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(54) Title: LOCATION-BASED IMS SERVER SELECTION

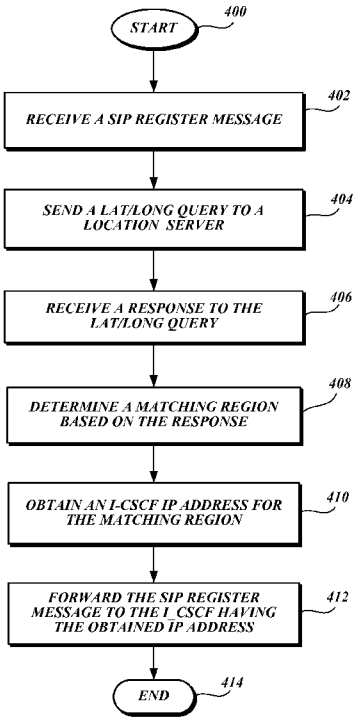

Fig.4.

(57) Abstract: A user location is estimated based on an IP address assigned to the user's device/equipment during registration for multimedia application services that are provided over the IP multimedia subsystems (IMS) network. The latitude and longitude information of the user location is obtained based on the IP address assigned to the user device/equipment. Such information is used to determine an appropriate server(s) for establishing an IP multimedia service session. In some embodiments, a closely located IMS server(s) is selected for proxying, interrogating, providing or delivering IP multimedia services. In this manner, each user device/equipment communicates with IMS servers that are located close to the user and thus, the geographically distributed load among the IMS gateway servers can be achieved.

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LOCATION-BASED IMS SERVER SELECTION

BACKGROUND

Through advancements in wireless access technologies, Internet Protocol (IP) based communications for multimedia applications became available for various types of mobile devices. Examples of such applications include white board discussions, video conferencing, Push to talk over Cellular (PoC), Voice over IP, real-time content sharing including videos/audio files, instant messaging, interactive gaming, and the like. One of the challenges to provide those IP multimedia application services is to provide a good user experience with these rich media applications among a large variety of different computing and mobile devices running over diverse (e.g., different types of wireless, fixed, or the like) networks.

An architectural framework for delivering internet protocol (IP) multimedia to mobile users over various types of wireless and fixed networks to provide the same level of standardization is called the IP Multimedia Subsystem (IMS). Many implementations of IMS employ Session Initiation Protocol (SIP) for session management, including, for example, to establish, modify, and terminate media sessions for various applications. Typically, several different roles of servers or proxies, collectively called Call Session Control Function (CSCF), are used to process SIP signaling packets in the IMS.

Among those servers, an I-CSCF (Interrogating-CSCF) is a server located at the edge of a particular domain. Its IP address is published in the Domain Name System (DNS) of the domain so that remote servers can discover an I-CSCF for a subscriber user, and use the discovered I-CSCF as a forwarding point (e.g., registering) for communication packets to the domain. For example, when a User Equipment (UE) initiates a registration process to the IMS, one I-CSCF is discovered for the UE and the I-CSCF assigns a proper Serving-CSCF (S-CSCF) for delivering IP multimedia services to the UE.

Currently, no consideration is given to the distance between the locations of a UE and its respective I-CSCF during the discovery process. Thus, in some cases, an I-CSCF that is located far from an UE is discovered for the UE even though another I-CSCF that is located closer to the UE is also available. Data packets traveling a long distance can become a major hindrance for providing a good user experience with rich or real-time media applications, especially among a large variety of different computing and mobile devices running over diverse networks.

SUMMARY

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

A system and method are provided to select proper network servers to deliver IP multimedia application services that are provided over the IMS. The latitude and longitude information of a user's location is estimated based on the IP address assigned to the user device/equipment. Such information is used to determine appropriate IP multimedia subsystem (IMS) servers that provide the multimedia application services to mobile users. In some embodiments, a closely located IMS server(s), for example, a P-CSCF, an I-CSCF, or an S-CSCF, is selected based on the latitude and longitude information of the user's location. In this manner, each user device communicates with the IMS servers that are located close to the user device and, thus, the overall distance between the user device and the selected S-CSCF is relatively short, thereby providing a good user experience with rich or real-time media applications.

In accordance with an aspect of one embodiment, a system provides a user with an IP multimedia service. The system comprises a location server for providing geographic information associated with an IP address and a plurality of IMS servers. In one aspect, each IMS server is configured to transmit a query to the location server in order to obtain geographic information about the user device after the user device initiates a request for an IP multimedia service. The query includes an IP address of a user device. The IMS server is configured to receive a response including the geographic information about the user device and to identify a region that corresponds to the geographic information about the user device. The IMS server is configured to select a destination server that resides within the identified region.

In accordance with another aspect of one embodiment, a computer implemented method is provided for selecting a destination server in establishing an IP multimedia service session. The method includes obtaining an IP address of a user device that initiates an IP multimedia service and transmitting a query to a location server in order to obtain geographic information about the user device. Subsequently, the location server sends a response to the query including the geographic information about the user device. The geographic information, such as longitude and latitude values associated with the IP

address of the user device, is extracted from the response and is used to determine a matching region, where a service area is divided into several regions. Once the matching region is determined, a destination server that resides within the matching region is selected for the user device. The destination server can be a proxy IMS server, an interrogating IMS server or serving IMS server. A table representing a relationship between a region and an IMS server is maintained and referenced when the destination server is being determined.

In accordance with yet another aspect of one embodiment, a computer-readable medium is provided having instructions encoded thereon to select a server that provides IP multimedia services based on the geographic location of a user device. The instructions cause a computing device to obtain an IP address of a user device and to transmit a query to a location server, requesting geographic location information associated with the user device, where the query includes an IP address of the user device. The instructions further cause the computing device to receive a response to the query sent from the location server. The response includes the geographic location information associated with the user device. An IMS server that is located close to the user device is selected and the registration information is forwarded to the IMS server, allowing the user device to establish an IP multimedia service session with the selected IMS server.

DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of claimed subject matter will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a block diagram depicting an exemplary environment where described embodiments of the disclosed technology can be implemented;

FIGURES 2A and 2B are schematic diagrams depicting various IMS servers which are geographically distributed;

FIGURE 3 is a functional diagram depicting interactions among various components of the exemplary environment shown in FIGURE 1 in accordance with some embodiments of the disclosed technology; and

FIGURE 4 is a block diagram depicting an IMS server selection routine in accordance with some embodiments of the disclosed technology.

DETAILED DESCRIPTION

The detailed description set forth below in connection with the appended drawings is intended as a description of various embodiments of the disclosed technology and is not intended to represent the only embodiments. Generally stated, a user's location is estimated based on an IP address assigned to the user's device/equipment during registration for IP multimedia application services that are provided by the IMS. The latitude and longitude information of the user's location is obtained based on the IP address assigned to the user device/equipment. Such information is then used to determine appropriate IMS server(s) that provides the multimedia application services to mobile users. In some embodiments, closely located IMS servers, such as a P-CSCF, I-CSCF, S-CSCF, or the like, are selected for providing or delivering IP multimedia services. In those embodiments, each user device/equipment communicates with IMS servers that are located close to the user device and, thus, data packets travels a relatively short distance, thereby providing a good user experience with rich or real-time media applications. In one aspect, geographically distributed load balancing can be achieved among the IMS gateway servers.

Referring now to FIGURE 1, the following is intended to provide a general overview of an IMS network environment 100 where some embodiments of the disclosed technology may be implemented. The IMS network environment 100 includes an Application/Service Layer 110, an IMS Layer 120, and one or more access gateway servers 130. The IMS network environment 100 further includes one or more networks 102, 104 such as an IP multimedia and telephony core network, as generally defined by 3GPP and 3GPP2 standards and organizations based on IETF Internet protocols.

As shown in FIGURE 1, the Application/Service Layer 110 includes a home subscriber server (HSS) 116, one or more application service (AS) servers 112 and the like. In one embodiment, the HSS 116 may be a central repository/database that contains subscriber- or user-specific data, including, but not limited to, user authorizations, service permissions, user profiles, user preferences, etc. The HSS 116 may be configured to integrate several functions/elements, including authentication and authorization, and the like. The AS servers 112 may host and execute services through the IMS layer 120 using a Session Initiation Protocol (SIP).

The IMS layer 120 includes several types of IMS servers. In general, the IMS layer 120 carries out the primary SIP signaling functions in the IMS network environment

100. As discussed above, the IMS servers may include: a Proxy CSCF (P-CSCF) 126, which is the first point of contact for user devices in a visiting network and routes communications to a home network, an Interrogating-CSCF (I-CSCF) 128 which is the entry point of its domain (e.g., the home network where the I-CSCF is located), and one or more Serving-CSCFs (S-CSCFs) 122 which manage session control functions, and the like.

By way of example, in the IMS layer 120, when a user initiates a call request, the P-CSCF 126 is at the entry point of a network (visitor or home network) where the call request is received from the user. Upon receipt of a request to a call connection, the P-CSCF 126, in turn, sends a call signaling to an I-CSCF 128 of the home network, which determines an S-CSCF 122 responsible for delivering the services to the user (subscriber). Generally stated, the I-CSCF learns the identity of a proper S-CSCF by communicating with the HSS. The S-CSCF executes comprehensive call control based on the services of the user (calling party) and the called party. The S-CSCF may extract the service information of the user from the HSS, which defines the trigger points (TP) of services and pointers to SIP Application Servers (such as AS0, AS1, and AS2 depicted in FIGURE 1) where the specific application (service) logic resides.

In one aspect, the IMS layer 120 provides a horizontal control layer that isolates the access network from the Application/Service Layer 120. Generally, the Application/Service Layer 110 does not need to have its own control functions, as the IMS layer 120 is used for providing control functions. This allows third party service providers to easily integrate and deploy their services on the IMS infrastructure.

In some embodiments, the IMS network environment 100 comprises one or more networks that may correspond to a number of IP-based and other networks such as the Internet, DSL networks, public switched telephone networks ("PSTN") and other wire-line networks (e.g., SS7-based networks), wireless networks such as those using CDMA, GSM, IEEE 802.11x, and/or UMTS communications or the like, and local area networks. For example, the IP-core network 102 is interfaced with other networks 104 through an access gateway server 130. In one embodiment, an access gateway server 130 may include a Gateway GPRS Support Node (GGSN) for General Packet Radio Service (GPRS), a Packet Data Gateway (PDG) for WiFi, Systems Architecture Evolution Gateway (SAE-GW) or a Packet Data Network Gateway (PDN-GW) for 3GPP Long Term Evolution (LTE), and the like.

In the IMS network environment 100, the user devices or User Equipments (UEs) 106, 108 may be electronic devices capable of communicating with one another over the network(s) in the IMS network environment 100. In some embodiments, the user devices 106, 108 may include computing devices, wire-line connected communication devices such as conventional telephones and enhanced/multimedia-capable telephones, wireless devices such as mobile phones, wireless PDA's, wireless devices with high-speed data transfer capabilities, such as those compliant with "3-G" or "4-G" standards, and the like. As will be well appreciated, the computing/communication devices may include a variety of configurations or forms such as, but not limited to, laptop or tablet computers, personal digital assistants (PDAs), hybrid PDA/mobile phones, mobile phones, smart phones, media players, home messaging hub devices, digital picture frame devices, and the like.

Further, as will be appreciated by one skilled in the art, the user devices 106, 108 communicate with one another over the networks in a standard manner, depending on the particular networks used and the particular type of terminals. Each user device may cover communications frequency bands such as the cellular telephone bands at 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz, the global positioning system (GPS) band, data service bands such as the 3G data communications band (e.g., the Universal Mobile Telecommunications System (UMTS) communication band), the WiFi® (IEEE 802.11) band, the Bluetooth® band and the like. In some embodiments, the user device may include several circuitries that are required to support one or more of following: the General Packet Radio Service (GPRS) standard, Enhanced Digital GSM Evolution (EDGE), or Evolution of GSM (E-GSM) standard, Code Division Multiple Access (CDMA) standard, Wideband Code Division Multiple Access (WCDMA or W-CDMA) standard, Orthogonal Frequency Division Multiplex (OFDM) standard, Time Division Multiple Access (TDMA) standard, and the other standards.

In some embodiments, in order to assist various servers (hereinafter "IMS network servers") in the IMS network environment 100 to estimate a location of a user device 106, 108, a location server(s) 124 may maintain geographic information that is associated with an IP address of the user device 106, 108. For example, the location server 124 may maintain longitude/latitude information about a particular IP address, i.e., the longitude and latitude values (herein after, "Lat/Long information") of a geographic location associated with an IP address.

In some embodiments, in order to obtain geographic location information relating to the user device, an IMS network server (e.g., an access gateway server 130, P-CSCF 126, I-CSCF 128, and HSS 116) may send a query request along with the IP address associated with the user device to the location server. As will be well appreciated, the geographic location information may be any type of information, including, but not limited to, the longitude and latitude values of a geographic location associated with the IP address of the user device. Upon receipt of a query request, the location server extracts the IP-address of the user device from the query request and identifies the Lat/Long information based on the extracted IP-address. It should be understood that some Lat/Long information of IP-addresses may be previously determined or can be determined through some predefined logic implemented in the location server. After identifying the Lat/long information, the location server sends the IMS network server 116, 126, 128, 130 a query response that includes the identified Lat/Long information.

By way of example, assume that a user device 106, 108 discovers a proper P-CSCF via an access gateway server 130. In this example, the access gateway server 130 identifies an IP address of the user device 106, 108 and sends a location query request asking the location server 124 to provide geographic information (e.g., Lat/Long information) that corresponds to the identified IP address. The location server 124 then returns a response including the Lat/Long information that corresponds to the IP address. Once the Lat/Long information of the IP address assigned to the user device is obtained, the access gateway server 130 selects a P-CSCF 128 that is located close to the user, among available P-CSCF servers.

By way of another example, consider that an IMS network server is a P-CSCF 126 to which a user device 106, 108 initiates or requests IP multimedia service by sending a registration request. As with the access gateway server example, in this example, the P-CSCF 126 identifies an IP address of the user device 106, 108 and sends a location query request asking the location server 124 to provide the Lat/Long information that corresponds to the identified IP address. Once the Lat/Long information of the IP address assigned to the user device is obtained, in some embodiments, the P-CSCF selects an I-CSCF 128 that is located close to the user device, among available I-CSCFs, using a table (e.g., TABLE-1 depicted below) or a data store representing a relationship between a region and an I-CSCF server.

Generally, the multiple P-CSCFs, I-CSCFs and S-CSCFs may spread over different locations within a service provider's coverage area to service subscriber users. In one embodiment, the coverage/service area may be represented on an area map, divided into regions to implement some of the described embodiments. The term "a region," as used herein, refers to a geographical area that is a portion of a service area, defined by boundary information. The boundary information can be defined by maximum and minimum latitude and longitude values. Examples of the regions and their boundary information will be discussed below in connection with TABLE 1 and FIGURE 2B.

In one embodiment, the coverage/service area may be divided into several different sets of regions based on a set of criteria or rules. For example, a set of regions are defined so that at least one P-CSCF and I-CSCF can be mapped within each region based on its geographic location. Another set of regions may be defined so that a single S-CSCF is be mapped within one region. As will be well appreciated, the regions can be redefined anytime when it is appropriate and the IMS network server may update the information about the regions accordingly. The regions can be redefined if there are changes in locations of the IMS servers (e.g., P-CSCFs, I-CSCFs, S-CSCFs) or the like. In some instances, one or more IMS servers can be added or removed to/from one region because of business/public policy reasons, load balancing, or the like.

In addition, in some embodiments, a set of criteria or rules is defined to provide conditions as to how to define or redefine regions. For example, one criterion may be that the area is divided into regions such that each region contains one particular IMS server that has a physical presence within the region. Another criterion may be that, if the number of end-user subscribers and population reaches a threshold, regions need to be redefined by, for example, dividing one region into two or more regions and adding more IMS servers. As such, a country or a continent can be divided into several regions based on a set of predefined criteria and the regions can be readily reflected on a map.

For ease of discussion, in the described embodiments, it is assumed that each region is defined to assist an IMS network server to select an appropriate IMS server for a given user device based on the Lat/Long information of the user device. As such, in one embodiment, each IMS network server maintains a table representing a relationship between region information and an IMS server IP address.

Referring now to FIGURES 2A and 2B, schematic diagrams 200, 250 depict a map of an area that is divided into a first set of regions 202-224 or a second set of regions 260-272. As shown, each region 202-224, 260-272 can be defined by its boundary information (e.g., maximum and minimum latitude and longitude values). In some embodiments, the regions are predefined in any IMS network server where the information about the regions is stored and used to select another server for communication.

As will be appreciated one of ordinary skill in the art, a table representing a relationship between a region and an P-CSCF IP address may be maintained in an access gateway server 130, a table representing a relationship between a region and an I-CSCF IP address may be maintained in a P-CSCF 126, a table representing a relationship between a region and S-CSCF IP address may be maintained in HSS 116 or I-CSCF 128, and the like. Additionally or alternatively, such tables or data stores can be remotely or centrally maintained but readily accessible by the IMS network servers 116, 126, 128, 130.

By way of example, an access gateway server or a P-CSCF maintains a table or a database representing a relationship between a region and an IMS Server IP address along with geographic information of each region. For example, consider the following simplified table representing the relationships between regions and IP addresses where the regions are reflected on a map 250 as depicted in FIGURE 2B. The exemplary table (a region and IMS Server) is described as follows:

TABLE 1

Region	Max Latitude	Min Latitude	Max Longitude	Min Longitude	IMS Server IP address (I-CSCF, P-CSCF, or S-CSCF)
260	50	38	88	68	000.xxx.111 000.xxx.222
262	38	24	90	68	000.xxx.333
264	50	38	105	88	000.xxx.440 000.xxx.430
266	38	24	105	90	000.xxx.555
268	50	43	105	125	000.xxx.666
…	…	…	…	…	…

As shown, Region 260, defined by its boundary information (50, 38, 88, 68), corresponds to the first entry of the above-depicted table. Region 260 includes two IMS servers, each having an IP address, 000.xxx.111 and 000.xxx.222 respectively. Likewise, Region 262, defined by its boundary information (38, 24, 90, 68), corresponds to the second entry. An IMS server having an IP address, 000.xxx.333, resides in Region 262, and so on.

In one embodiment, a HSS maintains a different table or a database representing a relationship between a region and S-CSCF information, which will be discussed in detail below in connection with TABLE 2 and FIGURE 3. It should be understood that the above-mentioned table is merely an example, cannot be construed as limiting the scope of the subject matter. For example, a region may be defined to have various different shapes, such as a polygon defined by multiple longitude/latitude points, or the like.

Referring now to FIGURE 3, a functional diagram 300 depicts the interactions among various components of the IMS network environment 100 shown in FIGURE 1 in accordance with some embodiments. As discussed previously, the IMS layer 120 is generally responsible for the registration, security and call/service control logic for providing multimedia application services to subscriber users. In the IMS layer 120, each IMS server component (e.g., P-CSCF, I-CSCF, S-CSCF, etc.) operates in accordance with its responsibilities during user registration and call/service control. As will be understood by one skilled in the art, one IMS server can have multiple responsibilities. For example, one server can operate as both an I-CSCF and S-CSCF.

By way of example, when a user device initiates or requests an IP multimedia service, a registration request is sent to a P-CSCF through an access gateway server. In one embodiment, the user device obtains its IP connectivity through an "IP connectivity Access network" that includes an access gateway server, when the user device initiates or requests an IP multimedia service. A term "IP connectivity Access network," as used herein, refers to the collection of network entities and interfaces that provides the underlying IP transport connectivity between the user device and the IMS entities. An example of an IP-Connectivity Access Network is the GPRS core network with GERAN and/or UTRAN radio access networks.

After obtaining the IP connectivity, the user device has an assigned IP address. Next, a P-CSCF discovery process is performed.

In some embodiments, in order to discover a proper P-CSCF for the user device, a Lat/Long query including an IP address of the user device may be sent to the location server. As discussed above in connection with FIGURE 1, the location server maintains the geographic information about an IP address, i.e., Lat/Long information associated with an IP address.

Upon receipt of a query request, the location server extracts the IP-address of the user device from the query request and identifies the Lat/Long information based on the extracted IP-Address. It should be understood that some Lat/Long information of IP-addresses may be previously determined or can be determined through some predefined logic implemented in the location server. After identifying the Lat/Long information, the location server sends the access gateway server a query response that includes the identified Lat/Long information

Upon receipt of the response from the location server, the access gateway server extracts the Lat/Long information from the response. Subsequently, the access gateway server identifies a region that includes the user device's location estimated based on the Lat/Long information. As discussed previously, a region may be a geographical boundary defined by maximum and minimum latitude and longitude values. Thus, the Lat/Long information of the user device may be compared with the maximum and minimum latitude and longitude values of each region. As depicted in the above TABLE 1, the access gateway server uses a table or data store representing a relationship between a region and a P-CSCF server along with the boundary information of the region.

After a P-CSCF is discovered for the user device, the user device sends registration information to the discovered P-CSCF. Upon receipt of the register information, such as the SIP register message, the P-CSCF identifies the IP address of the user device from the register information and generates a query request for obtaining geographic location information relating to the user device. Then, the P-CSCF sends a query request along with the IP address of the user device to the location server. Upon receipt of a query request, the location server identifies the Lat/Long information based on the IP-Address included in the query request and sends the P-CSCF a query response that includes the identified Lat/Long information. The above example can be implemented with modification of SIP header specific to the operator's requirements.

Upon receipt of the response from the location server, the P-CSCF extracts the Lat/Long information from the response. As depicted in the above TABLE 1, the P-

CSCF includes a table or data store representing a relationship between a region and IMS servers (e.g., I-CSCF servers) along with the boundary information of the region. The Lat/Long information of the user device may be compared with the maximum and minimum latitude and longitude values of each region. In some embodiments, the P-CSCF determines, based on the table, the region that includes the user's estimated location and then determines one or more I-CSCFs that correspond to the region. In some instances, there may be several I-CSCFs residing within one region. In those instances, the P-CSCF may identify an I-CSCF that is located closer to the user's estimated location through communication with the location server.

After the P-CSCF selects an I-CSCF for the user device based on the Lat/Long information of the user device, the P-CSCF forwards the registration information (e.g., P-CSCF address/name, Public User Identity, Private User Identity, P-CSCF network identifier, UE IP address) to the selected I-CSCF. In one embodiment, the I-CSCF may provide the HSS with the information relating to the user device, for example, UE IP address, Device Type and the like, so that the HSS can check whether the particular user (operating the user device) is already registered or authorized to use certain IMS application services. As such, the HSS may indicate whether the user is allowed to register in that P-CSCF network (identified by the P-CSCF network identifier), or to subscribe the requested IP media service according to user profile information. The P-CSCF network identifier is a string that identifies the home network that is the network where the P-CSCF is located (e.g., the P-CSCF network identifier may be the domain name of the P-CSCF network).

Next, the I-CSCF performs an S-CSCF discovery process. In some embodiments, the I-CSCF discovers, through interacting with the HSS, a proper S-CSCF to deliver services for the user device. In those embodiments, the HSS may return the proper S-CSCF's name, or the S-CSCF capabilities, if it is necessary to select a new S-CSCF. The I-CSCF, using the name of the S-CSCF, may determine the IP address of the S-CSCF through a DNS server.

In some cases, one or more S-CSCFs having requested capabilities may be available for providing the services to the subscriber. In such cases, an S-CSCF located physically closer to the user device than other S-CSCFs may be selected by the HSS. In those cases, the HSS obtains the Lat/Long information of the user device from a location

server by exchanging a query request including the IP address of the user device and a query response.

As will be discussed above, the HSS may use a mapping table to select, among several available S-CSCFs for the requested service, an S-CSCF that is located close to the user device. For example, consider the following simplified table depicting a mapping of a region and information of its corresponding S-CSCF (e.g., IP address, S-CSCF's capabilities, etc.) where the regions are reflected on a map 200 as depicted in FIGURE 2A. The exemplary table (a region and S-CSCF table) is described as follows:

TABLE 2

Region	Max Latitude	Min Latitude	Max Longitude	Min Longitude	S-CSCF IP address	S-CSCF Capabilities
202	50	42	125	115	000.xxx.111	AS0, AS1
204	42	38	125	115	000.xxx.222	AS1
206	38	30	125	115	000.xxx.333	AS0,AS1,AS2
208	30	24	125	115	000.xxx.332	AS0,AS1
210	50	38	115	118	000.xxx.444	AS1,AS2
212	38	24	115	118	000.xxx.555	AS2
214	50	38	108	88	000.xxx.666	AS1,AS2
216	38	24	108	88	000.xxx.777	AS0,AS2
…	…	…	…	…	…	

As shown, Region 202, defined by its boundary information (50, 42, 125, 115), corresponds to the first entry of the region and S-CSCF table. Region 202 includes an S-CSCF that has its IP address, 000.xxx.111 and has capabilities of AS0 and AS1. Likewise, Region 204, defined by its boundary information (42, 38, 125, 115), corresponds to the second entry. An S-CSCF having its IP address, 000.xxx.222 and capability of AS1 resides in Region 204 and so on. Consider a scenario where a user has requested a Push-to Talk service that AS2 can provide and the location of the user device is estimated within a Region 204. The HSS looks up the table and select an S-CSCF with 000.xxx.333 that is located in a region 206 close to the user device among S-CSCFs having the AS2 (Push-to Talk) capability after verifying the user's subscription profile.

In some embodiments, the HSS returns the S-CSCF capabilities and the user's service validation information and the I-CSCF selects a new S-CSCF based on the

capabilities returned. In one embodiment, the I-CSCF identifies the IP address of the user device from the register information and generates a query request for obtaining geographic location information relating to the user device. Then, as with an access gateway or a P-CSCF discussed above, the I-CSCF obtains the Lat/Long information based on the IP-Address from the location server by exchanging a request and response. The I-CSCF consults with a region and IMS server table, for example, TABLE-1 above, to select a proper S-CSCF that is located close to the user device.

After a proper S-CSCF is selected by the HSS or the I-CSCF, the I-CSCF assigns the selected S-CSCF to the user device and forwards the register information (P-CSCF address/name, Public User Identity, Private User Identity, P-CSCF network identifier, UE IP address) to the selected S-CSCF. Subsequently, the S-CSCF stores the registration information such as the P-CSCF address/name, or the like. In the Application/Service Layer 110, the HSS stores the S-CSCF name for that user and the user information is passed from the HSS to the S-CSCF, which is used to access the platform(s) used for service control while the user is registered at this S-CSCF.

After the proper S-CSCF is determined for the user device, the SIP registration between the user device and the S-CSCF is established. After the successful registration, the application level registration is performed. The process of the application level registration is well known to one of skill in the art and thus the detailed description about the process of the application level registration is omitted in the description.

Referring now to FIGURE 4, a flow diagram depicts an IMS server selection routine 400 in accordance with some embodiments of the described technology. For ease of discussion, it is assumed that a user is operating a user device to request IP multimedia application service through a proper access gateway server and a P-CSCF has been discovered as discussed above in connection with the diagram depicted in FIGURE 3.

The routine 400 begins with block 402 where the P-CSCF receives a SIP register message from the user device. As discussed above, when a user device initiates IP multimedia application services, the user device is required to register with I/S-CSCFs through Session Interface Protocol. At block 404, upon receipt of a SIP register message, the P-CSCF sends a Lat/Long query to a location server. The P-CSCF extracts an IP address of the user device and generates the Lat/Long query including the IP address. At block 406, the P-CSCF receives, from the location server, a response to the query. As discussed above, the location server may maintain the Lat/Long information about a

particular IP address. When a user device initiates or requests IP multimedia service by sending a registration request to a proxy P-CSCF, the P-CSCF identifies an IP address of the user device and sends a location query request asking the location server to provide the longitude/latitude information that corresponds to the identified IP address. The location server then returns a response including the Lat/Long information that corresponds to the IP address.

At block 408, the P-CSCF determines a matching region based on Lat/Long information contained in the response. In one embodiment, the P-CSCF maintains a table/database representing a relationship between a region and IMS server(s). Alternatively, the table/database representing a relationship between a region and IMS server(s) may be stored and maintained in a remote data store which the P-CSCF can access. After the P-CSCF identifies the Lat/Long information of the IP address, the P-CSCF compares the information to find a region that contains the location represented by the Lat/Long information.

At block 410, the P-CSCF determines an I-CSCF from the table based on the region information. In one embodiment, the P-CSCF obtains an IP address of an I-CSCF that is located in the region from a table representing a relationship between a region and the I-CSCF. At block 412, the P-CSCF forwards the SIP register message to the I-CSCF associated with the obtained IP address. The routine 400 then terminates at block 414.

It should be well understood that the routine 400 described above with reference to FIGURE 4 does not show all of the functions and steps performed within the IMS network environment 100. Instead, the routine 400 generally describes the processes performed in a P-CSCF to determine an I-CSCF that is located close to a user device based on the Lat/Long information of the user device. It is noted that similar steps can be implemented in other IMS network servers so that each IMS network server can select a next destination server to eventually establish an IP multimedia session. The IMS network server may consult a table discussed above in connection with FIGURES 2A, 2B and 3 when selecting a next destination server. Accordingly, those skilled in the art and others will recognize that some functions/steps and/or exchanges of data described above may be performed in a different order, omitted/added, or otherwise varied without departing from the scope of the claimed subject matter.

In some embodiments, the IMS network servers may obtain the Lat/Long information of a user device from sources other than the location server. For example, a

user device equipped with a built-in GPS unit may be configured to obtain its Lat/Long information using the GPS unit and to transmit the Lat/Long information to the P-CSCF.

While illustrative embodiments have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the scope of the invention.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A system for providing IP multimedia services, the system comprising:

a location server for providing geographic information associated with an IP address; and

one or more IP multimedia subsystem (IMS) servers for providing IP multimedia services, each IMS server configured to:

transmit a query to the location server in order to obtain geographic information about the user device, the query including an IP address of the user device, the user device initiating a request for an IP multimedia service;

receive a response to the query, the response including the geographic information about the user device;

identify a region that corresponds to the geographic information about the user device; and

select a destination server that resides within the identified region.

2. The system of Claim 1, wherein if there are a plurality of destination servers that reside within the identified region, the IMS server selects, among the plurality of destination servers, one destination server that is located close to the user device.

3. The system of Claim 1, wherein the IMS server is a proxy IMS server and the destination server is an interrogating server.

4. The system of Claim 1, wherein the user device discovers the proxy IMS server through an access gateway server.

5. The system of Claim 4, wherein the access gateway server is configured to:

receive the geographic information associated with the IP address of the user device;

identify a matching region based on the geographic information about the user device; and

select a proxy IMS server that is located close to the user device within the matching region.

6. The system of Claim 1, wherein the IMS server is an interrogating IMS server and the destination server is a serving IMS server having a capability of providing the requested IP multimedia service

7. The system of Claim 1, wherein the IMS server is a home subscriber server (HSS) and the destination server is a serving IMS server having a capability to provide the requested IP multimedia service.

8. The system of Claim 1, wherein a location server provides the longitude and latitude values associated with the IP address of the user device.

9. The system of Claim 8, wherein the region represents a geographical area defined by boundary information.

10. The system of Claim 9, wherein the boundary information includes maximum and minimum values of latitude and longitude.

11. A computer-implemented method for selecting a destination server in establishing an IP multimedia service session for a user device, the computer-implemented method comprising:

obtaining registration information initiating an IP multimedia service;

obtaining geographic information about the user device;

determining a matching region based on the geographic information about the user device;

selecting a destination server that is located close to the user device in the matching region; and

forwarding the registration information to the destination server.

12. The computer-implemented method of Claim 11, wherein the geographic information includes longitude and latitude values associated with an IP address of the user device, the longitude and latitude values provided from a location server.

13. The computer-implemented method of Claim 12, wherein the region represents a geographical area defined by boundary information.

14. The computer-implemented method of Claim 13, wherein the boundary information includes maximum and minimum values of latitude and longitude.

15. The computer-implemented method of Claim 14, wherein determining a matching region includes identifying a region that includes a location represented by the longitude and latitude values associated with the IP address of the user device.

16. The computer-implemented method of Claim 11, wherein the destination server is a proxy IMS server that is configured to select an interrogating IMS server for the user device.

17. The computer-implemented method of Claim 11, wherein the destination server is an interrogating IMS server that is configured to select a serving IMS server for the user device.

18. The computer-implemented method of Claim 11, wherein the interrogating IMS server communicates with a home subscriber server (HSS) that is configured to:

determine a matching region based on the geographic information about the user device;

select a serving IMS server having a capability with respect to the initiated IP multimedia service, the serving IMS server based on the matching region; and

return the selected serving IMS server information to the interrogating IMS server.

19. The computer implemented method of Claim 18, wherein the selected serving IMS server communicates with IP multimedia application servers to deliver the IP multimedia services to the user device.

20. A server for providing IP multimedia services, the server configured to:

obtain an IP address of a user device that initiates a request for an IP multimedia service;

determine geographic information associated with the IP address;

identify a matching region based on the determined geographic information about the user device;

select a destination server that is located close to the user device within the matching region; and

forward information related to the request to the selected destination server.

21. The server of Claim 20, further configured to:

transmit a query to a location server in order to obtain the geographic information about the user device, the query including an IP address of the user device; and

receive a response to the query, the response including the geographic information about the user device.

22. The server of Claim 20, wherein if the destination server is a proxy IMS server, a table representing a relationship between a region and one or more proxy IMS servers is used.

23. The server of Claim 20, wherein if the destination server is an interrogating IMS server, a table representing a relationship between a region and one or more Interrogating IMS servers is used.

24. The server of Claim 20, wherein if the destination server is a serving IMS server, a table representing a relationship between a region and a serving IMS server along with a capability of the serving IMS server is used.

25. The server of Claim 25, wherein a region is associated with one serving IMS server that has a physical presence within the region.

26. The server of Claim 20, wherein a region represents a geographical area that is a portion of a service area, the geographical area being defined by boundary information that includes maximum and minimum values of latitude and longitude of the geographical area.

27. A computer-readable medium having instructions encoded thereon to select a server of IP multimedia services based on the geographic location of a user device, wherein the instructions, when executed by a computing device, cause the computing device to:

obtain an IP address of a user device;

transmit a query to a location server, requesting geographic location information about the user device, the query including the IP address of the user device;

receive, from the location server, a response to the query, the response including the geographic location information that corresponds to the IP address of the user device;

determine an IMS server that is located close to a user's current location, the user's current location estimated by the geographic location information; and

forward registration information to allow the user device to establish an IP multimedia service session with the IMS server.

28. The computer-readable medium of Claim 27, wherein the registration information is received from the user device initiating a request for an IP multimedia service.

29. The computer-readable medium of Claim 27, wherein the geographic location information about the user device includes longitude and latitude values associated with the IP address of the user device.

30. The computer-readable medium of Claim 29, wherein a service area for the IP multimedia service is divided into a plurality of regions, each region including at least one IMS server.

31. The computer-readable medium of Claim 30, wherein the instructions cause the computing device to identify a region which encompasses the user's current location.

32. The computer-readable medium of Claim 31, wherein the instructions cause the computing device to:

obtain boundary information of each region;

compare the longitude and latitude values with the boundary information of each region; and

wherein the identified region has boundary information that encompasses the longitude and latitude values.

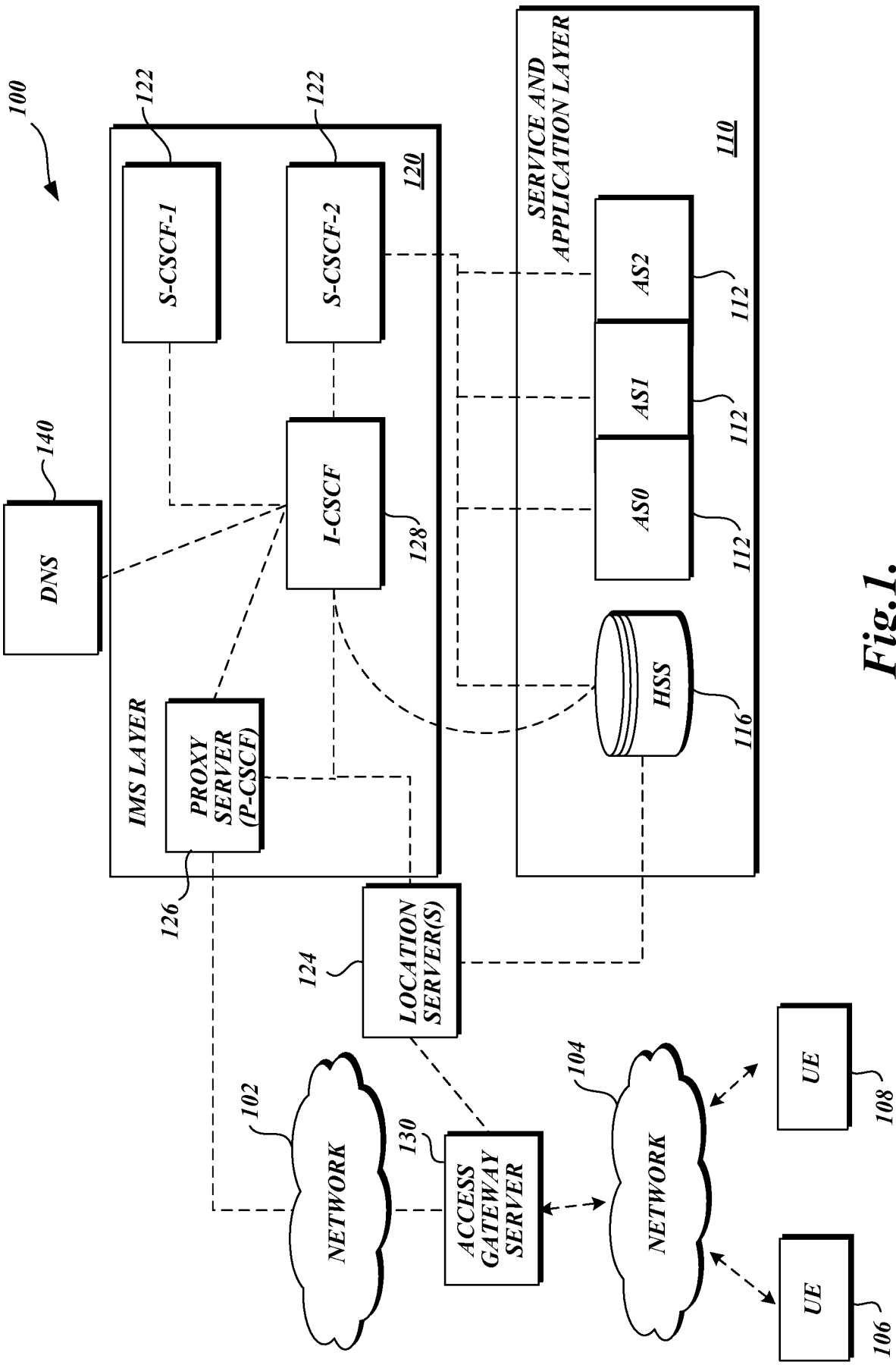
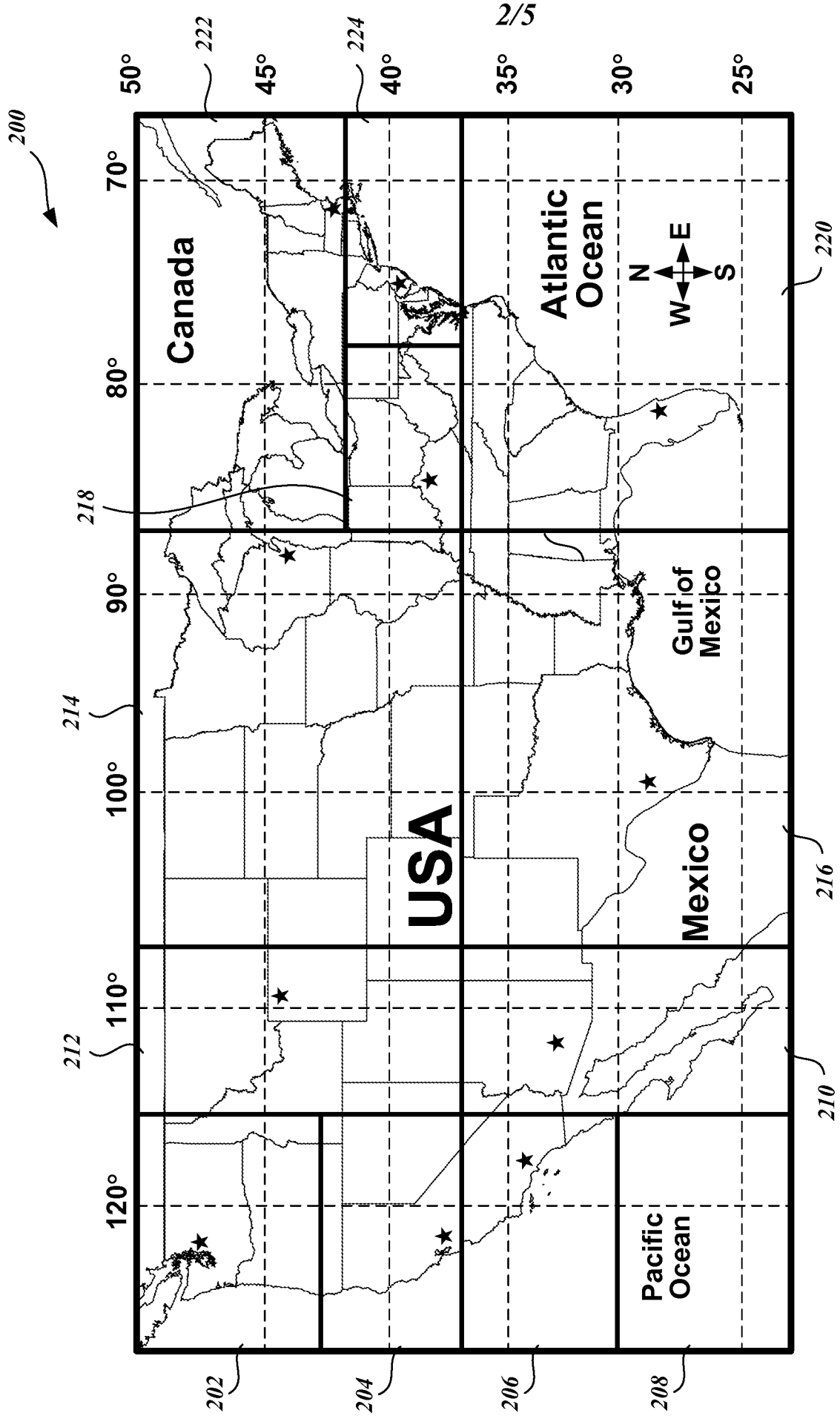

100
122
122
S-CSCF-1
S-CSCF-2
120
SERVICE AND APPLICATION LAYER
110
AS2
AS1
AS0
112
112
112
140
DNS
I-CSCF
128
IMS LAYER
PROXY SERVER (P-CSCF)
HSS
116
126
124
LOCATION SERVER(S)
102
NETWORK
130
ACCESS GATEWAY SERVER
104
NETWORK
UE
108
UE
106

Fig.1.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222
224
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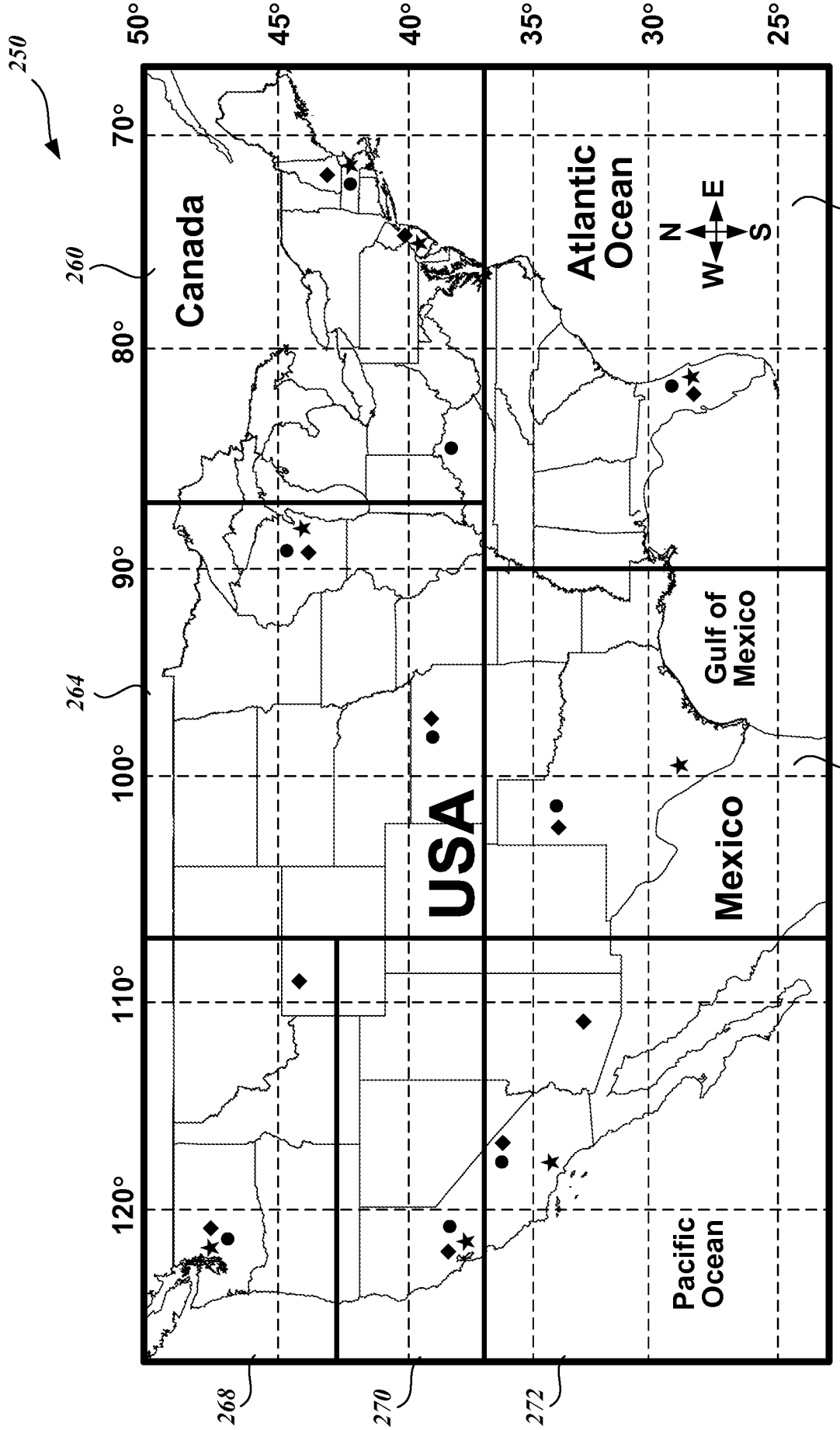
45°
40°
35°
30°
25°
70°
80°
90°
100°
110°
120°
Canada
Atlantic Ocean
N
E
W
S
220
218
Gulf of Mexico
USA
Mexico
214
216
212
210
Pacific Ocean
202
204
206
208
★ S-CSCF

Fig.2A.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45°
40°
35°
30°
25°
70°
80°
90°
100°
110°
120°
260
262
264
266
268
270
272
Canada
Atlantic Ocean
N
E
W
S
USA
Gulf of Mexico
Mexico
Pacific Ocean
S-CSCF
I-CSCF
P-CSCF

Fig.2B.

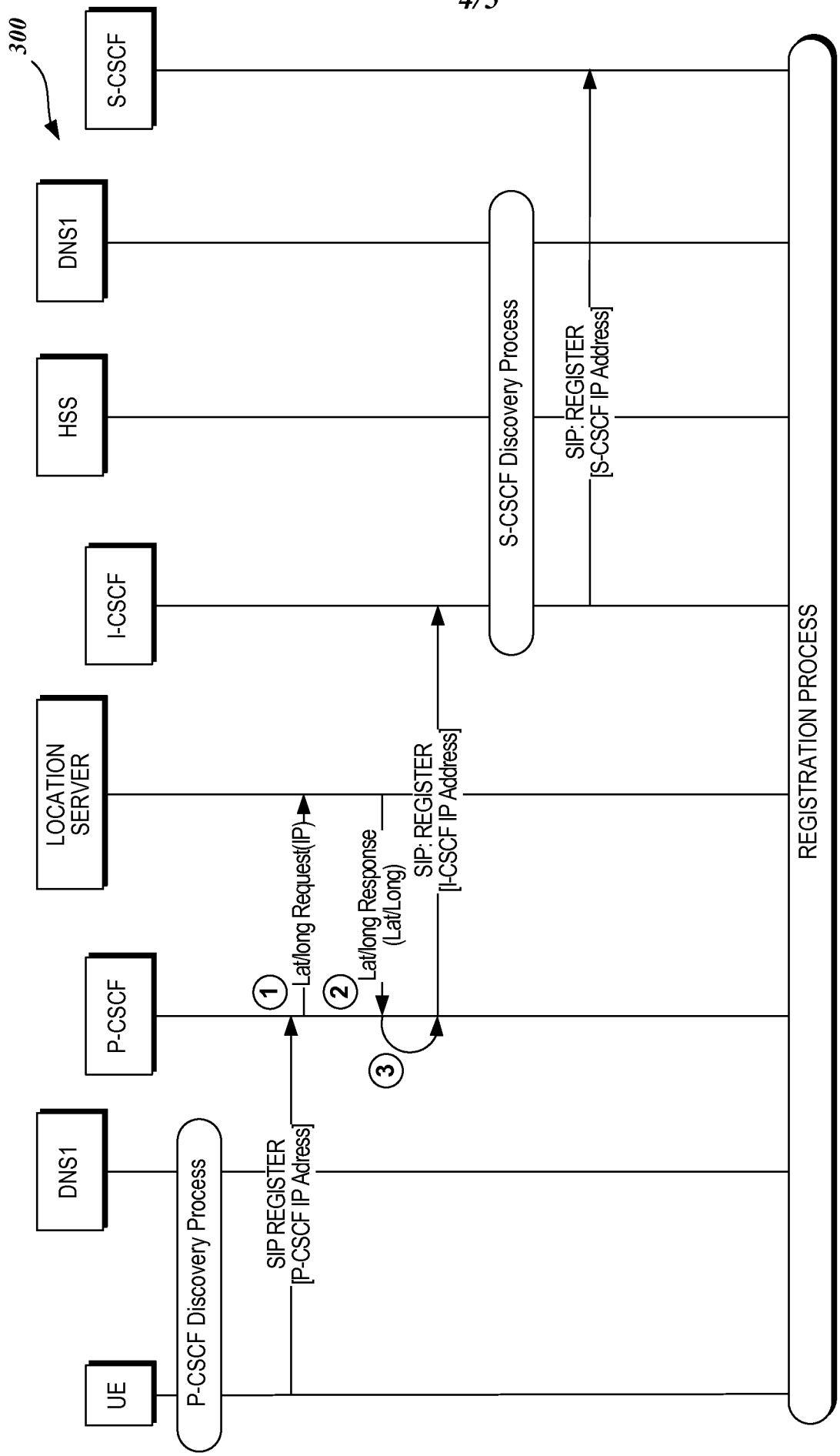
300
S-CSCF
DNS1
HSS
I-CSCF
LOCATION SERVER
P-CSCF
DNS1
UE
P-CSCF Discovery Process
SIP REGISTER [P-CSCF IP Adress]
1
Lat/long Request(IP)
2
Lat/long Response (Lat/Long)
3
SIP: REGISTER [I-CSCF IP Address]
S-CSCF Discovery Process
SIP: REGISTER [S-CSCF IP Address]
REGISTRATION PROCESS

Fig.3.

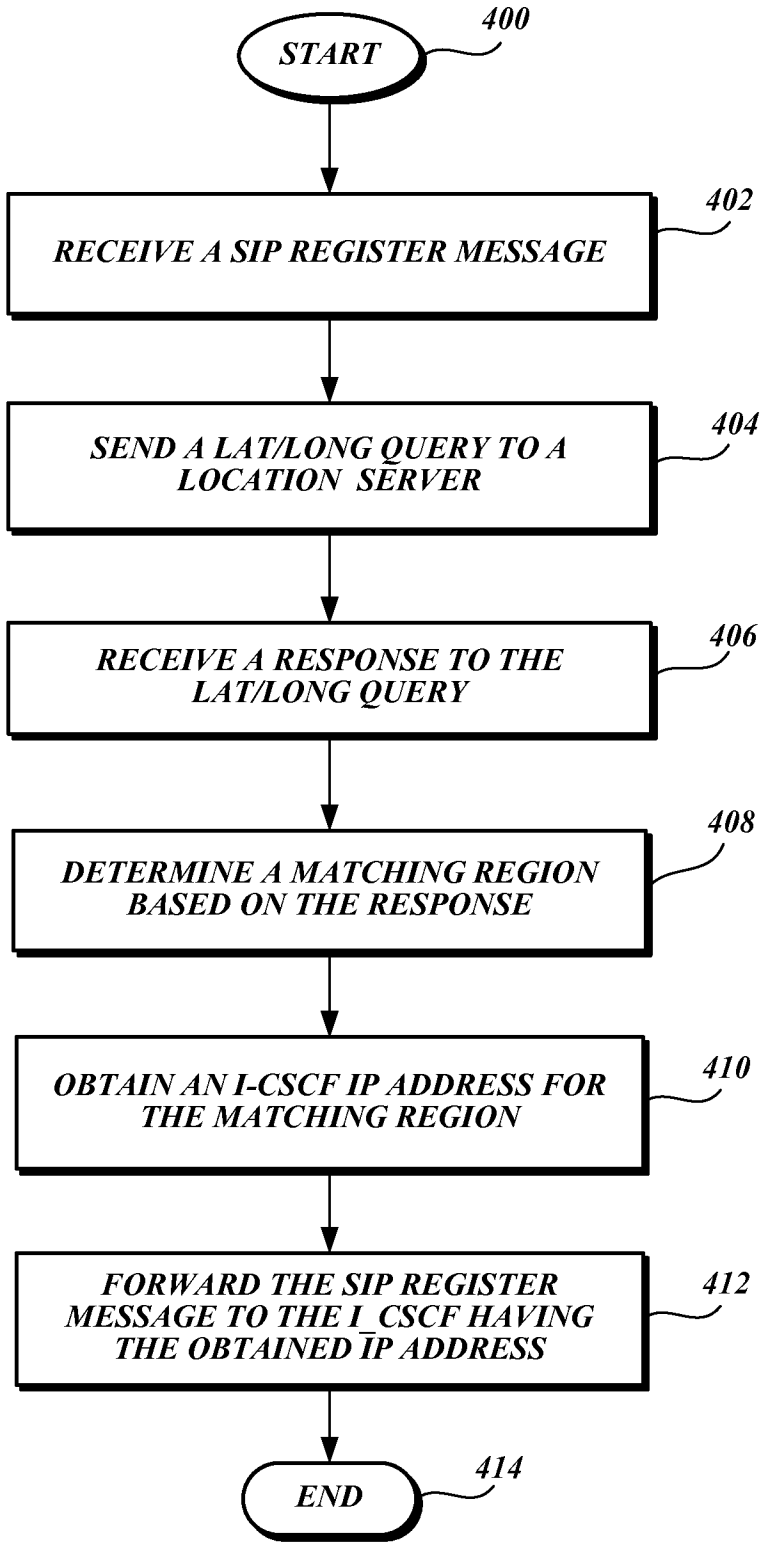
START
400
RECEIVE A SIP REGISTER MESSAGE
402
SEND A LAT/LONG QUERY TO A LOCATION SERVER
404
RECEIVE A RESPONSE TO THE LAT/LONG QUERY
406
DETERMINE A MATCHING REGION BASED ON THE RESPONSE
408
OBTAIN AN I-CSCF IP ADDRESS FOR THE MATCHING REGION
410
FORWARD THE SIP REGISTER MESSAGE TO THE I_CSCF HAVING THE OBTAINED IP ADDRESS
412
END
414

Fig.4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/023958

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04L12/28 (2010.01)
USPC - 370/338
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(8) - H04L12/28 (2010.01)
USPC - 370/338; 455/404.2; 709/227

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)
Patbase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/0115934 A1 (DAUSTER et al) 24 May 2007 (24.05.2007) entire document	1-32
Y	US 2008/0160972 A1 (HARAN et al) 03 July 2008 (03.07.2008) entire document	1-32
Y	US 6,788,676 B2 (PARTANEN et al) 07 September 2004 (07.09.2004) entire document	3, 4, 5, 16

☐ Further documents are listed in the continuation of Box C. ☐

* 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
24 March 2010	07 APR 2010

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774