

QOS FLOW MAPPING FOR MULTIPLEXED MEDIA FLOWS

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to apparatuses and methods for Quality of Service (QoS) flow mapping for multiplexed media flows.

BACKGROUND

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

[0003] There is a scenario where multiple different media streams of Extended Reality (XR) service could be multiplexed on a single transport layer connection that shares the same Internet Protocol (IP) 5-tuple with a transport protocol and each of the media streams may have its own Quality of Service (QoS) requirements. The transport protocol multiplexes different data streams from an application to use the same IP 5-tuple. For example, a Virtual Reality (VR) or Augmented Reality (AR) application may use multiple streams within one session for its diverse traffic profile and purpose: one stream for signalling, one stream for control, one stream for audio and one or more streams for video. These streams are all sharing the same connection while having different QoS requirements or parameters.

[0004] However, for the current 5GS QoS framework, when service data flow is

mapped onto a QoS flow, it only has one set of QoS parameters and does not support differentiated QoS handling within one QoS flow.

SUMMARY

[0005] The present disclosure relates to apparatuses, UE and methods supporting QoS flow mapping for multiplexed media flows. With the apparatuses, the UE and the methods, the second apparatus or the UE may identify multiplexed media flows with different QoS requirements within a single transport layer connection. Then, the second apparatus or the UE may perform QoS Flow mapping for the media flows with different QoS requirements.

[0006] Some implementations of a first apparatus described herein may comprise at least one memory and at least one processor coupled with the at least one memory. The at least one processor is configured to cause the first apparatus to: obtain protocol description and multiplexing identification information associated with multiple sets of Quality of Service (QoS) parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams; determine QoS Flow Identifiers (QFIs) for QoS flows, wherein each of the QFIs is associated with one of the media streams; and provide a second apparatus or a UE with the following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0007] In some implementations, the multiplexing identification information comprises at least one of the following: an identity of the transport layer connection, or identities of the media streams.

[0008] In some implementations, the at least one processor is further configured to cause the first apparatus to provide the second apparatus with the following: the protocol description, and a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet.

[0009] In some implementations, the single transport layer connection comprises a connection based on a Quick User Datagram Protocol (UDP) Internet Connection (QUIC)

protocol, and the protocol description further comprises third information about the QUIC protocol.

[0010] In some implementations, the at least one processor is further configured to cause the first apparatus to: provide a Radio Access Network (RAN) node with a second indication indicating that the QoS flows are associated with the single transport layer connection.

[0011] In some implementations, the at least one processor is further configured to cause the first apparatus to: obtain alternative Protocol Data Unit (PDU) Set QoS parameters for the media streams; and provide a Radio Access Network (RAN) node with at least one alternative QoS profile, wherein each of the at least one alternative QoS profile comprises at least the alternative PDU Set QoS parameters.

[0012] In some implementations, the at least one alternative QoS profile comprises at least one dedicated alternative QoS profile.

[0013] In some implementations, the at least one dedicated alternative QoS profile comprises a first dedicated alternative QoS profile for uplink (UL) and a second dedicated alternative QoS profile for downlink (DL). In some implementations, the first dedicated alternative QoS profile for UL comprises at least one of the following: a UL PDU Set Delay Budget (PSDB), a UL PDU Set Error Rate (PSER), or a UL PDU Set Integrated Handling Information (PSIHI). In some implementations, the second dedicated alternative QoS profile for DL comprises at least one of the following: a DL PSDB, a DL PSER, or a DL PSIHI.

[0014] In some implementations, the first dedicated alternative QoS profile for UL further comprises a UL Guaranteed Flow Bit Rate (GFBR), and the second dedicated alternative QoS profile for DL further comprises a DL GFBR.

[0015] In some implementations, each of the at least one dedicated alternative QoS profile comprises at least one of the following: a PDU Error Rate (PER), a PDU Delay Budget (PDB), a UL Guaranteed Flow Bit Rate (GFBR), a DL GFBR, an averaging window, a Maximum Data Burst Volume (MDBV), a UL PDU Set Delay Budget (PSDB), a UL PDU Set Error Rate (PSER), a UL PDU Set Integrated Handling Information (PSIHI), a DL PSDB, a DL PSER, or a DL PSIHI.

[0016] In some implementations, the at least one processor is configured to cause the

first apparatus to provide the RAN node with a prioritized list of the at least one alternative QoS profile.

[0017] In some implementations, the at least one processor is further configured to cause the first apparatus to: provide the RAN node with a third indication, wherein the third indication indicates the RAN node to provide the first apparatus with fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled.

[0018] In some implementations, the at least one processor is further configured to cause the first apparatus to obtain at least one of the following from the RAN node: a fourth indication indicating that the QoS profile is not fulfilled, a sixth indication indicating that PDU Set QoS parameters comprised in the QoS profile are not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0019] In some implementations, the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled comprises at least one of the following: an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0020] In some implementations, the at least one processor is further configured to cause the first apparatus to provide the third apparatus with at least one of the following: the fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0021] Some implementations of a second apparatus described herein may comprise at least one memory and at least one processor coupled with the at least one memory. The at least one processor is configured to cause the second apparatus to: obtain the following from a first apparatus: protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection, second information about mapping among QFIs, the multiplexing identification information and multiple sets of QoS parameters for the media streams, and a first indication indicating

the second apparatus to obtain the multiplexing identification information from the data packet; obtain the multiplexing identification information from the data packet based on the protocol description and the first indication; and map the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping.

[0022] In some implementations, the multiplexing identification information comprises at least one of the following: an identity of the transport layer connection, or identities of the media streams.

[0023] In some implementations, the single transport layer connection comprises a connection based on a quick user datagram protocol (UDP) internet connection (QUIC) protocol, and the protocol description further comprises third information about the QUIC protocol.

[0024] In some implementations, the at least one processor is configured to cause the second apparatus to obtain the multiplexing identification information from the data packet by: obtaining the multiplexing identification information from one of the following: a plaintext part of the data packet based on a quick user datagram protocol (UDP) internet connection (QUIC) protocol, a general packet radio service (GPRS) tunnel protocol-user plane (GTP-U) header of the data packet, or a real-time transport protocol (RTP) header extension for the data packet based on an RTP protocol.

[0025] Some implementations of a UE described herein may comprise a processor and a transceiver coupled to the processor. The processor is configured to: obtain the following via the transceiver: second information about mapping among QFIs for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection; and map the media streams to the QoS Flows based on the second information about the mapping.

[0026] In some implementations, the processor is further configured to: obtain protocol description from a first apparatus, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the uplink data packet. In such implementations, the processor is configured to map the media streams to the QoS Flows based on the protocol description and the second

information about the mapping.

[0027] In some implementations, the multiplexing identification information comprises at least one of the following: an identity of the transport layer connection, or identities of the media streams.

[0028] In some implementations, the single transport layer connection comprises a connection based on a Quick User Datagram Protocol (UDP) Internet Connection (QUIC) protocol, and the protocol description further comprises third information about the QUIC protocol.

[0029] Some implementations of a third apparatus described herein may comprise at least one memory and at least one processor coupled with the at least one memory. The at least one processor is configured to cause the third apparatus to: provide a first apparatus with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams.

[0030] In some implementations, the at least one processor is further configured to cause the third apparatus to: provide the first apparatus with alternative Protocol Data Unit (PDU) Set Quality of Service (QoS) parameters.

[0031] In some implementations, the at least one processor is further configured to cause the third apparatus to: provide the first apparatus with a third indication, wherein the third indication indicates a Radio Access Network (RAN) node to provide fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled to the first apparatus if a QoS profile is not fulfilled.

[0032] In some implementations, the at least one processor is further configured to cause the third apparatus to: obtain at least one of the following from the first apparatus: a fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0033] In some implementations, the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled comprises at least one of the

following: an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0034] In some implementations, the at least one processor is further configured to cause the third apparatus to provide a fourth apparatus with at least one of the following: the fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0035] Some implementations of a RAN node described herein may comprise a processor and a transceiver coupled to the processor. The processor is configured to: obtain at least one alternative QoS profile via the transceiver from a first apparatus, wherein each of the at least one alternative QoS profile comprises at least alternative Protocol Data Unit (PDU) Set QoS parameters for media streams.

[0036] In some implementations, the at least one alternative QoS profile comprises at least one dedicated alternative QoS profile comprising at least the PDU Set QoS parameters.

[0037] In some implementations, the at least one dedicated alternative QoS profile comprises a first dedicated alternative QoS profile for uplink (UL) and a second dedicated alternative QoS profile for downlink (DL).

[0038] In some implementations, the first dedicated alternative QoS profile for UL comprises at least one of the following: a UL PDU Set Delay Budget (PSDB), a UL PDU Set Error Rate (PSER), or a UL PDU Set Integrated Handling Information (PSIHI).

[0039] In some implementations, the second dedicated alternative QoS profile for DL comprises at least one of the following: a DL PSDB, a DL PSER, or a DL PSIHI.

[0040] In some implementations, the first dedicated alternative QoS profile for UL further comprises a UL Guaranteed Flow Bit Rate (GFBR), and the second dedicated alternative QoS profile for DL further comprises a DL GFBR.

[0041] In some implementations, each of the at least one dedicated alternative QoS profile comprises at least one of the following: a PDU Error Rate (PER), a PDU Delay Budget (PDB), a UL Guaranteed Flow Bit Rate (GFBR), a DL GFBR, an averaging window, a Maximum Data Burst Volume (MDBV), a UL PDU Set Delay Budget (PSDB),

a UL PDU Set Error Rate (PSER), a UL PDU Set Integrated Handling Information (PSIHI), a DL PSDB, a DL PSER, or a DL PSIHI.

[0042] In some implementations, the at least one processor is configured to obtain a prioritized list of the at least one alternative QoS profile from the first apparatus.

[0043] In some implementations, the at least one processor is further configured to: obtain a third indication via the transceiver from the first apparatus, wherein the third indication indicates the RAN node to provide fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled to the first apparatus if a QoS profile is not fulfilled.

[0044] In some implementations, the at least one processor is further configured to: provide the first apparatus with at least one of the following: a fourth indication indicating that the QoS profile is not fulfilled, a sixth indication indicating that PDU Set QoS parameters comprised in the QoS profile are not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0045] In some implementations, the at least one processor is further configured to: provide a source RAN node with at least one of the following: a fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0046] In some implementations, the fourth information about the at least one of the PDU Set QoS parameters which is fulfilled comprises at least one of the following: an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0047] Some implementations of a method described herein may comprise: obtaining protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams; determining QFIs for QoS flows, wherein each of the QFIs is associated with one of the media streams; and providing a second apparatus or a UE with the

following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0048] Some implementations of a method described herein may comprise: obtaining the following from a first apparatus: protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection, second information about mapping among QFIs, the multiplexing identification information and multiple sets of QoS parameters for the media streams, and a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet; obtaining the multiplexing identification information from the data packet based on the protocol description and the first indication; and mapping the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping.

[0049] Some implementations of a method described herein may comprise: obtaining the following: second information about mapping among QFIs for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection; and mapping the media streams to the QoS Flows based on the second information about the mapping.

[0050] Some implementations of a method described herein may comprise: providing a first apparatus with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams.

[0051] Some implementations of a method described herein may comprise: obtaining at least one alternative QoS profile from a first apparatus, wherein each of the at least one alternative QoS profile comprises at least alternative PDU Set QoS parameters for media streams.

[0052] It is to be understood that the summary section is not intended to identify key or essential features of implementations of the present disclosure, nor is it intended to be used to limit the scope of the present disclosure. Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053] Figs. 1A and 1B illustrate an example of a wireless communications system that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure, respectively;

[0054] Figs. 2 and 3 illustrate a signaling diagram illustrating an example process that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure, respectively;

[0055] Fig. 4 illustrates a signaling diagram illustrating an example process that supports enhancements to alternative QoS profile in accordance with aspects of the present disclosure;

[0056] Fig. 5 illustrates an example of a device that supports QoS flow mapping for multiplexed media flows or enhancements to alternative QoS profile in accordance with some aspects of the present disclosure;

[0057] Fig. 6 illustrates an example of a processor that supports QoS flow mapping for multiplexed media flows or enhancements to alternative QoS profile in accordance with other aspects of the present disclosure; and

[0058] Figs. 7, 8, 9, 10 and 11 illustrate a flowchart of a method that supports QoS flow mapping for multiplexed media flows in accordance with other aspects of the present disclosure, respectively.

DETAILED DESCRIPTION

[0059] Principles of the present disclosure will now be described with reference to some implementations. It is to be understood that these implementations are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein may be implemented in various manners other than the ones described below.

[0060] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0061] References in the present disclosure to “one implementation,” “an example implementation,” “an implementation,” “some implementations,” and the like indicate that the implementation(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every implementation includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same implementation(s). Further, when a particular feature, structure, or characteristic is described in connection with an implementation, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other implementations whether or not explicitly described.

[0062] It shall be understood that although the terms “first” and “second” or the like may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of implementations. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

[0063] The terminology used herein is for the purpose of describing particular implementations only and is not intended to be limiting of example implementations. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/ or combinations thereof.

[0064] As described above, for the current 5GS QoS framework, when service data flow is mapped onto a QoS flow, it only has one set of QoS parameters and does not support differentiated QoS handling within one QoS flow. Therefore, for multiple media streams multiplexed on the single transport layer connection that shares the same IP 5-tuple with different QoS requirements or parameters, it is essential to first distinguish,

identify each of them, and then apply the QoS flow mapping for each stream with different QoS requirements or parameters.

[0065] In view of the above, implementations of the present disclosure provide a solution that supports QoS flow mapping for multiplexed media flows. In one aspect of the solution, a first apparatus obtains protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection. The protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams. Then, the first apparatus determines QoS Flow Identifiers (QFIs) for QoS flows, wherein each of the QFIs is associated with one of the media streams. In turn, the first apparatus provides a second apparatus or a UE with the following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters. With this solution, the second apparatus or the UE may identify multiplexed media flows with different QoS requirements within a single transport layer connection. Then, the second apparatus or the UE may perform QoS Flow mapping for the media flows with different QoS requirements.

[0066] Aspects of the present disclosure are described in the context of a wireless communications system.

[0067] Fig. 1A illustrates an example of a wireless communications system 100A that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The wireless communications system 100A may include one or more network entities 102 (also referred to as network equipment (NE)), one or more terminal devices or UEs 104, a core network 106, and a data network (DN) 108. The wireless communications system 100A may support various radio access technologies. In some implementations, the wireless communications system 100A may be a 4G network, such as an LTE network or an LTE-advanced (LTE-A) network. In some other implementations, the wireless communications system 100A may be a 5G network, such as an NR network. In other implementations, the wireless communications system 100A may be a combination of a 4G network and a 5G network, or other suitable radio access technology including institute of electrical and electronics engineers (IEEE) 802.11 (Wi-

Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100A may support radio access technologies beyond 5G. Additionally, the wireless communications system 100A may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0068] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100A. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Hereinafter, some implementations of the present disclosure will be described by taking an RAN node as an example of the network entity 102. Thus, the network entity 102 may be used interchangeably with the RAN node 102. For example, the RAN nodes 102 may comprise a RAN node 102-1 and a RAN node 102-2.

[0069] A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0070] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the

description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0071] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100A. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100A. In some other implementations, a UE 104 may be mobile in the wireless communications system 100A.

[0072] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in Fig. 1. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in Fig. 1. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100A.

[0073] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0074] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network

interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0075] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN Intelligent Controller (RIC) (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) system, or any combination thereof.

[0076] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0077] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host

upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaptation protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU 160.

[0078] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0079] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-c, F1-u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0080] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers,

signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0081] The core network 106 may communicate with the data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0082] In the wireless communications system 100A, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100A (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0083] One or more numerologies may be supported in the wireless communications system 100A, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., $\mu=0$) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., $\mu=1$) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., $\mu=2$) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an

extended cyclic prefix. A fourth numerology (e.g., $\mu=3$) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., $\mu=4$) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0084] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0085] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100A. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0086] In the wireless communications system 100A, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100A may support one or multiple operating frequency bands, such as frequency range

designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0087] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., =0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., =1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., =2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., =2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., =3), which includes 120 kHz subcarrier spacing.

[0088] Fig. 1B illustrates an example of a wireless communications system 100B that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. Specifically, Fig. 1B illustrates network entities or Network Functions (NFs) in the core network 106 as shown in Fig. 1A.

[0089] As shown in Fig. 1B, the core network 106 may comprise at least a Session Management Function (SMF) 120, a User Plane Function (UPF) 130, a Policy Control Function (PCF) 140, a Network Exposure Function (NEF) 150, an Application Function (AF) 160, and an Access and Mobility management Function (AMF) 170.

[0090] In some implementations, the AMF 170 may communicate with the RAN node 102 and the SMF 120 via N2 interface and N11 interface, respectively.

[0091] In some implementations, the SMF 120 may communicate with the UPF 130 and the PCF 140 via N4 interface and N7 interface, respectively.

[0092] In some implementations, the UPF 130 may communicate with the RAN node 102 and the DN 108 via N3 interface and N6 interface, respectively. In some

implementations, the UPF 130 may comprise a PDU Session Anchor (PSA) UPF.

[0093] In some implementations, the core network 106 may comprise more than one UPFs. In such implementations, one UPF may communicate with another UPF via N9 interface.

[0094] In some implementations, the NEF 150 may communicate with the PCF 140 and the AF 160 via N30 interface and N33 interface, respectively.

[0095] Fig. 2 illustrates a signaling diagram illustrating an example process 200 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The process 200 may involve the RAN node 102 in Fig. 1A or 1B, the NEF 150, the AF 160 and the DN 108 in Fig. 1B. The process 200 may also involve a first apparatus, a second apparatus and a third apparatus. In some implementations, the first apparatus may perform the SMF 120 in Fig. 1B. Alternatively, the first apparatus may perform other network function than the SMF 120 in Fig. 1B. In some implementations, the second apparatus may perform the UPF 130 in Fig. 1B. Alternatively, the second apparatus may perform other network function than the UPF 130 in Fig. 1B. In some implementations, the third apparatus may perform the PCF 140 in Fig. 1B. Alternatively, the third apparatus may perform other network function than the PCF 140 in Fig. 1B. For the purpose of discussion, the process 200 will be described with reference to Fig. 1B. The process 200 may involve the RAN node 102, the UPF 130, the SMF 120, the PCF 140, the NEF 150, the AF 160 and the DN 108 in Fig. 1B.

[0096] As shown in Fig. 2, the AF 160 may provide 210 the NEF 150 with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams. The media streams are carried in a data packet and multiplexed on a single transport layer connection. The protocol description comprises first information about where to obtain the multiplexing identification information from the data packet. The multiplexing identification information is used for identifying the media streams.

[0097] In some implementations, the single transport layer connection may comprise a connection based on a quick user datagram protocol (UDP) internet connection (QUIC) protocol. In such implementations, the protocol description may indicate to obtain the multiplexing identification information from a plaintext part of the data packet based on the QUIC protocol or from a general packet radio service (GPRS) tunnel protocol-user

plane (GTP-U) header of the data packet.

[0098] In some implementations, the single transport layer connection may comprise a connection based on a real-time transport protocol (RTP). In such implementations, the protocol description may indicate to obtain the multiplexing identification information from an RTP header extension for the data packet based on the RTP protocol.

[0099] In some implementations, the protocol description may further indicate the transport protocol (e.g. RTP, Secure Real-time Transport Protocol (SRTP)), transport protocol header extensions (e.g. RTP Header Extension for PDU Set Marking as defined in TS 26.522), payload type and format (e.g. H.264 or H.265), and format parameters (e.g. H.264 profile level and packetization mode) used by a service data flow or a media flow.

[0100] In some implementations, the multiplexing identification information may comprise at least one of the following: an identity (ID) of the transport layer connection, or IDs of the media streams. For example, if the single transport layer connection may comprise a connection based on the QUIC protocol, the ID of the transport layer connection may comprise a Connection ID, and the IDs of the media streams may comprise Stream IDs.

[0101] In some implementations, the Connection ID is normally used to identify a QUIC connection between communication endpoints. For encrypted data part, when the frame type is set as stream type, it means application data is transmitted via the QUIC connection. Stream means a unidirectional or bidirectional channel for sequential bytes in a QUIC connection. A QUIC connection can carry multiple media streams simultaneously.

[0102] In some implementations, a Stream ID may be used to differentiate the multiple streams within the same QUIC connection (with the same Connection ID). When the Stream ID is generated, it is guaranteed that it is only and unique within this QUIC connection. That is to say, the Stream ID is unique among all the streams within a connection and accordingly can be used to detect and identify different multiplexed media streams. For QUIC protocol, the Connection ID and the Stream ID can be combined or separately used to uniquely identify a media stream among the multiplexed media streams.

[0103] Hereinafter, some implementations of the present disclosure will be described by taking the Connection ID and the Stream ID as examples of the multiplexing

identification information. It shall be understood that the multiplexing identification information may comprise any appropriate information for identifying the media streams based on the transport layer protocol applied to the present disclosure.

[0104] In some implementations, the AF 160 may provide the multiplexing identification information in association with the multiple sets of QoS parameters. In other words, the AF 160 may provide a mapping between the multiplexing identification information and the multiple sets of QoS parameters.

[0105] For example, the mapping between the multiplexing identification information and the multiple sets of QoS parameters may comprise: Connection ID#X1+stream ID#Y1>>>QoS parameters set#1, Connection ID#X2+stream ID#Y2>>>QoS parameters set#2.

[0106] For another example, the mapping between the multiplexing identification information and the multiple sets of QoS parameters may comprise: Stream ID#X1>>>QoS parameters set#1, Stream ID#X2>>>QoS parameters set#2.

[0107] In some implementations, the AF 160 may further provide the NEF 150 with a flow description of an AF session together with the multiplexing identification information associated with the multiple sets of QoS parameters. In such implementations, the flow description may be a packet filter set which includes direction, source and destination IP address, protocol, source and destination port number and so on. For example, the packet filter set may be an IP packet filter set or an Ethernet packet filter set. Alternatively, the flow description may be an Application identifier (i.e., AppID).

[0108] In some implementations, different media streams may have different Forward Error Correction (FEC) ratio associated with a PDU set Importance (PSI) value for potential PDU set discarding at the RAN node 102. Therefore, in addition to the mapping of the multiplexing identification information and the multiple sets of QoS parameters, the AF 160 may further provide the NEF 150 with a mapping between the multiplexing identification information and the FEC ratio. For example, the mapping between the multiplexing identification information, the FEC ratio and PDU set QoS parameters may comprise: Connection ID#X1+Stream ID#Y1>>>PSI value #1>> FEC ratio X%.

[0109] In some implementations, different media streams may have different PDU set QoS parameters. Therefore, in addition to the mapping of the multiplexing

identification information and the multiple sets of QoS parameters, the AF 160 may further provide the NEF 150 with a mapping between the multiplexing identification information and PDU set QoS parameters. For example, the mapping between the multiplexing identification information and PDU set QoS parameters may comprise: Connection ID#X1+Stream ID#Y1>>>PDU set QoS parameters #1.

[0110] It shall be noted that for the FEC ratio associated with a PSI value, a PDU set importance list may be associated with the same FEC ratio X% or a PDU set importance list may be associated with different FEC ratios. For example, PSI value #1 is associated with FEC ratio X%, PSI value #2 is associated with FEC ratio Y%, PSI value #3 is associated with FEC ratio Z%, and so on.

[0111] In some implementations, the AF 160 may transmit a Nnef_AFsessionWithQoS_Create message to the NEF 150. The Nnef_AFsessionWithQoS_Create message may comprise the protocol description and the multiplexing identification information associated with the multiple sets of QoS parameters.

[0112] In some implementations, the Nnef_AFsessionWithQoS_Create message may further comprise other information or parameters as described above.

[0113] Upon receiving the Nnef_AFsessionWithQoS_Create message, the NEF 150 authorizes 215 the AF request of the AF session with required QoS parameters and may apply policies to control the overall amount of QoS authorized for the AF 160. If the authorization is not granted, the NEF 150 replies to the AF 160 with a Result value indicating that the authorization is failed. Alternatively, in the case of trusted AF, the AF 160 can provide these parameters directly to the PCF 140 without the involvement of the NEF 150.

[0114] After successful authorization, the NEF 150 may provide 220 the PCF 140 with the protocol description and the multiplexing identification information associated with the multiple sets of QoS parameters.

[0115] In some implementations, the NEF 150 may further provide the PCF 140 with the flow description.

[0116] In some implementations, the NEF 150 may further provide the PCF 140 with the mapping between the multiplexing identification information and the FEC ratio.

[0117] In some implementations, the NEF 150 may further provide the PCF 140 with the mapping between the multiplexing identification information and the PDU set QoS parameters.

[0118] In some implementations, the NEF 150 may transmit a Npcf_PolicyAuthorization_Create message to the PCF 140. The Npcf_PolicyAuthorization_Create message may comprise the protocol description and the multiplexing identification information associated with the multiple sets of QoS parameters.

[0119] In some implementations, the Npcf_PolicyAuthorization_Create message may further comprise other information or parameters as described above.

[0120] Alternatively, the PCF 140 may obtain the above information or parameters based on the operator local configuration.

[0121] Then, the PCF 140 may provide 225 the SMF 120 with the protocol description and the multiplexing identification information associated with the multiple sets of QoS parameters.

[0122] In some implementations, the PCF 140 may further provide the SMF 120 with the flow description.

[0123] In some implementations, the PCF 140 may further provide the SMF 120 with the mapping between the multiplexing identification information and the FEC ratio.

[0124] In some implementations, the PCF 140 may further provide the SMF 120 with the mapping between the multiplexing identification information and the PDU set QoS parameters.

[0125] In some implementations, the PCF 140 may generate Policy and Charging Control (PCC) rules and transmit the PCC rules to the SMF 120. The PCC rules may comprise the protocol description and the multiplexing identification information associated with the multiple sets of QoS parameters.

[0126] In some implementations, the PCC rules may further comprise other information or parameters as described above.

[0127] Alternatively, the SMF 120 may be pre-configured with the protocol description and the multiplexing identification information associated with the multiple

sets of QoS parameters.

[0128] In some implementations, the SMF 120 may be further pre-configured with other information or parameters as described above.

[0129] In turn, the SMF 120 determines 230 QFIs for QoS flows. Each of the QFIs is associated with one of the media streams.

[0130] In some implementations, according to the PCC rules from the PCF 140, the SMF 120 may perform binding of the PCC rules to the QoS flows based on the multiple sets of QoS parameters. The SMF 120 may assign a QFI for a new QoS flow and derive its QoS profile, corresponding UPF instructions (including the packet detection rule) and at least one QoS Rule from at least one PCC rule bound to the QoS flow and other information provided by the PCF 140.

[0131] Then, the SMF 120 provides 235 the UPF 130 with the following: the protocol description; second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters; and a first indication indicating the UPF 130 to obtain the multiplexing identification information from the data packet.

[0132] In some implementations, the second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters may comprise the following:

- QFI#1---Connection ID #X1+Stream ID#Y1---QoS parameters set #1,
and
- QFI#2---Connection ID #X2+Stream ID#Y2---QoS parameters set #2.

[0133] In some implementations, the SMF 120 may transmit a PDR to the UPF 130. The PDR may comprise the second information about mapping and the first indication. The PDR may comprise both DL part and UL part of a Service Data Flow (SDF) template.

[0134] In some implementations, the SMF 120 may further transmit an indication in QoS enforcement rule (QER) to the UPF 130 for indicating the UPF 130 about the multiplexing information identification. Upon receiving the indication and the protocol description, the UPF 130 will know when and how to obtain the multiplexing identification information from a DL data packet and perform the following QFI making for QoS flows.

[0135] In some implementations, optionally, the SMF 120 may provide 240 the RAN node 102 with a second indication indicating that the QoS flows are associated with the single transport layer connection. For example, the SMF 120 may provide the second indication in an N2 SM message via the AMF 170. The second indication may be utilized by the RAN node 102 for potential sequential processing among multiple media streams if necessary.

[0136] In some implementations, the SMF 120 may further provide the RAN node 102 with the QFIs and the QoS profile comprising 5QI, Address Resolution Protocol (ARP), the multiple sets of QoS parameters and the PDU set QoS parameters, the PSI-FEC ratio mapping list. The RAN node 102 may determine the FEC ratio by checking the GTP-U header of a DL packet from the UPF 130 to get the PSI and conduct packet discarding. The RAN node 102 may conduct PDU set based handling based on the PDU set QoS parameters.

[0137] After receiving 245 a DL data packet from the application server 118 in the DN 108, the UPF 130 obtains 250 the multiplexing identification information from the data packet based on the protocol description and the first indication.

[0138] In some implementations, the UPF 130 may obtain the multiplexing identification information from a plaintext part of the data packet based on a QUIC protocol, from a QUIC header or other part of the data packet that is not encrypted.

[0139] Alternatively, in some implementations, the UPF 130 may obtain the multiplexing identification information from a GTP-U header of the data packet.

[0140] Alternatively, in some implementations, the UPF 130 may obtain the multiplexing identification information from an RTP header extension for the data packet based on an RTP protocol.

[0141] The UPF 130 maps 255 the media streams onto the QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0142] After obtaining the multiplexing identification information, the UPF 130 will be able to identify each of the media streams with the unique identification information. Then, by checking the correspondence list of the QFI and the multiplexing identification

information associated with QoS parameters received from the SMF 120, the UPF 130 can map the multiplexed media flows in a service data flow into the corresponding QoS flows marked by the QFIs with different QoS parameters based on the service data flow template and the multiplexing identification information.

[0143] After receiving the DL data packet from the UPF 130, the RAN node 102 maps the QoS flows to air interface resources (i.e., DRBs in the case of 3GPP RAN) and sends the data packet to the UE 104.

[0144] With the process 200, the UPF 130 may identify multiplexed media flows with different QoS requirements within a single transport layer connection. Then, the UPF 130 may perform QoS flow mapping for the media flows with different QoS requirements.

[0145] Fig. 3 illustrates a signaling diagram illustrating an example process 300 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The process 300 may involve the UE 104 in Fig. 1A or 1B, the NEF 150 and the AF 160 in Fig. 1B. The process 300 may also involve a first apparatus and a third apparatus. In some implementations, the first apparatus may perform the SMF 120 in Fig. 1B. Alternatively, the first apparatus may perform other network function than the SMF 120 in Fig. 1B. In some implementations, the third apparatus may perform the PCF 140 in Fig. 1B. Alternatively, the third apparatus may perform other network function than the PCF 140 in Fig. 1B. For the purpose of discussion, the process 300 will be described with reference to Fig. 1B. The process 300 may involve the UE 104, the SMF 120, the PCF 140, the NEF 150 and the AF 160 in Fig. 1B.

[0146] Actions 210, 215, 220, 225 and 230 in the process 300 are the same as those in the process 200. Details of these actions are omitted for brevity.

[0147] The process 300 is different from the process 200 in actions 335, 340, 345 and 350.

[0148] Specifically, the SMF 120 provides 335 the UE 104 with the following: the second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0149] In some implementations, the second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters may comprise the following:

- QFI#1---Connection ID #X1+Stream ID#Y1---QoS parameters set #1,
and
- QFI#2---Connection ID #X2+Stream ID#Y2---QoS parameters set #2.

[0150] In some implementations, according to the PCC rules from the PCF 140, the SMF 120 may generate an explicitly signalled QoS rule and provide it to the UE 104. The QoS rule may comprise the second information about mapping.

[0151] In some implementations, the QoS rule may further comprise the packet filter set that is generated from the UL SDF filters.

[0152] In some implementations, the SMF 120 may further provide the UE 104 with the protocol description to assist the UE 104 in obtaining the multiplexing identification information. For example, the SMF 120 may provide the UE 104 with the protocol description together with the QoS rule.

[0153] After receiving 340 a UL data packet from an application, the UE 104 obtains 345 the multiplexing identification information from the data packet based on the protocol description.

[0154] In some implementations, the SMF 120 may further provide the UE 104 with the first indication indicating the UE 104 to obtain the multiplexing identification information from the data packet. In such implementations, the UE 104 may obtain the multiplexing identification information from the data packet based on the protocol description and the first indication.

[0155] Alternatively, in some implementations, the SMF 120 may not provide the UE 104 with the first indication. The UE 104 may use or may not use the protocol description to obtain the multiplexing identification information from the UL data packet based on implementation of the UE 104.

[0156] In some implementations, the UE 104 may obtain the multiplexing identification information from a plaintext part of the data packet based on a QUIC protocol, from a QUIC header or other part of the data packet that is not encrypted.

[0157] Alternatively, in some implementations, the UE 104 may obtain the multiplexing identification information from a GTP-U header of the data packet.

[0158] Alternatively, in some implementations, the UE 104 may obtain the

multiplexing identification information from an RTP header extension for the data packet based on an RTP protocol.

[0159] The UE 104 maps the media streams onto the QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0160] In some implementations, the UE 104 may mark a UL PDU with the QFI.

[0161] Then, the UE 104 may transmit the UL PDU using the corresponding access specific resource for the QoS flow based on the mapping provided by the RAN node 102. The RAN node 102 transmits the PDUs over N3 tunnel towards the UPF 130, including the QFI in the encapsulation header of the UL PDU.

[0162] After obtaining the multiplexing identification information, the UE 104 will be able to identify each of the media streams with the unique identification information. Then, by checking the correspondence list of the QFI and the multiplexing identification information associated with QoS parameters received from the SMF 120, the UE 104 can map the multiplexed media flows in a service data flow into the corresponding QoS flows marked by the QFIs with different QoS parameters based on the service data flow template and the multiplexing identification information.

[0163] After receiving the UL data packet from the UE 104, the RAN node 102 maps the QoS flows to air interface resources (i.e., DRBs in the case of 3GPP RAN) and sends the data packet to the UPF 130.

[0164] With the process 300, the UE 104 may identify multiplexed media flows with different QoS requirements within a single transport layer connection. Then, the UE 104 may perform QoS flow mapping for the media flows with different QoS requirements.

[0165] Hereinafter, some implementations for enhancements to alternative QoS profile will be described with reference to Fig. 4.

[0166] In some implementations, PDU Set QoS Parameters are used to support PDU Set based QoS handling in the RAN node 102. At least one PDU Set QoS Parameter shall be sent to the RAN node 102 to enable PDU Set based QoS handling.

[0167] Currently, a legacy alternative QoS profile comprises a PDU Error Rate (PER),

a PDU Delay Budget (PDB), a Guaranteed Flow Bit Rate (GFBR), averaging window and optionally the Maximum Data Burst Volume (MDBV), but the PDU Set QoS parameters are not included in the legacy alternative QoS profile. Therefore, there is a need to enhance the legacy alternative QoS profile with PDU set QoS parameters.

[0168] Fig. 4 illustrates a signaling diagram illustrating an example process 400 that supports enhancements to alternative QoS profile in accordance with aspects of the present disclosure. The process 400 may involve the RAN node 102-1 in Fig. 1A or 1B, the NEF 150 and the AF 160 in Fig. 1B. The process 400 may also involve a first apparatus, a second apparatus and a third apparatus. In some implementations, the first apparatus may perform the SMF 120 in Fig. 1B. Alternatively, the first apparatus may perform other network function than the SMF 120 in Fig. 1B. In some implementations, the third apparatus may perform the PCF 140 in Fig. 1B. Alternatively, the third apparatus may perform other network function than the PCF 140 in Fig. 1B. For the purpose of discussion, the process 400 will be described with reference to Fig. 1B. The process 400 may involve the RAN node 102-1, the SMF 120, the PCF 140, the NEF 150, the AF 160 in Fig. 1B.

[0169] As shown in Fig. 4, the AF 160 may provide 410 the NEF 150 with alternative PDU Set QoS parameters for media streams.

[0170] In some implementations, the alternative PDU Set QoS parameters may comprise alternative UL PDU Set QoS parameters for a QoS flow and alternative DL PDU Set QoS parameters for the QoS flow. The alternative UL PDU Set QoS parameters for the QoS flow may be the same as or different from the alternative DL PDU Set QoS parameters for the QoS flow.

[0171] In some implementations, the alternative UL PDU Set QoS parameters may comprise at least one of the following: a UL PDU Set Delay Budget (PSDB), a UL PDU Set Error Rate (PSER), or a UL PDU Set Integrated Handling Information (PSIHI).

[0172] In some implementations, the alternative DL PDU Set QoS parameters may comprise at least one of the following: a DL PSDB, a DL PSER, or a DL PSIHI.

[0173] In some implementations, the AF 160 may provide the NEF 150 with multiple alternative PDU Set QoS parameter sets. Each of the multiple alternative PDU Set QoS parameter sets may comprise the alternative UL PDU Set QoS parameters.

[0174] In some implementations, each of the multiple alternative PDU Set QoS parameter sets may be assigned a priority. The AF 160 may provide the NEF 150 with the multiple alternative PDU Set QoS parameter sets in an order of priorities for the multiple alternative PDU Set QoS parameter sets. In other words, the AF 160 may provide the NEF 150 with the multiple alternative PDU Set QoS parameter sets in a prioritized order.

[0175] In some implementations, the AF 160 may provide the NEF 150 with alternative service requirements. The alternative service requirements may comprise alternative QoS parameter sets and the alternative PDU Set QoS parameter sets.

[0176] In some implementations, the AF 160 may further provide the NEF 150 with QoS parameters and PDU Set QoS parameters.

[0177] In some implementations, the AF 160 may further provide the NEF 150 with a flow description of an AF session together with the alternative PDU Set QoS parameters. In such implementations, the flow description may be a packet filter set which includes direction, source and destination IP address, protocol, source and destination port number and so on. For example, the packet filter set may be an IP packet filter set or an Ethernet packet filter set. Alternatively, the flow description may be an Application identifier (i.e., AppID).

[0178] In some implementations, the AF 160 may transmit a Nnef_AFsessionWithQoS_Create message to the NEF 150. The Nnef_AFsessionWithQoS_Create message may comprise the alternative PDU Set QoS parameters.

[0179] In some implementations, the Nnef_AFsessionWithQoS_Create message may further comprise at least one of the following: the flow description, the QoS parameters, the PDU Set QoS parameters, or alternative QoS parameter sets.

[0180] Upon receiving the Nnef_AFsessionWithQoS_Create message, the NEF 150 authorizes 415 the AF request of the AF session with required QoS parameters and may apply policies to control the overall amount of QoS authorized for the AF 160. If the authorization is not granted, the NEF 150 replies to the AF 160 with a Result value indicating that the authorization is failed. Alternatively, in the case of trusted AF, the AF 160 can provide these parameters directly to the PCF 140 without the involvement of the

NEF 150.

[0181] After successful authorization, the NEF 150 may provide 420 the PCF 140 with the alternative PDU Set QoS parameters.

[0182] In some implementations, the NEF 150 may provide the PCF 140 with the multiple alternative PDU Set QoS parameter sets. Each of the multiple alternative PDU Set QoS parameter sets may comprise the alternative UL PDU Set QoS parameters. For example, the NEF 150 may provide the PCF 140 with the multiple alternative PDU Set QoS parameter sets in a prioritized order.

[0183] In some implementations, the NEF 150 may further provide the PCF 140 with alternative service requirements. The alternative service requirements may comprise the alternative QoS parameter sets and the alternative PDU Set QoS parameter sets.

[0184] In some implementations, the NEF 150 may further provide the PCF 140 with the QoS parameters and the PDU Set QoS parameters.

[0185] In some implementations, the NEF 150 may further provide the PCF 140 with the flow description.

[0186] In some implementations, the NEF 150 may transmit a Npcf_PolicyAuthorization_Create message to the PCF 140. The Npcf_PolicyAuthorization_Create message may comprise the alternative PDU Set QoS parameters.

[0187] In some implementations, the Npcf_PolicyAuthorization_Create message may further comprise at least one of the following: the flow description, the QoS parameters, the PDU Set QoS parameters, or alternative QoS parameter sets.

[0188] Alternatively, the PCF 140 may obtain the above information or parameters based on the operator local configuration.

[0189] Then, the PCF 140 may provide 425 the SMF 120 with the alternative PDU Set QoS parameters.

[0190] In some implementations, the PCF 140 may further provide the SMF 120 with the alternative QoS parameters, the QoS parameters and the PDU Set QoS parameters.

[0191] In some implementations, the PCF 140 may further provide the SMF 120 with

the flow description.

[0192] In some implementations, the PCF 140 may further provide the SMF 120 with a third indication.

[0193] In some implementations, the third indication may indicate the RAN node 102-1 to provide the SMF 120 with fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled.

[0194] In some implementations, the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled may comprise at least one of the following: an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0195] Alternatively, in some implementations, the third indication may indicate the RAN node 102-1 to provide the SMF 120 with information about at least one of the alternative UL PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled and indicate the RAN node 102-1 to provide the SMF 120 with information about at least one of the alternative UL PDU Set QoS parameters which is fulfilled if the QoS profile is not fulfilled.

[0196] In some implementations, the information about the at least one of the alternative UL PDU Set QoS parameters which is fulfilled may comprise at least one of the following: a first index of a first alternative QoS profile for UL comprising at least one of the alternative UL PDU Set QoS parameters which is fulfilled, or a seventh indication of the at least one of the alternative UL PDU Set QoS parameters which is fulfilled.

[0197] In some implementations, the information about the at least one of the alternative DL PDU Set QoS parameters which is fulfilled may comprise at least one of the following: a second index of a second alternative QoS profile for DL comprising at least one of the alternative DL PDU Set QoS parameters which is fulfilled, or an eighth indication of the at least one of the alternative DL PDU Set QoS parameters which is fulfilled.

[0198] In some implementations, the PCF 140 may further provide the SMF 120 with a QoS Notification Control (QNC) indication. The QNC indication indicates whether

notifications are requested from the RAN node 102-1 when the GFBR can no longer (or can again) be guaranteed for a QoS flow during the lifetime of the QoS flow. The GFBR is comprised in a legacy alternative QoS profile.

[0199] In some implementations, the PCF 140 may generate PCC rules and transmit the PCC rules to the SMF 120. The PCC rules may comprise the alternative PDU Set QoS parameters.

[0200] In some implementations, the PCC rules may further comprise at least one of the following: the flow description, the QoS parameters, the alternative QoS parameters, the PDU Set QoS parameters, the QNC indication, or the third indication.

[0201] Upon receiving the alternative PDU Set QoS parameters, the SMF 120 generates 430 at least one alternative QoS profile. Each of the at least one alternative QoS profile comprises at least the alternative PDU Set QoS parameters.

[0202] In some implementations, the at least one alternative QoS profile may comprise at least one dedicated alternative QoS profile.

[0203] In some implementations, the at least one dedicated alternative QoS profile may comprise at least one dedicated alternative QoS profile for UL and at least one dedicated alternative QoS profile for DL. Hereinafter, a dedicated alternative QoS profile for UL is also referred to as an “alternative UL PDU set QoS profile”, and a dedicated alternative QoS profile for DL is also referred to as an “alternative DL PDU set QoS profile”.

[0204] In some implementations, an alternative UL PDU set QoS profile may comprise at least one of the following: a UL PSDB, a UL PSER, or a UL PSIHL.

[0205] In some implementations, an alternative DL PDU set QoS profile may comprise at least one of the following: a DL PSDB, a DL PSER, or a DL PSIHL.

[0206] In some implementations, the alternative UL PDU set QoS profile may further comprise a UL GFBR, and the alternative DL PDU set QoS profile may further comprise a DL GFBR.

[0207] In some implementations, the SMF 120 may further generate a QoS profile and the QoS profile may comprise the QoS parameters and the PDU Set QoS parameters.

[0208] In some implementations, the SMF 120 may further generate at least one

legacy alternative QoS profile. Each of the at least one legacy alternative QoS profile may comprise one of the alternative QoS parameter sets. Each of the alternative QoS parameter sets may comprise at least one of the following: a PER, a PDB, a GFBR, averaging window and optionally the MDBV.

[0209] In some implementations, the SMF 120 may add the alternative PDU Set QoS parameters to a legacy alternative QoS profile to obtain an upgraded alternative QoS profile. In such implementations, the upgraded alternative QoS profile may comprise at least one of the following: a PER, a PDB, a UL GFBR, a DL GFBR, an averaging window, an MDBV, a UL PSDB, a UL PSER, a ULPSIHI, a DL PSDB, a DL PSER, or a DL PSIHI. In other words, each of the at least one alternative QoS profile may comprise at least one of the following: a PER, a PDB, a UL GFBR, a DL GFBR, an averaging window, an MDBV, a UL PSDB, a UL PSER, a ULPSIHI, a DL PSDB, a DL PSER, or a DL PSIHI.

[0210] Then, the SMF 120 provides DL the RAN node 102-1 with the at least one alternative QoS profile. For example, the SMF 120 may provide the RAN node 102-1 with the at least one alternative QoS profile via the AMF 170 via NAS signaling.

[0211] In some implementations, the SMF 120 may provide 435 the RAN node 102-1 with the at least one alternative UL PDU set QoS profile.

[0212] In some implementations, each of the at least one alternative UL PDU set QoS profile may be assigned a priority. The SMF 120 may provide the RAN node 102-1 with the at least one alternative UL PDU set QoS profile in an order of priorities for the at least one alternative UL PDU set QoS profile. In other words, the SMF 120 may provide the RAN node 102-1 with the at least one alternative UL PDU set QoS profile in a prioritized order.

[0213] Alternatively or additionally, in some implementations, the SMF 120 may provide the RAN node 102-1 with the at least one alternative DL PDU set QoS profile.

[0214] In some implementations, each of the at least one alternative DL PDU set QoS profile may be assigned a priority. The SMF 120 may provide the RAN node 102-1 with the at least one alternative DL PDU set QoS profile in an order of priorities for the at least one alternative DL PDU set QoS profile. In other words, the SMF 120 may provide the RAN node 102-1 with the at least one alternative DL PDU set QoS profile in a prioritized

order.

[0215] In some implementations, the SMF 120 may further provide the RAN node 102-1 with the third indication.

[0216] In some implementations, the third indication may indicate the RAN node 102-1 to provide the SMF 120 with fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled.

[0217] Alternatively, in some implementations, the third indication may indicate the RAN node 102-1 to provide the SMF 120 with the information about at least one of the alternative UL PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled and indicate the RAN node 102-1 to provide the SMF 120 with the information about at least one of the alternative DL PDU Set QoS parameters which is fulfilled if the QoS profile is not fulfilled.

[0218] In some implementations, the SMF 120 may further provide the RAN node 102-1 with at least one of the following: the QoS profile, or the QNC indication.

[0219] In some implementations, the SMF 120 may further provide the RAN node 102-1 with the at least one legacy alternative QoS profile.

[0220] In some implementations, each of the at least one legacy alternative QoS profile may be assigned a priority. The SMF 120 may provide the RAN node 102-1 with the at least one legacy alternative QoS profile in an order of priorities for the at least one legacy alternative QoS profile. In other words, the SMF 120 may provide the RAN node 102-1 with the at least one legacy alternative QoS profile in a prioritized order.

[0221] Upon receiving the QoS profile, the RAN node 102-1 may determine 440 whether the QoS parameters in the QoS profile can be fulfilled. If at least one of the QoS parameters in the QoS profile cannot be fulfilled and the RAN node 102-1 supports the PDU Set based handling, the RAN node 102-1 may further determine whether the PDU Set QoS parameters in the QoS profile can be fulfilled.

[0222] If at least one of the PDU Set QoS parameters in the QoS profile cannot be fulfilled, the RAN node 102-1 may further determine 445 whether the alternative PDU Set QoS parameters in the at least one alternative QoS profile can be fulfilled. For example, the RAN node 102-1 may determine whether the alternative PDU Set QoS parameters in the at least one alternative QoS profile can be fulfilled in a decreasing order

of the priorities for the at least one alternative QoS profile.

[0223] In some implementations, the RAN node 102-1 may determine whether at least one of the alternative UL PDU Set QoS parameters in an alternative UL PDU set QoS profile can be fulfilled. Alternatively or additionally, the RAN node 102-1 may further determine whether at least one of the alternative DL PDU Set QoS parameters in an alternative DL PDU set QoS profile can be fulfilled.

[0224] In some implementations, if the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with a fourth indication indicating that the QoS profile is not fulfilled. For example, if at least one of the QoS parameters in the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with the fourth indication. For example, the fourth indication may indicate that the “GFBR can no longer be guaranteed”.

[0225] Alternatively or additionally, in some implementations, if at least one of the PDU Set QoS parameters in the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with a sixth indication. The sixth indication indicates that PDU Set QoS parameters comprised in the QoS profile are not fulfilled.

[0226] Alternatively or additionally, in some implementations, if the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with the fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0227] In some implementations, the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled may comprise at least one of the following: an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0228] As described above, in some implementations, the at least one alternative QoS profile may comprise at least one dedicated alternative QoS profile. In such implementations, the fourth information may comprise an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0229] Alternatively, as described above, in some implementations, the SMF 120

may add the alternative PDU Set QoS parameters to a legacy alternative QoS profile to obtain an upgraded alternative QoS profile. In such implementations, the fourth information may comprise an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, as well as the fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled. Alternatively, in such implementations, the fourth information may comprise the fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0230] Alternatively, in some implementations, if the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with the information about the at least one of the alternative UL PDU Set QoS parameters which is fulfilled. The information about the at least one of the alternative UL PDU Set QoS parameters which is fulfilled may comprise at least one of the following: a first index of a first alternative QoS profile for UL comprising at least one of the alternative UL PDU Set QoS parameters which is fulfilled, or a seventh indication of the at least one of the alternative UL PDU Set QoS parameters which is fulfilled.

[0231] Alternatively or additionally, in some implementations, if the QoS profile cannot be fulfilled, the RAN node 102-1 may provide the SMF 120 with the information about the at least one of the alternative DL PDU Set QoS parameters which is fulfilled. The information about the at least one of the alternative DL PDU Set QoS parameters which is fulfilled may comprise at least one of the following: a second index of a second alternative QoS profile for DL comprising at least one of the alternative DL PDU Set QoS parameters which is fulfilled, or an eighth indication of the at least one of the alternative DL PDU Set QoS parameters which is fulfilled.

[0232] In some implementations, if at least one of the PDU Set QoS parameters in the QoS profile cannot be fulfilled, the RAN node 102-1 may further determine 445 whether the alternative QoS parameters in the at least one alternative QoS profile can be fulfilled.

[0233] Upon receiving 450 the fourth indication indicating that the QoS profile is not fulfilled, the sixth indication indicating that PDU Set QoS parameters comprised in the QoS profile are not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled, the SMF 120 may provide 455 the PCF 140 with at least one of the following: the fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the

alternative PDU Set QoS parameters which is fulfilled.

[0234] In some implementations, the SMF 120 may provide the PCF 140 with the fourth indication and the fourth information via policy control request trigger.

[0235] In turn, the PCF 140 may provide 460 the AF 160 with the fourth indication and the fourth information.

[0236] In some implementations, the PCF 140 may provide the AF 160 with the fourth indication and the fourth information via event report.

[0237] In some implementations, for handover scenario, the RAN node 102-1 may act as a target RAN node and the RAN node 102-2 may act as a source RAN node. In such implementations, the RAN node 102-1 may provide the RAN node 120-2 with at least one of the following: the fourth indication indicating that the QoS profile is not fulfilled, or the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

[0238] In some implementations, for Xn handover, the RAN node 102-1 may provide the SMF 120 with the fourth information in an N2 Path Switch Request message.

[0239] In some implementations, for N2 handover, the fourth information may be included in a Handover Request ACK message sent from the RAN node 102-1 (i.e., the target RAN node to the target AMF and then the SMF 120).

[0240] In some implementations, the process 400 may be performed in combination with any of the processes 200 and 300.

[0241] Fig. 5 illustrates an example of a device 500 that supports QoS flow mapping for multiplexed media flows in accordance with some aspects of the present disclosure. The device 500 may be an example of a first apparatus, a second apparatus or the UE 104 as described herein. The device 500 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 500 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 502, a memory 504, a transceiver 506, and, optionally, an I/O controller 508. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0242] The processor 502, the memory 504, the transceiver 506, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 502, the memory 504, the transceiver 506, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0243] In some implementations, the processor 502, the memory 504, the transceiver 506, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 502 and the memory 504 coupled with the processor 502 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 502, instructions stored in the memory 504).

[0244] For example, the processor 502 may support wireless communication at the device 500 in accordance with examples as disclosed herein. The processor 502 may be configured to operable to support a means for performing the following: obtaining protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams; determining QFIs for QoS flows, wherein each of the QFIs is associated with one of the media streams; and providing a second apparatus or a UE with the following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0245] Alternatively, in some implementations, the processor 502 may be configured to operable to support a means for performing the following: obtaining the following from a first apparatus: protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data

packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection, second information about mapping among QFIs, the multiplexing identification information and multiple sets of QoS parameters for the media streams, and a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet; obtaining the multiplexing identification information from the data packet based on the protocol description and the first indication; and mapping the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping.

[0246] Alternatively, in some implementations, the processor 502 may be configured to operable to support a means for performing the following: obtaining the following: second information about mapping among QFIs for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection; and mapping the media streams to the QoS Flows based on the second information about the mapping.

[0247] Alternatively, in some implementations, the processor 502 may be configured to operable to support a means for performing the following: providing a first apparatus with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the downlink data packet, and the multiplexing identification information is used for identifying the media streams.

[0248] Alternatively, in some implementations, the processor 502 may be configured to operable to support a means for performing the following: obtaining at least one alternative QoS profile via the transceiver from a first apparatus, wherein each of the at least one alternative QoS profile comprises at least alternative PDU Set QoS parameters for media streams.

[0249] The processor 502 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable

logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 502 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 502. The processor 502 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 504) to cause the device 500 to perform various functions of the present disclosure.

[0250] The memory 504 may include random access memory (RAM) and read-only memory (ROM). The memory 504 may store computer-readable, computer-executable code including instructions that, when executed by the processor 502 cause the device 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 502 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 504 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0251] The I/O controller 508 may manage input and output signals for the device 500. The I/O controller 508 may also manage peripherals not integrated into the device 500. In some implementations, the I/O controller 508 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 508 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 508 may be implemented as part of a processor, such as the processor 506. In some implementations, a user may interact with the device 500 via the I/O controller 508 or via hardware components controlled by the I/O controller 508.

[0252] In some implementations, the device 500 may include a single antenna 510. However, in some other implementations, the device 500 may have more than one antenna 510 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 506 may communicate bi-directionally, via the one or

more antennas 510, wired, or wireless links as described herein. For example, the transceiver 506 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 506 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 510 for transmission, and to demodulate packets received from the one or more antennas 510. The transceiver 506 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0253] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 510 for transmitting the amplified signal into the air or wireless medium.

[0254] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 510 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0255] Fig. 6 illustrates an example of a processor 600 that supports QoS flow mapping for multiplexed media flows in accordance with other aspects of the present disclosure. The processor 600 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 600 may include a controller 602 configured to perform various operations in accordance with examples as described herein. The processor 600 may optionally include at least one

memory 604. Additionally, or alternatively, the processor 600 may optionally include one or more arithmetic-logic units (ALUs) 606. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0256] The processor 600 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 600) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0257] The controller 602 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 600 to cause the processor 600 to support various operations in accordance with examples as described herein. For example, the controller 602 may operate as a control unit of the processor 600, generating control signals that manage the operation of various components of the processor 600. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0258] The controller 602 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 604 and determine subsequent instruction(s) to be executed to cause the processor 600 to support various operations in accordance with examples as described herein. The controller 602 may be configured to track memory address of instructions associated with the memory 604. The controller 602 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 602 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 600 to cause the processor 600 to support various operations in accordance with examples as described

herein. Additionally, or alternatively, the controller 602 may be configured to manage flow of data within the processor 600. The controller 602 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 600.

[0259] The memory 604 may include one or more caches (e.g., memory local to or included in the processor 600 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 604 may reside within or on a processor chipset (e.g., local to the processor 600). In some other implementations, the memory 604 may reside external to the processor chipset (e.g., remote to the processor 600).

[0260] The memory 604 may store computer-readable, computer-executable code including instructions that, when executed by the processor 600, cause the processor 600 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 602 and/or the processor 600 may be configured to execute computer-readable instructions stored in the memory 604 to cause the processor 600 to perform various functions (e.g., functions or tasks supporting transmit power prioritization). For example, the processor 600 and/or the controller 602 may be coupled with or to the memory 604, the processor 600, the controller 602, and the memory 604 may be configured to perform various functions described herein. In some examples, the processor 600 may include multiple processors and the memory 604 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0261] The one or more ALUs 606 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 606 may reside within or on a processor chipset (e.g., the processor 600). In some other implementations, the one or more ALUs 606 may reside external to the processor chipset (e.g., the processor 600). One or more ALUs 606 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 606 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 606 be configured with

a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 606 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 606 to handle conditional operations, comparisons, and bitwise operations.

[0262] The processor 600 may support wireless communication in accordance with examples as disclosed herein. The processor 600 may be configured to operable to support a means for performing the following: obtaining protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the downlink data packet, and the multiplexing identification information is used for identifying the media streams; determining QFIs for QoS flows, wherein each of the QFIs is associated with one of the media streams; and providing a second apparatus or a UE with the following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.

[0263] Alternatively, in some implementations, the processor 600 may be configured to operable to support a means for performing the following: obtaining the following from a first apparatus: protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection, second information about mapping among QFIs, the multiplexing identification information and multiple sets of QoS parameters for the media streams, and a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet; obtaining the multiplexing identification information from the data packet based on the protocol description and the first indication; and mapping the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping.

[0264] Alternatively, in some implementations, the processor 600 may be configured to operable to support a means for performing the following: obtaining the following:

second information about mapping among QFIs for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection; and mapping the media streams to the QoS Flows based on the second information about the mapping.

[0265] Alternatively, in some implementations, the processor 600 may be configured to operable to support a means for performing the following: providing a first apparatus with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the downlink data packet, and the multiplexing identification information is used for identifying the media streams.

[0266] Alternatively, in some implementations, the processor 600 may be configured to operable to support a means for performing the following: obtaining at least one alternative QoS profile via the transceiver from a first apparatus, wherein each of the at least one alternative QoS profile comprises at least alternative PDU Set QoS parameters for media streams.

[0267] Fig. 7 illustrates a flowchart of a method 700 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The operations of the method 700 may be implemented by a device or its components as described herein. For example, the operations of the method 700 may be performed by a first apparatus as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0268] At 710, the method may include obtaining protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection. The protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the

multiplexing identification information is used for identifying the media streams. The operations of 710 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 710 may be performed by a device as described with reference to Fig. 1B.

[0269] At 720, the method may include determining QFIs for QoS flows, wherein each of the QFIs is associated with one of the media streams. The operations of 720 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 720 may be performed by a device as described with reference to Fig. 1B.

[0270] At 730, the method may include providing a second apparatus or a UE with the following: second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters. The operations of 730 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 730 may be performed by a device as described with reference to Fig. 1B.

[0271] Fig. 8 illustrates a flowchart of a method 800 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The operations of the method 800 may be implemented by a device or its components as described herein. For example, the operations of the method 800 may be performed by a second apparatus as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0272] At 810, the method may include obtaining the following from a first apparatus: protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection, second information about mapping among QFIs, the multiplexing identification information and multiple sets of QoS parameters for the media streams, and a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet. The operations of 810 may be performed in accordance with examples as described herein. In

some implementations, aspects of the operations of 810 may be performed by a device as described with reference to Fig. 1B.

[0273] At 820, the method may include obtaining the multiplexing identification information from the data packet based on the protocol description and the first indication. The operations of 820 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 820 may be performed by a device as described with reference to Fig. 1B.

[0274] At 830, the method may include mapping the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping. The operations of 830 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 830 may be performed by a device as described with reference to Fig. 1B.

[0275] Fig. 9 illustrates a flowchart of a method 900 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The operations of the method 900 may be implemented by a device or its components as described herein. For example, the operations of the method 900 may be performed by the UE 104 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0276] At 910, the method may include obtaining the following: second information about mapping among QFIs for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection. The operations of 910 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 910 may be performed by a device as described with reference to Fig. 1A or 1B.

[0277] At 920, the method may include mapping the media streams to the QoS Flows based on the second information about the mapping. The operations of 920 may be performed in accordance with examples as described herein. In some implementations,

aspects of the operations of 920 may be performed by a device as described with reference to Fig. 1A or 1B.

[0278] Fig. 10 illustrates a flowchart of a method 1000 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The operations of the method 1000 may be implemented by a device or its components as described herein. For example, the operations of the method 1000 may be performed by a third apparatus as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0279] At 1010, the method may include providing a first apparatus with protocol description and multiplexing identification information associated with multiple sets of QoS parameters for media streams that are carried in a downlink data packet and multiplexed on a single transport layer connection. The protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams. The operations of 1010 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1010 may be performed by a device as described with reference to Fig. 1B.

[0280] Fig. 11 illustrates a flowchart of a method 1100 that supports QoS flow mapping for multiplexed media flows in accordance with aspects of the present disclosure. The operations of the method 1100 may be implemented by a device or its components as described herein. For example, the operations of the method 1100 may be performed by the RAN node 102 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0281] At 1110, the method may include obtaining at least one alternative QoS profile from a first apparatus. Each of the at least one alternative QoS profile comprises at least alternative PDU Set QoS parameters for media streams. The operations of 1110 may be performed in accordance with examples as described herein. In some implementations,

aspects of the operations of 1110 may be performed by a device as described with reference to Fig. 1A or 1B.

[0282] It shall be noted that implementations of the present disclosure which have been described with reference to Figs. 1 to 4 are also applicable to the device 500, the processor 600 as well as the methods 700, 800, 900, 1000, 1100.

[0283] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0284] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0285] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0286] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be

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

[0287] As used herein, including in the claims, an article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

[0288] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

WHAT IS CLAIMED IS:

1. A first apparatus, comprising:
 - at least one memory; and
 - at least one processor coupled with the at least one memory and configured to cause the first apparatus to:
 - obtain protocol description and multiplexing identification information associated with multiple sets of Quality of Service (QoS) parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams;
 - determine QoS Flow Identifiers (QFIs) for QoS flows, wherein each of the QFIs is associated with one of the media streams; and
 - provide a second apparatus or a User Equipment (UE) with the following:
 - second information about mapping among the QFIs, the multiplexing identification information and the multiple sets of QoS parameters.
2. The first apparatus of claim 1, wherein the multiplexing identification information comprises at least one of the following:
 - an identity of the transport layer connection, or
 - identities of the media streams.
3. The first apparatus of claim 1, wherein the at least one processor is further configured to cause the first apparatus to provide the second apparatus with the following:
 - the protocol description, and
 - a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet.
4. The first apparatus of claim 1, wherein the at least one processor is further configured to cause the first apparatus to:

obtain alternative Protocol Data Unit (PDU) Set QoS parameters for the media streams; and

provide a Radio Access Network (RAN) node with at least one alternative QoS profile, wherein each of the at least one alternative QoS profile comprises at least the alternative PDU Set QoS parameters.

5. The first apparatus of claim 4, wherein the at least one alternative QoS profile comprises at least one dedicated alternative QoS profile.

6. The first apparatus of claim 5, wherein the at least one dedicated alternative QoS profile comprises a first dedicated alternative QoS profile for uplink (UL) and a second dedicated alternative QoS profile for downlink (DL);

wherein the first dedicated alternative QoS profile for UL comprises at least one of the following:

- a UL PDU Set Delay Budget (PSDB),
- a UL PDU Set Error Rate (PSER), or
- a UL PDU Set Integrated Handling Information (PSIHI); and

wherein the second dedicated alternative QoS profile for DL comprises at least one of the following:

- a DL PSDB,
- a DL PSER, or
- a DL PSIHI.

7. The first apparatus of claim 6, wherein the first dedicated alternative QoS profile for UL further comprises a UL Guaranteed Flow Bit Rate (GFBR), and the second dedicated alternative QoS profile for DL further comprises a DL GFBR.

8. The first apparatus of claim 4, wherein each of the at least one dedicated alternative QoS profile comprises at least one of the following:

- a PDU Error Rate (PER),
- a PDU Delay Budget (PDB),
- a UL Guaranteed Flow Bit Rate (GFBR),
- a DL GFBR,
- an averaging window,

- a Maximum Data Burst Volume (MDBV),
- a UL PDU Set Delay Budget (PSDB),
- a UL PDU Set Error Rate (PSER),
- a UL PDU Set Integrated Handling Information (PSIHI),
- a DL PSDB,
- a DL PSER, or
- a DL PSIHI.

9. The first apparatus of claim 4, wherein the at least one processor is further configured to cause the first apparatus to:

- provide the RAN node with a third indication, wherein the third indication indicates the RAN node to provide the first apparatus with fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled if a QoS profile is not fulfilled.

10. The first apparatus of claim 9, wherein the at least one processor is further configured to cause the first apparatus to:

- obtain at least one of the following from the RAN node:
 - a fourth indication indicating that the QoS profile is not fulfilled,
 - a sixth indication indicating that PDU Set QoS parameters comprised in the QoS profile are not fulfilled, or
- the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.

11. The first apparatus of claim 9 or 10, wherein the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled comprises at least one of the following:

- an index of an alternative QoS profile comprising the at least one of the alternative PDU Set QoS parameters which is fulfilled, or
- a fifth indication of the at least one of the alternative PDU Set QoS parameters which is fulfilled.

12. A second apparatus, comprising:
at least one memory; and

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

obtain the following from a first apparatus:

protocol description, wherein the protocol description comprises first information about where to obtain multiplexing identification information from a data packet, and the multiplexing identification information is used for identifying media streams in the data packet multiplexed on a single transport layer connection,

second information about mapping among Quality of Service (QoS) Flow Identifiers (QFIs), the multiplexing identification information and multiple sets of QoS parameters for the media streams, and

a first indication indicating the second apparatus to obtain the multiplexing identification information from the data packet;

obtain the multiplexing identification information from the data packet based on the protocol description and the first indication; and

map the media streams onto QoS flows identified by the QFIs based on the multiplexing identification information and the second information about the mapping.

13. The second apparatus of claim 12, wherein the at least one processor is configured to cause the second apparatus to obtain the multiplexing identification information from the data packet by:

obtaining the multiplexing identification information from one of the following:

a plaintext part of the data packet based on a quick user datagram protocol (UDP) internet connection (QUIC) protocol,

a general packet radio service (GPRS) tunnel protocol-user plane (GTP-U) header of the data packet, or

a real-time transport protocol (RTP) header extension for the data packet based on an RTP protocol.

14. A user equipment (UE), comprising:

a processor; and

a transceiver coupled to the processor,

wherein the processor is configured to:

obtain the following via the transceiver from a first apparatus:

second information about mapping among Quality of Service (QoS) Flow Identifiers (QFIs) for QoS flows, multiplexing identification information for identifying media streams, and multiple sets of QoS parameters, wherein each of the QFIs is associated with one of the media streams that is carried in an uplink data packet and multiplexed on a single transport layer connection; and

map the media streams to the QoS Flows based on the second information about the mapping.

15. The UE of claim 14, wherein the processor is further configured to:

obtain protocol description from a first apparatus, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the uplink data packet; and

wherein the processor is configured to map the media streams to the QoS Flows based on the protocol description and the second information about the mapping.

16. A third apparatus, comprising:

at least one memory; and

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

provide a first apparatus with protocol description and multiplexing identification information associated with multiple sets of Quality of Service (QoS) parameters for media streams that are carried in a data packet and multiplexed on a single transport layer connection, wherein the protocol description comprises first information about where to obtain the multiplexing identification information from the data packet, and the multiplexing identification information is used for identifying the media streams.

17. The third apparatus of claim 16, wherein the at least one processor is further configured to cause the third apparatus to:

provide the first apparatus with alternative Protocol Data Unit (PDU) Set Quality of Service (QoS) parameters.

18. The third apparatus of claim 16, wherein the at least one processor is further configured to cause the third apparatus to:

provide the first apparatus with a third indication, wherein the third indication indicates a Radio Access Network (RAN) node to provide fourth information about at least one of the alternative PDU Set QoS parameters which is fulfilled to the first apparatus if a QoS profile is not fulfilled.

19. A Radio Access Network (RAN) node, comprising:

a processor; and

a transceiver coupled to the processor,

wherein the processor is configured to:

obtain at least one alternative Quality of Service (QoS) profile via the transceiver from a first apparatus, wherein each of the at least one alternative QoS profile comprises at least alternative Protocol Data Unit (PDU) Set QoS parameters for media streams.

20. The RAN node of claim 19, wherein the at least one processor is further configured to:

provide the first apparatus with at least one of the following:

a fourth indication indicating that the QoS profile is not fulfilled,

a sixth indication indicating that PDU Set QoS parameters comprised in the QoS profile are not fulfilled, or

the fourth information about the at least one of the alternative PDU Set QoS parameters which is fulfilled.