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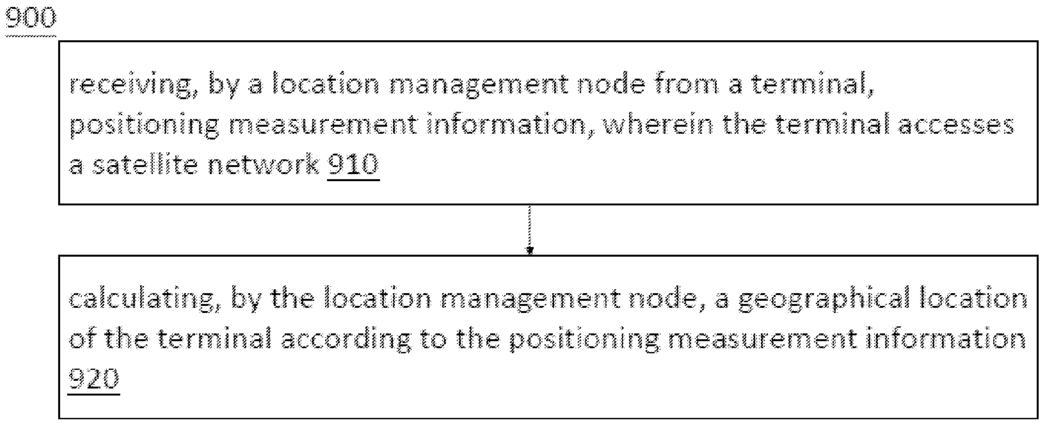

FIG. 9

(57) Abstract: Method, device and computer program product for wireless communication are provided. A method includes: receiving, by a location management node from a terminal, positioning measurement information, in which the terminal accesses a satellite network; and calculating, by the location management node, a geographical location of the terminal according to the positioning measurement information. The geographical location is able to be used in acquiring a terrestrial network location of the terminal.

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METHOD, DEVICE AND COMPUTER PROGRAM PRODUCT FOR WIRELESS COMMUNICATION

This document is directed generally to wireless communications.

The integration of satellite networks and terrestrial networks is a recent trend in satellite communications. Satellite communication is often used for public safety services (e.g., an emergency call) when terminal devices are out of coverage of the terrestrial base stations. For example, a ship in open sea can make use of satellite access (satellite communication) to get an emergency service from a 5G network.

In terrestrial network, the Cell ID is used to indicate the Cell where a user equipment (UE) is connected to. The Cell ID concept is also introduced in satellite network. In satellite network, the Cell ID is called Satellite Cell ID.

For emergency services, the Cell ID is needed by the core network to select an appropriate correct Emergency Center (e.g., a public safety answering point, PSAP). Normally, a PSAP is configured to serve a particular area in a public land mobile network (PLMN). For example, a PSAP may serve a list of Tracking Areas (TAs), and each TA includes a group of Cells.

In order to adopt the concepts and procedures of the Cell ID in the terrestrial network to the satellite network, a satellite is configured with at least one Satellite Cell ID, so that a satellite beam can broadcast a Satellite Cell ID. Such a Satellite Cell ID is received by the radio access network (RAN) and reported to the core network (CN). In emergency service, this Satellite Cell ID is used for PSAP selection. However, because a satellite beam often covers a large area and may cross boundaries of multiple administrative areas (e.g., cross the boundary of two countries), the CN may not be able to accurately select an Emergency Center (e.g., a PSAP) by using the Satellite Cell ID.

In order to select a correct Emergency Center, the core network shall be able to obtain the accurate location of the UE which can be either the geographical location or the terrestrial network location (e.g., a Cell ID or a tracking area (TA)) corresponding to the geographical location of the UE.

The present disclosure relates to methods, devices, and computer program products for wireless communication, which can acquire a more accurate terrestrial network location of the terminal.

One aspect of the present disclosure relates to a wireless communication method. In an embodiment, the wireless communication method includes: receiving, by a location management node from a terminal, positioning measurement information, in which the terminal accesses a satellite network; and calculating, by the location management node, a geographical location of the terminal according to the positioning measurement information. The geographical location is able to be used in acquiring a terrestrial network location of the terminal.

Another aspect of the present disclosure relates to a wireless communication method. In an embodiment, the wireless communication method includes: receiving, by a location management node from an access management node, a location retrieval request; mapping, by the location management node, a geographical location to a terrestrial network location; and sending, by the location management node to the access management node, the mapped terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to a wireless communication method. In an embodiment, the wireless communication method includes: sending, by an access management node to a location management node, a location retrieval request; and receiving, by the access management node from the location management node, a terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to a wireless communication method. In an embodiment, the wireless communication method includes: sending, by an access management node to a location management node, a location retrieval request; receiving, by the access management node from the location management node, a geographical location; and mapping, by the access management node, the geographical location to a terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to a wireless communication method. In an embodiment, the wireless communication method includes: acquiring, by a terminal, positioning measurement information in response to the terminal accessing a satellite network; and sending, by the terminal to a network node, the positioning measurement information. The positioning measurement information is able to be used to acquire a terrestrial network location of the terminal.

Another aspect of the present disclosure relates to a location management node. In an embodiment, the location management node includes a communication unit and a processor. The processor is configured to receive, from a terminal, positioning measurement information, in which the terminal accesses a satellite network; and calculate a geographical location of the terminal according to the positioning measurement information. The geographical location is able to be used in acquiring a terrestrial network location of the terminal.

Another aspect of the present disclosure relates to a location management node. In an embodiment, the location management node includes a communication unit and a processor. The processor is configured to receive, from an access management node, a location retrieval request; map a geographical location to a terrestrial network location; and send, to the access management node, the mapped terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to an access management node. In an embodiment, the access management node includes a communication unit and a processor. The processor is configured to send, to a location management node, a location retrieval request; and receive, from the location management node, a terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to an access management node. In an embodiment, the access management node includes a communication unit and a processor. The processor is configured to send, to a location management node, a location retrieval request; receive, from the location management node, a geographical location; and map the geographical location to a terrestrial network location. The terrestrial network location corresponds to a terminal accessing a satellite network.

Another aspect of the present disclosure relates to a terminal. In an embodiment, the terminal includes a communication unit and a processor. The processor is configured to acquire positioning measurement information in response to the terminal accessing a satellite network; and send the positioning measurement information. The positioning measurement information is able to be used to acquire a terrestrial network location of the terminal.

Various embodiments may preferably implement the following features:

Preferably, the positioning measurement information is received through an access management node.

Preferably, the positioning measurement information is received by the access management node through a registration message or an uplink Non-Access Stratum, NAS, transport message.

Preferably, the positioning measurement information is received by the location management node from an access management node in a Long-Term Evolution Positioning Protocol, LPP, message.

Preferably, the positioning measurement information includes at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

Preferably, the wireless communication method further includes: receiving, by the location management node from an access management node, a location retrieval request; mapping, by the location management node, the geographical location to the terrestrial network location; and sending, by the location management node to the access management node, the mapped terrestrial network location.

Preferably, the location retrieval request includes at least one of an indication of requiring a terrestrial network location or an indication of mapping a geographical location to a terrestrial network location.

Preferably, the terrestrial network location includes at least one of a cell ID or a Tracking Area Code, TAC.

Preferably, the wireless communication method further includes: receiving, by the location management node from an access management node, a location retrieval request; and sending, by the location management node to the access management node, the geographical location.

Preferably, the terrestrial network location is able to be used to setup an emergency session of the terminal.

Preferably, the wireless communication method further includes: receiving, by the location management node from the terminal, positioning measurement information by initiating a positioning procedure; and calculating, by the location management node, the geographical location of the terminal according to the positioning measurement information.

Preferably, the wireless communication method further includes: receiving, by the location management node from the access management node, the positioning measurement information through a Long-Term Evolution Positioning Protocol, LPP, message.

Preferably, the wireless communication method further includes: receiving, by the access management node from the terminal, positioning measurement information; and sending, by the access management node to the location management node, the positioning measurement information. The geographical location corresponds to the positioning measurement information.

Preferably, the positioning measurement information is received through a registration message or an uplink Non-Access Stratum, NAS, transport message.

Preferably, the positioning measurement information is sent to the location management node in a Long-Term Evolution Positioning Protocol, LPP, message.

Preferably, the positioning measurement information is acquired in response to an emergency service being required by the terminal.

Preferably, the positioning measurement information is sent to an access management node through a registration message or an uplink Non-Access Stratum, NAS, transport message.

Preferably, the positioning measurement information is encapsulated in a Long-Term Evolution Positioning Protocol, LPP, message.

The present disclosure relates to a computer program product including a computer-readable program medium code stored thereupon, the code, when executed by a processor, causing the processor to implement a wireless communication method recited in any one of foregoing methods.

The exemplary embodiments disclosed herein are directed to providing features that will become readily apparent by reference to the following description when taken in conjunction with the accompany drawings. In accordance with various embodiments, exemplary systems, methods, devices and computer program products are disclosed herein. It is understood, however, that these embodiments are presented by way of example and not limitation, and it will be apparent to those of ordinary skill in the art who read the present disclosure that various modifications to the disclosed embodiments can be made while remaining within the scope of the present disclosure.

Thus, the present disclosure is not limited to the exemplary embodiments and applications described and illustrated herein. Additionally, the specific order and/or hierarchy of steps in the methods disclosed herein are merely exemplary approaches. Based upon design preferences, the specific order or hierarchy of steps of the disclosed methods or processes can be re-arranged while remaining within the scope of the present disclosure. Thus, those of ordinary skill in the art will understand that the methods and techniques disclosed herein present various steps or acts in a sample order, and the present disclosure is not limited to the specific order or hierarchy presented unless expressly stated otherwise.

The above and other aspects and their implementations are described in greater detail in the drawings, the descriptions, and the claims.

FIG. 1A shows a schematic diagram of a satellite access network architecture according to an embodiment of the present disclosure.

FIG. 1B shows another schematic diagram of a satellite access network architecture according to an embodiment of the present disclosure.

FIG. 2A and FIG. 2B show schematic diagrams of a procedure of making an emergency call from for a UE accessing a satellite network according to an embodiment of the present disclosure.

FIG. 3A and FIG. 3B show schematic diagrams of another procedure of making an emergency call from for a UE accessing a satellite network according to an embodiment of the present disclosure.

FIG. 4A and FIG. 4B show schematic diagrams of still another procedure of making an emergency call from for a UE accessing a satellite network according to an embodiment of the present disclosure.

FIG. 5A and FIG. 5B show schematic diagrams of still another procedure of making an emergency call from for a UE accessing a satellite network according to an embodiment of the present disclosure.

FIG. 6 shows an example of a schematic diagram of a terminal according to an embodiment of the present disclosure.

FIG. 7 shows an example of a schematic diagram of a wireless network node according to an embodiment of the present disclosure.

FIG. 8 shows an example of a schematic diagram of another wireless network node according to another embodiment of the present disclosure.

FIG. 9 illustrates a wireless communication method according to an embodiment of the present disclosure.

FIG. 10 illustrates another wireless communication method according to an embodiment of the present disclosure.

FIG. 11 illustrates another wireless communication method according to an embodiment of the present disclosure.

FIG. 12 illustrates another wireless communication method according to an embodiment of the present disclosure.

FIG. 13 illustrates another wireless communication method according to an embodiment of the present disclosure.

The integration of the satellite networks and the terrestrial networks is a recent trend in satellite communication. An important development of non-terrestrial network (NTN) is focused on the effective use of the cellular networks, the functional entities, the signaling procedures and the interfaces of the terrestrial network. Effective integration and unified management of the satellite networks and the terrestrial networks are conducive.

A simple architecture of accessing a 5G network via satellite is the transparent satellite access network architecture, in which the satellite acts as an analogue radio frequency (RF) repeater and provides a transparent tunnel between the UE and the RAN. In general, the satellite repeats an NR-Uu radio interface from a feeder link (between the NTN gateway and the satellite) to a service link (between the satellite and the UE) and *vice versa*.

FIG. 1A shows a schematic diagram of a transparent satellite access network architecture according to an embodiment of the present disclosure. The network entities or network functions shown in FIG. 1A are illustrated as follows:

1) UE: User Equipment

The UE corresponds to a mobile terminal accessing to 5G network, either directly via NG-RAN (gNB) or via a satellite.

2) SAT RF: Satellite Radio Function

The satellite payload implements frequency conversion and a Radio Frequency amplifier in both uplink and downlink direction.

3) NTN GW: Non-Terrestrial Network Gateway

The NTN GW supports all necessary functions to forward the signal of the NR-Uu interface. In some embodiments, the NTN GW is deployed on the ground, and one NTN GW may be configured to serve multiple gNBs.

4) NG RAN: Next Generation Radio Access Network

In 5G, the NG RAN is an NR base station, which is also named gNB.

5) AMF: Access and Mobility Management function.

The AMF provides access management and mobility management for a UE, e.g., registration to network, registration during UE mobility, etc.

6) SMF: Session Management Function

The SMF provides PDU session management for a UE, e.g., internet protocol (IP) address allocation, QoS flow setup, etc.

7) UPF: User plane function.

The UPF provides IP traffic routing and forwarding management.

8) PCF: Policy Control Function

The PCF provides QoS policy rules to control plane functions to enforce the rules.

9) UDM: Unified Data Management

The UDM manages data for access authorization, user registration, and data network profiles.

When there is no terrestrial network coverage, the UE may find suitable satellites to setup (e.g., build or set) a satellite connection for accessing the 5G network through the satellite access, so as to get the public safety service (e.g., an emergency service). For example, a ship in open sea may make use of satellite access to have an emergency call by using 5G network.

FIG. 1B shows a schematic diagram of a network architecture supporting emergency service with satellite access according to an embodiment of the present disclosure. In this embodiment, the emergency service is implemented by the IP multimedia subsystem (IMS subsystem), and the Location Services (LCS service) is involved to provide the location information of the UE.

In this architecture, there are additional network entities or network functions:

10) LMF: Location Management Function

The LMF provides location management functionality in 5G network.

11) E-SMLC: Evolved Serving Mobile LoCation

The E-SMLC provides necessary functionality related to a network-based positioning method. The E-SMLC interrogates the RAN node to get necessary measurements which are useful for various positioning methods.

12) IMS Core: IP multimedia subsystem Core

The IMS Core provides IMS session management and involves Proxy - Call Session Control Function (P-CSCF), Serving - Call Session Control Function (S-CSCF), Home Subscriber Server (HSS), etc.

13) LRF: Location Retrieval Function

The LRF provides location retrieval functionality for the emergency service. In an embodiment, the LRF is collocated with LMF.

More specifically, the UE sets up a connection with a satellite in step 201 shown in FIG. 2A. In an embodiment, when the UE moves to an area without terrestrial network coverage (e.g., the area is not covered by the terrestrial network), the UE may decide to access the 5G network via the satellite. The UE then searches available satellites and selects suitable satellite(s) to setup (e.g., set, establish, build) satellite connection.

In step 202, the UE sets up radio resource control (RRC) connection towards a gNB (e.g., RAN node or NG-RAN). In an operator’s network, one or more NTN GW(s) may be deployed for satellite access. An NTN GW is normally deployed on the ground and configured to connect one or more NG-RAN, to serve multiple satellites.

When a satellite receives a message (e.g., RRC message) from the UE, the satellite forwards the message to the connected NTN GW, and the NTN GW forwards the message to a proper NG-RAN. The NTN GW may use a satellite cell identifier (ID) corresponding to the satellite to decide which NG-RAN to forward the message.

In step 203, the UE sends a registration request to the NG-RAN, where the registration request is encapsulated in an RRC message. The RRC message is transparently forwarded by the satellite and the NTN GW.

In step 204, the NG-RAN selects an appropriate AMF for the UE. In an embodiment, the NG-RAN may select an AMF which is able to serve satellite communication, e.g., by using the Satellite Radio access technology (RAT) and Satellite Cell ID.

In step 205, the NG-RAN forwards the registration request to the selected AMF. In an embodiment, the registration request message is encapsulated in an NG application protocol (NG-AP) message. In an embodiment, the gNB indicates the following information in the NG-AP message: the global RAN Node ID of the NG-RAN, the satellite cell ID, etc. The AMF determines whether the satellite RAT is currently used, e.g., based on the global RAN node ID of the NG-RAN.

In step 206, the AMF retrieves UE subscription from the UDM, to determine whether the registration request can be accepted.

In step 207, if the registration request is accepted, the AMF returns a registration accept message which is encapsulated in an NG-AP message towards the NG-RAN.

In step 208, the NG-RAN forwards the registration accept message to the UE.

In step 209, the UE sends a PDU session establishment request message to the AMF. In an embodiment, an Emergency indication is carried to indicate the PDU session is specific to emergency service.

In step 210, the AMF selects a proper SMF. In an embodiment, the Satellite RAT and the satellite cell ID may be used for SMF selection.

In step 211 shown in FIG. 2B, the AMF sends a PDU session establishment request message to the SMF.

In step 212, the AMF sends PDU Session Establishment Response to the UE. In an embodiment, once the PDU session is established for the emergency service, the UE gets P-CSCF address from the network, and may setup an emergency call to the IMS.

In step 213, the UE sends a Session Initiation Protocol invitation (SIP INVITE) request to the IMS Core, in which the request carries an emergency indication. In an embodiment, the UE may provide its location information (e.g., Cell ID) in the SIP message. In an embodiment, the P-CSCF forwards the SIP INVITE to the S-CSCF to handle the SIP INVITE for the emergency service.

In step 214, the IMS Core sends a Location Retrieval Request to the LRF and/or LMF when the location information is not provided by the UE or not trusted.

In step 215, the LRF and/or LMF triggers a position procedure to obtain the UE location when needed. In an embodiment, depending on the positioning method being used, the position procedure may involve a Serving Mobile LoCation (SMLC) or an E-SMLC, the NG-RAN, or the UE. In an embodiment, for the emergency service, the Cell ID is needed to select a proper PSAP.

In step 216, the LRF and/or LMF selects a proper PSAP based on the UE location it obtained.

In step 217, the LRF and/or LMF returns Location-Routing information to the IMS Core, in which the Location-Routing information carries the PSAP information and the UE location.

In step 218, the IMS Core routes the SIP INVITE to the PSAP.

In step 219, subsequent steps for completing the emergency session are executed.

In the procedure shown in FIG. 2A and FIG. 2B, the Satellite Cell ID is used to select a PSAP for the emergency service. However, in some embodiments, a satellite beam may cover a large area and may cross boundaries of multiple administrative areas (e.g., cross the boundary of two countries), so that the Satellite Cell ID may not be able to accurately select an appropriate PSAP.

Therefore, in some embodiments of the present disclosure, the CN obtains the geographical location of the UE and maps it to a terrestrial network location (e.g., a Cell ID or a Tracking Area Code (TAC)), so as to accurately select a PSAP for the emergency service.

Embodiment 1:

In some embodiments, once the AMF detects that an UE is connected to the RAN via a satellite (e.g., a Satellite RAT is detected during Registration procedure), the AMF may trigger a network-initiated cell mapping procedure, so as to retrieve the geographical location (e.g., GPS coordinates) of the UE and map the geographical location to a terrestrial network location (e.g., a Cell ID or a TAC).

FIG. 3A and FIG. 3B show schematic diagrams of the network-initiated cell mapping procedure according to an embodiment of the present disclosure.

In steps 301 to 306, the UE performs a registration procedure to the AMF. In some embodiments, operations in steps 301 to 306 are similar to the operations in steps 203 to 208. Details of steps 301 to 306 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

In an embodiment, the AMF detects that the Satellite RAT is currently used, the AMF then determines to trigger a network-initiated cell mapping procedure. Two possible approaches may be used: (a) Cell mapping performed by LMF in steps 307 to 310; and (b) Cell mapping performed by AMF in steps 311 to 314.

In step 307, the AMF sends a Location Retrieval Request to a selected LMF, with the Location QoS (Quality of Service) set to appropriate values. In an embodiment, one or more indication may be included in the request to request the LMF to return a terrestrial network location (e.g., a Cell ID, a TAC, etc.) and/or to trigger the LMF to map a geographic location to a terrestrial network location.

In an embodiment, in order to make the LMF obtain an accurate UE location, the AMF may set the parameter LcsQoSClass in LocationQoS IE as “Best Effort Class”, or set the Horizontal accuracy or Vertical accuracy to the accuracy in a Global Navigation Satellite System (GNSS) positioning method. With such Location QoS setting, the LMF triggers the UE-based or UE-assisted positioning procedure to obtain the geographical location of the UE.

In an embodiment, the Location Retrieval Request mentioned above may further include a “Network Location Required” indication to require the LMF to return a terrestrial network location (e.g., a Cell ID, a TAC, etc.), or a “Geographical Location Mapping to Network Location” indication to require the LMF to map a geographical location to a terrestrial network location.

In step 308, the LMF initiates a positioning procedure, to obtain the geographical location (e.g., the GPS coordinates) of the UE. In an embodiment, the positioning procedure may include requesting the UE to report the positioning measurement information it detected, such as GNSS measurement information or GPS coordinates. In an embodiment, based on the positioning measurement information detected by the UE, the LMF calculates the geographical location of the UE.

In step 309, when the geographical location of the UE is acquired, the LMF performs a cell mapping operation to map the geographical location to the terrestrial network location (e.g., a Cell ID or a TAC). In an embodiment, the knowledge or information of mapping the geographical location to the terrestrial network location may be configured or stored in the LMF, or in other storage or network function. In an embodiment, the LMF maps the geographical location to the terrestrial network location according to the knowledge or information.

In step 310, the LMF sends a Location Retrieval Response to the AMF, in which the Location Retrieval Response carries the mapped terrestrial network location of the UE (e.g., a Cell ID).

In the following paragraphs, the approach (b) Cell mapping performed by AMF will be described in steps 311 to 314.

In step 311, the AMF sends a Location Retrieval Request to a selected LMF, with the Location QoS (Quality of Service) set to appropriate values.

In an embodiment, in order to make the LMF obtain an accurate UE location, the AMF may set the parameter LcsQoSClass in LocationQoS IE as “Best Effort Class”, or set the Horizontal accuracy or Vertical accuracy to the accuracy in Global Navigation Satellite System (GNSS) positioning method. With such Location QoS setting, the LMF triggers the UE-based or UE-assisted positioning procedure to obtain the geographical location of the UE.

In step 312, the LMF initiates a positioning procedure, to obtain the geographical location (e.g., the GPS coordinates) of the UE. In an embodiment, the positioning procedure may include requesting the UE to report the positioning measurement information it detected, such as GNSS measurement information or GPS coordinates. In an embodiment, based on the positioning measurement information detected by the UE, the LMF calculates the geographical location of the

UE.

In step 313, the LMF sends a Location Retrieval Response to the AMF, in which the Location Retrieval Response carries the geographical location of the UE.

In step 314, when the geographical location of the UE is received, the AMF performs a cell mapping operation to map the geographical location to the terrestrial network location (e.g., a Cell ID or a TAC). In an embodiment, the knowledge or information of mapping the geographical location to the terrestrial network location may be configured or stored in the AMF, or in other storage or network function. In an embodiment, the AMF maps the geographical location to the terrestrial network location according to the knowledge or information.

By using either the approach (a) (i.e., steps 307 to 310) or the approach (b) (i.e., steps 311 to 314), the AMF may acquire the mapped terrestrial network location which corresponds to a relatively accurate geographical location of the UE. Such a mapped terrestrial network location may be used by the AMF to select another network function (NF), like an SMF, or be used in subsequent messages or procedures relevant to other NFs.

In step 315, the UE requests to establish a PDU session. For example, the UE requests to establish a PDU session for an emergency service. During the PDU session procedure, the AMF uses the mapped terrestrial network location to select an SMF, and sends the mapped terrestrial network location to SMF.

In step 316, the UE sets up an IMS session for an emergency service. In this procedure, the mapped terrestrial network location is obtained by the LMF/LRF or the AMF, so as to select an appropriate Emergency Center (e.g., a PSAP).

Embodiment 2:

In some embodiments of the present disclosure, the UE may start a positioning system (e.g., a GNSS) before or after performing a registration procedure to the CN (e.g., to an AMF) via satellite access or a satellite network. In some embodiments, the UE may report the positioning measurement information to the CN within a short period of time after the registration procedure, so that the CN can map the geographical location of the UE to a terrestrial network location.

FIG. 4A and FIG. 4B show schematic diagrams of the network-initiated cell mapping procedure according to an embodiment of the present disclosure.

In steps 401 to 406, the UE performs a registration procedure to the AMF. In some embodiments, operations in steps 401 to 406 are similar to the operations in steps 203 to 208. Details of steps 401 to 406 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

In an embodiment, if an emergency call is needed, the UE starts a positioning system (e.g., a GNSS). In an embodiment, the UE may report the detected positioning measurement information, before it initiates an emergency call.

In steps 407, the UE starts a positioning system. The UE may start the positioning system before or after performing registration procedure to the network, i.e., before or after steps 401 to 406. Thus, the present disclosure is not limited to the embodiment illustrated in FIG. 4A and FIG. 4B.

In steps 408, the UE sends an Uplink NAS Transport message towards the AMF, in which the Uplink NAS Transport message carries a Long-Term Evolution Positioning Protocol (LPP) message. In an embodiment, the UE may set the positioning measurement information (e.g., GNSS measurement information or GPS coordinates) to be included in the LPP message.

In steps 409, the AMF forwards the LPP message sent by the UE to a selected LMF.

In an embodiment, the AMF determines to trigger a network-initiated cell mapping procedure. Two possible approaches may be used: (a) Cell mapping performed by LMF in steps 410 to 412; and (b) Cell mapping performed by AMF in steps 413 to 415.

Approach (a): Cell mapping performed by LMF

Similar to steps 307 to 310 of the procedure illustrated in FIG. 3A and FIG. 3B, in steps 410 to 412, the AMF sends a Location Retrieval Request to the LMF (step 410), to request the LMF to return the mapped terrestrial network location. In steps 410 to 412, since the UE has already provided the positioning measurement information to the LMF, the LMF can directly calculate the geographical location by using the positioning measurement information provided by the UE (step 411). Thus, in such embodiments, the LMF may not trigger the positioning procedure. Afterward, the LMF sends a Location Retrieval Response to the AMF, in which the Location Retrieval Response carries the mapped terrestrial network location of the UE (e.g., a Cell ID) (step 412).

Details of steps 410 to 412 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

Approach (b): Cell mapping performed by AMF

Similar to step 311 to 314 of the procedure illustrated in FIG. 3A and FIG. 3B, in steps 413 to 415, the AMF sends a Location Retrieval Request to the LMF (step 413), to request the LMF to return the geographical location of the UE. The LMF can directly calculate the geographical location by using the positioning measurement information provided by the UE and return the geographical location to the AMF (step 414). Thus, in such embodiments, the LMF may not trigger the positioning procedure. Afterward, the AMF maps the received geographical location to a terrestrial network location (e.g., a Cell ID or a TAC) (step 415).

Details of steps 413 to 415 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

By using either the approach (a) (i.e., steps 410 to 412) or the approach (b) (i.e., steps 413 to 415), the AMF can acquire the mapped terrestrial network location which corresponds to a relatively accurate geographical location of the UE. Such a mapped terrestrial network location can be used by the AMF to select another network function (NF), like an SMF, or be used in subsequent messages or procedures relevant to other NFs.

In step 416, the UE requests to establish a PDU session. For example, the UE requests to establish a PDU session for an emergency service. During the PDU session procedure, the AMF uses the mapped terrestrial network location to select an SMF, and sends the mapped terrestrial network location to SMF.

In step 417, the UE sets up an IMS session for an emergency service. In this procedure, the mapped terrestrial network location is obtained by the LMF/LRF or the AMF, so as to select an appropriate Emergency Center (e.g., a PSAP).

Embodiment 3:

In some embodiments of the present disclosure, the UE may start a positioning system (e.g., a GNSS) before performing a registration procedure to the CN (e.g., to an AMF) via satellite access or a satellite network. In some embodiments, during the registration procedure, the UE may set the positioning measurement information in, for example, an LPP message encapsulated in a Registration Request, so that the CN can map the geographical location of the UE to a terrestrial network location.

FIG. 5A and FIG. 5B show schematic diagrams of the network-initiated cell mapping procedure according to an embodiment of the present disclosure.

In steps 501, the UE starts a positioning system (e.g., a GNSS).

In steps 502 to 507, the UE performs a registration procedure to the AMF. In some embodiments, operations in steps 501 to 507 are similar to the operations in steps 203 to 208. The difference is that the UE may set the positioning measurement information (e.g., GNSS measurement information or GPS coordinates) in the Registration Request message in step 502. In an embodiment, the positioning measurement information may be encapsulated in an LPP message within the Registration Request message.

Other details of steps 502 to 507 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

In steps 508, the AMF extracts the positioning measurement information (e.g., the GNSS measurement information or the GPS coordinates) from the Registration Request sent by the UE.

In steps 509, the AMF sends the positioning measurement information from the UE to a selected LMF in, for example, an LPP message.

In an embodiment, the AMF determines to trigger a network-initiated cell mapping procedure. Two possible approaches can be used: (a) Cell mapping performed by LMF in steps 510 to 412; and (b) Cell mapping performed by AMF in steps 513 to 515.

Approach (a): Cell mapping performed by LMF

Similar to steps 307 to 310 of the procedure illustrated in FIG. 3A and FIG. 3B, in steps 510 to 512, the AMF sends a Location Retrieval Request to the LMF (step 510), to request the LMF to return the mapped terrestrial network location. In steps 510 to 512, since the UE has already provided the positioning measurement information to the LMF, the LMF can directly calculate the geographical location by using the positioning measurement information provided by the UE (step 511). Thus, in such embodiments, the LMF may not trigger the positioning procedure. Afterward, the LMF sends a Location Retrieval Response to the AMF, in which the Location Retrieval Response carries the mapped terrestrial network location of the UE (e.g., a Cell ID) (step 512).

Details of steps 510 to 512 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

Approach (b): Cell mapping performed by AMF

Similar to step 311 to 314 of the procedure illustrated in FIG. 3A and FIG. 3B, in steps 513 to 515, the AMF sends a Location Retrieval Request to the LMF (step 513), to request the LMF to return the geographical location of the UE. The LMF can directly calculate the geographical location by using the positioning measurement information provided by the UE and return the geographical location to the AMF (step 514). Thus, in such embodiments, the LMF may not trigger the positioning procedure. Afterward, the AMF maps the received geographical location to a terrestrial network location (e.g., a Cell ID or a TAC) (step 515).

Details of steps 513 to 515 can be ascertained by reference to the paragraphs above, and will not be repeated herein.

By using either the approach (a) (i.e., steps 510 to 512) or the approach (b) (i.e., steps 513 to 515), the AMF can acquire the mapped terrestrial network location which corresponds to a relatively accurate geographical location of the UE. Such a mapped terrestrial network location can be used by the AMF to select another network function (NF), like an SMF, or be used in subsequent messages or procedures relevant to other NFs.

In step 516, the UE requests to establish a PDU session. For example, the UE requests to establish a PDU session for an emergency service. During the PDU session procedure, the AMF uses the mapped terrestrial network location to select an SMF, and sends the mapped terrestrial network location to SMF.

In step 517, the UE sets up an IMS session for an emergency service. In this procedure, the mapped terrestrial network location is obtained by the LMF/LRF or the AMF, so as to select an appropriate Emergency Center (e.g., a PSAP).

FIG. 6 relates to a schematic diagram of a terminal 60 (e.g., a terminal node or a terminal device) according to an embodiment of the present disclosure. The terminal 60 may be a user equipment (UE), a mobile phone, a laptop, a tablet computer, an electronic book or a portable computer system and is not limited herein. The terminal 60 may include a processor 600 such as a microprocessor or Application Specific Integrated Circuit (ASIC), a storage unit 610 and a communication unit 620. The storage unit 610 may be any data storage device that stores a program code 612, which is accessed and executed by the processor 600. Embodiments of the storage unit 612 include but are not limited to a subscriber identity module (SIM), read-only memory (ROM), flash memory, random-access memory (RAM), hard-disk, and optical data storage device. The communication unit 620 may a transceiver and is used to transmit and receive signals (e.g., messages or packets) according to processing results of the processor 600. In an embodiment, the communication unit 620 transmits and receives the signals via at least one antenna 622.

In an embodiment, the storage unit 610 and the program code 612 may be omitted and the processor 600 may include a storage unit with stored program code.

The processor 600 may implement any one of the steps in exemplified embodiments on the terminal 60, e.g., by executing the program code 612.

The communication unit 620 may be a transceiver. The communication unit 620 may as an alternative or in addition be combining a transmitting unit and a receiving unit configured to transmit and to receive, respectively, signals to and from a wireless network node.

In some embodiments, the terminal 60 may be used to perform the operations of the UE described above. In some embodiments, the processor 600 and the communication unit 620 collaboratively perform the operations described above. For example, the processor 600 performs operations and transmit or receive signals through the communication unit 620.

FIG. 7 relates to a schematic diagram of a wireless network node 70 (e.g., a location management node or a location management device) according to an embodiment of the present disclosure. The wireless network node 70 may be a satellite, a base station (BS), a network entity, a Mobility Management Entity (MME), Serving Gateway (S-GW), Packet Data Network (PDN) Gateway (P-GW), a radio access network (RAN), a next generation RAN (NG-RAN), a data network, a core network or a Radio Network Controller (RNC), and is not limited herein. In addition, the wireless network node 70 may include (perform) at least one network function such as an access and mobility management function (AMF), a session management function (SMF), a location management function (LMF), a location retrieve function (LRF), a user place function (UPF), a policy control function (PCF), an application function (AF), etc. The wireless network node 70 may include a processor 700 such as a microprocessor or ASIC, a storage unit 710 and a communication unit 720. The storage unit 710 may be any data storage device that stores a program code 712, which is accessed and executed by the processor 700. Examples of the storage unit 712 include but are not limited to a SIM, ROM, flash memory, RAM, hard-disk, and optical data storage device. The communication unit 720 may be a transceiver and is used to transmit and receive signals (e.g., messages or packets) according to processing results of the processor 700. In an example, the communication unit 720 transmits and receives the signals via at least one antenna 722.

In an embodiment, the storage unit 710 and the program code 712 may be omitted. The processor 700 may include a storage unit with stored program code.

The processor 700 may implement any steps described in exemplified embodiments on the wireless network node 70, e.g., via executing the program code 712.

The communication unit 720 may be a transceiver. The communication unit 720 may as an alternative or in addition be combining a transmitting unit and a receiving unit configured to transmit and to receive, respectively, signals to and from a terminal.

In some embodiments, the wireless network node 70 may be used to perform the operations of the LMF and/or LRF described above. In some embodiments, the processor 700 and the communication unit 720 collaboratively perform the operations described above. For example, the processor 700 performs operations and transmit or receive signals through the communication unit 720.

FIG. 8 relates to a schematic diagram of a wireless network node 80 (e.g., an access management node or an access management device) according to an embodiment of the present disclosure. The wireless network node 80 may be a satellite, a base station (BS), a network entity, a Mobility Management Entity (MME), Serving Gateway (S-GW), Packet Data Network (PDN) Gateway (P-GW), a radio access network (RAN), a next generation RAN (NG-RAN), a data network, a core network or a Radio Network Controller (RNC), and is not limited herein. In addition, the wireless network node 80 may include (perform) at least one network function such as an access and mobility management function (AMF), a session management function (SMF), a user place function (UPF), a policy control function (PCF), an application function (AF), etc. The wireless network node 80 may include a processor 800 such as a microprocessor or ASIC, a storage unit 810 and a communication unit 820. The storage unit 810 may be any data storage device that stores a program code 812, which is accessed and executed by the processor 800. Examples of the storage unit 812 include but are not limited to a SIM, ROM, flash memory, RAM, hard-disk, and optical data storage device. The communication unit 820 may be a transceiver and is used to transmit and receive signals (e.g., messages or packets) according to processing results of the processor 800. In an example, the communication unit 820 transmits and receives the signals via at least one antenna 822.

In an embodiment, the storage unit 810 and the program code 812 may be omitted. The processor 800 may include a storage unit with stored program code.

The processor 800 may implement any steps described in exemplified embodiments on the wireless network node 80, e.g., via executing the program code 812.

The communication unit 820 may be a transceiver. The communication unit 820 may as an alternative or in addition be combining a transmitting unit and a receiving unit configured to transmit and to receive, respectively, signals to and from a wireless terminal (e.g., a user equipment).

In some embodiments, the wireless network node 80 may be used to perform the operations of the AMF described above. In some embodiments, the processor 800 and the communication unit 820 collaboratively perform the operations described above. For example, the processor 800 performs operations and transmit or receive signals through the communication unit 820.

FIG. 9 illustrates a wireless communication method 900 according to an embodiment of the present disclosure. In an embodiment, the wireless communication method 900 may be performed by using a location management node (e.g., a location management device). In an embodiment, the location management node may be implemented by using the wireless network node 70 described above, but is not limited thereto.

In an embodiment, the wireless communication method 900 includes operations 910 and 920.

Operation 910 includes receiving, by a location management node from a terminal (e.g., a UE), positioning measurement information. In an embodiment, the terminal accesses a satellite network.

Operation 920 includes calculating, by the location management node, a geographical location of the terminal according to the positioning measurement information. In an embodiment, the geographical location is able to be used in acquiring a terrestrial network location of the terminal.

Through such a method, the terrestrial network location of the terminal accessing a satellite network may be acquired by using the actual geographical location of the terminal, so that a more accurate terrestrial network location of the terminal may be used for relevant services (e.g., an emergency service).

In an embodiment, the positioning measurement information is received through an access management node (e.g., an AMF). In an embodiment, the positioning measurement information is received by the access management node through a registration message (e.g., the registration request in step 502 described above) or an uplink NAS transport message (e.g., the uplink NAS transport message in step 408 described above).

In an embodiment, the wireless communication method 900 may further includes operations of receiving, by the location management node from an access management node, a location retrieval request; mapping, by the location management node, the geographical location to the terrestrial network location; and sending, by the location management node to the access management node, the mapped terrestrial network location.

In an embodiment, the location retrieval request includes at least one of an indication of requiring a terrestrial network location or an indication of mapping a geographical location to a terrestrial network location.

In an alternative embodiment, the wireless communication method 900 may further includes operations of receiving, by the location management node from an access management node, a location retrieval request; and sending, by the location management node to the access management node, the geographical location.

Details in this regard can be ascertained with reference to the paragraphs above, and will not be repeated herein.

FIG. 10 illustrates a wireless communication method 1000 according to an embodiment of the present disclosure. In an embodiment, the wireless communication method 1000 may be performed by using a location management node (e.g., a location management device). In an embodiment, the location management node may be implemented by using the wireless network node 70 described above, but is not limited thereto.

In an embodiment, the wireless communication method 1000 includes operations 1010 to 1030.

Operation 1010 includes receiving, by a location management node from an access management node (e.g., an AMF), a location retrieval request.

Operation 1020 includes mapping, by the location management node, a geographical location to a terrestrial network location.

Operation 1030 includes sending, by the location management node to the access management node, the mapped terrestrial network location. In an embodiment, the terrestrial network location corresponds to a terminal (e.g., a UE) accessing a satellite network.

Through such a method, the terrestrial network location of the terminal accessing a satellite network may be acquired by using the actual geographical location of the terminal, so that a more accurate terrestrial network location of the terminal may be used for relevant services (e.g., an emergency service).

In an embodiment, the terrestrial network location is able to be used to setup an emergency session of the terminal, but is not limited thereto.

In an embodiment, the wireless communication method 1000 may further includes operations of receiving, by the location management node from the terminal, positioning measurement information by initiating a positioning procedure; and calculating, by the location management node, the geographical location of the terminal according to the positioning measurement information.

In an embodiment, the wireless communication method 1000 may further includes an operation of receiving, by the location management node from the access management node, the positioning measurement information through an LPP message (e.g., the LPP message in steps 409 and 509).

Details in this regard can be ascertained with reference to the paragraphs above, and will not be repeated herein.

FIG. 11 illustrates a wireless communication method 1100 according to an embodiment of the present disclosure. In an embodiment, the wireless communication method 1100 may be performed by using an access management node (e.g., an access management device). In an embodiment, the access management node may be implemented by using the wireless network node 80 described above, but is not limited thereto.

In an embodiment, the wireless communication method 1100 includes operations 1110 and 1120.

Operation 1110 includes sending, by an access management node to a location management node (e.g., an LMF and/or an LRF), a location retrieval request.

Operation 1120 includes receiving, by the access management node from the location management node, a terrestrial network location. In an embodiment, the terrestrial network location corresponds to a terminal (e.g., a UE) accessing a satellite network.

Through such a method, a more accurate terrestrial network location of the terminal may be acquired and be used for relevant services (e.g., an emergency service).

In an embodiment, the wireless communication method 1100 may further includes operations of receiving, by the access management node from the terminal, positioning measurement information; and sending, by the access management node to the location management node, the positioning measurement information.

In an embodiment, the positioning measurement information is received through a registration message or an uplink NAS transport message (e.g., the uplink NAS transport message in step 408 described above).

In an embodiment, the positioning measurement information is sent to the location management node in an LPP message (e.g., the LPP message in steps 409 and 509).

In an embodiment, the terrestrial network location is able to be used to setup an emergency session of the terminal.

Details in this regard can be ascertained with reference to the paragraphs above, and will not be repeated herein.

FIG. 12 illustrates a wireless communication method 1200 according to an embodiment of the present disclosure. In an embodiment, the wireless communication method 1200 may be performed by using an access management node (e.g., an access management device). In an embodiment, the access management node may be implemented by using the wireless network node 80 described above, but is not limited thereto.

In an embodiment, the wireless communication method 1200 includes operations 1210 to 1230.

Operation 1210 includes sending, by an access management node to a location management node (e.g., an LMF and/or an LRF), a location retrieval request.

Operation 1220 includes receiving, by the access management node from the location management node, a geographical location.

Operation 1230 includes mapping, by the access management node, the geographical location to a terrestrial network location. In an embodiment, the terrestrial network location corresponds to a terminal (e.g., a UE) accessing a satellite network.

Through such a method, a more accurate terrestrial network location of the terminal may be acquired and be used for relevant services (e.g., an emergency service).

Details in this regard can be ascertained with reference to the paragraphs above, and will not be repeated herein.

FIG. 13 illustrates a wireless communication method 1300 according to an embodiment of the present disclosure. In an embodiment, the wireless communication method 1300 may be performed by using a terminal (e.g., a terminal node or a terminal device). In an embodiment, the terminal may be implemented by using the terminal 60 described above, but is not limited thereto.

In an embodiment, the wireless communication method 1300 includes operations 1310 and 1320.

Operation 1310 includes acquiring, by a terminal, positioning measurement information in response to the terminal accessing a satellite network.

Operation 1320 includes sending, by the terminal to a network node (e.g., an AMF or an LMF), the positioning measurement information. In an embodiment, the positioning measurement information is able to be used to acquire a terrestrial network location of the terminal.

Through such a method, the terrestrial network location of the terminal accessing a satellite network may be acquired using the actual geographical location of the terminal, so that a more accurate terrestrial network location of the terminal may be used for relevant services (e.g., an emergency service).

In an embodiment, the positioning measurement information is acquired in response to an emergency service being required by the terminal.

In an embodiment, the wireless communication method 900 may further includes operations of receiving, by the location management node from an access management node, a location retrieval request; mapping, by the location management node, the geographical location to the terrestrial network location; and sending, by the location management node to the access management node, the mapped terrestrial network location.

In an embodiment, the positioning measurement information is encapsulated in a Long-Term Evolution Positioning Protocol, LPP, message.

Details in this regard can be ascertained with reference to the paragraphs above, and will not be repeated herein.

While various embodiments of the present disclosure have been described above, it should be understood that they have been presented by way of example only, and not by way of limitation. Likewise, the various diagrams may depict an example architectural or configuration, which are provided to enable persons of ordinary skill in the art to understand exemplary features and functions of the present disclosure. Such persons would understand, however, that the present disclosure is not restricted to the illustrated example architectures or configurations, but can be implemented using a variety of alternative architectures and configurations. Additionally, as would be understood by persons of ordinary skill in the art, one or more features of one embodiment can be combined with one or more features of another embodiment described herein. Thus, the breadth and scope of the present disclosure should not be limited by any one of the above-described exemplary embodiments.

It is also understood that any reference to an element herein using a designation such as "first," "second," and so forth does not generally limit the quantity or order of those elements. Rather, these designations can be used herein as a convenient means of distinguishing between two or more elements or instances of an element. Thus, a reference to first and second elements does not mean that only two elements can be employed, or that the first element must precede the second element in some manner.

Additionally, a person having ordinary skill in the art would understand that information and signals can be represented using any one of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits and symbols, for example, which may be referenced in the above description can be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

A skilled person would further appreciate that any one of the various illustrative logical blocks, units, processors, means, circuits, methods and functions described in connection with the aspects disclosed herein can be implemented by electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two), firmware, various forms of program or design code incorporating instructions (which can be referred to herein, for convenience, as "software" or a "software unit”), or any combination of these techniques.

To clearly illustrate this interchangeability of hardware, firmware and software, various illustrative components, blocks, units, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware, firmware or software, or a combination of these techniques, depends upon the particular application and design constraints imposed on the overall system. Skilled artisans can implement the described functionality in various ways for each particular application, but such implementation decisions do not cause a departure from the scope of the present disclosure. In accordance with various embodiments, a processor, device, component, circuit, structure, machine, unit, etc. can be configured to perform one or more of the functions described herein. The term “configured to” or “configured for” as used herein with respect to a specified operation or function refers to a processor, device, component, circuit, structure, machine, unit, etc. that is physically constructed, programmed and/or arranged to perform the specified operation or function.

Furthermore, a skilled person would understand that various illustrative logical blocks, units, devices, components and circuits described herein can be implemented within or performed by an integrated circuit (IC) that can include a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, or any combination thereof. The logical blocks, units, and circuits can further include antennas and/or transceivers to communicate with various components within the network or within the device. A general purpose processor can be a microprocessor, but in the alternative, the processor can be any conventional processor, controller, or state machine. A processor can also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other suitable configuration to perform the functions described herein. If implemented in software, the functions can be stored as one or more instructions or code on a computer-readable medium. Thus, the steps of a method or algorithm disclosed herein can be implemented as software stored on a computer-readable medium.

Computer-readable media includes both computer storage media and communication media including any medium that can be enabled to transfer a computer program or code from one place to another. A storage media can be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to store desired program code in the form of instructions or data structures and that can be accessed by a computer.

In this document, the term "unit" as used herein, refers to software, firmware, hardware, and any combination of these elements for performing the associated functions described herein. Additionally, for purpose of discussion, the various units are described as discrete units; however, as would be apparent to one of ordinary skill in the art, two or more units may be combined to form a single unit that performs the associated functions according embodiments of the present disclosure.

Additionally, memory or other storage, as well as communication components, may be employed in embodiments of the present disclosure. It will be appreciated that, for clarity purposes, the above description has described embodiments of the present disclosure with reference to different functional units and processors. However, it will be apparent that any suitable distribution of functionality between different functional units, processing logic elements or domains may be used without detracting from the present disclosure. For example, functionality illustrated to be performed by separate processing logic elements, or controllers, may be performed by the same processing logic element, or controller. Hence, references to specific functional units are only references to a suitable means for providing the described functionality, rather than indicative of a strict logical or physical structure or organization.

Various modifications to the implementations described in this disclosure will be readily apparent to those skilled in the art, and the general principles defined herein can be applied to other implementations without departing from the scope of this disclosure. Thus, the disclosure is not intended to be limited to the implementations shown herein, but is to be accorded the widest scope consistent with the novel features and principles disclosed herein, as recited in the claims below.

claim

1. A wireless communication method comprising:
receiving, by a location management node from a terminal, positioning measurement information, wherein the terminal accesses a satellite network; and
calculating, by the location management node, a geographical location of the terminal according to the positioning measurement information;
wherein the geographical location is able to be used in acquiring a terrestrial network location of the terminal.

2. The wireless communication method of claim 1, wherein the positioning measurement information is received through an access management node.

3. The wireless communication method of claim 2, wherein the positioning measurement information is received by the access management node through a registration message or an uplink Non-Access Stratum, NAS, transport message.

4. The wireless communication method of any one of claims 1 to 3, wherein the positioning measurement information is received by the location management node from an access management node in a Long-Term Evolution Positioning Protocol, LPP, message.

5. The wireless communication method of any one of claims 1 to 4, wherein the positioning measurement information comprises at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

6. The wireless communication method of any one of claims 1 to 5, further comprising:
receiving, by the location management node from an access management node, a location retrieval request;
mapping, by the location management node, the geographical location to the terrestrial

network location; and

sending, by the location management node to the access management node, the mapped terrestrial network location.

7. The wireless communication method of claim 6, wherein the location retrieval request comprises at least one of an indication of requiring a terrestrial network location or an indication of mapping a geographical location to a terrestrial network location.

8. The wireless communication method of any one of claims 1 to 7, wherein the terrestrial network location comprises at least one of a cell ID or a Tracking Area Code, TAC.

9. The wireless communication method of any one of claims 1 to 5 and 8, further comprising:

receiving, by the location management node from an access management node, a location retrieval request; and

sending, by the location management node to the access management node, the geographical location.

10. A wireless communication method comprising:

receiving, by a location management node from an access management node, a location retrieval request;

mapping, by the location management node, a geographical location to a terrestrial network location; and

sending, by the location management node to the access management node, the mapped terrestrial network location;

wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

11. The wireless communication method of claim 10, wherein the location retrieval request comprises at least one of an indication of requiring a terrestrial network location or an

indication of mapping a geographical location to a terrestrial network location.

12. The wireless communication method of claim 10 or 11, wherein the terrestrial network location comprises at least one of a cell ID or a Tracking Area Code, TAC.

13. The wireless communication method of any one of claims 10 to 12, wherein the terrestrial network location is able to be used to setup an emergency session of the terminal.

14. The wireless communication method of any one of claims 10 to 13, further comprising:
receiving, by the location management node from the terminal, positioning measurement information by initiating a positioning procedure; and
calculating, by the location management node, the geographical location of the terminal according to the positioning measurement information.

15. The wireless communication method of any one of claims 10 to 14, wherein the positioning measurement information comprises at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

16. The wireless communication method of any one of claims 10 to 14, further comprising:
receiving, by the location management node from the access management node, the positioning measurement information through a Long-Term Evolution Positioning Protocol, LPP, message.

17. A wireless communication method comprising:
sending, by an access management node to a location management node, a location retrieval request; and
receiving, by the access management node from the location management node, a terrestrial network location;

wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

18. The wireless communication method of claim 17, wherein the location retrieval request comprises at least one of an indication of requiring a terrestrial network location or an indication of mapping a geographical location to a terrestrial network location.

19. The wireless communication method of claim 17 or 18 further comprising:
receiving, by the access management node from the terminal, positioning measurement information; and
sending, by the access management node to the location management node, the positioning measurement information;
wherein the geographical location corresponds to the positioning measurement information.

20. The wireless communication method of claim 19, wherein the positioning measurement information is received through a registration message or an uplink Non-Access Stratum, NAS, transport message.

21. The wireless communication method of claim 19 or 20, wherein the positioning measurement information is sent to the location management node in a Long-Term Evolution Positioning Protocol, LPP, message.

22. The wireless communication method of any one of claims 17 to 21, wherein the positioning measurement information comprises at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

23. The wireless communication method of any one of claims 17 to 22, wherein the terrestrial network location is able to be used to setup an emergency session of the

terminal.

24. The wireless communication method of any one of claims 17 to 23, wherein the terrestrial network location comprises at least one of a cell ID or a Tracking Area Code, TAC.

25. A wireless communication method comprising:
sending, by an access management node to a location management node, a location retrieval request;
receiving, by the access management node from the location management node, a geographical location; and
mapping, by the access management node, the geographical location to a terrestrial network location;
wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

26. The wireless communication method of claim 25 further comprising:
receiving, by the access management node from the terminal, positioning measurement information; and
sending, by the access management node to the location management node, the positioning measurement information;
wherein the geographical location corresponds to the positioning measurement information.

27. The wireless communication method of claim 26, wherein the positioning measurement information is received through a registration message or an uplink Non-Access Stratum, NAS, transport message.

28. The wireless communication method of claim 26 or 27, wherein the positioning measurement information is sent to the location management node in a Long-Term

Evolution Positioning Protocol, LPP, message.

29. The wireless communication method of any one of claims 25 to 28, wherein the positioning measurement information comprises at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

30. The wireless communication method of any one of claims 25 to 29, wherein the terrestrial network location is able to be used to setup an emergency session of the terminal.

31. The wireless communication method of any one of claims 25 to 30, wherein the terrestrial network location comprises at least one of a cell ID or a Tracking Area Code, TAC.

32. A wireless communication method comprising:

acquiring, by a terminal, positioning measurement information in response to the terminal accessing a satellite network; and

sending, by the terminal to a network node, the positioning measurement information;

wherein the positioning measurement information is able to be used to acquire a terrestrial network location of the terminal.

33. The wireless communication method of claim 34, wherein the positioning measurement information is acquired in response to an emergency service being required by the terminal.

34. The wireless communication method of claim 32 or 33, wherein the positioning measurement information is sent to an access management node through a registration message or an uplink Non-Access Stratum, NAS, transport message.

35. The wireless communication method of any one of claims 32 to 34, wherein the positioning measurement information is encapsulated in a Long-Term Evolution Positioning Protocol, LPP, message.

36. The wireless communication method of any one of claims 32 to 35, wherein the positioning measurement information comprises at least one of Global Navigation Satellite System, GNSS, measurement information or Global Positioning System, GPS, coordinates.

37. The wireless communication method of any one of claims 32 to 36, wherein the terrestrial network location comprises at least one of a cell ID or a Tracking Area Code, TAC.

38. A location management node, comprising:
a communication unit; and
a processor configured to:
receive, from a terminal, positioning measurement information, wherein the terminal accesses a satellite network; and
calculate a geographical location of the terminal according to the positioning measurement information;
wherein the geographical location is able to be used in acquiring a terrestrial network location of the terminal.

39. The location management node of claim 38, wherein the processor is further configured to perform a wireless communication method of any of claims 2 to 9.

40. A location management node, comprising:
a communication unit; and
a processor configured to:
receive, from an access management node, a location retrieval request;

map a geographical location to a terrestrial network location; and

send, to the access management node, the mapped terrestrial network location;

wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

41. The location management node of claim 40, wherein the processor is further configured to perform a wireless communication method of any of claims 11 to 16.

42. An access management node, comprising:

a communication unit; and

a processor configured to:

send, to a location management node, a location retrieval request; and

receive, from the location management node, a terrestrial network location;

wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

43. The access management node of claim 42, wherein the processor is further configured to perform a wireless communication method of any of claims 18 to 24.

44. An access management node, comprising:

a communication unit; and

a processor configured to:

send, to a location management node, a location retrieval request;

receive, from the location management node, a geographical location; and

map the geographical location to a terrestrial network location;

wherein the terrestrial network location corresponds to a terminal accessing a satellite network.

45. The access management node of claim 44, wherein the processor is further configured to perform a wireless communication method of any of claims 26 to 31.

46. A terminal, comprising:

a communication unit; and

a processor configured to:

acquire positioning measurement information in response to the terminal accessing a satellite network; and

send the positioning measurement information;

wherein the positioning measurement information is able to be used to acquire a terrestrial network location of the terminal.

47. The terminal of claim 46, wherein the processor is further configured to perform a wireless communication method of any of claims 33 to 37.

48. A computer program product comprising a computer-readable program medium code stored thereupon, the code, when executed by a processor, causing the processor to implement a wireless communication method recited in any of claims 1 to 37.

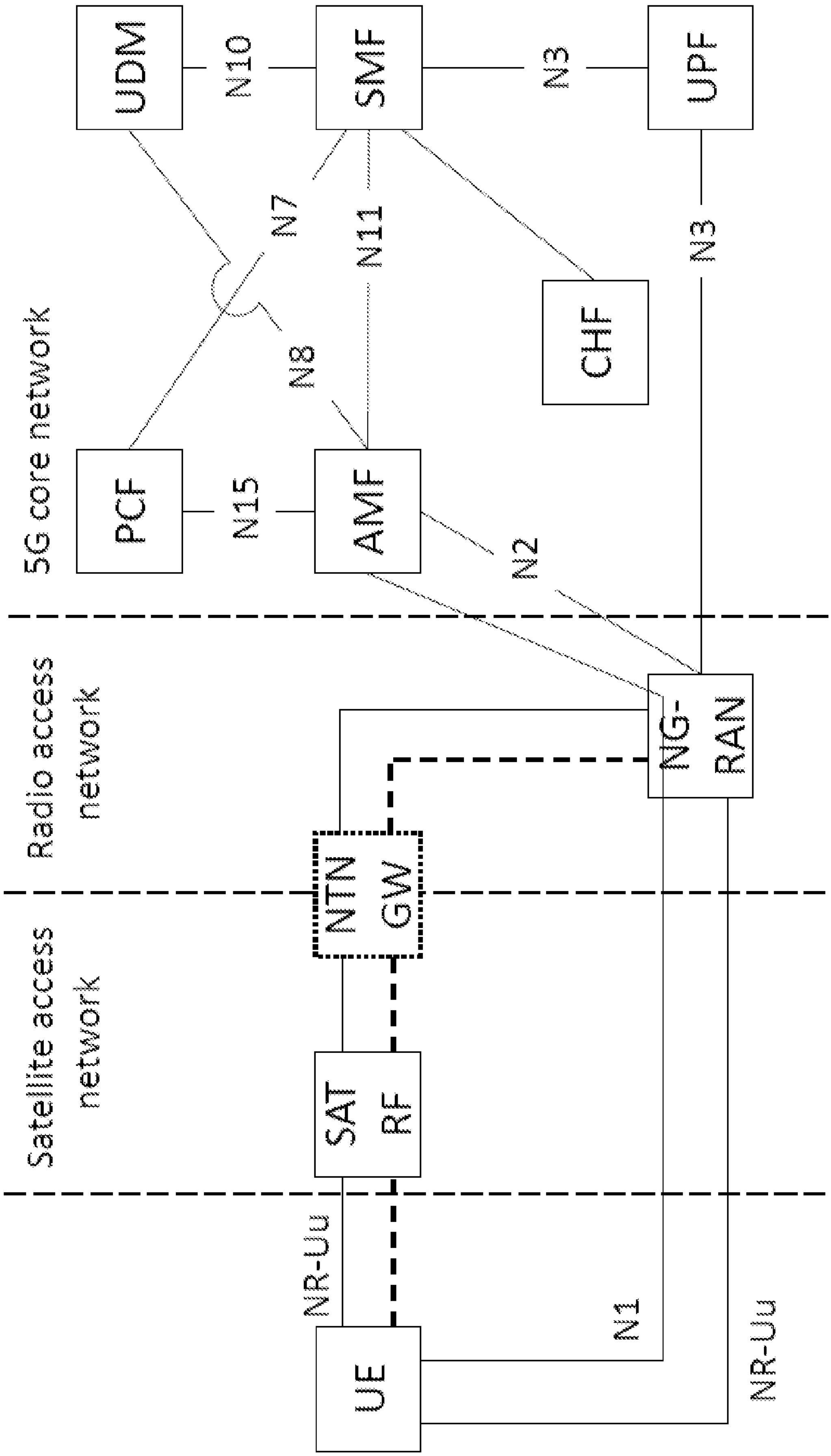
5G core network
Radio access network
Satellite access network
UDM
N10
SMF
N3
UPF
N7
N11
N8
N3
CHF
PCF
N15
AMF
N2
NG-RAN
NTN GW
SAT RF
NR-Uu
N1
NR-Uu
UE

FIG. 1A

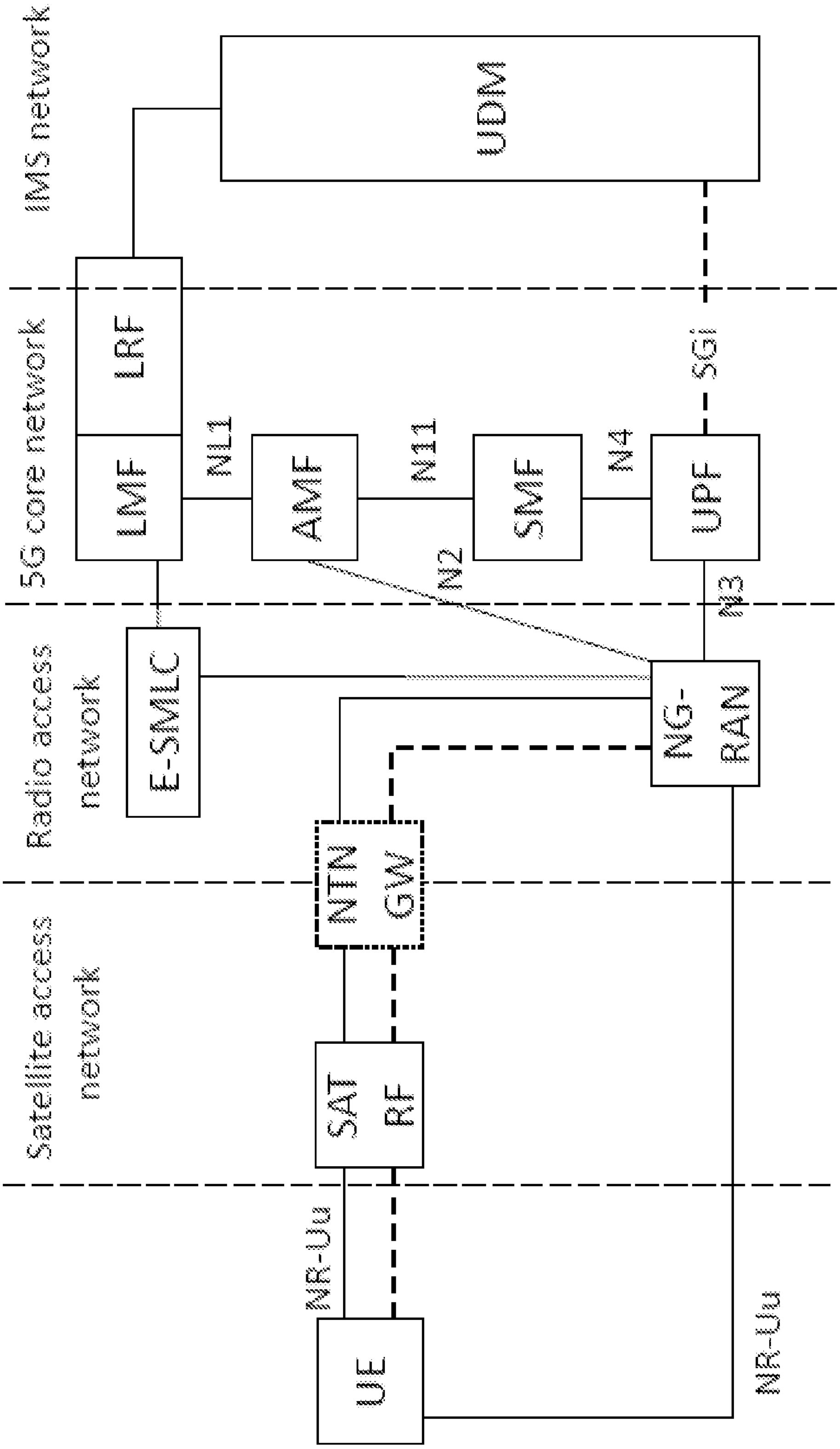
IMS network
5G core network
Radio access network
Satellite access network
UDM
LRF
LMF
AMF
SMF
UPF
NL1
N11
N4
SGi
N2
N3
E-SMLC
NG-RAN
NTN GW
SAT RF
NR-Uu
UE
NR-Uu

FIG. 1B

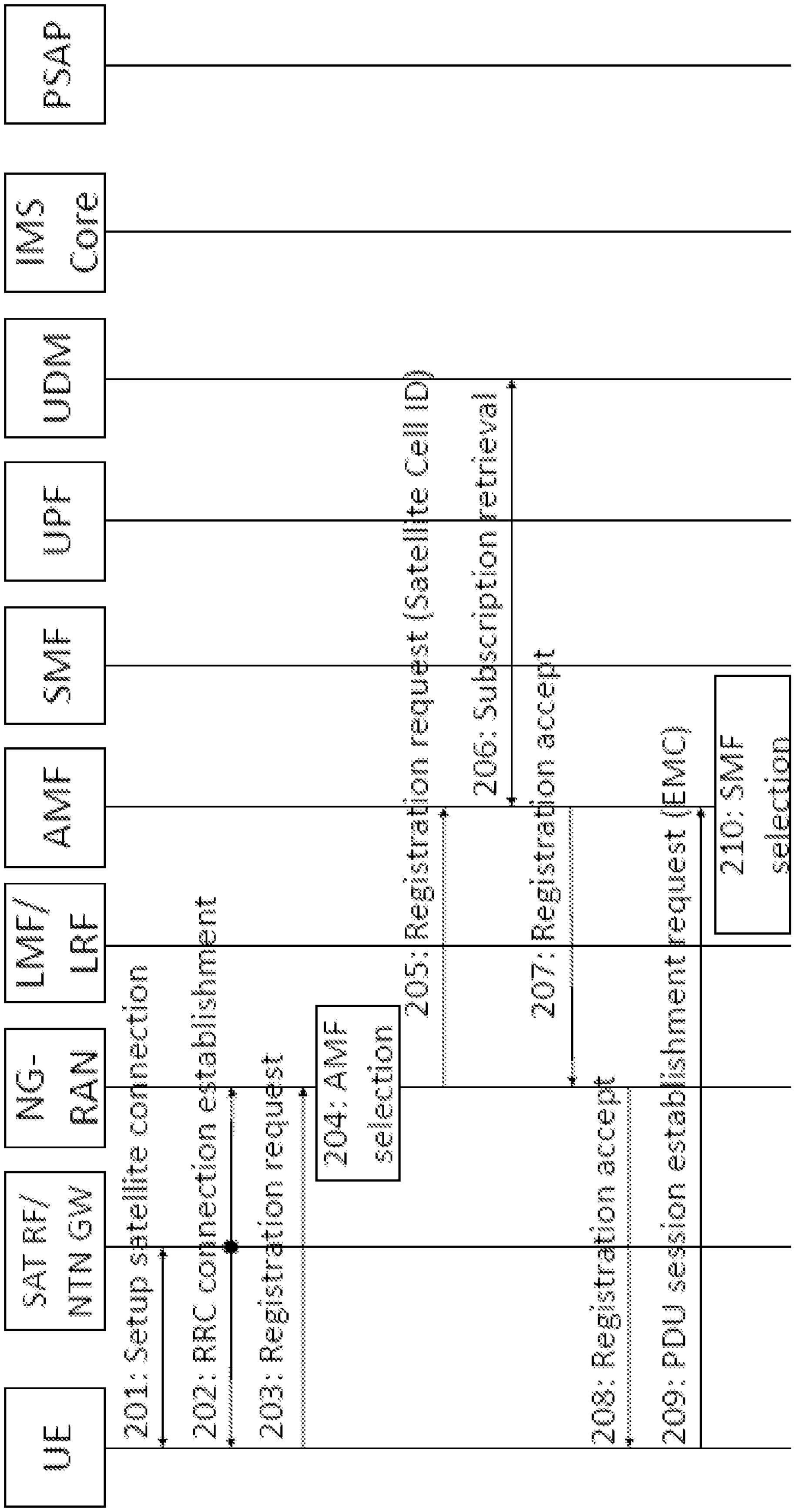
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
201: Setup satellite connection
202: RRC connection establishment
203: Registration request
204: AMF selection
205: Registration request (Satellite Cell ID)
206: Subscription retrieval
207: Registration accept
208: Registration accept
209: PDU session establishment request (EMC)
210: SMF selection

FIG. 2A

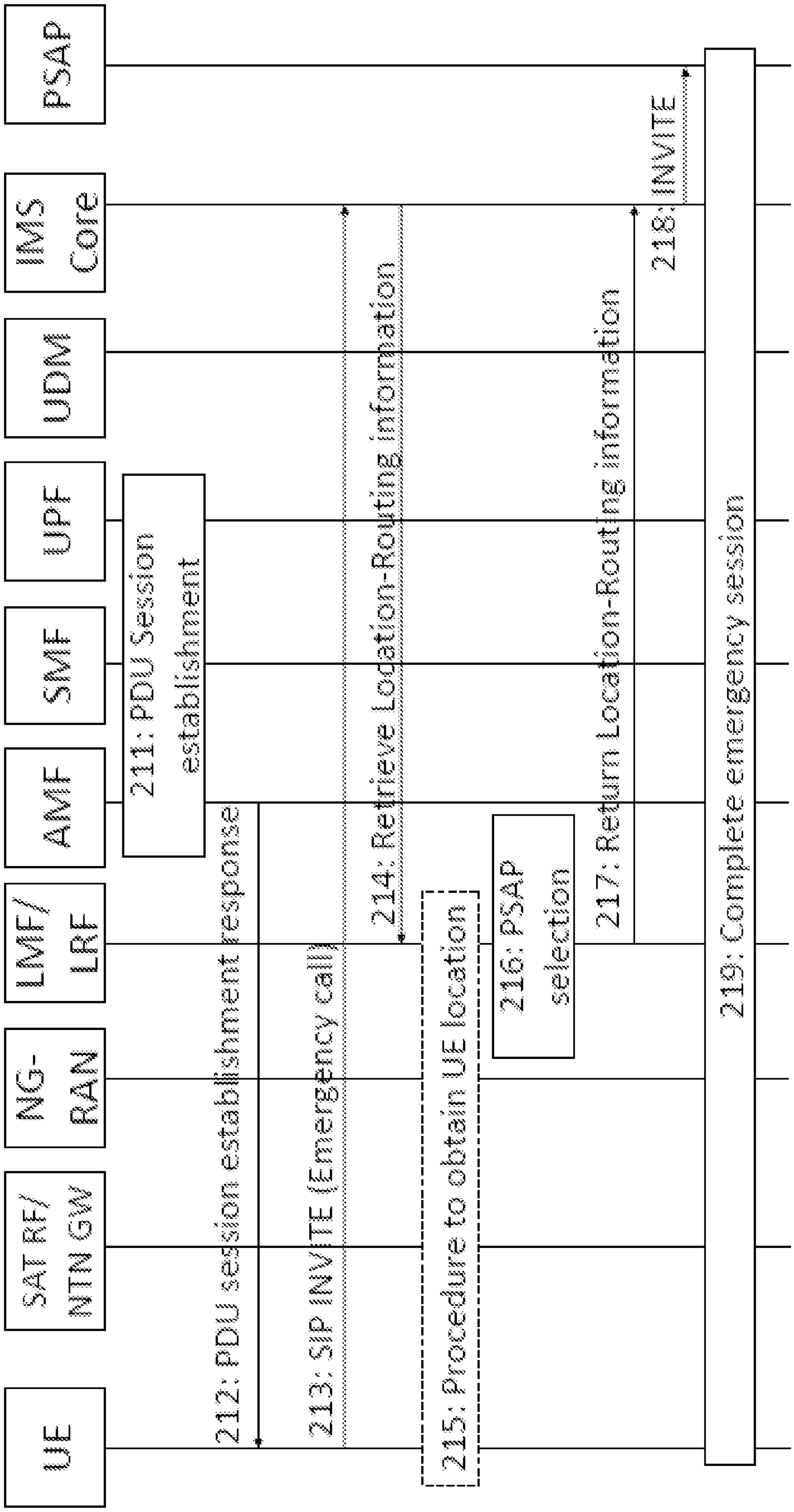
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
211: PDU Session establishment
212: PDU session establishment response
213: SIP INVITE (Emergency call)
214: Retrieve Location-Routing information
215: Procedure to obtain UE location
216: PSAP selection
217: Return Location-Routing information
218: INVITE
219: Complete emergency session

FIG. 2B

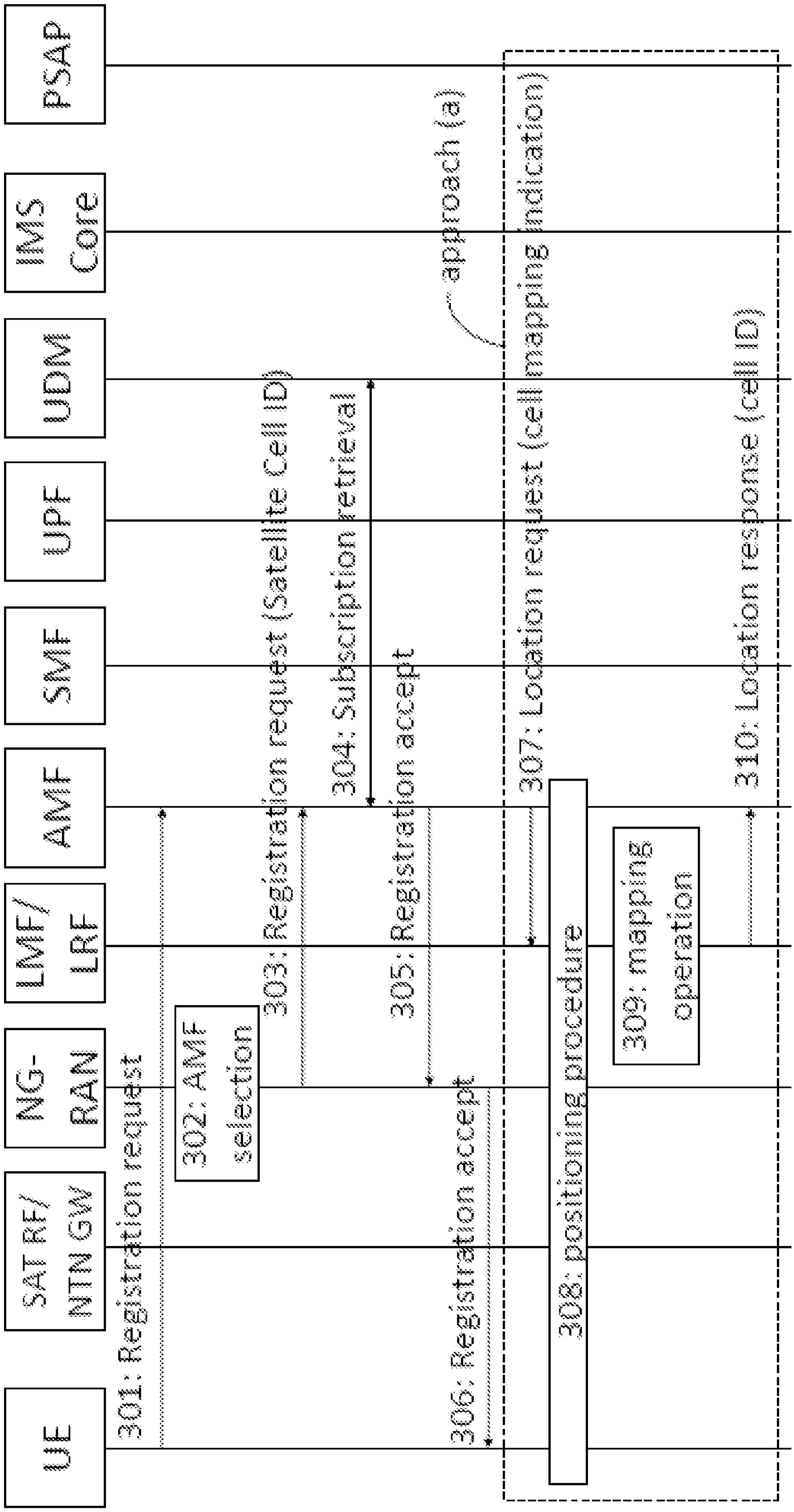
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
301: Registration request
302: AMF selection
303: Registration request (Satellite Cell ID)
304: Subscription retrieval
305: Registration accept
306: Registration accept
approach (a)
307: Location request (cell mapping indication)
308: positioning procedure
309: mapping operation
310: Location response (cell ID)

FIG. 3A

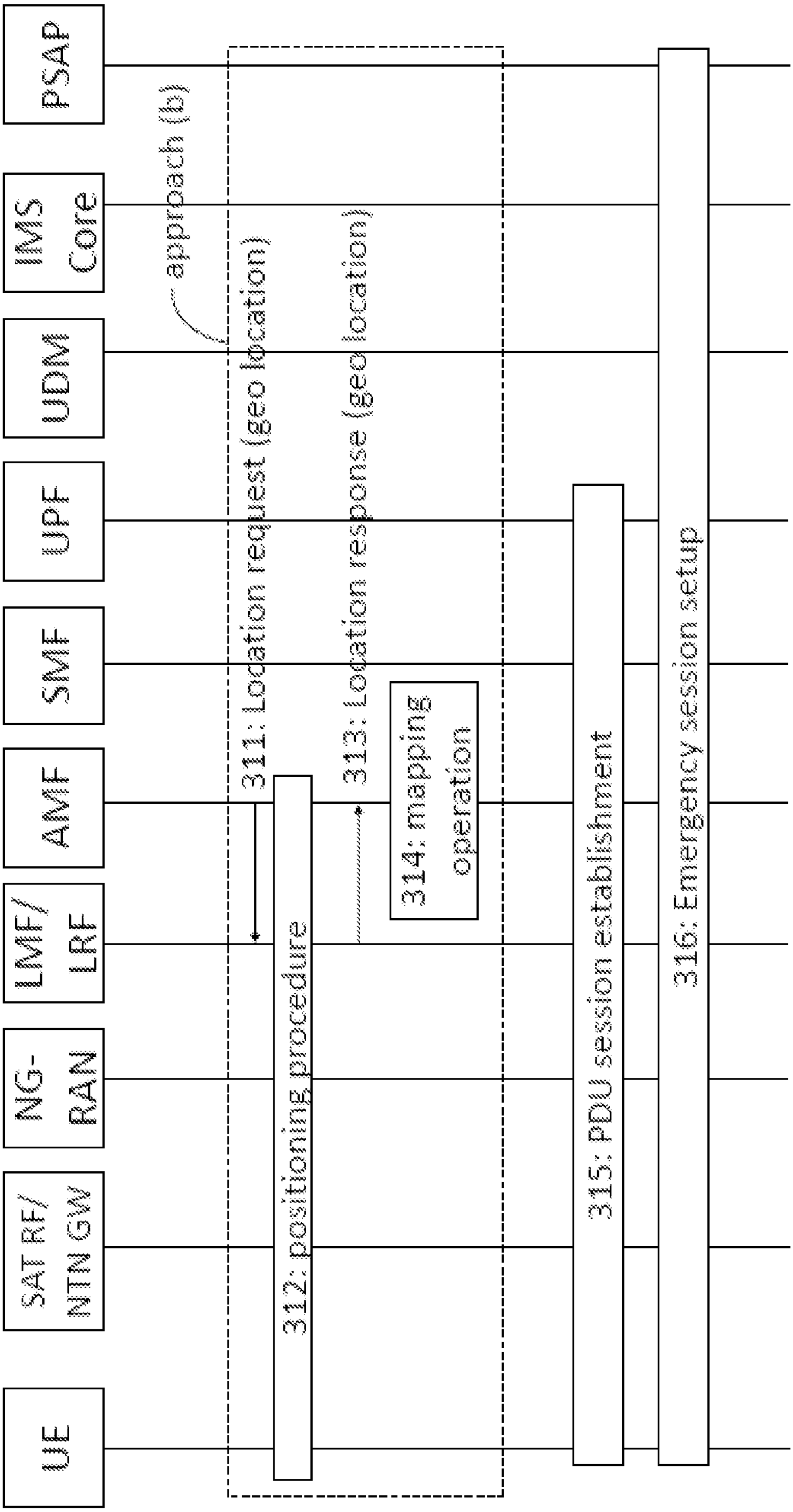
UE
SAT RF/
NTN GW
NG-
RAN
LMF/
LRF
AMF
SMF
UPF
UDM
IMS
Core
PSAP
approach (b)
311: Location request (geo location)
312: positioning procedure
313: Location response (geo location)
314: mapping
operation
315: PDU session establishment
316: Emergency session setup

FIG. 3B

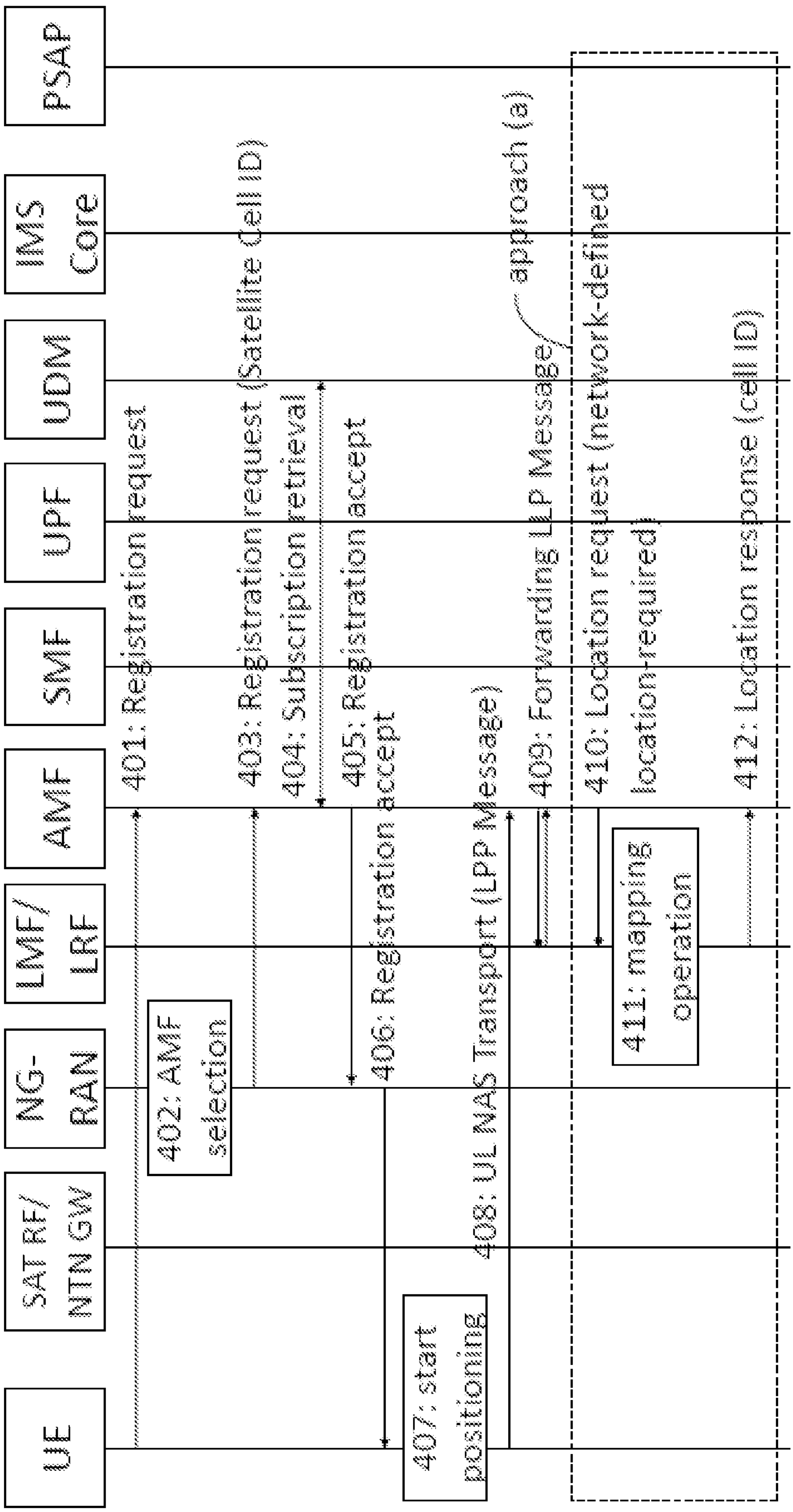
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
401: Registration request
402: AMF selection
403: Registration request (Satellite Cell ID)
404: Subscription retrieval
405: Registration accept
406: Registration accept
407: start positioning
408: UL NAS Transport (LPP Message)
409: Forwarding LLP Message
approach (a)
410: Location request (network-defined location-required)
411: mapping operation
412: Location response (cell ID)

FIG. 4A

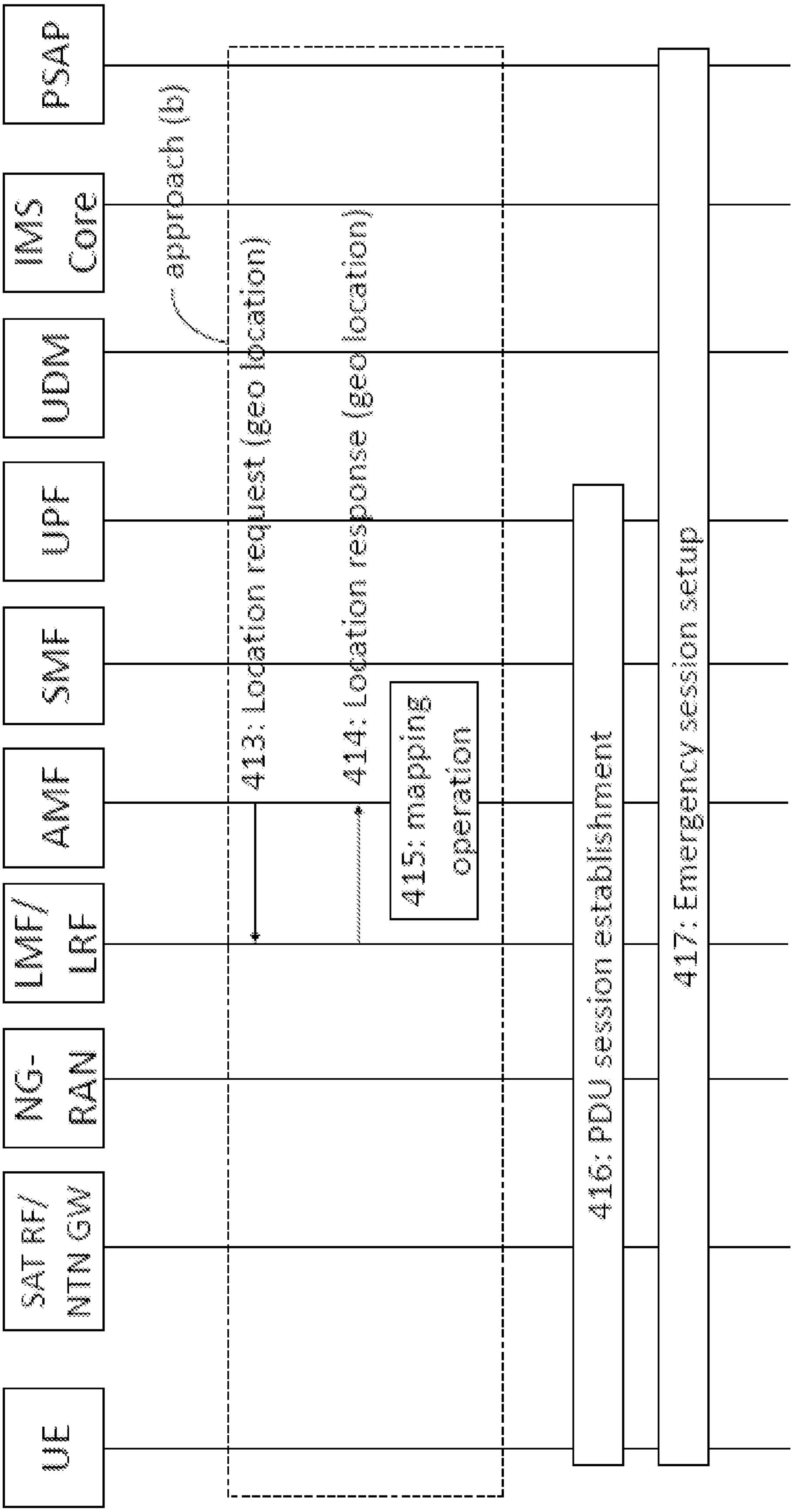
UE
SAT RF/
NTN GW
NG-
RAN
LMF/
LRF
AMF
SMF
UPF
UDM
IMS
Core
PSAP
approach (b)
413: Location request (geo location)
414: Location response (geo location)
415: mapping
operation
416: PDU session establishment
417: Emergency session setup

FIG. 4B

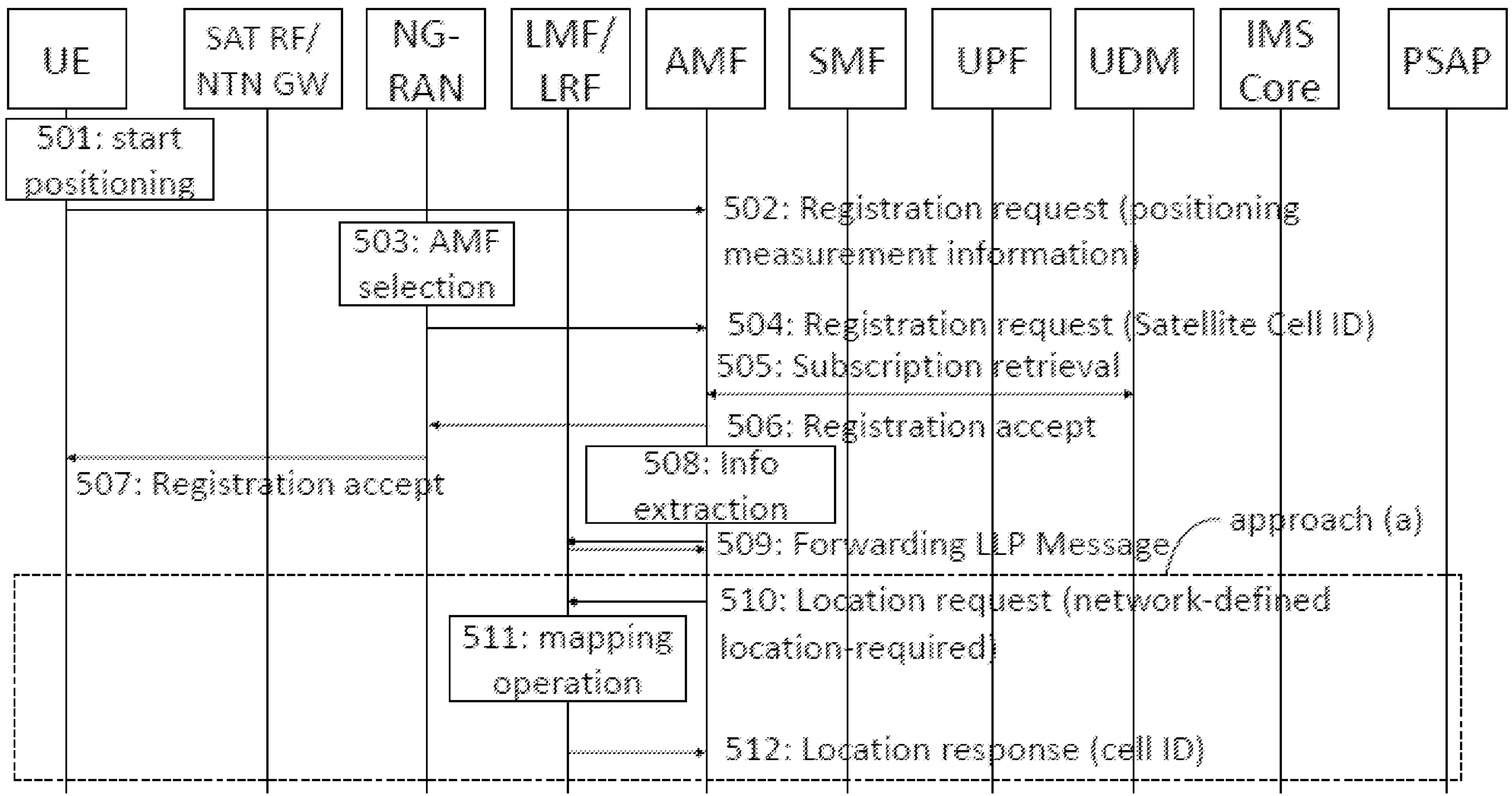
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
501: start positioning
502: Registration request (positioning measurement information)
503: AMF selection
504: Registration request (Satellite Cell ID)
505: Subscription retrieval
506: Registration accept
507: Registration accept
508: Info extraction
509: Forwarding LLP Message
approach (a)
510: Location request (network-defined location-required)
511: mapping operation
512: Location response (cell ID)

FIG. 5A

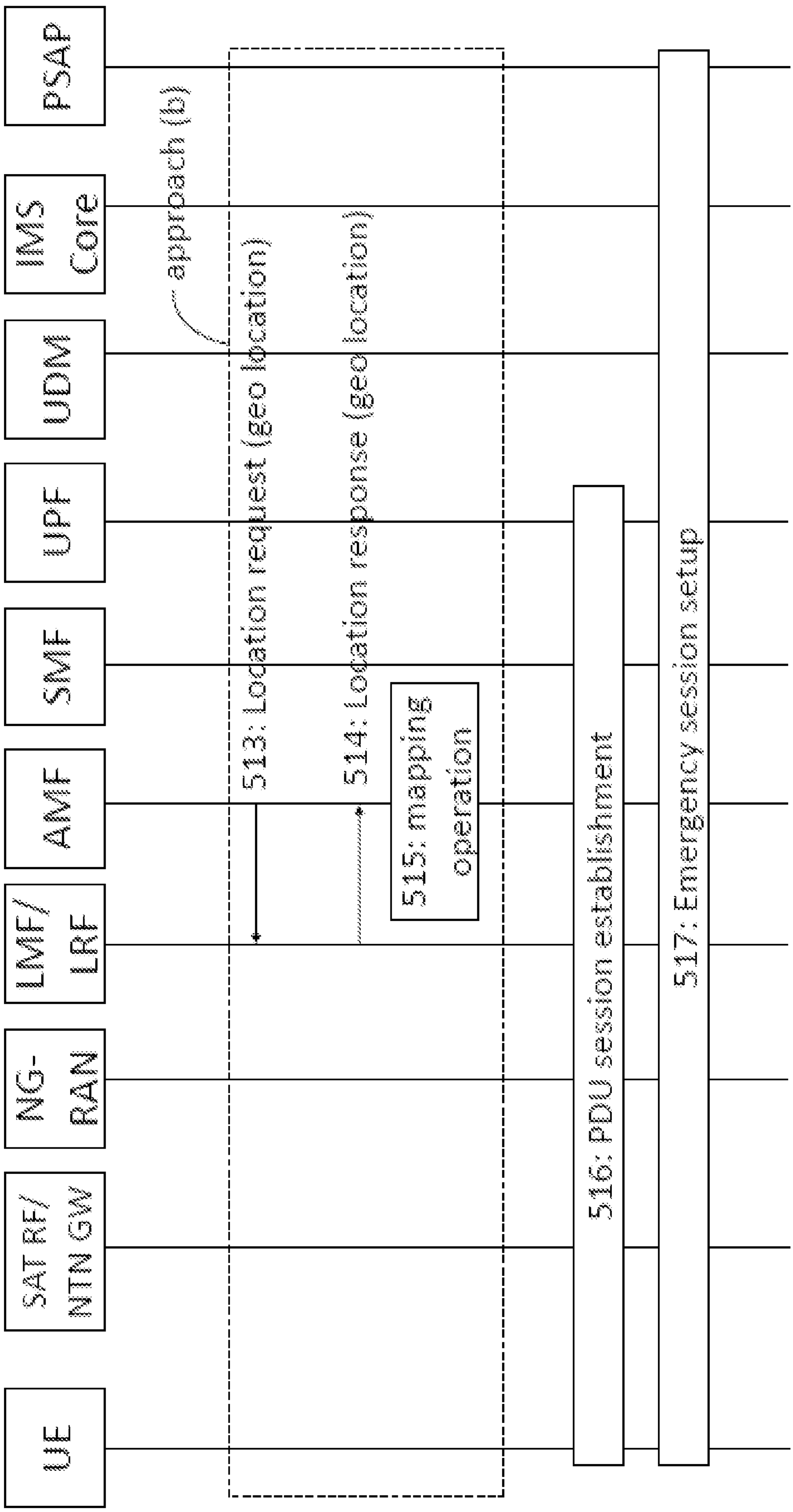
UE
SAT RF/ NTN GW
NG-RAN
LMF/ LRF
AMF
SMF
UPF
UDM
IMS Core
PSAP
approach (b)
513: Location request (geo location)
514: Location response (geo location)
515: mapping operation
516: PDU session establishment
517: Emergency session setup

FIG. 5B

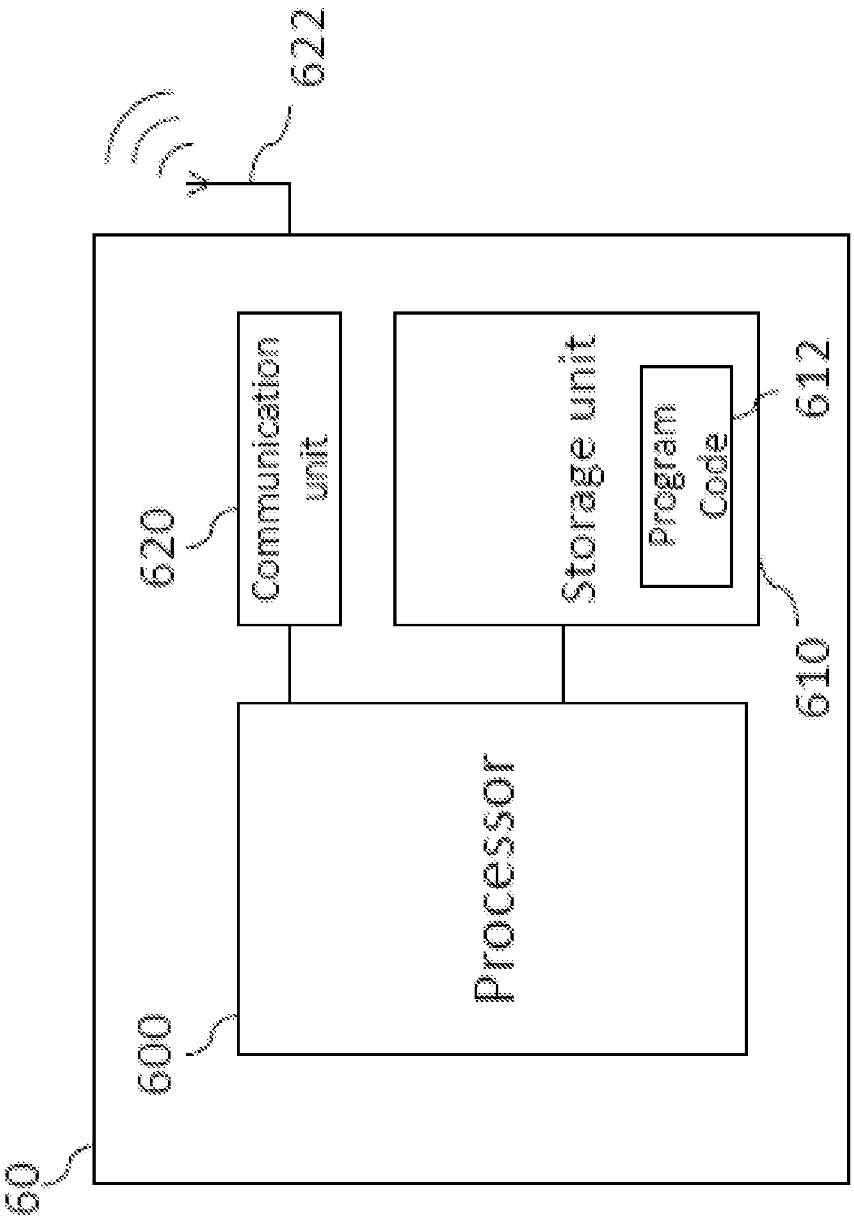
622
Communication unit
620
Storage unit
Program Code
612
610
Processor
600
60

FIG. 6

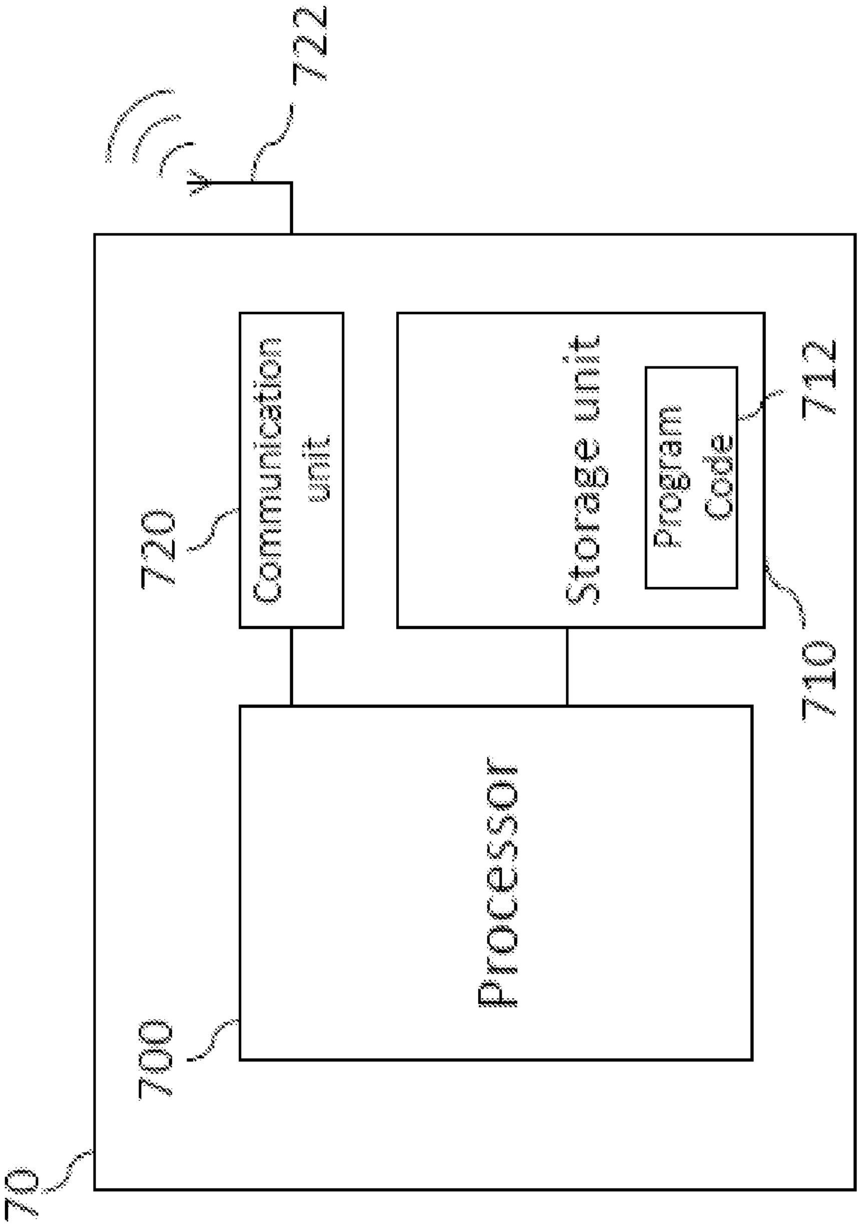
722
Communication unit
720
Storage unit
Program Code
712
710
Processor
700
70

FIG. 7

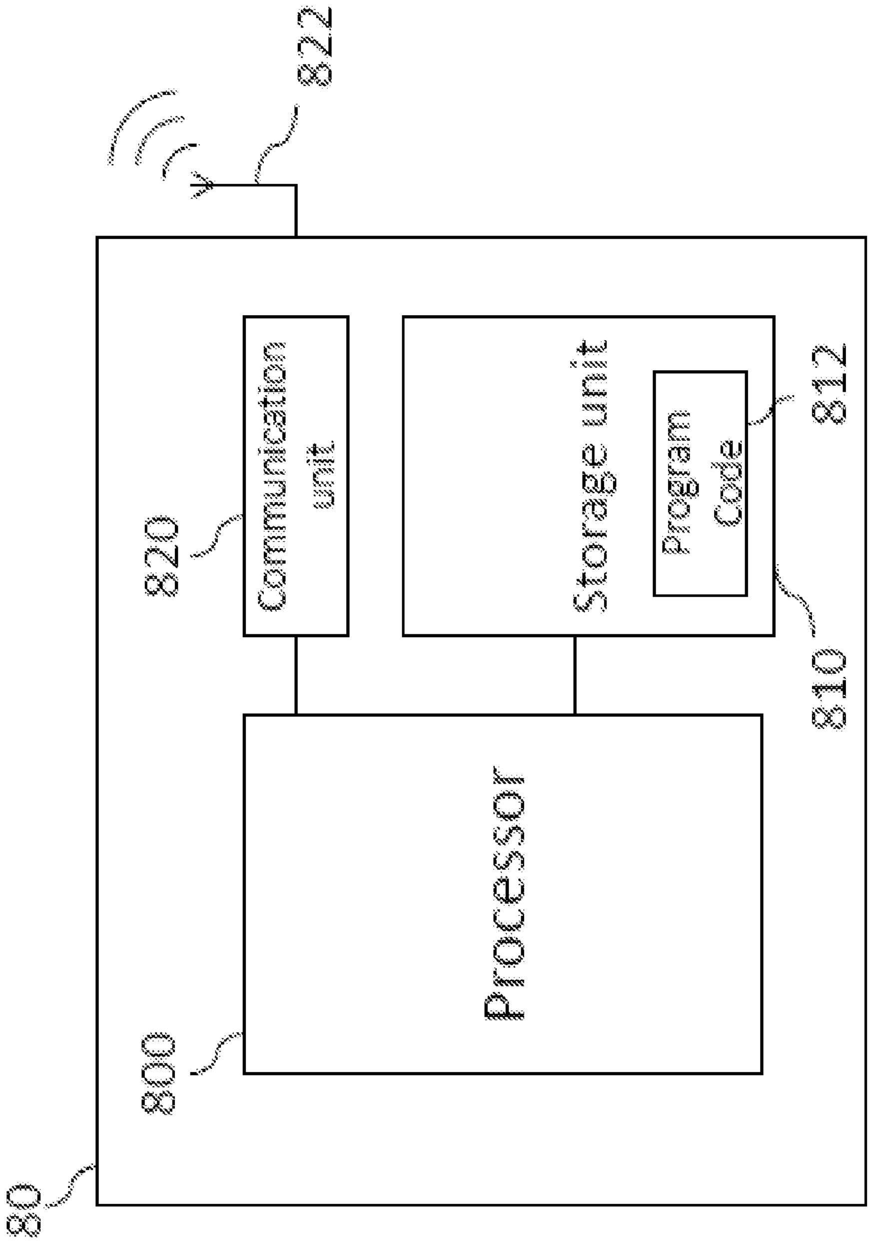
822
Communication unit
820
Storage unit
Program Code
812
810
Processor
800
80

FIG. 8

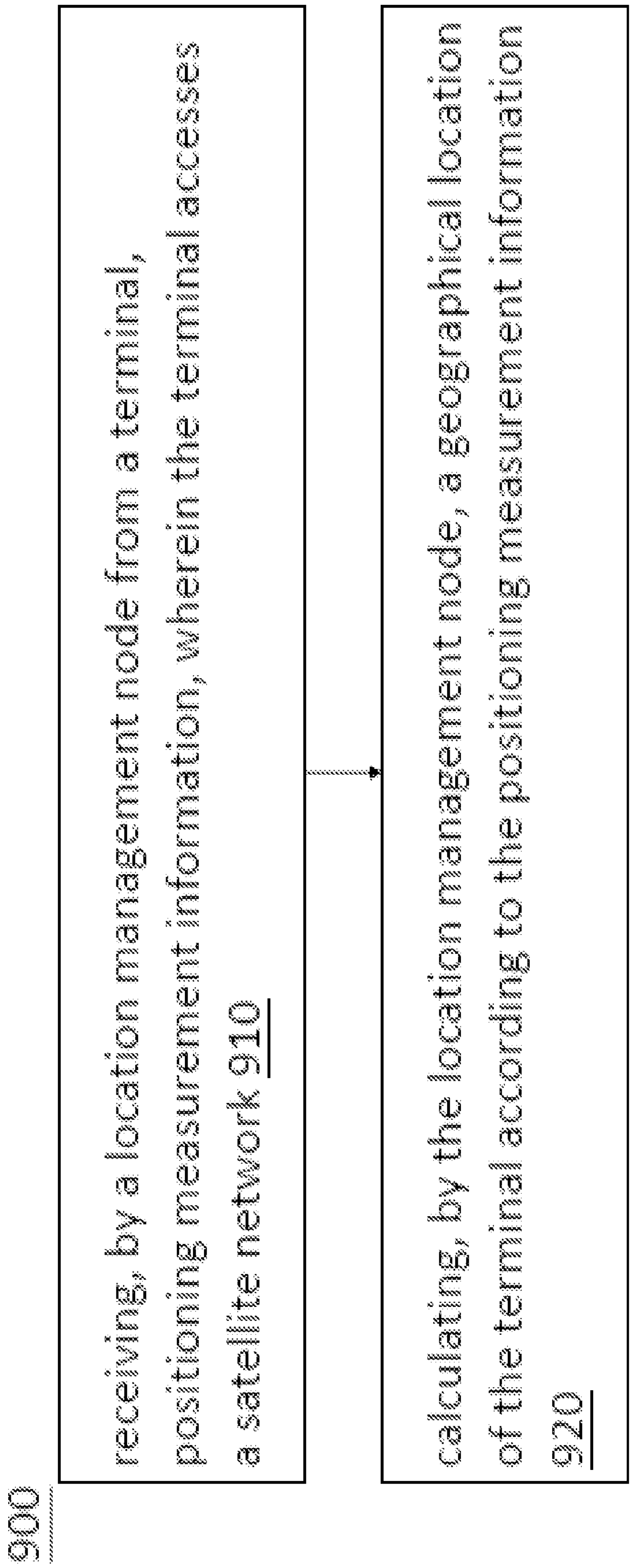
900
receiving, by a location management node from a terminal, positioning measurement information, wherein the terminal accesses a satellite network 910
calculating, by the location management node, a geographical location of the terminal according to the positioning measurement information 920

FIG. 9

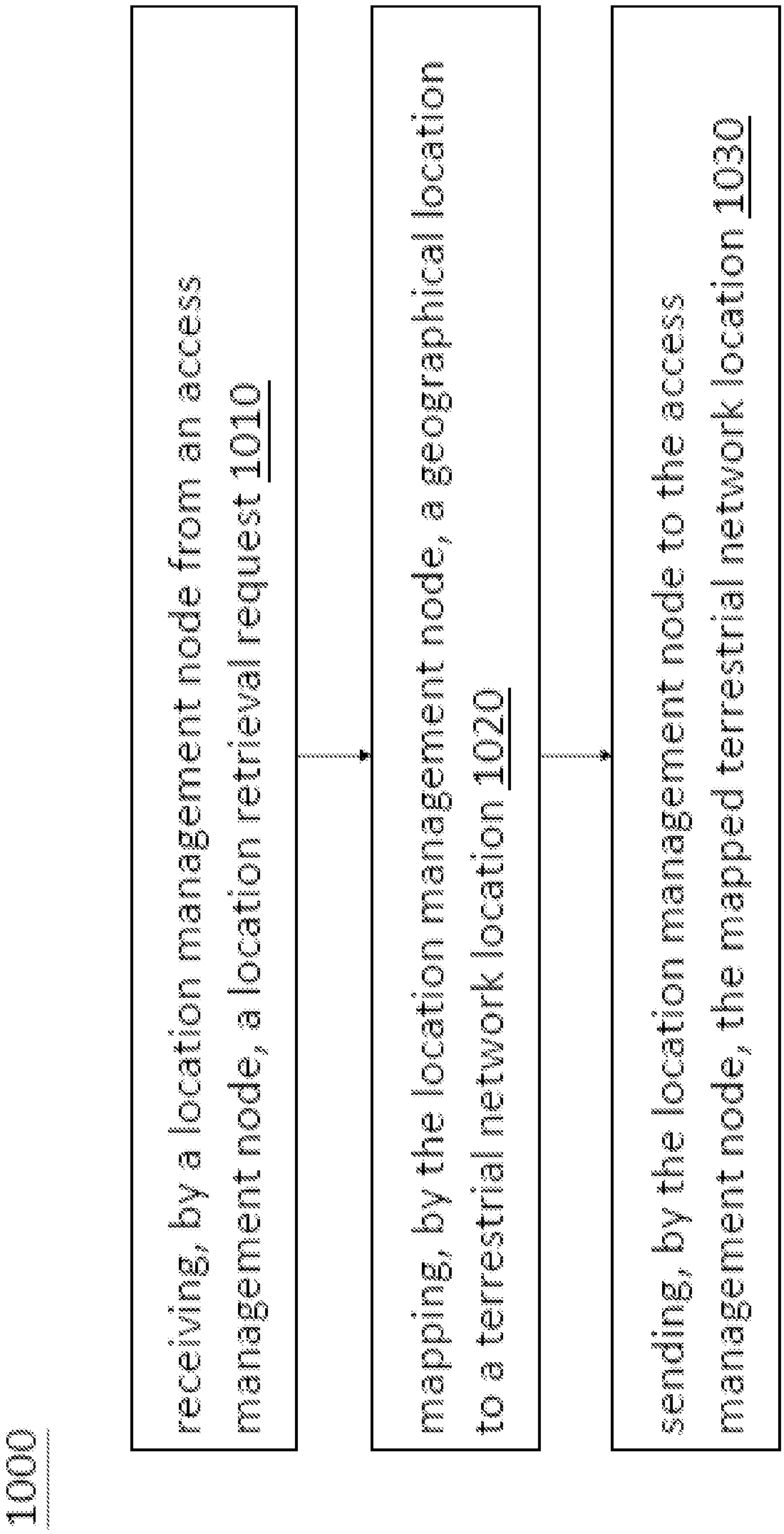
1000
receiving, by a location management node from an access management node, a location retrieval request 1010
mapping, by the location management node, a geographical location to a terrestrial network location 1020
sending, by the location management node to the access management node, the mapped terrestrial network location 1030

FIG. 10

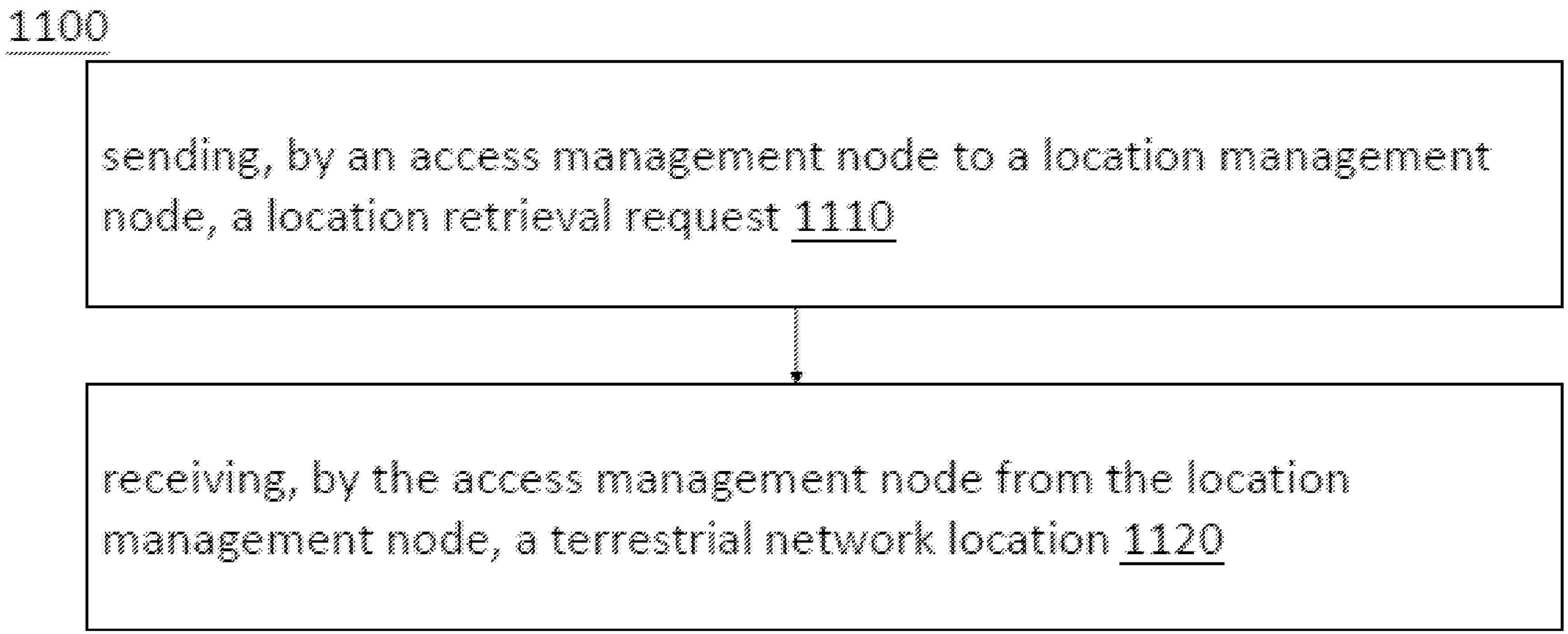
1100
sending, by an access management node to a location management node, a location retrieval request 1110
receiving, by the access management node from the location management node, a terrestrial network location 1120

FIG. 11

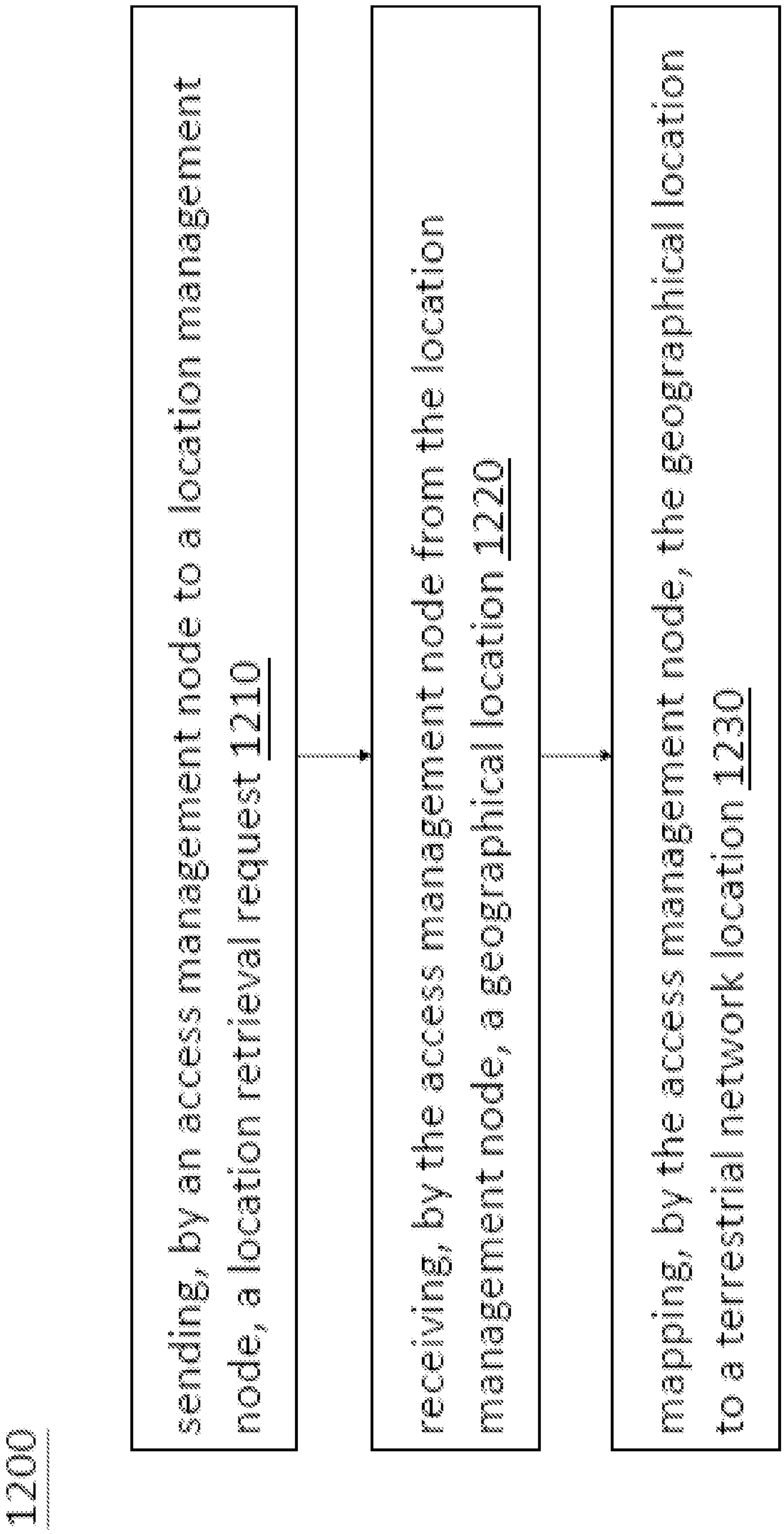
1200
sending, by an access management node to a location management node, a location retrieval request 1210
receiving, by the access management node from the location management node, a geographical location 1220
mapping, by the access management node, the geographical location to a terrestrial network location 1230

FIG. 12

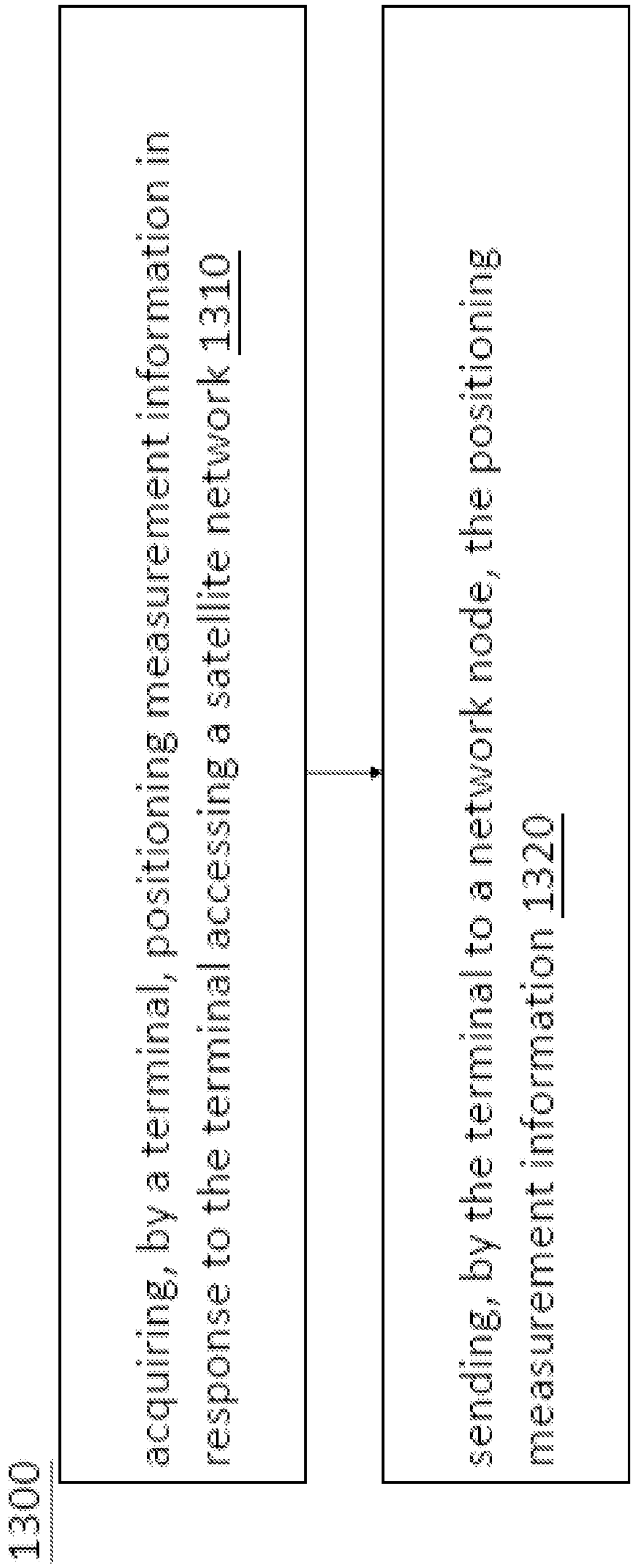
1300
acquiring, by a terminal, positioning measurement information in response to the terminal accessing a satellite network 1310
sending, by the terminal to a network node, the positioning measurement information 1320

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/124496

A. CLASSIFICATION OF SUBJECT MATTER

H04W 64/00(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)

H04W H04Q

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

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

CNPAT, CNKI, WPI, EPODOC, 3GPP: position, location, UE, GPS, satellite, management, measurement, geographic, terrestrial, non-terrestrial, NTN, cell, track area, ID, identity, identifier, network location, geographical location, map+, match +, retrieval, search, lookup

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2018217323 A1 (QUALCOMM INCORPORATED) 29 November 2018 (2018-11-29) description, paragraphs [0046]-[0053], claims 1-30	1-48
Y	US 2011219226 A1 (TELEFONAKTIEBOLAGET LM ERICSSON PUBL) 08 September 2011 (2011-09-08) description, paragraph [0003]	1-48
A	WO 2020200010 A1 (HUAWEI TECHNOLOGIES CO., LTD.) 08 October 2020 (2020-10-08) the whole document	1-48
A	QUALCOMM INCORPORATED. "Discussion of Radio Cells versus Fixed Location Areas." *SA WG2 Meeting #141e; S2-2007690.*, 23 October 2020 (2020-10-23), the whole document	1-48
A	CN 106549703 A (BEIJING UNIVERSITY OF POSTS AND TELECOMMUNICATIONS) 29 March 2017 (2017-03-29) the whole document	1-48
A	CN 110536341 A (ZTE CORPORATION) 03 December 2019 (2019-12-03) the whole document	1-48

☐ 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

"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
15 July 2021	**02 August 2021**

Name and mailing address of the ISA/CN	Authorized officer
National Intellectual Property Administration, PRC **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088** **China**	**LI,Yan**
Facsimile No. **(86-10)62019451**	Telephone No. **53961771**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/124496

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
WO	2018217323	A1	29 November 2018	CN	110651512	A	03 January 2020
				US	2020037283	A1	30 January 2020
				JP	2020522167	A	27 July 2020
				EP	3632170	A1	08 April 2020
				TW	201902276	A	01 January 2019
				BR	112019024571	A2	09 June 2020
				CA	3060621	A1	29 November 2018
				CN	112543504	A	23 March 2021
				US	2018343635	A1	29 November 2018
				KR	20200013692	A	07 February 2020
US	2011219226	A1	08 September 2011	CN	102197664	A	21 September 2011
				EP	2345263	A1	20 July 2011
				WO	2010053423	A1	14 May 2010
WO	2020200010	A1	08 October 2020	CN	111757267	A	09 October 2020
CN	106549703	A	29 March 2017		None		
CN	110536341	A	03 December 2019	WO	2020221014	A1	05 November 2020