided.

[0161] In the above description, providing the information indicating whether to include the SDAP header for each PC5 QoS flow by the UE to the AS layer may be provided only when a change occurs.

[0162] The UE may store the information as to whether to include the SDAP header for each PC5 QoS flow in a context managed according to each destination or each PC5 unicast link.

[0163] The AS layer stores the information as to whether to include the SDAP header, provided from the V2X layer and, when the user traffic should actually be transmitted, the AS layer transmits the user traffic by including or excluding the SDAP header for the corresponding PC5 QoS flow.

[0164] **[text missing or illegible when filed]**

[0165] According to an embodiment, upon transmitting the user traffic to the AS layer, the UE may provide the AS layer with the information as to whether to include the SDAP header together with the user traffic. To this end, the UE needs to determine whether the SDAP header should be included upon transmitting a PC5 QoS flow (this may be interpreted as a PH) corresponding to the user traffic. For this purpose, one of the following methods may be used.

[0166] First, the UE may check whether to include the SDAP header for all PC5 QoS flows of an SDAP configuration associated with a corresponding PC5 QoS flow at a timing at which a new PC5 QoS flow is added or an existing PC5 QoS flow is eliminated and store this information only in a context instead of providing the information to the AS layer. Next, when the user traffic should be transmitted, the UE determines whether the information indicating that the SDAP header should be included upon transmitting a PC5 QoS flow corresponding to the user traffic, based on the context, and provides the information to the AS layer.

[0167] Second, the UE may check whether to include the SDAP header for a corresponding PC5 QoS flow (in the case in which the PC5 QoS flow is added) and for all other PC5 QoS flows of an SDAP configuration associated with the corresponding PC5 QoS flow at a timing at which a new PC5 QoS flow is added or an existing PC5 QoS flow is eliminated and store this information only in a context instead of providing the information to the AS layer. Next, when the user traffic should be transmitted, the UE determines whether the information indicating that the SDAP header should be included upon transmitting a PC5 QoS flow corresponding to the user traffic, based on the context, and provides the information to the AS layer.

[0168] When the user traffic should be transmitted over PC5, whether to include the SDAP header is determined as follows. In addition, whether to include the SDAP header as determined above is provided to the AS layer.

[0169] a) When a plurality of V2X services is included in (or associated with) a destination associated with a corresponding PC5 QoS flow (this may be interpreted as the case in which the same destination layer-2 ID is used to transmit user traffic for the plural V2X services), it is determined that the SDAP header is included.

[0170] b) When a plurality of V2X services is included in (or associated with) a combination of a source (this may be a transmitter identified by a source layer-2 ID) and a destination, associated with a corresponding PC5 QoS flow, (this may be interpreted as the case in which a combination of the same source layer-2 ID and the same destination layer-2 ID is used for user traffic transmission for the plural V2X services), it is determined that the SDAP header is included.

[0171] c) When only one V2X service is included in (or associated with) a destination associated with a corresponding PC5 QoS flow (this may be interpreted as the case in which the destination layer-2 ID is used for user traffic transmission for one V2X service), it is determined that the SDAP header is not included.

[0172] d) When only one V2X service is included in (or associated with) a combination of a source and a destination, associated with a corresponding PC5 QoS flow, (this may be interpreted as the case in which a combination of the source layer-2 ID and the destination layer-2 ID is used for user traffic transmission for one V2X service), it is determined that the SDAP header is not included.

[0173] While the source has been described as the transmitter identified by the source layer-2 ID, the source may be a transmitter identified by the source layer-2 ID and a source IP address when IP-based transmission is used. In addition, while the destination has been described as a destination identified by the destination layer-2 ID, the destination may be a destination identified by the destination layer-2 ID and a destination IP address when IP-based transmission is used.

[0174] **[text missing or illegible when filed]**

Examples of Communication Systems Applicable to the Present Disclosure

[0175] The various descriptions, functions, procedures, proposals, methods, and/or operational flowcharts of the present disclosure described in this document may be applied to, without being limited to, a variety of fields requiring wireless communication/connection (e.g., 5G) between devices.

[0176] Hereinafter, a description will be given in more detail with reference to the drawings. In the following drawings/description, the same reference symbols may denote the same or corresponding hardware blocks, software blocks, or functional blocks unless described otherwise.

[0177] FIG. **11** illustrates a communication system **1** applied to the present disclosure.

[0178] Referring to FIG. **11**, a communication system **1** applied to the present disclosure includes wireless devices, BSs, and a network. Herein, the wireless devices represent devices performing communication using RAT (e.g., 5G NR or LTE) and may be referred to as communication/radio/5G devices. The wireless devices may include, without being limited to, a robot **100***a*, vehicles **100***b*-**1** and **100***b*-**2**, an eXtended Reality (XR) device **100***c*, a hand-held device **100***d*, a home appliance **100***e*, an Internet of things (IoT) device **100***f*, and an artificial intelligence (AI) device/server **400**. For example, the vehicles may include a vehicle having a wireless communication function, an autonomous driving vehicle, and a vehicle capable of performing communication between vehicles. Herein, the vehicles may include an unmanned aerial vehicle (UAV) (e.g., a drone). The XR device may include an augmented reality (AR)/virtual reality (VR)/mixed reality (MR) device and may be implemented in the form of a head-mounted device (HMD), a head-up display (HUD) mounted in a vehicle, a television, a smartphone, a computer, a wearable device, a home appliance device, a digital signage, a vehicle, a robot, etc. The hand-held device may include a smartphone, a smartpad, a wearable device (e.g., a smartwatch or smartglasses), and a computer (e.g., a notebook). The home appliance may include a TV, a refrigerator, and a washing machine. The IoT device may include a sensor and a smartmeter. For example, the BSs and the network may be implemented as wireless devices and a specific wireless device **200***a* may operate as a BS/network node with respect to other wireless devices.

[0179] The wireless devices **100***a* to **100***f* may be connected to the network **300** via the BSs **200**. An AI technology may be applied to the wireless devices **100***a* to **100***f* and the wireless devices **100***a* to **100***f* may be connected to the AI server **400** via the network **300**. The network **300** may be configured using a 3G network, a 4G (e.g., LTE) network, or a 5G (e.g., NR) network. Although the wireless devices **100***a* to **100***f* may communicate with each other through the BSs **200**/network **300**, the wireless devices **100***a* to **100***f* may perform direct communication (e.g., sidelink communication) with each other without passing through the BSs/network. For example, the vehicles **100***b***-1** and **100***b***-2** may perform direct communication (e.g. V2V/V2X communication). The IoT device (e.g., a sensor) may perform direct communication with other IoT devices (e.g., sensors) or other wireless devices **100***a* to **100***f*.

[0180] Wireless communication/connections **150***a*, **150***b*, or **150***c* may be established between the wireless devices **100***a* to **100***f*/BS **200**, or BS **200**/BS **200**. Herein, the wireless communication/connections may be established through various RATs (e.g., 5G NR) such as UL/DL communication **150***a*, sidelink communication **150***b* (or D2D communication), or inter BS communication (e.g. relay, integrated access backhaul (IAB)). The wireless devices and the BSs/the wireless devices may transmit/receive radio signals to/from each other through the wireless communication/connections **150***a* and **150***b*. For example, the wireless communication/connections **150***a* and **150***b* may transmit/receive signals through various physical channels. To this end, at least a part of various configuration information configuring processes, various signal processing processes (e.g., channel encoding/decoding, modulation/demodulation, and resource mapping/demapping), and resource allocating processes, for transmitting/receiving radio signals, may be performed based on the various proposals of the present disclosure.

Examples of Wireless Devices Applicable to the Present Disclosure

[0181] FIG. **12** illustrates wireless devices applicable to the present disclosure.

[0182] Referring to FIG. **12**, a first wireless device **100** and a second wireless device **200** may transmit radio signals through a variety of RATs (e.g., LTE and NR). Herein, {the first wireless device **100** and the second wireless device **200**} may correspond to {the wireless device **100***x* and the BS **200**} and/or {the wireless device **100***x* and the wireless device **100***x*} of FIG. **11**.

[0183] The first wireless device **100** may include one or more processors **102** and one or more memories **104** and additionally further include one or more transceivers **106** and/or one or more antennas **108**. The processor(s) **102** may control the memory(s) **104** and/or the transceiver(s) **106** and may be configured to implement the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. For example, the processor(s) **102** may process information within the memory(s) **104** to generate first information/signals and then transmit radio signals including the first information/signals through the transceiver(s) **106**. The processor(s) **102** may receive radio signals including second information/signals through the transceiver **106** and then store information obtained by processing the second information/signals in the memory(s) **104**. The memory(s) **104** may be connected to the processor(s) **102** and may store a variety of information related to operations of the processor(s) **102**. For example, the memory(s) **104** may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) **102** or for performing the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. Herein, the processor(s) **102** and the memory(s) **104** may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) **106** may be connected to the processor(s) **102** and transmit and/or receive radio signals through one or more antennas **108**. Each of the transceiver(s) **106** may include a transmitter and/or a receiver. The transceiver(s) **106** may be interchangeably used with Radio Frequency (RF) unit(s). In the present disclosure, the wireless device may represent a communication modem/circuit/chip.

[0184] The second wireless device **200** may include one or more processors **202** and one or more memories **204** and additionally further include one or more transceivers **206** and/or one or more antennas **208**. The processor(s) **202** may control the memory(s) **204** and/or the transceiver(s) **206** and may be configured to implement the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. For example, the processor(s) **202** may process information within the memory(s) **204** to generate third information/signals and then transmit radio signals including the third information/signals through the transceiver(s) **206**. The processor(s) **202** may receive radio signals including fourth information/signals through the transceiver(s) **106** and then store information obtained by processing the fourth information/signals in the memory (s) **204**. The memory(s) **204** may be connected to the processor(s) **202** and may store a variety of information related to operations of the processor(s) **202**. For example, the memory(s) **204** may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) **202** or for performing the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. Herein, the processor(s) **202** and the memory(s) **204** may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) **206** may be connected to the processor(s) **202** and transmit and/or receive radio signals through one or more antennas **208**. Each of the transceiver(s) **206** may include a transmitter and/or a receiver. The transceiver(s) **206** may be interchangeably used with RF unit(s). In the present disclosure, the wireless device may represent a communication modem/circuit/chip.

[0185] Hereinafter, hardware elements of the wireless devices **100** and **200** will be described more specifically. One or more protocol layers may be implemented by, without being limited to, one or more processors **102** and

202. For example, the one or more processors **102** and **202** may implement one or more layers (e.g., functional layers such as PHY, MAC, RLC, PDCP, RRC, and SDAP). The one or more processors **102** and **202** may generate one or more Protocol Data Units (PDUs) and/or one or more service data unit (SDUs) according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. The one or more processors **102** and **202** may generate messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. The one or more processors **102** and **202** may generate signals (e.g., baseband signals) including PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document and provide the generated signals to the one or more transceivers **106** and **206**. The one or more processors **102** and **202** may receive the signals (e.g., baseband signals) from the one or more transceivers **106** and **206** and acquire the PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document.

[0186] The one or more processors **102** and **202** may be referred to as controllers, microcontrollers, microprocessors, or microcomputers. The one or more processors **102** and **202** may be implemented by hardware, firmware, software, or a combination thereof. As an example, one or more application specific integrated circuits (ASICs), one or more digital signal processors (DSPs), one or more digital signal processing devices (DSPDs), one or more programmable logic devices (PLDs), or one or more field programmable gate arrays (FPGAs) may be included in the one or more processors **102** and **202**. The descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be implemented using firmware or software and the firmware or software may be configured to include the modules, procedures, or functions. Firmware or software configured to perform the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be included in the one or more processors **102** and **202** or stored in the one or more memories **104** and **204** so as to be driven by the one or more processors **102** and **202**. The descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be implemented using firmware or software in the form of code, commands, and/or a set of commands

[0187] The one or more memories **104** and **204** may be connected to the one or more processors **102** and **202** and store various types of data, signals, messages, information, programs, code, instructions, and/or commands The one or more memories **104** and **204** may be configured by read-only memories (ROMs), random access memories (RAMs), electrically erasable programmable read-only memories (EPROMs), flash memories, hard drives, registers, cash memories, computer-readable storage media, and/or combinations thereof. The one or more memories **104** and **204** may be located at the interior and/or exterior of the one or more processors **102** and **202**. The one or more memories **104** and **204** may be connected to the one or more processors **102** and **202** through various technologies such as wired or wireless connection.

[0188] The one or more transceivers **106** and **206** may transmit user data, control information, and/or radio signals/channels, mentioned in the methods and/or operational flowcharts of this document, to one or more other devices. The one or more transceivers **106** and **206** may receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document, from one or more other devices. For example, the one or more transceivers **106** and **206** may be connected to the one or more processors **102** and **202** and transmit and receive radio signals. For example, the one or more processors **102** and **202** may perform control so that the one or more transceivers **106** and **206** may transmit user data, control information, or radio signals to one or more other devices. The one or more processors **102** and **202** may perform control so that the one or more transceivers **106** and **206** may receive user data, control information, or radio signals from one or more other devices. The one or more transceivers **106** and **206** may be connected to the one or more antennas **108** and **208** and the one or more transceivers **106** and **206** may be configured to transmit and receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document, through the one or more antennas **108** and **208**. In this document, the one or more antennas may be a plurality of physical antennas or a plurality of logical antennas (e.g., antenna ports). The one or more transceivers **106** and **206** may convert received radio signals/channels etc. from RF band signals into baseband signals in order to process received user data, control information, radio signals/channels, etc. using the one or more processors **102** and **202**. The one or more transceivers **106** and **206** may convert the user data, control information, radio signals/channels, etc. processed using the one or more processors **102** and **202** from the base band signals into the RF band signals. To this end, the one or more transceivers **106** and **206** may include (analog) oscillators and/or filters.

Examples of Signal Process Circuit Applicable to the Present Disclosure

[0189] FIG. **13** illustrates a signal process circuit for a transmission signal.

[0190] Referring to FIG. **13**, a signal processing circuit **1000** may include scramblers **1010**, modulators **1020**, a layer mapper **1030**, a precoder **1040**, resource mappers **1050**, and signal generators **1060**. An operation/function of FIG. **13** may be performed, without being limited to, the processors **102** and **202** and/or the transceivers **106** and **206** of FIG. **12**. Hardware elements of FIG. **13** may be implemented by the processors **102** and **202** and/or the transceivers **106** and **206** of FIG. **12**. For example, blocks **1010** to **1060** may be implemented by the processors **102** and **202** of FIG. **12**. Alternatively, the blocks **1010** to **1050** may be implemented by the processors **102** and **202** of FIG. **12** and the block **1060** may be implemented by the transceivers **106** and **206** of FIG. **12**.

[0191] Codewords may be converted into radio signals via the signal processing circuit **1000** of FIG. **13**. Herein, the codewords are encoded bit sequences of information blocks.

The information blocks may include transport blocks (e.g., a UL-SCH transport block, a DL-SCH transport block). The radio signals may be transmitted through various physical channels (e.g., a PUSCH and a PDSCH).

[0192] Specifically, the codewords may be converted into scrambled bit sequences by the scramblers **1010**. Scramble sequences used for scrambling may be generated based on an initialization value, and the initialization value may include ID information of a wireless device. The scrambled bit sequences may be modulated to modulation symbol sequences by the modulators **1020**. A modulation scheme may include pi/2-Binary Phase Shift Keying (pi/2-BPSK), m-Phase Shift Keying (m-PSK), and m-Quadrature Amplitude Modulation (m-QAM). Complex modulation symbol sequences may be mapped to one or more transport layers by the layer mapper **1030**. Modulation symbols of each transport layer may be mapped (precoded) to corresponding antenna port(s) by the precoder **1040**. Outputs z of the precoder **1040** may be obtained by multiplying outputs y of the layer mapper **1030** by an N*M precoding matrix W. Herein, N is the number of antenna ports and M is the number of transport layers. The precoder **1040** may perform precoding after performing transform precoding (e.g., DFT) for complex modulation symbols. Alternatively, the precoder **1040** may perform precoding without performing transform precoding.

[0193] The resource mappers **1050** may map modulation symbols of each antenna port to time-frequency resources. The time-frequency resources may include a plurality of symbols (e.g., a CP-OFDMA symbols and DFT-s-OFDMA symbols) in the time domain and a plurality of subcarriers in the frequency domain. The signal generators **1060** may generate radio signals from the mapped modulation symbols and the generated radio signals may be transmitted to other devices through each antenna. For this purpose, the signal generators **1060** may include IFFT modules, CP inserters, digital-to-analog converters (DACs), and frequency up-converters.

[0194] Signal processing procedures for a signal received in the wireless device may be configured in a reverse manner of the signal processing procedures **1010** to **1060** of FIG. **13**. For example, the wireless devices (e.g., **100** and **200** of FIG. **12**) may receive radio signals from the exterior through the antenna ports/transceivers. The received radio signals may be converted into baseband signals through signal restorers. To this end, the signal restorers may include frequency DL converters, analog-to-digital converters (ADCs), CP remover, and FFT modules. Next, the baseband signals may be restored to codewords through a resource demapping procedure, a postcoding procedure, a demodulation processor, and a descrambling procedure. The codewords may be restored to original information blocks through decoding. Therefore, a signal processing circuit (not illustrated) for a reception signal may include signal restorers, resource demappers, a postcoder, demodulators, descramblers, and decoders.

Examples of Application of Wireless Device Applicable to the Present Disclosure

[0195] FIG. **14** illustrates another example of a wireless device applied to the present disclosure. The wireless device may be implemented in various forms according to a use-case/service (refer to FIG. **11**).

[0196] Referring to FIG. **14**, wireless devices **100** and **200** may correspond to the wireless devices **100** and **200** of FIG. **12** and may be configured by various elements, components, units/portions, and/or modules. For example, each of the wireless devices **100** and **200** may include a communication unit **110**, a control unit **120**, a memory unit **130**, and additional components **140**. The communication unit may include a communication circuit **112** and transceiver(s) **114**. For example, the communication circuit **112** may include the one or more processors **102** and **202** and/or the one or more memories **104** and **204** of FIG. **12**. For example, the transceiver(s) **114** may include the one or more transceivers **106** and **206** and/or the one or more antennas **108** and **208** of FIG. **12**. The control unit **120** is electrically connected to the communication unit **110**, the memory **130**, and the additional components **140** and controls overall operation of the wireless devices. For example, the control unit **120** may control an electric/mechanical operation of the wireless device based on programs/code/commands/information stored in the memory unit **130**. The control unit **120** may transmit the information stored in the memory unit **130** to the exterior (e.g., other communication devices) via the communication unit **110** through a wireless/wired interface or store, in the memory unit **130**, information received through the wireless/wired interface from the exterior (e.g., other communication devices) via the communication unit **110**.

[0197] The additional components **140** may be variously configured according to types of wireless devices. For example, the additional components **140** may include at least one of a power unit/battery, input/output (I/O) unit, a driving unit, and a computing unit. The wireless device may be implemented in the form of, without being limited to, the robot (**100***a* of FIG. **11**), the vehicles (**100***b***-1** and **100***b***-2** of FIG. **11**), the XR device (**100***c* of FIG. **11**), the hand-held device (**100***d* of FIG. **11**), the home appliance (**100***e* of FIG. **11**), the IoT device (**100***f* of FIG. **11**), a digital broadcast terminal, a hologram device, a public safety device, an MTC device, a medicine device, a FinTech device (or a finance device), a security device, a climate/environment device, the AI server/device (**400** of FIG. **11**), the BSs (**200** of FIG. **11**), a network node, etc. The wireless device may be used in a mobile or fixed place according to a use-example/service.

[0198] In FIG. **14**, the entirety of the various elements, components, units/portions, and/or modules in the wireless devices **100** and **200** may be connected to each other through a wired interface or at least a part thereof may be wirelessly connected through the communication unit **110**. For example, in each of the wireless devices **100** and **200**, the control unit **120** and the communication unit **110** may be connected by wire and the control unit **120** and first units (e.g., **130** and **140**) may be wirelessly connected through the communication unit **110**. Each element, component, unit/portion, and/or module within the wireless devices **100** and **200** may further include one or more elements. For example, the control unit **120** may be configured by a set of one or more processors. As an example, the control unit **120** may be configured by a set of a communication control processor, an application processor, an electronic control unit (ECU), a graphical processing unit, and a memory control processor. As another example, the memory **130** may be configured by a RAM, a DRAM, a ROM, a flash memory, a volatile memory, a non-volatile memory, and/or a combination thereof.

[0199] Hereinafter, an example of implementing FIG. **14** will be described in detail with reference to the drawings.

Examples of a Hand-Held Device Applicable to the Present Disclosure

[0200] FIG. **15** illustrates a hand-held device applied to the present disclosure. The hand-held device may include a smartphone, a smartpad, a wearable device (e.g., a smartwatch or a smartglasses), or a portable computer (e.g., a notebook). The hand-held device may be referred to as a mobile station (MS), a user terminal (UT), a mobile subscriber station (MSS), a subscriber station (SS), an advanced mobile station (AMS), or a wireless terminal (WT).

[0201] Referring to FIG. **15**, a hand-held device **100** may include an antenna unit **108**, a communication unit **110**, a control unit **120**, a memory unit **130**, a power supply unit **140***a*, an interface unit **140***b*, and an I/O unit **140***c*. The antenna unit **108** may be configured as a part of the communication unit **110**. Blocks **110** to **130**/**140***a* to **140***c* correspond to the blocks **110** to **130**/**140** of FIG. **14**, respectively.

[0202] The communication unit **110** may transmit and receive signals (e.g., data and control signals) to and from other wireless devices or BSs. The control unit **120** may perform various operations by controlling constituent elements of the hand-held device **100**. The control unit **120** may include an application processor (AP). The memory unit **130** may store data/parameters/programs/code/commands needed to drive the hand-held device **100**. The memory unit **130** may store input/output data/information. The power supply unit **140***a* may supply power to the hand-held device **100** and include a wired/wireless charging circuit, a battery, etc. The interface unit **140***b* may support connection of the hand-held device **100** to other external devices. The interface unit **140***b* may include various ports (e.g., an audio I/O port and a video I/O port) for connection with external devices. The I/O unit **140***c* may input or output video information/signals, audio information/signals, data, and/or information input by a user. The I/O unit **140***c* may include a camera, a microphone, a user input unit, a display unit **140***d*, a speaker, and/or a haptic module.

[0203] As an example, in the case of data communication, the I/O unit **140***c* may acquire information/signals (e.g., touch, text, voice, images, or video) input by a user and the acquired information/signals may be stored in the memory unit **130**. The communication unit **110** may convert the information/signals stored in the memory into radio signals and transmit the converted radio signals to other wireless devices directly or to a BS. The communication unit **110** may receive radio signals from other wireless devices or the BS and then restore the received radio signals into original information/signals. The restored information/signals may be stored in the memory unit **130** and may be output as various types (e.g., text, voice, images, video, or haptic) through the I/O unit **140***c*.

Examples of a Vehicle or an Autonomous Driving Vehicle Applicable to the Present Disclosure

[0204] FIG. **16** illustrates a vehicle or an autonomous driving vehicle applied to the present disclosure. The vehicle or autonomous driving vehicle may be implemented by a mobile robot, a car, a train, a manned/unmanned aerial vehicle (AV), a ship, etc.

[0205] Referring to FIG. **16**, a vehicle or autonomous driving vehicle **100** may include an antenna unit **108**, a communication unit **110**, a control unit **120**, a driving unit **140***a*, a power supply unit **140***b*, a sensor unit **140***c*, and an autonomous driving unit **140***d*. The antenna unit **108** may be configured as a part of the communication unit **110**. The blocks **110**/**130**/**140***a* to **140***d* correspond to the blocks **110**/**130**/**140** of FIG. **14**, respectively.

[0206] The communication unit **110** may transmit and receive signals (e.g., data and control signals) to and from external devices such as other vehicles, BSs (e.g., gNBs and road side units), and servers. The control unit **120** may perform various operations by controlling elements of the vehicle or the autonomous driving vehicle **100**. The control unit **120** may include an ECU. The driving unit **140***a* may cause the vehicle or the autonomous driving vehicle **100** to drive on a road. The driving unit **140***a* may include an engine, a motor, a powertrain, a wheel, a brake, a steering device, etc. The power supply unit **140***b* may supply power to the vehicle or the autonomous driving vehicle **100** and include a wired/wireless charging circuit, a battery, etc. The sensor unit **140***c* may acquire a vehicle state, ambient environment information, user information, etc. The sensor unit **140***c* may include an inertial measurement unit (IMU) sensor, a collision sensor, a wheel sensor, a speed sensor, a slope sensor, a weight sensor, a heading sensor, a position module, a vehicle forward/backward sensor, a battery sensor, a fuel sensor, a tire sensor, a steering sensor, a temperature sensor, a humidity sensor, an ultrasonic sensor, an illumination sensor, a pedal position sensor, etc. The autonomous driving unit **140***d* may implement technology for maintaining a lane on which a vehicle is driving, technology for automatically adjusting speed, such as adaptive cruise control, technology for autonomously driving along a determined path, technology for driving by automatically setting a path if a destination is configured, and the like.

[0207] For example, the communication unit **110** may receive map data, traffic information data, etc. from an external server. The autonomous driving unit **140***d* may generate an autonomous driving path and a driving plan from the obtained data. The control unit **120** may control the driving unit **140***a* such that the vehicle or the autonomous driving vehicle **100** may move along the autonomous driving path according to the driving plan (e.g., speed/direction control). In the middle of autonomous driving, the communication unit **110** may aperiodically/periodically acquire recent traffic information data from the external server and acquire surrounding traffic information data from neighboring vehicles. In the middle of autonomous driving, the sensor unit **140***c* may obtain a vehicle state and/or surrounding environment information. The autonomous driving unit **140***d* may update the autonomous driving path and the driving plan based on the newly obtained data/information. The communication unit **110** may transfer information about a vehicle position, the autonomous driving path, and/or the driving plan to the external server. The external server may predict traffic information data using AI technology, etc., based on the information collected from vehicles or autonomous driving vehicles and provide the predicted traffic information data to the vehicles or the autonomous driving vehicles.

Examples of a Vehicle and AR/VR Applicable to the Present Disclosure

[0208] FIG. **17** illustrates a vehicle applied to the present disclosure. The vehicle may be implemented as a transport means, an aerial vehicle, a ship, etc.

[0209] Referring to FIG. **17**, a vehicle **100** may include a communication unit **110**, a control unit **120**, a memory unit **130**, an I/O unit **140***a*, and a positioning unit **140***b*. Herein, the blocks **110** to **130**/**140***a* and **140***b* correspond to blocks **110** to **130**/**140** of FIG. **14**.

[0210] The communication unit **110** may transmit and receive signals (e.g., data and control signals) to and from external devices such as other vehicles or BSs. The control unit **120** may perform various operations by controlling constituent elements of the vehicle **100**. The memory unit **130** may store data/parameters/programs/code/commands for supporting various functions of the vehicle **100**. The I/O unit **140***a* may output an AR/VR object based on information within the memory unit **130**. The I/O unit **140***a* may include an HUD. The positioning unit **140***b* may acquire information about the position of the vehicle **100**. The position information may include information about an absolute position of the vehicle **100**, information about the position of the vehicle **100** within a traveling lane, acceleration information, and information about the position of the vehicle **100** from a neighboring vehicle. The positioning unit **140***b* may include a GPS and various sensors.

[0211] As an example, the communication unit **110** of the vehicle **100** may receive map information and traffic information from an external server and store the received information in the memory unit **130**. The positioning unit **140***b* may obtain the vehicle position information through the GPS and various sensors and store the obtained information in the memory unit **130**. The control unit **120** may generate a virtual object based on the map information, traffic information, and vehicle position information and the I/O unit **140***a* may display the generated virtual object in a window in the vehicle (**1410** and **1420**). The control unit **120** may determine whether the vehicle **100** normally drives within a traveling lane, based on the vehicle position information. If the vehicle **100** abnormally exits from the traveling lane, the control unit **120** may display a warning on the window in the vehicle through the I/O unit **140***a*. In addition, the control unit **120** may broadcast a warning message regarding driving abnormity to neighboring vehicles through the communication unit **110**. According to situation, the control unit **120** may transmit the vehicle position information and the information about driving/vehicle abnormality to related organizations.

Examples of an XR Device Applicable to the Present Disclosure

[0212] FIG. **18** illustrates an XR device applied to the present disclosure. The XR device may be implemented by an HMD, an HUD mounted in a vehicle, a television, a smartphone, a computer, a wearable device, a home appliance, a digital signage, a vehicle, a robot, etc.

[0213] Referring to FIG. **18**, an XR device **100***a* may include a communication unit **110**, a control unit **120**, a memory unit **130**, an I/O unit **140***a*, a sensor unit **140***b*, and a power supply unit **140***c*. Herein, the blocks **110** to **130**/**140***a* to **140***c* correspond to the blocks **110** to **130**/**140** of FIG. **14**, respectively.

[0214] The communication unit **110** may transmit and receive signals (e.g., media data and control signals) to and from external devices such as other wireless devices, hand-held devices, or media servers. The media data may include video, images, and sound. The control unit **120** may perform various operations by controlling constituent elements of the XR device **100***a*. For example, the control unit **120** may be configured to control and/or perform procedures such as video/image acquisition, (video/image) encoding, and metadata generation and processing. The memory unit **130** may store data/parameters/programs/code/commands needed to drive the XR device **100***a*/generate XR object. The I/O unit **140***a* may obtain control information and data from the exterior and output the generated XR object. The I/O unit **140***a* may include a camera, a microphone, a user input unit, a display unit, a speaker, and/or a haptic module. The sensor unit **140***b* may obtain an XR device state, surrounding environment information, user information, etc. The sensor unit **140***b* may include a proximity sensor, an illumination sensor, an acceleration sensor, a magnetic sensor, a gyro sensor, an inertial sensor, an RGB sensor, an IR sensor, a fingerprint recognition sensor, an ultrasonic sensor, a light sensor, a microphone and/or a radar. The power supply unit **140***c* may supply power to the XR device **100***a* and include a wired/wireless charging circuit, a battery, etc.

[0215] For example, the memory unit **130** of the XR device **100***a* may include information (e.g., data) needed to generate the XR object (e.g., an AR/VR/MR object). The I/O unit **140***a* may receive a command for manipulating the XR device **100***a* from a user and the control unit **120** may drive the XR device **100***a* according to a driving command of a user. For example, when a user desires to watch a film or news through the XR device **100***a*, the control unit **120** transmits content request information to another device (e.g., a hand-held device **100***b*) or a media server through the communication unit **130**. The communication unit **130** may download/stream content such as films or news from another device (e.g., the hand-held device **100***b*) or the media server to the memory unit **130**. The control unit **120** may control and/or perform procedures such as video/image acquisition, (video/image) encoding, and metadata generation/processing with respect to the content and generate/output the XR object based on information about a surrounding space or a real object obtained through the I/O unit **140***a*/sensor unit **140***b*.

[0216] The XR device **100***a* may be wirelessly connected to the hand-held device **100***b* through the communication unit **110** and the operation of the XR device **100***a* may be controlled by the hand-held device **100***b*. For example, the hand-held device **100***b* may operate as a controller of the XR device **100***a*. To this end, the XR device **100***a* may obtain information about a 3D position of the hand-held device **100***b* and generate and output an XR object corresponding to the hand-held device **100***b*.

Examples of a Robot Applicable to the Present Disclosure

[0217] FIG. **19** illustrates a robot applied to the present disclosure. The robot may be categorized into an industrial robot, a medical robot, a household robot, a military robot, etc., according to a used purpose or field.

[0218] Referring to FIG. **19**, a robot **100** may include a communication unit **110**, a control unit **120**, a memory unit **130**, an I/O unit **140***a*, a sensor unit **140***b*, and a driving unit

140*c*. Herein, the blocks **110** to **130**/**140***a* to **140***c* correspond to the blocks **110** to **130**/**140** of FIG. **14**, respectively.

[0219] The communication unit **110** may transmit and receive signals (e.g., driving information and control signals) to and from external devices such as other wireless devices, other robots, or control servers. The control unit **120** may perform various operations by controlling constituent elements of the robot **100**. The memory unit **130** may store data/parameters/programs/code/commands for supporting various functions of the robot **100**. The I/O unit **140***a* may obtain information from the exterior of the robot **100** and output information to the exterior of the robot **100**. The I/O unit **140***a* may include a camera, a microphone, a user input unit, a display unit, a speaker, and/or a haptic module. The sensor unit **140***b* may obtain internal information of the robot **100**, surrounding environment information, user information, etc. The sensor unit **140***b* may include a proximity sensor, an illumination sensor, an acceleration sensor, a magnetic sensor, a gyro sensor, an inertial sensor, an IR sensor, a fingerprint recognition sensor, an ultrasonic sensor, a light sensor, a microphone, a radar, etc. The driving unit **140***c* may perform various physical operations such as movement of robot joints. In addition, the driving unit **140***c* may cause the robot **100** to travel on the road or to fly. The driving unit **140***c* may include an actuator, a motor, a wheel, a brake, a propeller, etc.

Examples of an AI Device Applicable to the Present Disclosure

[0220] FIG. **20** illustrates an AI device applied to the present disclosure. The AI device may be implemented by a fixed device or a mobile device, such as a TV, a projector, a smartphone, a PC, a notebook, a digital broadcast terminal, a tablet PC, a wearable device, a Set Top Box (STB), a radio, a washing machine, a refrigerator, a digital signage, a robot, a vehicle, etc.

[0221] Referring to FIG. **20**, an AI device **100** may include a communication unit **110**, a control unit **120**, a memory unit **130**, an I/O unit **140***a*/**140***b*, a learning processor unit **140***c*, and a sensor unit **140***d*. The blocks **110** to **130**/**140***a* to **140***d* correspond to blocks **110** to **130**/**140** of FIG. **14**, respectively.

[0222] The communication unit **110** may transmit and receive wired/radio signals (e.g., sensor information, user input, learning models, or control signals) to and from external devices such as other AI devices (e.g., **100***x*, **200**, or **400** of FIG. **11**) or an AI server (e.g., **400** of FIG. **11**) using wired/wireless communication technology. To this end, the communication unit **110** may transmit information within the memory unit **130** to an external device and transmit a signal received from the external device to the memory unit **130**.

[0223] The control unit **120** may determine at least one feasible operation of the AI device **100**, based on information which is determined or generated using a data analysis algorithm or a machine learning algorithm. The control unit **120** may perform an operation determined by controlling constituent elements of the AI device **100**. For example, the control unit **120** may request, search, receive, or use data of the learning processor unit **140***c* or the memory unit **130** and control the constituent elements of the AI device **100** to perform a predicted operation or an operation determined to be preferred among at least one feasible operation. The control unit **120** may collect history information including the operation contents of the AI device **100** and operation feedback by a user and store the collected information in the memory unit **130** or the learning processor unit **140***c* or transmit the collected information to an external device such as an AI server (**400** of FIG. **11**). The collected history information may be used to update a learning model.

[0224] The memory unit **130** may store data for supporting various functions of the AI device **100**. For example, the memory unit **130** may store data obtained from the input unit **140***a*, data obtained from the communication unit **110**, output data of the learning processor unit **140***c*, and data obtained from the sensor unit **140**. The memory unit **130** may store control information and/or software code needed to operate/drive the control unit **120**.

[0225] The input unit **140***a* may acquire various types of data from the exterior of the AI device **100**. For example, the input unit **140***a* may acquire learning data for model learning, and input data to which the learning model is to be applied. The input unit **140***a* may include a camera, a microphone, and/or a user input unit. The output unit **140***b* may generate output related to a visual, auditory, or tactile sense. The output unit **140***b* may include a display unit, a speaker, and/or a haptic module. The sensing unit **140** may obtain at least one of internal information of the AI device **100**, surrounding environment information of the AI device **100**, and user information, using various sensors. The sensor unit **140** may include a proximity sensor, an illumination sensor, an acceleration sensor, a magnetic sensor, a gyro sensor, an inertial sensor, an RGB sensor, an IR sensor, a fingerprint recognition sensor, an ultrasonic sensor, a light sensor, a microphone, and/or a radar.

[0226] The learning processor unit **140***c* may learn a model consisting of artificial neural networks, using learning data. The learning processor unit **140***c* may perform AI processing together with the learning processor unit of the AI server (**400** of FIG. **11**). The learning processor unit **140***c* may process information received from an external device through the communication unit **110** and/or information stored in the memory unit **130**. In addition, an output value of the learning processor unit **140***c* may be transmitted to the external device through the communication unit **110** and may be stored in the memory unit **130**.

[0227] **[text missing or illegible when filed]**

INDUSTRIAL APPLICABILITY

[0228] The above-described embodiments of the present disclosure are applicable to various mobile communication systems.

1. An operation method of a first user equipment (UE) in a wireless communication system, the operation method comprising:

establishing a PC5 unicast link with a second UE; and

transmitting user traffic to the second UE,

wherein whether to include a service data adaptation protocol (SDAP) header for second PC5 quality of service (QoS) flow(s) used to transmit the user traffic is determined, based on addition or elimination of a first PC5 QoS flow to or from the PC5 unicast link.

2. The operation method of claim **1**, wherein the second PC5 QoS flow(s) are all PC5 QoS flows using a same PC5 unicast link as the first PC5 QoS flow.

3. The operation method of claim **1**, wherein a vehicle-to everything (V2X) layer of the UE provides an access stratum (AS) layer with information about whether to include the SDAP header for the second PC5 QoS flow(s).

4. The operation method of claim **1**, wherein the SDAP header is included based on inclusion of two or more services in the PC5 unicast link.

5. The operation method of claim **1**, wherein the SDAP header is not included based on inclusion of one service in the PC5 unicast link.

6. The operation method of claim **1**, wherein the first UE and the second UE have one or more PC5 unicast links.

7. The operation method of claim **1**, wherein the determination of whether to include the SDAP header for the second PC5 QoS flow(s) used to transmit the user traffic is made even in at least one of a case in which the PC5 unicast link is established, a case in which a new service is added to the PC5 unicast link, or a case in which an existing service is eliminated from the PC5 unicast link.

8. The operation method of claim **3**, wherein the information about whether to include the SDAP header is provided only upon occurrence of a change in inclusion or exclusion of the SDAP header.

9. The operation method of claim **1**, wherein the first UE stores the information about whether to include the SDAP header in a context managed according to each PC5 unicast link.

10. The operation method of claim **1**, wherein the SDAP header includes a PC5 QoS flow identifier (PFI).

11. The operation method of claim **3**, wherein the AS layer stores the information about whether to include the SDAP header for the second PC5 QoS flow(s).

12. The operation method of claim **11**, wherein the first UE includes the SDAP header in the user traffic based on the information about whether to include the SDAP header for the second PC5 QoS flow(s).

13. The operation method of claim **12**, wherein, upon receiving the SDAP header, the second UE provides the user traffic using a service corresponding to the PFI.

14. The operation method of claim **11**, wherein the first UE excludes the SDAP header from the user traffic based on the information about whether to include the SDAP header for the second PC5 QoS flow(s).

15. The operation method of claim **14**, wherein, upon failing to receive the SDAP header, the second UE provides the user traffic using a service identified by a destination layer-2 identifier (ID) of the user traffic.

16. A first user equipment (UE) in a wireless communication system, the first UE comprising:

at least one processor; and

at least one computer memory operably connected to the at least one processor and configured to store instructions for causing the at least one processor to perform operations based on execution of the instructions,

wherein the operations include:

establishing a PC5 unicast link with a second UE; and

transmitting user traffic to the second UE, and

wherein whether to include a service data adaptation protocol (SDAP) header for second PC5 quality of service (QoS) flow(s) used to transmit the user traffic is determined based on addition or elimination of a first PC5 QoS flow to or from the PC5 unicast link.

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