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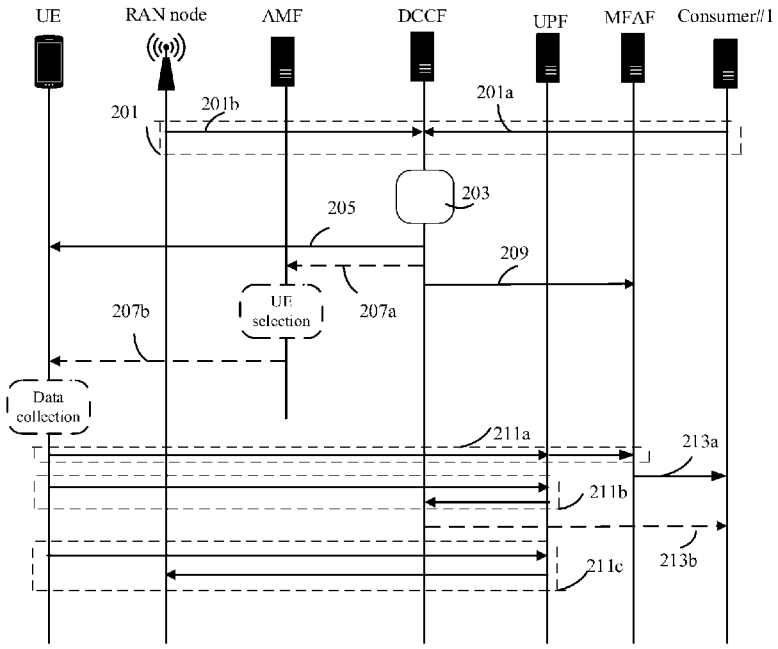


Figure 2

(57) Abstract: Various aspects of the present disclosure relate to a method and apparatus of supporting data collection. An exemplary method performed by a UE for wireless communications may include receiving a request message associated with data collection, and transmitting collected data to a destination address determined based on the request message over an IP connection.

[Continued on next page]

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METHOD AND APPARATUS OF SUPPORTING DATA COLLECTION

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to techniques of supporting data collection, e.g., user equipment (UE) side data collection.

BACKGROUND

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

SUMMARY

[0003] An article "a" before an element is unrestricted and understood to refer to "at least one" of those elements or "one or more" of those elements. The terms "a," "at least one," "one or more," and "at least one of one or more" may be interchangeable. As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of" or "one or both of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is

described as "based on condition A" may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on. Further, as used herein, including in the claims, a "set" may include one or more elements.

[0004] Some implementations of the methods and apparatuses described herein may further include a UE for wireless communication, which may include: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the UE to: receive a request message associated with data collection; and transmit collected data to a destination address determined based on the request message over an internet protocol (IP) connection.

[0005] In some implementations of the methods and apparatuses described herein, the request message indicates one or more of the following: indication on whether UE should transmit collected data over IP connection or not; destination address information; criteria information of interested data; description information of interested data; notification correlation identifier (ID); logging configuration on how UE should perform data logging; or reporting configuration on how UE should perform data reporting.

[0006] In some implementations of the methods and apparatuses described herein, the request message is a non-access stratum (NAS) message received from a data collection coordination function (DCCF) or an access and mobility management function (AMF), or a message from a data collection application function (DCAF) or a radio resource control (RRC) message from a radio access network (RAN) node.

[0007] In some implementations of the methods and apparatuses described herein, at least one processor is configured to cause the UE to: establish the IP connection with a DCCF; and transmit the collected data to the DCCF with an address of the DCCF indicated in the request message over the IP connection.

[0008] In some implementations of the methods and apparatuses described herein, at least one processor is configured to cause the UE to: establish the IP connection with a

messaging framework adaptor framework (MFAF); and transmit the collected data to the MFAF with an address of the MFAF indicated in the request message over the IP connection.

[0009] In some implementations of the methods and apparatuses described herein, at least one processor is configured to cause the UE to: establish the IP connection with a RAN node; and transmit the collected data to the RAN node with an address of the RAN node indicated in the request message over the IP connection.

[0010] In some implementations of the methods and apparatuses described herein, at least one processor is configured to cause the UE to: establish the IP connection with a DCAF; and transmit the collected data to the DCAF over the IP connection.

[0011] Some implementations of the methods and apparatuses described herein may further include a processor for wireless communication, which may include: at least one controller coupled with at least one memory and configured to cause the processor to: receive a request message associated with data collection; and transmit collected data to a destination address determined based on the request message over an IP connection.

[0012] Some implementations of the methods and apparatuses described herein may further include a data consumer node for wireless communication, which may include: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the data consumer node to: transmit a request message associated with data collection; and receive UE collected data over an IP connection.

[0013] In some implementations of the methods and apparatuses described herein, the data consumer node is a RAN node or a core network (CN) entity, or an over the top (OTT) server, or an operations administration and maintenance (OAM), the request message is transmitted to a DCCF, and the UE collected data is received from the DCCF or a MFAF.

[0014] In some implementations of the methods and apparatuses described herein, the request message indicates one or more of the following: identification information of target UE(s); criteria information of interested data; description of interested data; notification uniform resource identifier (URI); notification correlation ID; logging requirement of interested data; or reporting requirement of interested data.

[0015] In some implementations of the methods and apparatuses described herein, the data consumer node is a RAN node, the request message is transmitted to a UE, and the UE collected data is received from a DCCF, a MFAF or the UE.

[0016] In some implementations of the methods and apparatuses described herein, the request message indicates one or more of the following: indication on whether UE should transmit collected data over IP connection or not; destination address information; criteria information of interested data; description information of interested data; notification correlation ID; logging configuration on how UE should perform data logging; or reporting configuration on how UE should perform data reporting.

[0017] In some implementations of the methods and apparatuses described herein, in the case that the UE collected data is received from the DCCF or MFAF, the at least one processor is configured to cause the data consumer node to configure the DCCF or the MFAF by indicating one or more of: address information for data notification; or information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

[0018] Some implementations of the methods and apparatuses described herein may further include a CN entity, which may include: at least one memory; and at least one processor coupled with the at least one memory and configured to cause the CN entity to: receive a first request message associated with data collection from a data consumer node; and select a UE for data collection based on the first request message or transmit UE selection related information to another CN entity based on the first request message to select a UE for data collection.

[0019] In some implementations of the methods and apparatuses described herein, the at least one processor is configured to cause the CN entity to select a UE based on one or more of the following: UE identification information indicated in the first request message; UE location related information; UE subscription information; or UE data collection policy information.

[0020] In some implementations of the methods and apparatuses described herein, the at least one processor is configured to cause the CN entity to: transmit a second request message

associated with data collection to the UE, or an AMF or a DCAF, wherein the second request message is based on the first request message.

[0021] In some implementations of the methods and apparatuses described herein, in the case that the second request message is transmitted to the AMF or DCAF, the at least one processor is configured to cause the CN entity to: transmit the UE selection related information or identification information of the UE selected by the CN entity in the second request message.

[0022] In some implementations of the methods and apparatuses described herein, the UE selection related information includes one or more of the following indicated in the first request message: identification information of target UE(s); criteria information of interested data; or description of interested data.

[0023] In some implementations of the methods and apparatuses described herein, the at least one processor is configured to cause the CN entity to configure a MFAF by indicating one or more of: address information for data notification; or information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

[0024] In some implementations of the methods and apparatuses described herein, the at least one processor is configured to cause the CN entity to: receive UE collected data from the UE, or DCAF over an IP connection; and transmit received UE collected data to the data consumer node over the IP connection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Figure 1 illustrates an example of a wireless communications system in accordance with aspects of the present disclosure.

[0026] Figure 2 illustrates an example of a UE side data collection procedure under scheme 1 in accordance with aspects of the present disclosure.

[0027] Figure 3 illustrates another example of a UE side data collection procedure under scheme 1 in accordance with aspects of the present disclosure.

[0028] Figure 4 illustrates an example of a UE side data collection procedure under scheme 2 in accordance with aspects of the present disclosure.

[0029] Figure 5 illustrates an example of a UE in accordance with aspects of the present disclosure.

[0030] Figure 6 illustrates an example of a processor in accordance with aspects of the present disclosure.

[0031] Figure 7 illustrates an example of a network apparatus in accordance with aspects of the present disclosure.

[0032] Figure 8 illustrates a flowchart of method performed by a UE in accordance with aspects of the present disclosure.

[0033] Figure 9 illustrates a flowchart of method performed by a data consumer node in accordance with aspects of the present disclosure.

[0034] Figure 10 illustrates another flowchart of method performed by a CN entity in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0035] AI, at least including machine learning (ML) is used to learn and perform certain tasks via training neural networks (NNs) with vast amounts of data, which is successfully applied in computer vison (CV) and nature language processing (NLP) areas. Deep learning, which is a subordinate concept of ML, utilizes multi-layered NNs as an "AI model" (or referred to as AI/ML model or the like) or "AI-based model" (or referred to as AI/ML based model or the like) to learn how to solve problems and/or optimize performance from vast amounts of data. If AI models used on AI-based methods are well trained, the AI-based methods can obtain better performance than the traditional methods. Thus, 3rd generation partnership program (3GPP) has been considering to introduce AI into 3GPP since 2016.

[0036] Currently, AI/ML models at RAN side, e.g., gNB side can be trained by gNB or OAM, and the data collection for training relies on existing layer 1 (L1) measurement report (e.g., channel state information (CSI) report) and layer 3 (L3) measurement report (e.g., radio resource control (RRC) measurement report) framework with enhancements. For example, a

CSI report is enhanced to convey the measurement results of more beams. A RRC measurement report in RRC connected state is enhanced to support logging of measurement results and report the logged results later, because the data collection for AI/ML training has relaxed latency requirements.

[0037] However, the current UE side data collection is based on the legacy 5G framework via existing and/or enhanced control plane signaling, which is not suitable for collecting training data in a large size or scale. Thus, it is considered beneficial to support an approach that enables UE side data collection via user plane (UP) or data plane, so that collecting data in a large size or scale will be more feasible.

[0038] From the perspective of UE side, various aspects of the present disclosure propose a UE supporting data collection. An exemplary UE may receive a request message associated with data collection from a RAN node or a CN entity. For example, UE may receive a NAS message associated with data collection from a DCCF or an AMF, or receive a message (e.g., an application layer message) associated with data collection from a DCAF, or receive a RRC message associated with data collection from a gNB. UE may perform data collection based on the received request message or already have collected and stored the requested data before receiving the request message. UE may determine a destination address based on the request message, e.g., the address of DCCF, MFAF, DCAF or RAN node etc., and transmit the collected data to the destination address over an IP connection.

[0039] From the perspective of data consumer side, various aspects of the present disclosure propose a data consumer node, e.g., a RAN node, an over the top (OTT) server, a CN entity (e.g., an AF) or an OAM etc. An exemplary data consumer node may transmit a request message associated with data collection, e.g., via the DCCF or directly to the UE (e.g., in the case of a RAN node as the data consumer node). Accordingly, the data consumer node may receive UE collected data in response to the request message over an IP connection, e.g., from the DCCF or MFAF or directly from the UE via user plane function (UPF) (e.g., in the case of a RAN node as the data consumer node).

[0040] From the perspective of CN side, various aspects of the present disclosure propose a CN entity supporting data collection. An exemplary CN entity, e.g., a DCCF may receive a first request message associated with data collection from a data consumer node, e.g., from

a RAN node, an OTT server, a CN entity or an OAM etc. The DCCF may select a UE for data collection by itself based on the first request message, or transmit UE selection related information to another network node or entity, e.g., an AMF or a DCAF etc., based on the first request message, so that a UE for data collection will be selected by the AMF or DCAF etc.

[0041] Aspects of the present disclosure are described in the context of a wireless communications system.

[0042] Figure 1 illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more NE 102, one or more UE 104, and a CN 106. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a NR network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G, for example, 6G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0043] The one or more NE 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a network function, a network entity, a radio access network (RAN), a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0044] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. For example, an NE 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, an NE 102 may be moveable, for example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NE 102.

[0045] The one or more UE 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples.

[0046] A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 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.

[0047] An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g., S1, N2, N3, or network interface). In some implementations, the NE 102 may communicate with each other directly. In some other implementations, the NE 102 may communicate with each other or indirectly (e.g., via the CN 106. In some implementations, one or more NE 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).

[0048] The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management 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 NE 102 associated with the CN 106.

[0049] The CN 106 may communicate with a packet data network over one or more backhaul links (e.g., via an S1, N2, N3, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the CN 106 (e.g., one or more network functions of the CN 106).

[0050] In the wireless communications system 100, the NEs 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the NEs 102 and the UEs 104 may support a single frame structure. In some other

implementations, such as in 5G and among other suitable radio access technologies, the NEs 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0051] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., μ=0) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., μ=0) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., μ=1) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., μ=2) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., μ=3) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., μ=4) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0052] 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.

[0053] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., μ=0, μ=1, μ=2, μ=3, μ=4) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may

include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., μ =0) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0054] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the NEs 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the NEs 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0055] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., μ=0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., μ=1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., μ=3), which includes 120 kHz subcarrier spacing.

[0056] In accordance with a data collection framework based on network data analytics function (NWDAF) and DCCF, which has been supported for AI/ML operations within the 5GC, a data consumer CN node can request data from DCCF, and DCCF will find the corresponding data source CN node and deliver the data from the data source CN node to the data consumer CN node. Thus, the current 5GC data collection framework does not involve gNB or UE, and does not support UE side data collection.

[0057] Considering CN evolution based on the 5GC, various aspects of the present disclosure propose enhancing the existing DCCF based framework for data consumers to collect UE side data via user plane or data plane, so that the UE collected data in larger size or scale could and would be efficiently transmitted.

[0058] In addition, considering 3GPP evolution, terminologies, especially the name of each network function (NF) may change, and thus the related terminologies are only exemplary herein. In future, e.g., in 6G standardization, the network functions providing the same functionality/service may be differently named or may be incorporated or separated. Thus, for mainly mentioned network functions herein, their functionalities (and/or services) are illustrated below for reference.

[0059] AMF may mainly include the following functionalities, wherein part or all of the AMF functionalities may be supported in a single instance of AMF or the like:

- Registration management
- Connection management
- Reachability management
- Mobility management
- UE mobility event notification.

[0060] Session management function (SMF) may mainly include the following functionalities, wherein part or all of the SMF functionalities may be supported in a single instance of SMF or the like:

- Session management, e.g., session establishment, modifying and releasing, including tunnel maintain between UPF and access network (AN) node
- Selection and control of user plane function, including controlling the UPF to proxy address resolution protocol (ARP) or IPv6 neighbour discovery, or to forward all ARP/IPv6 neighbour solicitation traffic to the SMF, for Ethernet PDU sessions

- Configures traffic steering at UPF to route traffic to proper destination
- Termination of interfaces towards policy control functions
- Termination of session management (SM) parts of NAS messages
- Downlink data notification.

[0061] UPF may mainly include the following functionalities, wherein part or all of the UPF functionalities may be supported in a single instance of UPF or the like:

- Anchor point for Intra-/Inter-radio access technology (RAT) mobility (when applicable)
- Allocation of UE IP address/prefix (if supported) in response to SMF request
- External PDU session point of interconnect to data network
- Packet routing & forwarding (e.g. support of uplink classifier to route traffic flows to an instance of a data network, support of Branching point to support multi-homed PDU Session, support of traffic forwarding within a 5G virtual network (VN) group (UPF local switching, via N6, via N19))
- Packet inspection (e.g. Application detection based on service data flow template and the optional PFDs received from the SMF in addition)
- Downlink packet buffering and downlink data notification triggering.

[0062] DCCF may mainly include the following functionalities, wherein part or all of the DCCF functionalities may be supported in a single instance of DCCF or the like:

- Determining data sources that can provide data for a received data request
- Determining whether data is already being collected from a data source
- Instructing a messaging framework to send data to consumers or notification endpoints
- Instructing a messaging framework to do formatting and processing of the data sent via the messaging framework
- Formatting and processing of data
- Sending data to consumers or notification endpoints
- Registering NWDAFs and ADRFs that are already receiving data from a data source.

[0063] MFAF may mainly include the following functionalities, wherein part or all of the MFAF functionalities may be supported in a single instance of MFAF or the like:

- Interfacing with a DCCF that controls how a messaging framework will process, format and send data to consumers or notification endpoints
- Receiving data from data sources via services offered by those data sources

- Sending data received from data sources to a messaging framework (outside the scope of 3GPP)
- Receiving data from a messaging framework (outside the scope of 3GPP)
- Processing, formatting and sending data to specified consumers or notification endpoints.

[0064] DCAF may mainly include the following functionalities, wherein part or all of the DCAF functionalities may be supported in a single instance of DCAF or the like:

- Interaction with UE side data collection client, and receive application layer data from UE
- Interface with a DCCF that provides the application layer data to the DCCF.

[0065] RAN may mainly host the following functionalities, wherein part or all of the RAN functionalities may be supported in a single RAN node or the like:

- Functions for radio resource management: radio bearer control, radio admission control, connection mobility control, dynamic allocation of resources to UEs in both uplink and downlink (scheduling)
- IP and Ethernet header compression, uplink data decompression, encryption and integrity protection of data
- Connection setup and release
- Scheduling and transmission of paging messages
- Scheduling and transmission of system broadcast information (originated from the AMF or OAM)
- Measurement and measurement reporting configuration for mobility and scheduling
- Computing service.

[0066] Regarding the data that can be collected from UE side, it may be one or more of: L1 operation related data, L3 operation related data, or application layer operation related data.

[0067] Exemplary L1 operation related data may include one or more of the following:

- CSI compression, including one or more of the following:
  - For UE side or network (NW) type1 training and type3 training:
    - ground-truth CSI in scaler quantization and/or codebook-based quantization (e.g., e-type II like).
    - Assisted information for categorizing the data for the purpose of differentiating characteristics of data due to specific configuration, scenarios, site etc.

- For NW first training in training collaboration type 3:
  - CSI generation model training dataset (e.g., raw channel or the eigenvector as model input and latent space vector before or after quantization as model output)
  - Assisted information for categorizing the data for the purpose of differentiating characteristics of data due to specific configuration, scenarios, site etc.
- For UE side proxy model training in monitoring:
  - proxy model training dataset (e.g., the latent space vector after quantization as proxy model input and the target CSI to be recovered as proxy model output)
  - Assisted information for categorizing the data for the purpose of differentiating characteristics of data due to specific configuration, scenarios, site etc.

- CSI prediction, including one or more of the following:
  - Consecutive CSIs (historical CSIs+future CSIs) where the type of CSIs includes raw channel matrices, or PMIs, or Eigen vectors, etc.
  - Assistance information for model management e.g., site/scenario/dataset related information
- Beam prediction, including one or more of the following:
  - Set B
    - L1-RSRP measurement based on Set B or a subset of Set B
  - Label data can be one of the options
    - L1-RSRP measurement based on Set A or a subset of Set A
    - Partial L1-RSRP measurement based on Set A or a subset of Set A + beam indicator
    - Top-k beam indicator
  - Time related information, e.g. timestamps
  - Assistance information includes one or more from
    - Site/Scenarios/Dataset related information, e.g. Dataset ID
    - gNB-side related assistance information
    - UE-side related assistance information
- Positioning, including one or more of the following:
  - Measurement type:
    - CIR/PDP/DP
    - RSRP/RSRPP/RSRQ/RSTD
  - Label type
    - Location coordinate
    - Timing estimation
    - line of sight (LOS)/non-line of sight (NLOS)
  - Assistance information:
    - Time stamp
    - Quality indicator
    - RS configuration

[0068] Exemplary L3 operation related data may include one or more of the following:

- For radio resource management (RRM) measurement prediction, or RRM event prediction, or MDT:
  - The L3 RSRP measurement result per Cell, CSI-RS, SS/PBCH block (SSB) etc.
  - Time stamp
  - Quality indicator
  - RS configuration

[0069] Exemplary application layer related data may include one or more of the following:

- For quality of experience (QoE) or video streaming evaluation:
  - Throughput
  - Initial Playout Delay
  - Buffer Level
  - Play list
  - Device information
  - Playout delay for media start-up
  - Corruption duration
  - Frame rate
  - Jitter duration
  - Codec information

[0070] In accordance with various aspects of the present disclosure, UE side data collection can be configured (or triggered or initiated or the like) in various manners and the collected data can be forwarded or transmitted to the data consumer (or data consumer node) in various manners. Hereinafter, some exemplary implementations of the present disclosure will be illustrated in view of different configuration manners and/or different data transmission manners.

[0071] In accordance with some aspects of the present disclosure (scheme 1), in the case that any data consumer node, e.g., a RAN node, a CN node, or an OTT server, or OAM that would like to collect data (e.g., radio related data as illustrated above) from UE side, the data consumer node may send a request message to the DCCF. After receiving the request related to data collection, the DCCF will then configure the UE in various ways, e.g., via AMF or DCAF etc. The data consumer may also refer to an analytics consumer or other endpoint, e.g., where to receive the requested mapping data or analytics as "notificationAddress" attribute etc.

[0072] Figure 2 illustrates an example of a UE side data collection procedure under scheme 1 in accordance with aspects of the present disclosure.

[0073] Referring to Figure 2, in step 201, when a data consumer would like to collect data from UE, it will send a message to the DCCF to request or subscribe UE side data. The request message (or subscription message, or subscription request message, hereinafter, the first request message) may be a message that is provide by the DCCF for other nodes to invoke data management services from the DCCF, e.g., Ndccf_DataManagement_Subscribe message or the like. For example, Consumer#1, which is a non-RAN data consumer may transmit a first request message to the DCCF in step 201a, or a RAN node may transmit a first request message to the DCCF in step 201b.

[0074] An exemplary first request message may indicate one or more of the following:

- Identification information of the target UE(s), e.g., subscription permanent identifier (SUPI), or globally unique temporary identity (GUTI) or the like
- Criteria information of interested data, e.g.:
  - Scenarios, e.g., whether it is indoor or outdoor, large cell, or small cell
  - Information related to the L1/L3 measurement configuration (e.g., ID or Index) configured by the RAN node to the UE (this can be obtained from the RAN node)
  - Quality indication, e.g., if the measurement is reliable/accurate or not and how much reliable/accurate
  - NLOS/LOS
  - Area information, e.g., a list of interested areas
  - Frequency information, e.g., a list of interested frequencies
  - Cell information, e.g., a list of interested cells
  - SSB information, e.g., a list of interested SSB indexes
  - UE type information, e.g., MIMO capable UE, IoT UE, stationary UE, moving UE
- Description of the interested data, e.g., the measurement type, or quantity etc., as listed above
- Notification URI, e.g., the address information of the data consumer
- Notification correlation ID
- Logging requirement of the interested data, e.g., periodicity or duration etc.
- Reporting requirement of the interested data, e.g., periodicity or duration etc.

[0075] After receiving the first request message related to data collection, the DCCF may check or collect information related to the requested data collection. For example, the DCCF may check whether the data consumer is authenticated to perform UE side data collection for

specific UE(s), e.g., with the authentication server function (AUSF) (not shown), check whether the related UE consent(s) is available, e.g., with the unified data management (UDM) (not shown), and/or check whether any related policy (e.g., privacy policy) is available, e.g., with the point coordination function (PCF) or binding support function (BSF) (not shown).

[0076] In step 203, the DCCF may determine or select a UE from which the interested data can be requested. For example, the DCCF may determine a UE based on one or more of the following: UE identification information, e.g., provided in the first request message, UE location related information, UE subscription information, or UE data collection policy information. Regarding the UE location related information, e.g., current serving cell etc., it may be provided by the AMF. For example, the DCCF may request the AMF to provide the UE information in a certain serving cell. Regarding the UE subscription information, it may be provided by the UDM, e.g., by the aforementioned checking. Regarding the UE data collection policy information, it may be provided by the PCF or BSF, e.g., by the aforementioned checking.

[0077] The DCCF may directly or indirectly request or subscribe UE side data from the selected UE, and accordingly, the UE may receive a message (hereinafter, second request message) that requests or subscribes UE side data. For example, in the case that the DCCF has a NAS protocol layer, e.g., end to end (E2E) with the UE, the DCCF may generate a NAS message as the second request message and directly transmit the NAS message to the UE in step 205. In some other scenarios, the DCCF may transmit a message indicating information associated with generating the second request message to the AMF in step 207a. The AMF may generate a NAS message as the second request message based on the information received from the DCCF, and then transmit the NAS message to the selected UE in step 207b.

[0078] An exemplary second request message towards the UE may indicate one or more of the following:

- Indication on whether UE should transmit the collected data over IP connection or not, e.g., indicating using NAS messages implying not using IP connection
- Destination address information, e.g., the address of MFAF (if MFAF will forward collected data from UE to data consumer), or address of DCCF (if DCCF will forward collected data from UE to data consumer), or address of a RAN node (via

the UPF), wherein, exemplary address information may be a uniform resource identifier (URI), an IP address, a port number, fully qualified domain name (FQDN) etc.; in addition, in the case of a RAN node as a data consumer, the data forwarding or notification to the RAN node may also be performed by the MFAF or DCCF, while UE does not need to know that the address is owned by which entity or node

- Criteria information of interested data (or request data)
- Description information of interested data (or request data)
- Notification correlation ID
- Logging configuration of how UE should perform data logging, e.g., periodicity and/or duration etc., of data logging; for example, UE should log the interested data every period of time within an overall duration
- Reporting configuration on how UE should perform data reporting, e.g., periodicity and/or duration etc., of data reporting; for example, UE should report the logged data every period of time within an overall duration.

[0079] In some other implementations of the present disclosure, the DCCF may even not select the UE by itself and need the AMF to determine the UE. For example, the DCCF may transmit UE selection related information, e.g., including identification information of target UE(s), criteria information and/or the description information of the interested data etc., to the AMF step 207a. After receiving UE selection related information, the AMF may select the UE that fulfills the criteria information and/or the description information of interested data, e.g., if UE is served by a cell or frequency of interest. The information that the AMF may use to determine the UE is similar to that used by the DCCF, and will not repeat. After determining the UE, the AMF may generate a NAS message as the second request message in the case that the DCCF also provides information associated with generating the second request message, and then transmit the NAS message to the selected UE in step 207b. The AMF may report the selected UE to the DCCF. In some scenarios, the AMF may lack the information related to generation of the second request message, and the DCCF may generate and transmit a NAS message to the UE selected and reported by the AMF similar to that in step 205.

[0080] In the case that an additional CN entity, e.g., the MFAF may be used to forward UE side collected data to the data consumer, the DCCF may configure the additional CN entity, e.g., the MFAF with respect to messaging rules for data forwarding or notification. For example, in step 209, the DCCF may generate a Nmfaf_3daDataManagmenet_Configure

message to configure the MFAF with respect to the messaging rules, e.g., indicating address information for data notification and/or information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address. Exemplary address information for data notification may include a notification address, e.g., URI, IP address, port number and/or FQDN etc., of data consumer. Exemplary information that will be further carried together with the received data from UE for the node or entity for data forwarding, e.g., MFAF may include: a) a notification correlation ID for the data consumer if the configuration is used for mapping analytics or data collection; and/or b) UE ID information e.g., SUPI etc. For example, if the MFAF receives data from the data source associated with the notification correlation ID indicated in the configuration information, the MFAF is expected to forward the received data to the associated notification URI.

[0081] In the UE side, after receiving the request message related to data collection, e.g., the NAS message as the second request message from the DCCF or AMF, UE may perform data collection (if necessary) as requested and transmit the collected data, e.g., as IP packets to the network according to the destination address over IP connection, e.g., to the MFAF in step 211a, or to the DCCF in step 211b, or to the RAN node (as the data consumer) in step 211c. UE application layer, or data collection client entity inside UE, or a dedicated protocol layer (e.g., a layer above IP layer and below application layer) of UE may be responsible for collecting the data from access stratum (AS) and generate the IP packets. The transmission of the collected data from UE to the network over the IP connection may be sent over a dedicated PDU session, or dedicated slice, or dedicated radio bearer.

[0082] Regarding the IP connection between UE and the node or entity with the destination address, it may be established before or after receiving the second request message. Taking MFAF as an example, according to the given address information, e.g., indicated in the second request message or by other means (e.g., a UE route selection policy (URSP) rule configured by PCF), if the PDU session (or data plane or data slice etc.) is not established yet, UE may establish a secured IP connection with the MFAF. If the FQDN of the MFAF is sent to the UE, a DNS server or resolver is used to resolve the IP address of the MFAF, e.g. edge application server discovery function (EASDF) or local domain name system (DNS)

for local MFAF address resolution. UE may use the address of the MFAF, together with the information in the URSP, to determine the PDU session parameters. Then, UE may use the PDU session parameter to establish a PDU session. When SMF receives the request of establishing a PDU session, it may select a proper UPF based on the PDU session parameters, and establishes the connection between the UPF and MFAF. The IP connection between the UE with other node or entity can be established similarly.

[0083] In the case that the MFAF or DCCF receives the UE side data, the MFAF or DCCF will forward the received data to the data consumer, e.g., to Consumer#1 in step 213a or 213b, or to the RAN node (not shown). For example, after receiving the data collected and transmitted from UE, the MFAF may forward the UE collected data to the corresponding data consumer as configured, which may be a gNB, CN entity, OTT server, or OAM etc., e.g., by transmitting a Nmfaf_3daDataManagmenet_Notify message.

[0084] Figure 3 illustrates another example of a UE side data collection procedure under scheme 1 in accordance with aspects of the present disclosure.

[0085] Referring to Figure 3, similarly, in step 301, when a data consumer would like to collect data from UE, it may send a message (first request message) to the DCCF to request or subscribe UE side data. For example, Consumer#1, which is a non-RAN data consumer may transmit a first request message to the DCCF in step 301a, or a RAN node may transmit a first request message to the DCCF in step 301b.

[0086] After receiving the first request message related to data collection, the DCCF may check or collect information related to the requested data collection. In step 303, the DCCF may determine or select a UE from which the interested data can be requested. The DCCF may directly or indirectly request or subscribe UE side data from the selected UE, and accordingly, the UE may receive a message (hereinafter, second request message) that requests or subscribes UE side data. For example, in the case that the DCCF has a NAS protocol layer with the UE, the DCCF may generate a NAS message as the second request message and directly transmit the NAS message to the UE in step 305.

[0087] However, different from those illustrated in view of Figure 2, in some implementations of the present disclosure, the DCAF, rather than the AMF may be involved to generate and/or transmit the second request message, and/or even select the UE.

[0088] For example, in some other scenarios, after selecting the UE, the DCCF may transmit a message indicating information associated with generating the second request message to the DCAF in step 307a. The DCAF may generate a message, e.g., an application layer message as the second request message based on the information received from the DCCF, and then transmit the application layer message to the selected UE in step 307b. The second request message transmitted from the DCAF to the UE and that transmitted from the AMF to the UE are mainly different in types, and thus will not repeat.

[0089] In some other scenarios, the DCCF may not select the UE by itself and need the DCAF to determine the UE. For example, the DCCF may transmit UE selection related information, e.g., including identification information of target UE(s), criteria information and/or the description information of the interested data etc., to the DCAF step 307a. After receiving UE selection related information, the DCAF may select the UE that fulfills the criteria information and/or the description information of interested data, e.g., if UE is served by a cell or frequency of interest. The information that the DCAF may use to determine the UE is similar to that used by the DCCF, and will not repeat. After determining the UE, the DCAF may generate a message, e.g., an application layer message as the second request message if the DCCF also provides information associated with generating the second request message, and then transmit the application layer message to the selected UE in step 307b. The DCAF may report the selected UE to the DCCF. In some scenarios, the DCAF may lack the information related to generation of the second request message, and the DCCF may generate and transmit a NAS message to the UE selected and reported by the DCAF as in step 305.

[0090] In the case that an additional CN entity, e.g., the MFAF may be used to forward UE side collected data to the data consumer, the DCCF may configure the additional CN entity, e.g., the MFAF with respect to messaging rules for data forwarding or notification. For example, in step 309, the DCCF may generate a Nmfaf_3daDataManagmenet_Configure

message to configure the MFAF with respect to the messaging rules, which is similar to that illustrated in view of Figure 2 and will not repeat.

[0091] In the UE side, after receiving the request message related to data collection, e.g., the NAS message from the DCCF or the application layer message or the like from the DCAF, UE may perform data collection (if necessary) as requested and transmit the collected data, e.g., as IP packets to the network according to the destination address. In the case that the request message is received from the DCCF, it is similar to that illustrated in view of Figure 2, and will not repeat. In the case that the request message is received from the DCAF, UE may determine the address of the DCAF based on the received application layer message or the like, and transmit the collected data to the DCAF over IP connection established, e.g., in application layer in step 311. That is, the destination address for data transmitted from UE is the address of the DCAF.

[0092] After receiving the UE side collected data, the DCAF may transmit or forward the received data to the DCCF or MFAF as indicated by the DCCF. For example, the DCAF may transmit the received UE side data to the MFAF in step 313a (e.g., the DCCF provides the address of the MFAF as the destination address), or to the DCCF in step 313b (e.g., the DCCF provides the address of the DCCF as the destination address). Similarly, after the MFAF or DCCF receives the UE side data, the MFAF or DCCF will forward the received data to the data consumer, e.g., to Consumer#1 in step 315a or 315b, or to the RAN node in step 317a or 317b.

[0093] More details on the scenarios applying the DCAF are identical or similar to those illustrated in view of Figure 2, and will not repeat herein.

[0094] In accordance with some other aspects of the present disclosure (scheme 2), UE side data collection may be configured by a RAN node, e.g., gNB, rather than the DCCF. In the case that the RAN node would like to collect data from UE side, the RAN node will then configure the UE. Regarding the data collected from UE side, it may be forwarded to the RAN node over the IP connection via the UPF, or further via the DCCF or MFAF etc. as illustrated in scheme 1.

[0095] Figure 4 illustrates an example of a UE side data collection procedure under scheme 2 in accordance with aspects of the present disclosure.

[0096] Referring to Figure 4, when a RAN node would like to collect UE side data from a UE under its coverage, the RAN node may check or collect information related to the interested data collection. For example, the RAN node may check whether the RAN node is authenticated to perform UE side data collection for this particular UE, e.g., with the AUSF (not shown), check whether the related UE consent(s) is available, e.g., with the UDM (not shown), and/or check whether any related policy (e.g., privacy policy) is available, e.g., with the PCF or BSF (not shown).

[0097] Since the RAN node is aware of the UE where the data to be collected under its coverage, the RAN node may configure the determined UE (or selected UE or target UE) to collect data, e.g., via RRC message. For example, in step 401, the RAN node may transmit a RRC message (the second request message) to the selected UE or target UE where the interested data is expected to be collected. The RRC message towards the UE as the second request message and the NAS message or application layer message as the second request message towards UE are identical or similar except the types, and thus will not repeat. In the case that the UE is indicated not to transmit the collected data over IP connection, NAS messages or RRS messages can be used for data transmission.

[0098] In the case that the data collected from the UE will be transmitted over the IP connection, it may be transmitted to a destination address in the form of IP packets as illustrated in scheme 1.

[0099] In some implementations of the present disclosure, the destination address is the address of the MFAF. Accordingly, the RAN node may configure the MFAF with respect to messaging rules for data forwarding or notification. For example, in step 403a, the RAN node may generate a *Nmfaf_3daDataManagmenet_Configure* message to configure the MFAF with respect to the messaging rules, e.g., indicating address information for data notification and/or information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

[0100] In some other implementations of the present disclosure, the destination address is the address of the DCCF. Accordingly, the RAN node may configure the DCCF with respect to messaging rules for data forwarding or notification. For example, in step 403b, the RAN node may generate a *Nmfaf_3daDataManagmenet_Configure* message to configure the DCCF with respect to the messaging rules, e.g., indicating address information for data notification and/or information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

[0101] In some other implementations of the present disclosure, the RAN node may establish a connection with UPF directly, and the destination address is the address of the RAN node.

[0102] Similarly, regarding the IP connection between UE and the RAN node, it may be established before or after receiving the second request message. According to the given address information, e.g., indicated in the second request message or by other means (e.g., a URSP rule configured by PCF), if the PDU session (or data plane or data slice etc.) is not established yet, UE may establish a secured IP connection with the RAN node. If the FQDN of the RAN node is sent to the UE, a DNS server or resolver is used to resolve the IP address of the RAN node, e.g., EASDF or local DNS for local RAN node address resolution. UE may use the address of the RAN node, together with the information in the URSP, to determine the PDU session parameters. Then, UE may use the PDU session parameter to establish a PDU session. When SMF receives the request of establishing a PDU session, it may select a proper UPF based on the PDU session parameters, and establishes the connection between the UPF and RAN node.

[0103] In the UE side, after receiving the request message related to data collection, e.g., the RRC message as the second request message from the RAN node, UE may perform data collection (if necessary) as requested and transmit the collected data, e.g., as IP packets to the network according to the destination address, e.g., to the MFAF in step 405a or to the DCCF in step 405b, or to the RAN node in step 405c over IP connection. In the case that the MFAF or DCCF receives the UE side data, the MFAF or DCCF will further forward the received data to the RAN node, e.g., in step 407a or 407b.

[0104] More details on scheme 2 are identical or similar to those illustrated in view of scheme 1, and will not repeat herein.

[0105] There are also other implementations of schemes 1 and 2. For example, similar to those illustrated in view of Figures 2 and 3, in the case that a non-RAN data consumer desires to request or subscribe UE side data, the DCCF may transmit the information related to UE selection to the RAN node, so that the target UE will be selected; and/or the DCCF may transmit information related to generate the second request message, so that the RAN node may generate and transmit a RRC message as the second request message to the selected UE. Such implementations can be well understand by persons skilled in the art based on the above illustrated exemplary implementations of the present disclosure, and will not repeat.

[0106] Figure 5 illustrates an example of a UE 500 in accordance with aspects of the present disclosure. The UE 500 may include a processor 502, a memory 504, a controller 506, and a transceiver 508. The processor 502, the memory 504, the controller 506, or the transceiver 508, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0107] The processor 502, the memory 504, the controller 506, or the transceiver 508, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0108] The processor 502 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 502 may be configured to operate the memory 504. In some other implementations, the memory 504 may be integrated into the processor 502. The processor 502 may be configured to execute computer-readable instructions stored in the memory 504 to cause the UE 500 to perform various functions of the present disclosure.

[0109] The memory 504 may include volatile or non-volatile memory. The memory 504 may store computer-readable, computer-executable code including instructions when executed by the processor 502 cause the UE 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 504 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0110] In some implementations, the processor 502 and the memory 504 coupled with the processor 502 may be configured to cause the UE 500 to perform one or more of the functions described herein (e.g., executing, by the processor 502, instructions stored in the memory 504). For example, the processor 502 may support wireless communication at the UE 500 in accordance with examples as disclosed herein. The UE 500 may be configured to support a means for receiving a request message associated with data collection; and a means for transmitting collected data to a destination address determined based on the request message over an IP connection.

[0111] The controller 506 may manage input and output signals for the UE 500. The controller 506 may also manage peripherals not integrated into the UE 500. In some implementations, the controller 506 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 506 may be implemented as part of the processor 502.

[0112] In some implementations, the UE 500 may include at least one transceiver 508. In some other implementations, the UE 500 may have more than one transceiver 508. The transceiver 508 may represent a wireless transceiver. The transceiver 508 may include one or more receiver chains 510, one or more transmitter chains 512, or a combination thereof.

[0113] A receiver chain 510 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 510 may include one or more antennas for receive the signal over the air or wireless medium. The receiver chain 510 may include at least one amplifier (e.g., a low-noise amplifier (LNA))

configured to amplify the received signal. The receiver chain 510 may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 510 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0114] A transmitter chain 512 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 512 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 512 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 512 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0115] Figure 6 illustrates an example of a processor 600 in accordance with 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, which may be, for example, an L1/L2/L3 cache. 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).

[0116] 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).

[0117] 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.

[0118] 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.

[0119] 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 implementations, 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).

[0120] 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. 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.

[0121] The one or more ALUs 606 may be configured to support various operations in accordance with examples as described herein. In some implementations, 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.

[0122] The processor 600 may support wireless communication in accordance with examples as disclosed herein. The processor 600 may be configured to or operable to support a means for a means for receiving a request message associated with data collection; and a

means for transmitting collected data to a destination address determined based on the request message over an IP connection.

[0123] Figure 7 illustrates an example of a network apparatus 700 in accordance with aspects of the present disclosure. The network apparatus 700 may include a processor 702, a memory 704, a controller 706, and a transceiver 708. The processor 702, the memory 704, the controller 706, or the transceiver 708, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0124] The processor 702, the memory 704, the controller 706, or the transceiver 708, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0125] The processor 702 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 702 may be configured to operate the memory 704. In some other implementations, the memory 704 may be integrated into the processor 702. The processor 702 may be configured to execute computer-readable instructions stored in the memory 704 to cause the network apparatus 700 to perform various functions of the present disclosure.

[0126] The memory 704 may include volatile or non-volatile memory. The memory 704 may store computer-readable, computer-executable code including instructions when executed by the processor 702 cause the network apparatus 700 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 704 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage

medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0127] In some implementations, the processor 702 and the memory 704 coupled with the processor 702 may be configured to cause the network apparatus 700 to perform one or more of the functions described herein (e.g., executing, by the processor 702, instructions stored in the memory 704). For example, the processor 702 may support wireless communication at the network apparatus 700 in accordance with examples as disclosed herein.

[0128] In some scenarios, the network apparatus 700 may be a data consumer, and configured to support a means for transmitting a request message associated with data collection; and a means for receiving UE collected data over an IP connection.

[0129] In some scenarios, the network apparatus 700 may be a CN entity, and configured to support a means for receiving a first request message associated with data collection from a data consumer node; and a means for selecting a UE for data collection based on the first request message or transmit UE selection related information to another CN entity based on the first request message to select a UE for data collection.

[0130] The controller 706 may manage input and output signals for the network apparatus 700. The controller 706 may also manage peripherals not integrated into the network apparatus 700. In some implementations, the controller 706 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 706 may be implemented as part of the processor 702.

[0131] In some implementations, the network apparatus 700 may include at least one transceiver 708. In some other implementations, the network apparatus 700 may have more than one transceiver 708. The transceiver 708 may represent a wireless transceiver. The transceiver 708 may include one or more receiver chains 710, one or more transmitter chains 712, or a combination thereof.

[0132] A receiver chain 710 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 710 may include one or more antennas for receive the signal over the air or wireless medium. The

receiver chain 710 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 710 may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 710 may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0133] A transmitter chain 712 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 712 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 712 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 712 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0134] Figure 8 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a UE as described herein. In some implementations, the UE may execute a set of instructions to control the function elements of the UE to perform the described functions.

[0135] At step 801, the method may include receiving a request message associated with data collection. The operations of step 801 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 801 may be performed by a UE as described with reference to Figure 5.

[0136] At step 803, the method may include transmitting collected data to a destination address determined based on the request message over an IP connection. The operations of step 803 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 803 may be performed by a UE as described with reference to Figure 5.

[0137] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0138] Figure 9 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a data consumer node as described herein. In some implementations, the data consumer node may execute a set of instructions to control the function elements of the data consumer node to perform the described functions.

[0139] At step 901, the method may include transmitting a request message associated with data collection. The operations of step 901 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 901 may be performed by a data consumer as described with reference to Figure 7.

[0140] At step 903, the method may include receiving UE collected data over an IP connection. The operations of step 903 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 903 may be performed by a data consumer as described with reference to Figure 7.

[0141] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0142] Figure 10 illustrates another flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a CN entity as described herein. In some implementations, the CN entity may execute a set of instructions to control the function elements of the CN entity to perform the described functions.

[0143] At step 1001, the method may include receiving a first request message associated with data collection from a data consumer node. The operations of step 1001 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 1001 may be performed by a CN entity described with reference to Figure 7.

[0144] At step 1003, the method may include selecting a UE for data collection based on the first request message or transmit UE selection related information to another CN entity based on the first request message to select a UE for data collection. The operations of step 1003 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 1003 may be performed by a CN entity as described with reference to Figure 7.

[0145] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0146] 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 user equipment (UE) for wireless communication, comprising:

at least one memory; and

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

receive a request message associated with data collection; and

transmit collected data to a destination address determined based on the request message over an internet protocol (IP) connection.

2. The UE of claim 1, wherein the request message indicates one or more of the following:

indication on whether UE should transmit collected data over IP connection or not;

destination address information;

criteria information of interested data;

description information of interested data;

notification correlation identifier (ID);

logging configuration on how UE should perform data logging; or

reporting configuration on how UE should perform data reporting.

3. The UE of claim 1, wherein the request message is a non-access stratum (NAS) message received from a data collection coordination function (DCCF) or an access and mobility management function (AMF), or a message from a data collection application function (DCAF) or a radio resource control (RRC) message from a radio access network (RAN) node.

4. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

establish the IP connection with a data collection coordination function (DCCF); and

transmit the collected data to the DCCF with an address of the DCCF indicated in the request message over the IP connection.

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

establish the IP connection with a messaging framework adaptor framework (MFAF); and

transmit the collected data to the MFAF with an address of the MFAF indicated in the request message over the IP connection.

6. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

establish the IP connection with a radio access network (RAN) node; and

transmit the collected data to the RAN node with an address of the RAN node indicated in the request message over the IP connection.

7. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

establish the IP connection with a data collection application function (DCAF); and

transmit the collected data to the DCAF over the IP connection.

8. A processor for wireless communication, comprising:

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

receive a request message associated with data collection; and

transmit collected data to a destination address determined based on the request message over an internet protocol (IP) connection.

9. A data consumer node for wireless communication, comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the data consumer node to:

transmit a request message associated with data collection; and

receive user equipment (UE) collected data over an internet protocol (IP) connection.

10. The data consumer node of claim 9, wherein the data consumer node is a radio access network (RAN) node, or a core network (CN) entity, or an over the top (OTT) server or an operations administration and maintenance (OAM), the request message is transmitted to a data collection coordination function (DCCF), and the UE collected data is received from the DCCF or a messaging framework adaptor framework (MFAF).

11. The data consumer node of claim 10, wherein the request message indicates one or more of the following:

identification information of target UE(s);

criteria information of interested data;

description of interested data;

notification uniform resource identifier (URI);

notification correlation identifier (ID);

logging requirement of interested data; or

reporting requirement of interested data.

12. The data consumer node of claim 9, wherein the data consumer node is a radio access network (RAN) node, the request message is transmitted to a UE, and the UE collected data is received from a data collection coordination function (DCCF), a messaging framework adaptor framework (MFAF) or the UE.

13. The data consumer node of claim 12, wherein the request message indicates one or more of the following:

indication on whether UE should transmit collected data over IP connection or not;

destination address information;

criteria information of interested data;

description information of interested data;

notification correlation identifier (ID);

logging configuration on how UE should perform data logging; or

reporting configuration on how UE should perform data reporting.

14. The data consumer node of claim 12, wherein in the case that the UE collected data is received from the DCCF or MFAF, the at least one processor is configured to cause the data consumer node to configure the DCCF or the MFAF by indicating one or more of:

address information for data notification; or

information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

15. A core network (CN) entity, comprising:

at least one memory; and

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

receive a first request message associated with data collection from a data consumer node; and

select a UE for data collection based on the first request message or transmit UE selection related information to another CN entity based on the first request message to select a UE for data collection.

16. The CN entity of claim 15, wherein the at least one processor is configured to cause the CN entity to select a UE based on one or more of the following:

UE identification information indicated in the first request message;

UE location related information;

UE subscription information; or

UE data collection policy information.

17. The CN entity of claim 15, wherein the at least one processor is configured to cause the CN entity to:

transmit a second request message associated with data collection to the UE, or an access and mobility management function (AMF) or a data collection application function (DCAF), wherein the second request message is based on the first request message.

18. The CN entity of claim 17, wherein in the case that the second request message is transmitted to the AMF or DCAF, the at least one processor is configured to cause the CN entity to:

transmit the UE selection related information or identification information of the UE selected by the CN entity in the second request message.

19. The CN entity of claim 15, wherein the UE selection related information comprises one or more of the following indicated in the first request message:

identification information of target UE(s);

criteria information of interested data; or

description of interested data.

20. The CN entity of claim 15, wherein the at least one processor is configured to cause the CN entity to configure a messaging framework adaptor framework (MFAF) by indicating one or more of:

address information for data notification; or

information that will be further carried together with received UE collected data to associate with the received UE collected data with a data notification address.

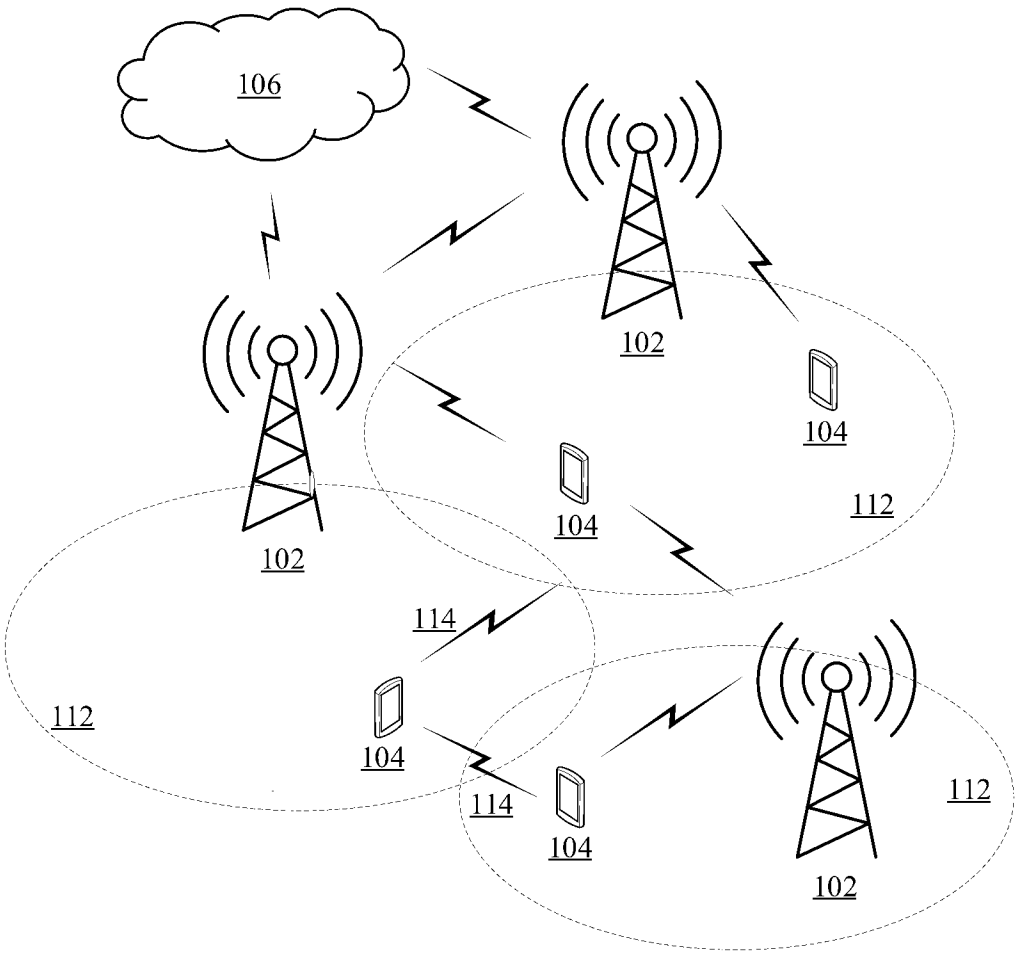


Figure 1

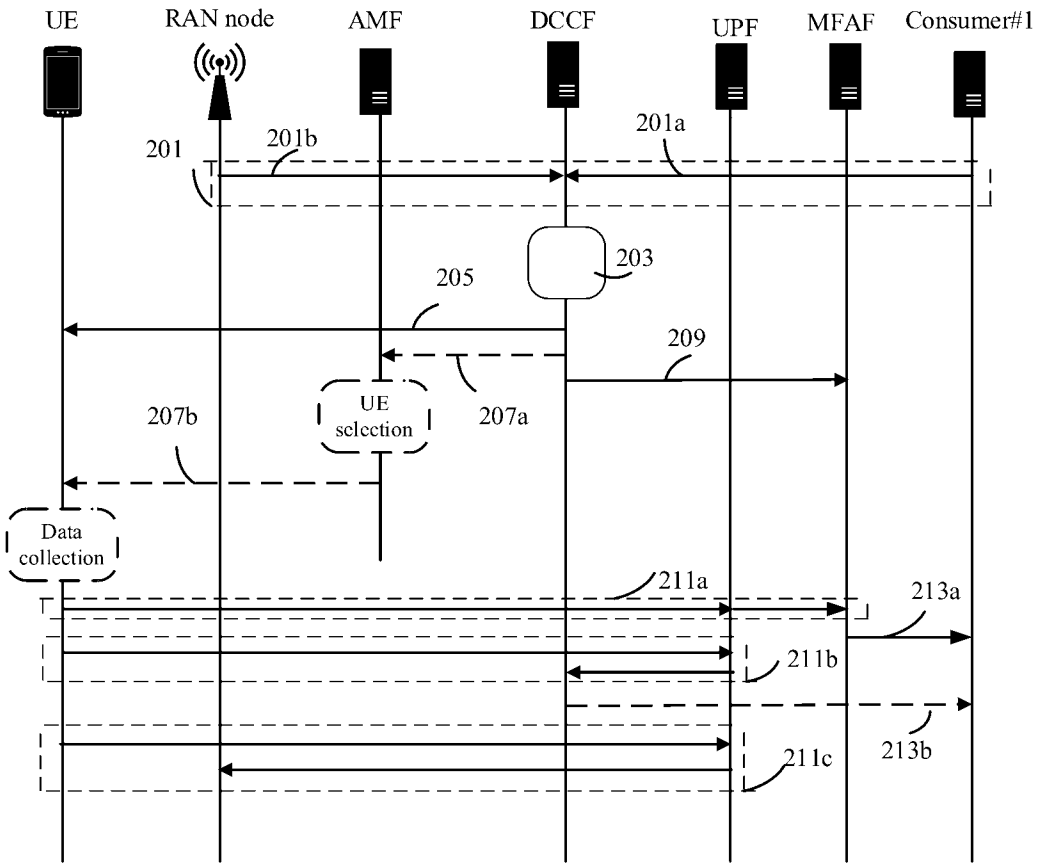

UE
RAN node
AMF
DCCF
UPF
MFAF
Consumer#1
201
201b
201a
203
205
209
UE selection
207a
207b
Data collection
211a
213a
211b
213b
211c

Figure 2

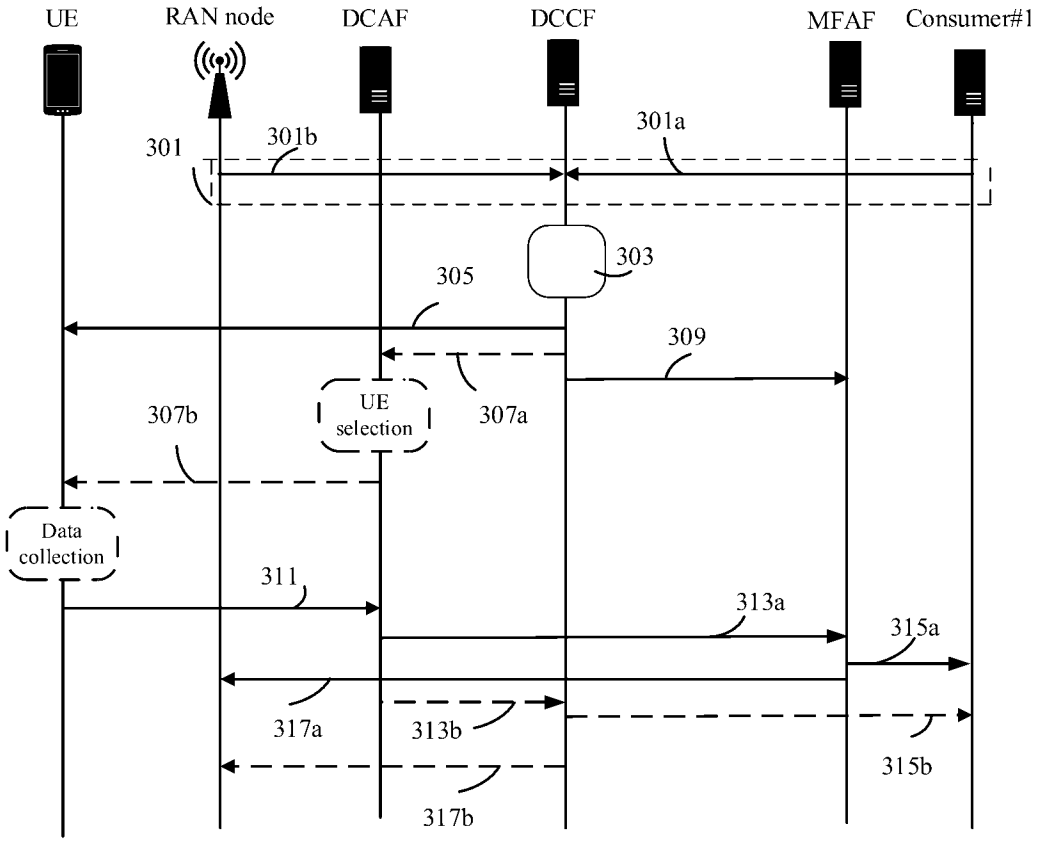

UE
RAN node
DCAF
DCCF
MFAF
Consumer#1
301
301b
301a
303
305
309
307b
UE selection
307a
Data collection
311
313a
315a
317a
313b
315b
317b

Figure 3

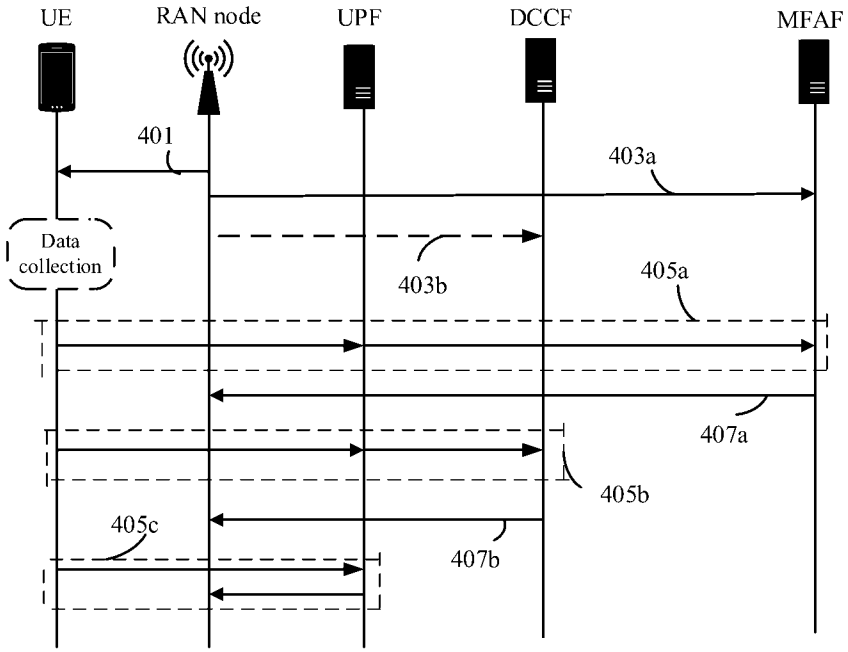


Figure 4

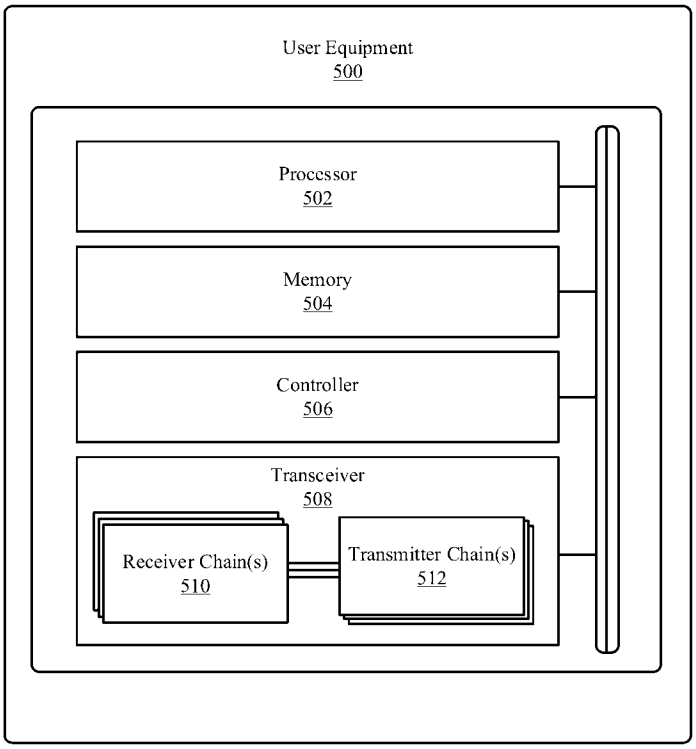


Figure 5

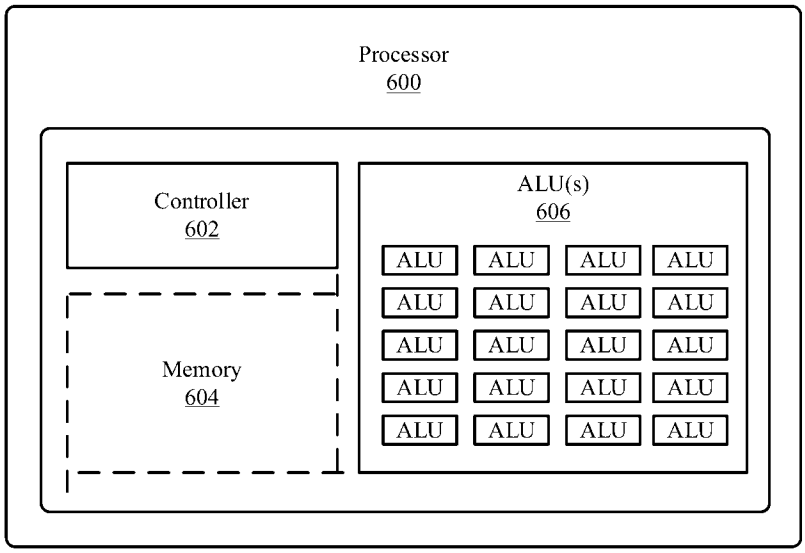


Figure 6

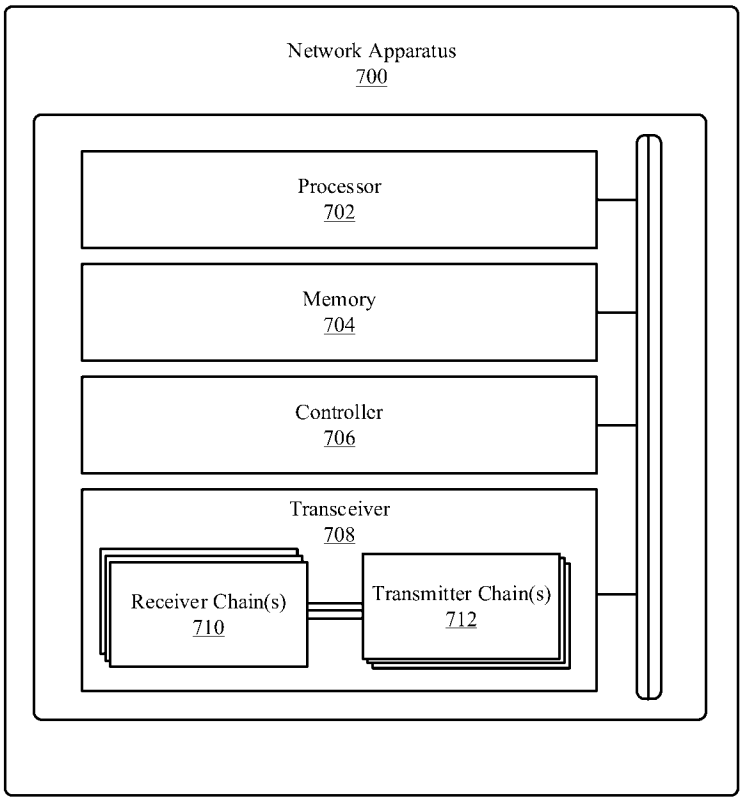


Figure 7

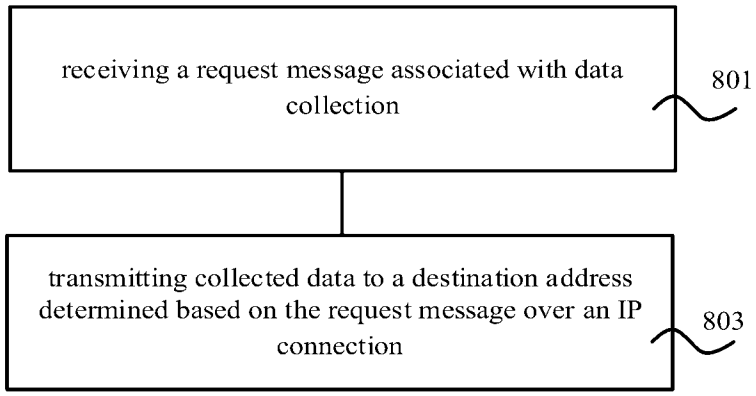


Figure 8

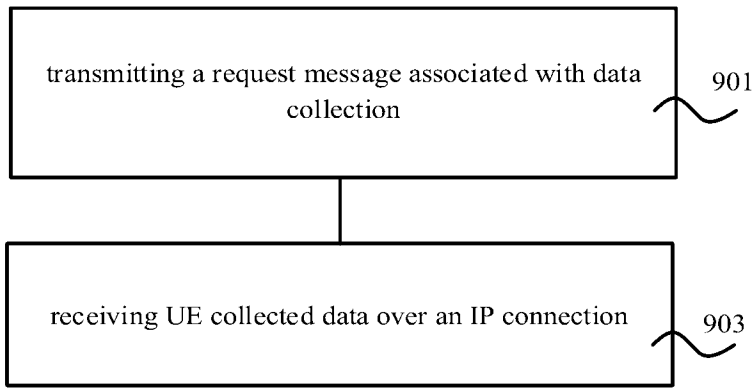


Figure 9

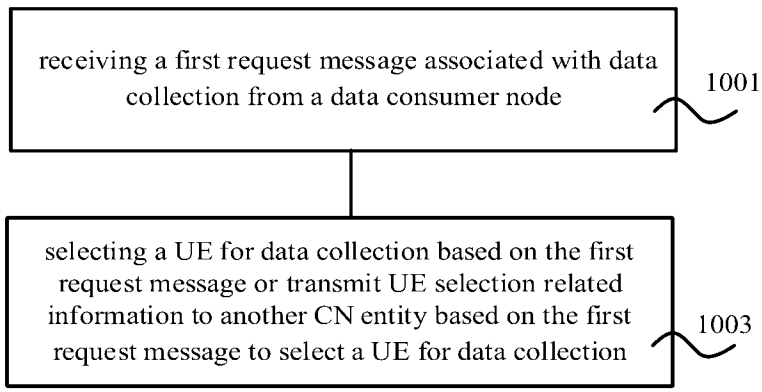


Figure 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/112361

A. CLASSIFICATION OF SUBJECT MATTER

H04L41/142(2022.01)i; G06N20/00(2019.01)i; H04W24/08(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04L, G06N, H04W

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

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

CNTXT, CNKI, ENTXTC, VEN, 3GPP: UE, receive, request, message, data, collection, report, destination address, internet protocol, IP, AI, ML, DCCF, AMF, NAS, RRC, RAN, ID

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2024188150 A1 (LG ELECTRONICS INC.) 06 June 2024 (2024-06-06) see description, paragraphs 42-478	1-20
X	WO 2024078603 A1 (VIVO MOBILE COMMUNICATION CO., LTD.) 18 April 2024 (2024-04-18) see description, page 5 line 16 to page 24 line 35	1-20
A	WO 2023180115 A1 (ERICSSON TELEFON AB L M) 28 September 2023 (2023-09-28) see the whole document	1-20
A	WO 2024110081 A1 (LENOVO SINGAPORE PTE LTD.) 30 May 2024 (2024-05-30) see the whole document	1-20
A	Ericsson, Nokia, Nokia Shanghai Bell. "S2-2009378 "KI#11 - Evaluation on data collection."" *3GPP tsg_sa\wg2_arch,* No. tsgs2_142e_electronic, 23 November 2020 (2020-11-23), see whole document	1-20

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
21 April 2025	**24 April 2025**

Name and mailing address of the ISA/CN	Authorized officer
CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China**	**LI,ZhenHua** Telephone No. **(+86) 010-62087678**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/112361

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
US 2024188150 A1	06 June 2024	KR 20230156835 A	14 November 2023
		WO 2022215974 A1	13 October 2022
		EP 4322504 A1	14 February 2024
		EP 4322504 A4	09 April 2025
WO 2024078603 A1	18 April 2024	None	
WO 2023180115 A1	28 September 2023	None	
WO 2024110081 A1	30 May 2024	None	