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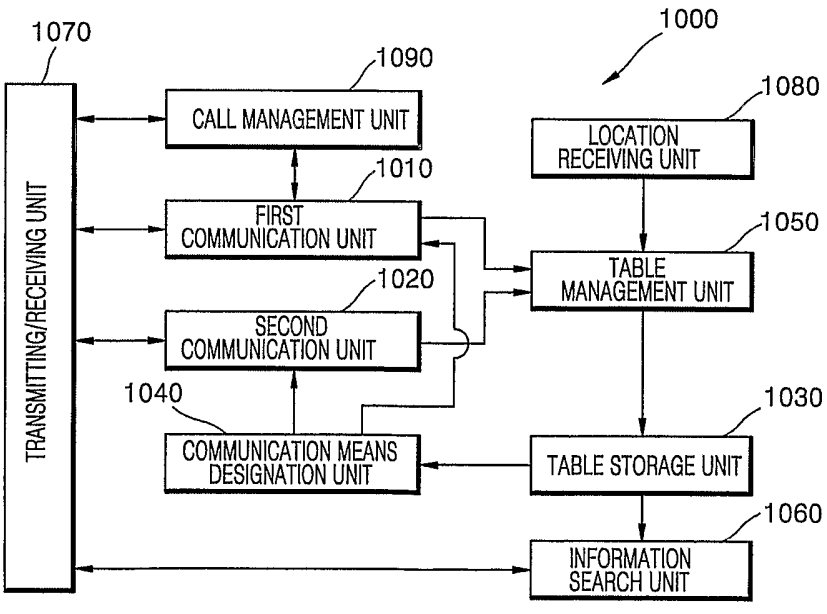

(57) Abstract: A wireless communication terminal and a wireless communication method thereof are provided. The wireless communication terminal comprises: a table storage unit, which stores a routing table in which identification information and location information of other communication terminals in a predetermined set region are recorded; a first communication unit, which establishes a communication path between the wireless communication terminal and a destination communication terminal by using a first frequency band; a second communication unit, which establishes a communication path between the wireless communication terminal and a destination communication terminal by using a second frequency band; and a communication means designation unit, which designates the first communication unit as a communication means if identification information of the destination terminal exists in the routing table and designates the second communication unit as the communication means if the identification information of the destination terminal does not exist in the routing table.

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WIRELESS COMMUNICATION DEVICE AND WIRELESS COMMUNICATION METHOD USING THE DEVICE

Technical Field

The present invention relates to a wireless communication device and a wireless communication method using the wireless communication device, and more particularly to a wireless communication terminal, which can communicate with other wireless communication terminals over a commercial network comprised of a plurality of base stations, and a wireless communication method using the wireless communication terminal.

Background Art

In the prior art, intermediate or central servers (i.e., base stations) should be installed in order to enable communication terminals to communicate with each other over a wireless communication network, enable the communication terminals to remotely access the Internet, or enable the communication terminals to communicate with other communication terminals in a remote area. However, if an intermediate server installed in a predetermined area is destroyed or broken down for some reason, communication terminals in the predetermined area cannot communicate with each other. In the meantime, in the case of ad hoc communication between communication terminals, it is difficult to locate communication terminals that are constantly moving from place to place.

Disclosure of the Invention

The present invention provides a wireless communication terminal, which can communicate with other wireless communication terminals even when communications via a commercial network are impossible, and a wireless communication method using the wireless communication terminal.

According to an aspect of the present invention, there is provided a wireless communication terminal comprising: a table storage unit, which stores a routing table in which identification information and location information of other communication terminals in a predetermined set region are recorded; a first communication unit, which

establishes a communication path between the wireless communication terminal and a destination communication terminal by using a first frequency band; a second communication unit, which establishes a communication path between the wireless communication terminal and a destination communication terminal by using a second frequency band; and a communication means designation unit, which designates the first communication unit as a communication means if identification information of the destination terminal exists in the routing table and designates the second communication unit as the communication means if the identification information of the destination terminal does not exist in the routing table.

According to another aspect of the present invention, there is provided a wireless communication method comprising: enabling a source terminal to receive identification information and location information of communication terminals in a predetermined set region and to form a routing table based on the received identification information and location information of the communication terminals; receiving identification information of a designation terminal that a user wishes to access from the user; checking whether the identification information of the destination terminal exists in the routing table; and establishing a communication path between the source terminal and the destination terminal via a first frequency band if the identification information of the destination terminal exists in the routing table and establishing the communication path between the source terminal and the destination terminal via a second frequency band if the identification information of the destination terminal does not exist in the routing table.

Accordingly, ad hoc communications are always possible even when communications over a commercial network are impossible. In addition, it is possible to flexibly set up communication paths and reduce the workload of a communication network by avoiding excessive frequency hopping, which is the problem with an ad hoc communication method.

Brief Description of the Drawings

FIG. 1 is a diagram illustrating communication paths set up on a distance basis by using relay communication terminals according to a preferred embodiment of the present invention;

FIG. 2A is a flowchart of a method of transmitting data between communication terminals using a relay communication terminal selected on a distance basis, according

to a preferred embodiment of the present invention;

FIG. 2B is a diagram illustrating an example of a data packet generated by a sending communication terminal;

FIG. 2C is a block diagram of a wireless communication terminal that designates a communication terminal as a relay terminal based on a distance basis;

FIG. 3A is a diagram illustrating a method of relay data between communication terminals in a case where a communication terminal is designated as a relay terminal on a distance basis;

FIG. 3B is a diagram illustrating a method of designating a communication terminal as a relay terminal so as to relay data between communication terminals by using the method of FIG. 3A;

FIG. 4A is a diagram illustrating a method of selecting a local server according to a preferred embodiment of the present invention;

FIG. 4B is a flowchart of a method of selecting a local server or temporary server communication terminal according to a preferred embodiment of the present invention;

FIGS. 5A and 5B are diagrams illustrating the hardware structure of a wireless communication terminal that designates a communication terminal as a relay communication terminal on a distance basis and system information stored in a PROM of the communication terminal;

FIG. 6 is a diagram illustrating the structure of a communication network in which a communication terminal located nearest to a server point at a predetermined moment of time is designated as a relay communication terminal;

FIG. 7A is a flowchart of a method of designating a communication terminal as a manager communication terminal according to a preferred embodiment of the present invention;

FIG. 7B is a flowchart of a method of setting central and local server point information in each communication terminal according to a preferred embodiment of the present invention;

FIG. 7C is a flowchart of a method of designating a communication terminal as a central or local server according to a preferred embodiment of the present invention;

FIG. 7D is a flowchart of a method of switching central or local servers according to a preferred embodiment of the present invention;

FIG. 8A is a flowchart of a communication method between a regular

communication terminal and a local server according to a preferred embodiment of the present invention;

FIG. 8B is a flowchart of a communication method of a central server according to a preferred embodiment of the present invention in a case where a sending terminal transmits data to the central server, as shown in FIG. 8A;

FIG. 9A is a block diagram of a communication terminal according to a preferred embodiment of the present invention, which is capable of designating a communication terminal located nearest to a server point as a relay terminal;

FIG. 9B is a diagram illustrating an example of the basic information table stored in a basic setting information management unit 904 of FIG. 9A;

FIG. 9C is a diagram illustrating an example of the adjacent communication terminal information table stored in an adjacent communication terminal information management unit 903 of FIG. 9A;

FIG. 9D is a diagram illustrating another example of the adjacent communication terminal information table stored in the adjacent communication terminal information management unit 903;

FIG. 10 is a block diagram of a wireless communication terminal according to a preferred embodiment of the present invention;

FIG. 11 is a diagram illustrating an example of a routing table;

FIG. 12A is a diagram illustrating a method of designating, as a relay terminal, a communication terminal that is determined as being located nearest to a destination terminal based on its coordinates obtained using a GPS function;

FIG. 12B is a diagram illustrating the structure of a communication network comprised of wireless communication terminals according to a preferred embodiment of the present invention;

FIG. 13 is a flowchart of a method of establishing a communication path between wireless communication terminals in the communication network of FIG. 12A or 12B; and

FIG. 14 is a flowchart of an information search method of a wireless communication terminal in the communication network of FIG. 12A or 12B, according to a preferred embodiment of the present invention.

Best mode for carrying out the Invention

In a typical wireless communication environment, a wireless communication terminal can communicate with any other wireless communication terminal that falls within a communication rage thereof, as long as their frequency bands are a match for each other's. However, once they go beyond each other's communication range, they cannot communicate with each other without the help of a relay base station. In the case of long-distance communication, it is more efficient for wireless communication terminals to use a relay base station to communicate with each other. However, in the case of short-distance communication, it is more convenient for the wireless communication terminals to use a communication terminal that serves a relay function to communicate with each other. Therefore, the present invention provides wireless communication terminals that each can serve as a bridge or router so that they can communicate with each other by using a wireless communication terminal located therebetween as a relay base station even when they are beyond each other's communication range. Hereinafter, the wireless communication terminal that serves as a relay base station will be called a relay communication terminal.

There are two different methods of selecting a relay communication terminal, i.e., a first method of selecting a relay communication terminal, in which a plurality of wireless communication terminals are located by using a global positioning system (GPS) function and the one that turns out to be located nearest to a destination communication terminal is selected from among the plurality of wireless communication terminals as a relay communication terminal, and a second method of selecting a relay communication terminal, in which, among the plurality of communication terminals, the one that is located nearest to a predetermined server point is selected as a relay communication terminal.

The first method of selecting a relay communication terminal will now be described more fully with reference to FIGS. 1 through 5B. In the first method of selecting a relay communication terminal, coordinates of each of the plurality of wireless communication terminals are obtained by using a GPS function, it is determined based on the coordinates of each of the plurality of wireless communication terminals which one of the plurality of wireless communication terminals is located nearest to the intermediate destination, and the determined wireless communication terminal is selected as a relay communication terminal. In the case of using wireless communication terminals that do not support the GPS function, coordinates of the

wireless communication terminals are stored in advance in a predetermined memory space of the wireless communication terminals. Here, coordinates of a wireless communication terminal serve as a media access control (MAC) of the wireless communication terminal. A MAC address, which is also called a physical address, is a serial number allotted to each port of a network device, such as a LAN card, so that different ports of the network device have different MAC addresses. Therefore, the MAC address is used for identifying a wireless communication terminal, to which it is allotted, during a data transmission process.

Each location on the earth can be represented by longitude and latitude. The longitude and latitude of each location on the earth do not change in any circumstances. In the present invention, each wireless communication terminal has its own serial code or location information (i.e., latitude and longitude) stored therein. The location information of each wireless communication terminal can be automatically obtained from GPS data input to each wireless communication terminal from an external source or can be manually input to each wireless communication terminal in advance. In addition, each wireless communication terminal periodically transmits its own serial code and/or location information to and receives serial codes and/or location information from other wireless communication terminals that fall within a communication range thereof and stores the received serial codes and/or location information of the other wireless communication terminals in a memory thereof as a table.

In the present invention, data may be transmitted between wireless communication terminals on a packet-by-packet basis, information on a source communication terminal and an intermediate destination communication terminal may be contained in a header of each packet, and commands for controlling each of the wireless communication terminals and information gathered from each of the wireless communication terminals may be included in the rest of each packet.

A method of relaying data between communication terminals according to a preferred embodiment of the present invention is as follows. A sending communication terminal searches location information of the other communication terminals, stored in its memory, for a serial code or location information of a final destination communication terminal. If there is no match for the serial code or location information of the final destination communication terminal in the location information of

other wireless communication terminals, the sending communication terminal determines that the final destination communication terminal does not exist within its communication range. Then, the sending communication terminal subtracts the location information (i.e., the latitude and longitude) of each of the other communication terminals from the location information (i.e., the latitude and longitude) of the final destination communication terminal, selects, from among the other communication terminals, the one whose location information has a slightest difference with the location information of the final destination communication terminal as a relay communication terminal, and transmits data desired to be transmitted to the final destination communication terminal to the selected communication terminal. If no response is received from the selected communication terminal for a predetermined period of time, however, the data desired to be transmitted to the final destination communication terminal is transmitted to a communication terminal whose location information has a second slightest difference with the location information of the final destination communication terminal.

The communication terminal selected as a relay communication terminal may transmit a signal confirming that it has received data from the sending communication terminal to the sending communication terminal, check a (time-to-live) TTL value included in the data received from the sending communication terminal, and discard the received data if the TTL value is 0. Thereafter, the relay communication terminal selects the one nearest to the final destination communication terminal from a list of communication terminals adjacent thereto, stored therein, and transmits the received data to the selected communication terminal, in which case, 1 is subtracted from the TTL value included in the received data and the subtraction result is transmitted to the selected communication terminal together with the received data. By subtracting 1 from the TTL value included in the received data, it is possible to prevent the received data from being indefinitely relayed from communication terminal to communication terminal.

In the present invention, a communication terminal may be set as a server, a local server or a communication terminal. A server has general information on all wireless communication terminals under its control and can transmit or receive data from an external source over the Internet because it has an Internet IP address. In addition, the server can transmit/receive data to/from each of the wireless

communication terminals. Each of the wireless communication terminals may have a serial code and location information (i.e., latitude and longitude) of the server. Therefore, if each of the wireless communication terminals does not know of location information of a final destination communication terminal, to which it is to transmit data, it transmits the data to the server so that the server can transmit the data to the final destination communication terminal.

In the present invention, a communication region, in which wireless communication terminals can communicate with one another, is divided into sub-communication regions, and a communication terminal in the middle of each of the sub-communication regions is determined as a local server. Thereafter, the local server collects data from wireless communication terminals in its sub-communication region and transmits the collected data to a server. Preferably, the server can designate a wireless communication terminal as a local server in a remote manner.

In the present invention, a communication terminal, which can serve as a bridge or a router between other communication terminals, stores its location information (latitude and longitude), lets all communication terminals within its communication range share its location information, and receives and stores information on all of the communication terminals within its communication range. The communication terminal uses the information on all of the communication terminals within its communication range when relaying data. In short, each communication terminal in a predetermined communication range can serve as a server, a local server, or a relay communication terminal.

Communication terminals mentioned in this disclosure include personal communication terminals, such as a mobile phone or a personal digital assistants (PDAs), measurement equipment having wireless communication functions, such as a water meter, and other types of devices that can call vehicles loaded with a wireless calling apparatus and transmit data to the vehicles.

FIG. 1 is a diagram illustrating communication paths set up on a distance basis by using a relay communication terminal according to a preferred embodiment of the present invention. Referring to FIG. 1, D1 through D20 represent communication terminals, C1 through C4 represent preliminary communication relay communication terminals, B1 and B2 represent secondary communication relay communication terminals, and A1 represents a tertiary communication relay communication terminal.

As shown in FIG. 1, only a communication path from ① to ② enables data to be transmitted from the communication terminal D1 to the communication terminal D12.

FIG. 2A is a flowchart of a method of transmitting data between communication terminals using a relay communication terminal selected on a distance basis, according to a preferred embodiment of the present invention. Referring to FIG. 2A, a receiving communication terminal receives information on other communication terminals in its communication range in step S200 and stores the received information in its database in step S205. The information on the other communication terminals includes a serial code of each of the other communication terminals and location information of each of the other communication terminals, including the latitude and longitude of each of the other communication terminals.

A sending communication terminal packetizes data to be transmitted to the receiving communication terminal in step S210 and transmits the packetized data to the receiving communication terminal in step S215. Referring to FIG. 2B, a data packet comprises a wireless preamble, a frame synchronization field, a calling serial code, an intermediate destination classification serial code, an intermediate destination serial code, intermediate destination coordinates, a final destination serial code, final destination coordinates, a source serial code, source coordinates, an initial source serial code, initial source coordinates, a TTL field, a data length field, a data field, and a frame check sequence field. One of the most prominent characteristics of the data packet illustrated in FIG. 2B is that the corresponding data packet contains the coordinates and serial codes of an intermediate destination, a final destination, a source, and an initial source.

More specifically, the wireless preamble is a signal that is necessary for a synchronization process performed before transmitting data and has a fixed length (e.g., 56-bite long) starting with a data value of 1 and ending with a data value of 0. The calling serial code is a signal that differentiates the sending communication terminal from the other communication terminals.

The intermediate destination classfication serial code indicates whether a single communication terminal or a group of communication terminals is to receive the data from the sending communication terminal. The intermediate destination serial code indicates information designated to the receiving communication terminal by the sending communication terminal. The intermediate destination coordinates are

location information, such as the longitude and latitude of the receiving communication terminal. In a case where a plurality of communication terminals are set as sending communication terminals that receive the data from the sending communication terminal, the intermediate destination coordinates may be set to a null value. The final destination serial code indicates a serial code of a final destination communication terminal. In a case where a plurality of communication terminals are designated as final destinations, a group serial code assigned to each group, into which the plurality of communication terminals are classified, may be used as the final destination serial code. The final destination coordinates indicate location information (i.e., longitude and latitude) of a final destination communication terminal. In a case where a plurality of communication terminals are set as final destinations, the final destination coordinates may be set to a null value. The initial source serial code indicates a serial code of an initial source communication terminal that has transmitted the data for the first time. The initial source coordinates include location information, i.e., longitude and latitude, of the initial source communication terminal. The TTL field has been described above, and the data length field contains length information of the data.

The receiving communication terminal stores the data packet received from the sending communication terminal in a buffer in step S220 and determines whether it is an intermediate destination of the received data packet in step S225 by analyzing the header data of the received data packet. If the receiving communication terminal turns out to be the intermediate destination of the data packet received from the sending communication terminal, it further determines whether it is a final destination of the received data packet in step S230 by further analyzing the header data of the received data packet. If the receiving communication terminal is not the final destination of the received data packet, it deletes the received data packet stored in the buffer in step S235.

If the receiving communication terminal turns out to be the final destination of the received data packet in step S230, it processes the received data packet in step S240. Otherwise, the receiving communication terminal searches the information on other communication terminals in its communication range, which has been stored in step S205, in step S245 and checks whether, in its communication range, a communication terminal corresponding to the final destination of the received data packet exists in step S250. If the communication terminal corresponding to the final destination of the

received data packet exists in the communication range of the receiving communication terminal, the receiving communication terminal transmits the received data packet to the corresponding communication terminal in step S255.

If the communication terminal corresponding to the final destination of the received data packet does not exist in the communication range of the receiving communication terminal, the receiving communication terminal selects one of the communication terminals in its communication range that is located nearest to the communication terminal corresponding to the final destination of the received data packet in step S260 and transmits the received data packet to the selected communication terminal in step S265. In step S260, the one located nearest to the communication terminal corresponding to the final destination of the received data packet is selected from among the communication terminals in the communication range of the receiving communication terminal based on the longitude and latitude of each of the communication terminals in the communication range of the receiving communication terminal, a preferred embodiment of which is illustrated in FIG. 3A. If the receiving communication terminal processes the received data packet in step S240 or if the receiving communication terminal transmits the received data packet to another receiving communication terminal in step S255 or S265, it transmits information confirming that the processing of the received data packet is complete to the sending communication terminal in step S270 and receives acknowledgement information (ACK) from the sending communication terminal in step S275.

FIG. 2C is a block diagram of a communication terminal 280 for selecting a relay communication terminal on a distance basis. Referring to FIG. 2C, the communication terminal 280 includes a transmitting/receiving unit 282, a received data analyzing unit 284, a relay transmitting unit 286, a communication terminal coordinates managing unit 288, a calculation processing unit 290, a system controlling unit 292, and an input/output unit 294.

The transmitting/receiving unit 282 enables the communication terminal 280 to transmit/receive data to/from other communication terminals. The transmitting/receiving unit 282 may be connected to the Internet.

The received data analyzing unit 284 determines whether the communication terminal 280 is an intermediate destination of a data packet input to the transmitting/receiving unit 282 by analyzing a header of the input data packet and

further determines whether the communication terminal 280 is a final destination of the input data packet if the communication terminal 280 is the intermediate destination of the input data packet.

The communication terminal coordinates managing unit 288 receives serial codes and location information (i.e., longitudes and latitudes) of other communication terminals in a communication range of the communication terminal 280 via the transmitting/receiving unit 282 and stores the received serial codes and location information.

If the communication terminal 280 is the intermediate destination of the input data packet but not the final destination of the input data packet, the relay transmitting unit 286 checks whether a communication terminal corresponding to the final destination of the input data packet exists in the communication range of the communication terminal 280 based on the serial codes and location information of the other communication terminals in the communication range of the communication terminal 280, which are stored in the communication terminal coordinates managing unit 288. If the communication terminal corresponding to the final destination of the input data packet exists in the communication range of the communication terminal 280, the relay transmitting unit 286 transmits the input data packet to the communication terminal corresponding to the final destination of the input data packet. Otherwise, the relay transmitting unit 286 selects one of the other communication terminals in the communication range of the communication terminal 280 that is located nearest to the communication terminal corresponding to the final destination of the input data packet as a relay communication terminal and transmits the input data packet to the selected communication terminal. Here, a communication terminal whose longitude and latitude respectively have slightest differences with the longitude and latitude of the final destination of the input data packet is selected as the relay communication terminal.

If the communication terminal 280 is not only the intermediate destination but also the final destination of the input data packet, the calculation processing unit 290 processes and stores the input data packet.

The input/output unit 294 receives data from user or external devices, such as sensor, and outputs control data or information data.

The system controlling unit 292 controls the transmitting/receiving unit 292, the received data analyzing unit 294, the relay transmitting unit 286, the communication

terminal coordinates managing unit 288, the calculation processing unit 290, and the input/output unit 294 based on system information. Here, the system information may include a serial number of the communication terminal 280, location information, such as the longitude and latitude of the communication terminal 280, and state information such as information indicating whether the communication terminal 280 is currently moving from place to place or stands still and internet connection state information, information on a server communication terminal for the communication terminal 280, TTL information, and an IP address. Here, the TTL information, which is different from TTL information contained in an IP packet, indicates a value that prevents a data packet from being indefinitely relayed among communication terminals.

FIG. 3A is a diagram illustrating a method of relaying data among communication terminals according to a preferred embodiment of the present invention. Referring to FIG. 3A, a first circle 300 envisions a communication range of a communication terminal 1 (305), a second circle 310 envisions a communication range of a communication terminal 9 (315), and a third circle 320 envisions a communication range of a communication terminal 17 (325). In a memory 330 of the communication terminal 1 (305), a serial code and location information (longitude and latitude) of the communication terminal 1 (305) and serial codes and location information (longitudes and latitudes) of other communication terminals in the communication range of the communication terminal 1 (305) are stored. The communication terminal 1 (305) compares the location information of each of the other communication terminals in its communication range with location information of the communication terminal 17 (325), which is a final destination to which the communication terminal 1 (305) is to transmit predetermined data, selects the communication terminal 9 (315), which is nearest to the communication terminal 17 (325) among the communication terminals in the communication range of the communication terminal 1 (305), as a relay communication terminal, and transmits the predetermined data to the communication terminal 9 (315).

In a memory 340 of the communication terminal 9 (315), location information of the communication terminal 9 (315) and location information of other communication terminals in the communication range of the communication terminal 9 (315) are stored. The communication terminal 9 (315) compares the location information of each of the other communication terminals in its communication range with location information of a communication terminal 29 (335), which is a final destination to which the

communication terminal 9 (315) is to transmit the predetermined data, selects the communication terminal 17 (325), which is nearest to the communication terminal 29 (335) among the communication terminals in the communication range of the communication terminal 9 (315), as a relay communication terminal, and transmits the predetermined data to the communication terminal 17 (325).

In a memory 350 of the communication terminal 17 (325), location information of the communication terminal 17 (325) and location information of other communication terminals in the communication range of the communication terminal 17 (325) are stored. The communication terminal 17 (325) checks whether it is a final destination of the predetermined data and checks whether a communication terminal corresponding to the final destination of the predetermined data exists in its communication range by searching the location information of the other communication terminals in its communication range, if it is not the final destination of the predetermined data. During these processes, the communication terminal 17 (325) recognizes that it has information on the communication terminal 29 (335), which is the final destination of the predetermined data, and transmits the predetermined data to the communication terminal 29 (335). In FIG. 3A, reference numeral 360 indicates a memory of the communication terminal 19 (335), in which location information of the communication terminal 29 (335) is stored.

Accordingly, the predetermined data is transmitted from the communication terminal 1 (305) to the communication terminal 29 (335) via the communication terminal 9 (315) and the communication terminal 17 (325).

FIG. 3B is a diagram illustrating a step of selecting a relay communication terminal of the method of relaying data among communication terminals of FIG. 3A. Referring to FIG. 3B, reference numeral 370 is a table showing all of the communication terminals illustrated in FIG. 3A and their respective serial codes, latitudes, and longitudes. The table 370 also shows from which communication terminal to which communication terminal predetermined data is relayed by using arrows. More specifically, the arrows in the table 370 illustrate that the predetermined data is transmitted from the communication terminal 1 (305) to the communication terminal 9 (315), from the communication terminal 9 (315) to the communication terminal 17 (325), and from the communication terminal 17 (325) to the communication terminal 29 (335).

Reference numeral 380 specifies a serial code, and latitude and longitude of the communication terminal 1 (305) that initially transmits the predetermined data and a serial code, and latitude and longitude of the communication terminal 29 (335), which is a final destination of the predetermined data transmitted from the communication terminal 1 (305).

Reference numeral 390 specifies a process of selecting the communication terminal 9 (315) as a relay communication terminal, to which the communication terminal 1 (305) transmits the predetermined data. In order to select the communication terminal 9 (315) as a relay communication terminal, a difference between location information (i.e., longitude and latitude) of each communication terminal stored in the memory of the communication terminal 1 (305) and location information (i.e., longitude and latitude) of the communication terminal 29 (335) is obtained, and a communication terminal whose location information has a slightest difference with the location information of the communication terminal 29 (335) is selected as a relay communication terminal, to which the communication terminal 1 (305) transmits the predetermined data. As shown in FIG. 3B, the location information of a communication terminal 8 is different from the location information of the communication terminal 29 (335) by (12, 3), the location information of a communication terminal 9 is different from the location information of the communication terminal 29 (335) by (12, 1), the location information of a communication terminal 5 is different from the location information of the communication terminal 29 (335) by (15, 1), the location information of a communication terminal 7 is different from the location information of the communication terminal 29 (335) by (14, 0), the location information of a communication terminal 2 is different from the location information of the communication terminal 29 (335) by (17, -1), the location information of a communication terminal 6 is different from the location information of the communication terminal 29 (335) by (14, 2), a communication terminal 4 by (15, 4), and the location information of a communication terminal 3 is different from the location information of the communication terminal 29 (335) by (16, 1). Accordingly, the communication terminal 9 (315) is determined as a relay communication terminal because its location information has a slightest difference of (12, 1) with the location information of the communication terminal 29 (335). Here, the location information of

the communication terminal 8 (i.e., (12, 3)) is arbitrary selected.

FIG. 4A is a diagram illustrating a method of selecting a local server according to a preferred embodiment of the present invention. Referring to FIG. 4A, it is assumed that a communication terminal can communicate with other communication terminals within a 500 M radius. Accordingly, communication terminals vertically or horizontally located apart from a predetermined communication terminal by 500 M can be designated as a local server for the predetermined communication terminal. For example, communication terminals 21, 86, 96, and 161 can be designated as local servers for a communication terminal 91. Here, the communication terminal 96, which is designated as one of the local servers for the communication terminal 91, has communication terminals 66, 67, 68, 69, 70, 80, 81, 82, 83, 84, 94, 95, 97, 98, 108, 109, 110, 111, 112, 122, 123, 124, 125, and 126 under its control.

FIG. 4B is a flowchart of a method of selecting a local server or temporary server communication terminal according to a preferred embodiment of the present invention. Referring to FIG. 4B, in order to select local servers, a central server communication terminal is selected in step S400, and an entire region covered by communication network according to the present invention is divided into a plurality of sub-regions on the basis of a radio reception range in step S410. In step S420, a communication terminal located at the center of each of the plurality of sub-regions is designated as a local server for a corresponding sub-region. In step S430, information on the central server communication terminal is transmitted to each local server, and information on each local server is transmitted to the central server communication terminal. In step S440, each local server searches for all communication terminals under its control and transmits information on all of the searched communication terminals to the central server communication terminal.

In order to select temporary local servers, a temporary central server is selected in step S450, and an entire region under the control of the temporary central server communication terminal is divided into a plurality of sub-regions on the basis of a radio reception range in step S460. In step S470, a communication terminal located at the center of each of the plurality of sub-regions is designated as a temporary local server for a corresponding sub-region. In step S480, information on the temporary central server communication terminal is transmitted to each temporary local server, and information on each temporary local server is transmitted to the temporary central

server communication terminal. In step S490, each temporary local server searches for all communication terminals under its control and transmits information on all of the searched communication terminals to the temporary central server communication terminal.

FIGS. 5A and 5B illustrate the hardware structure of a communication terminal 500 for selecting a relay communication terminal on a distance basis and system information stored in a PROM of the communication terminal 500. Only elements of the communication terminal, which are considered new to those skilled in the art, will now be described in greater detail, and detailed descriptions of the rest of the elements of the communication terminal will be skipped because they are considered obvious to those skilled art.

Referring to FIG. 5A, carrier sense multiple access/collision avoidance (CSMA/CA) 502, which is a variation of CSMA/collision detection (CSMA/CD), can be used in connection with Apple's LocalTalk or other wireless access methods. While sensing carrier waves of a network, communication terminals sequentially transmit data over the network in a predetermined order when the network is determined to be in an idle state. Most of the communication terminals are expected to wait for a while before transmitting data over the network, and the amount of time, for which each of the communication terminals waits to transmit data over the network, is determined depending on where each of the communication terminals stands in a list of communication terminals waiting to transmit data over the network. Listing the communication terminals according to their priority levels and resetting the list of the communication terminals may be performed in various manners. During these processes, however, attempts of a plurality of communication terminals to transmit data over the network may collide with each other. To prevent this problem, a collision avoidance process is performed. Media access control (MAC)/logical link control (LLC) 504 indicates two sub-layers of a data link layer, as defined in the IEEE 802 standard.

A global positioning system (GPS) 506 is a satellite positioning system that provides location and temporal information of an object on the globe. Currently, a total of 27 GPS satellites, including 3 supplementary satellites, revolve around the Earth in different orbits. Accordingly, at least 4 satellite signals can be obtained at any place on the globe at any time. In order to position an object on the globe, at least 4 satellite

signals are needed at the same time. In general, GPS receivers are classified into 4-channel GPS receivers and 8-channel GPS receivers according to the number of satellite signals that they can process at the same time. GPS is generally adopted in navigation equipment for airplanes, ships, and vehicles together with geographic information system (GIS). GPS can also be used to position moving objects, such as people or vehicles.

A universal serial bus (USB) 508, which is one type of serial port that has drawn great attention from the public in accordance with the commercialization of Windows 98, serves as a plug-and-play interface between a computer and a peripheral device, such as an audio player, a joystick, a keyboard, a telephone, a scanner, or a printer. The operation principle of the USB 508 is similar to that of a typical serial port. However, the USB 508 guarantees a higher data transmission speed and easier connection between devices than the typical serial port. The USB 508 supports a data transmission speed of up to 12 Mbps, which is fast enough for most peripheral devices, and can chain up to 127 devices to one another. Even when the USB 508 is connected to a personal computer (PC) during the PC is already operating, the PC can recognize the connection of the USB 508 thereto. In addition, in case of adopting the USB 508, a peripheral device does not have to equip a power supply. In general, a PC has two USB ports. However, a USB hub enables more than 2 peripheral devices to be connected to the PC because the USB hub divides a single USB port into a plurality of USB ports.

A communication terminal serial code 552 is allotted to the communication terminal 500 based on the specification and the purpose of use of the communication terminal 552 so that the communication terminal serial code 552 can be differentiated from communication terminal serial codes respectively allotted to other communication terminals. For example, an Ethernet hard serial number can be allotted to the communication terminal 500 as the communication terminal serial code 552. The communication terminal serial code 552 is 2-byte long.

In a case where the communication terminal 500 uses a GPS receiver board, data detected from the GPS receiver board is automatically input to the communication terminal 500 as location information 554. In a case where the communication terminal 500 is fixed, it does not need the GPS receiver board, in which case, the location information 554 is manually input to the communication terminal 500. Communication

terminal role information 556 specifies the role of the communication terminal 500. In other words, the communication terminal role information 556 specifies whether the communication terminal 500 serves as a server, a local server, an Internet connection server, or a communication terminal that gathers and relays data, controls communication terminals adjacent thereto or devices connected thereto, and receives and outputs data. Server information 562 indicates a serial code and location information of a server. Server 2 information 564 indicates a serial code and location information of another server. Local server information 566 indicates a serial code and location information of a local server. Communication terminals periodically transmits their information to their local server, and the local server periodically transmits information on all of the communication terminals in its communication range to each of the corresponding communication terminals. Reception conditions information 568 enables predetermined data input to the communication terminal 500 to be filtered out by storing its own serial code and a group common code. Transmission conditions information 570 designates a communication terminal or a group of communication terminals as a receiving party that will receive data initially transmitted from the communication terminal 500. An information password 572 is a password required to modify data set in the communication terminal 500. An IP address 574 is an address allotted to a communication terminal connected to the Internet. The above-described information may be stored in a PROM so that it cannot be accidentally deleted.

In the case of designating a communication terminal as a temporary server, temporary system information can be temporarily stored in a RAM and then used. The temporary system information enables the communication terminal 500 to temporarily serve a predetermined function other than the ones originally set therein. Once the communication terminal 500 completes serving the predetermined function, the temporary system information stored in the RAM is deleted, and the wireless communication terminal serves what it is supposed to serve according to system information stored in the PROM thereof. The temporary system information may include a function that the communication terminal 500 is to temporarily serve, information on a temporary server, information on a temporary local server, temporary reception conditions, and a temporary password. TTL 576 is information that prevents packet data from being indefinitely relayed among wireless communication terminals.

A method of designating a communication terminal located nearest to a server

point, which has been determined in advance, as a relay communication terminal according to a preferred embodiment of the present invention will now be described in greater detail with reference to FIGS. 6 through 9.

In the method of designating, as a relay communication terminal, a communication terminal located nearest to a server point, which has been determined in advance, all communication terminals should be able to serve as relay communication terminals, and one of them that is located nearest to a server point should serve as a relay server. Each server point is represented by absolute coordinates comprising longitude and latitude. Each communication terminal create its own location information by receiving GPS signals and transmits its location information to communication terminals in the vicinity thereof so that its location information can be shared by its neighboring communication terminals.

Therefore, no communication terminal serves as a permanent relay server. Rather, any communication terminal that is located nearest to each server point temporarily serves as a relay server. In other words, a predetermined communication terminal may temporarily serve as a relay server when it gets nearer to a server point than other communication terminals while moving around. If the predetermined communication terminal keeps moving to get away from the server point, another communication terminal that is currently located nearest to the server point is designated as a new relay server. Accordingly, a wireless network can be maintained even if the relay server changes, and communication terminals can communicate with others in a remote area through a local server or central server.

Central or local server point values are set by a communication terminal designated as a manager communication terminal. The manager communication terminal is given information on communication terminals under its control, gathered by local servers, from a central server.

In the following paragraphs, it will be assumed for the convenience of explanation that a wireless communication network has a hierarchical structure comprising a manager communication terminal, a central server communication terminal, local server communication terminals, and regular communication terminals. However, the number of layers comprising the hierarchy of the wireless communication network can be adjusted to be smaller or larger than the one set forth herein. In other words, the local server communication terminals may be classified into first local

servers and second local servers. Here, the first local servers serve as relay communication terminals between the central server communication terminal and the second local servers, and the second local servers serve as relay communication terminals between the local servers and the regular communication terminals. In short, the number of layers of the hierarchy of the wireless communication network can be adjusted, if necessary.

In the present invention, a communication terminal located nearest to a central server point serves as a central server. The central server stores and manages identifications (IDs) and location information of a group of communication terminals under its control. In addition, the central server receives communication terminal search requests from communication terminal under its control and processes the communication terminal search requests. In addition, the central server receives a command from a manager communication terminal and transmits the received command to local server communication terminals and regular communication terminals. Moreover, the central server gathers information on the communication terminals under its control and transmits the gathered information to the manager communication terminal. Furthermore, only the central server may be allowed to have location information of the manager communication terminal.

In the present invention, a communication terminal located nearest to a local server position, i.e., a local server point, serves as a local server. The local server gathers location information of communication terminals under its control periodically or in real time and transmits the gathered information to a central server. Each of the communication terminals under the control of the local server may issue a request for location information of other communication terminals to the local server. Then, the local server responds to the request by searching data stored therein for the location information of the requested communication terminals or obtaining the location information of the requested communication terminals in cooperation with other local servers or the central server.

In the present invention, a central server point and local server points are set by a manager communication terminal. There is only one central server in a predetermined network, and location information of the central server, i.e., the latitude and longitude of the central server, is designated as the central server point. On the other hand, since there are a plurality of local servers in the predetermined network, the

local server points are not determined in the way that the central server point is determined. In other words, places longitudinally and/or latitudinally located a predetermined distance apart from the central server point and from one another are designated local server points for the central server point. For example, in a case where the central server point has a latitude of 35°5' and a longitude of 127°7', and a distance between latitudinally or longitudinally adjacent local server points is set to 1', places longitudinally and/or latitudinally located apart from the central server point by 2' are designated as the local server points, and their respective longitudes and latitudes are obtained by adding/subtracting a multiple of 2' to/from the latitude and/or longitude of the central server point. For example, the local server points may have (35°5', 127°7'), (35°5', 127°9'), ..., and (35°7', 127°9'). An example of the above-described method of setting local server points is illustrated in FIG. 1. The longitudinal and latitudinal distances among the local server points may be set differently.

FIG. 6 is a diagram illustrating the structure of a communication network in which a communication terminal located nearest to a server point at a predetermined moment of time is designated as a relay communication terminal. Referring to FIG. 6, a communication terminal 1 obtains its coordinates in real time through GPS or other methods. The coordinates of the communication terminal 1 are (35°8'10", 127°1'9"). Here, it is assumed that a central server point is (35°5', 127°5'), and a distance between latitudinally or longitudinally adjacent local servers is set to 2'. Then, differences between the coordinates of the communication terminal 1 and the coordinates of the central server point are (0°3'10", -0°3'51"). Given that the distance between latitudinally or longitudinally adjacent local servers is 2', it is possible to identify which communication region the communication terminal 1 belongs to based on the differences between the coordinates of the communication terminal 1 and the coordinates of the central server point. That is, the communication region that the communication terminal 1 belongs to is a second upper one from the central server point and a second one to the left of the central server point. A local server point in the corresponding communication region, i.e., (35°9', 127°1'), can be calculated by adding 2' to the latitude of the central server point and subtracting 2' from the longitude of the central server point.

A process of designating a communication terminal in a predetermined

communication region as a local server for the predetermined communication range is as follows. The communication terminal 1 receives information on other communication terminals in its communication region, such as their respective serial codes, role information, and location information, and records the received information in its adjacent communication terminal information table. By doing so, the communication terminal 1 recognizes that no communication terminal has yet been designated as a local server in the communication region that it belongs to and that there are two more communication terminals 2 and 3 in the corresponding communication region. In this case, the communication terminal 2 is designated as a local server because it is located nearer than the communication terminals 1 and 3 to the central server point.

Since the central server point is (35°5', 127°5') and the distance between latitudinally or longitudinally adjacent local server points is set to 2', the communication terminal 2 and a communication terminal 4 are designated as local servers in their respective communication regions because they are nearest to their respective local server points 9 and 10. The communication terminals 1 and 3, which are regular communication terminals, are connected to the communication terminal 2, which is a local server communication terminal, and a communication terminal 5, which is a regular communication terminal, is connected to the communication terminal 4, which is a local server communication terminal.

In the communication network of FIG. 6, a manager communication terminal is selected first, and a communication terminal that belongs to the same communication group as the manager communication terminal is allowed to set the central server point and local server points 1 through 24. Thereafter, a central server communication terminal and local server communication terminals are selected using the above-described method of designating a communication terminal as a central server or local server. Then, the wireless communication network of FIG. 6 is completed.

FIG. 7A is a flowchart of a method of designating a communication terminal as a manager communication terminal according to a preferred embodiment of the present invention. Hereinafter, a communication terminal that attempts to designate itself as a manager communication terminal will be called candidate communication terminal.

Referring to FIG. 7A, a candidate communication terminal receives a first password from a user in step S700. In step S702, the candidate communication

terminal checks whether the first password is valid based on information on the first password stored therein in advance. If the first password is valid, the candidate communication terminal checks whether there is a communication terminal that has already been designated as a manager communication terminal in a communication group that it belongs to by receiving and analyzing role information of all communication terminals in its communication group.

If at least one communication terminal has already been designated as a manager communication terminal in the communication group of the candidate communication terminal in step S706, the candidate communication terminal receives a second password from the user in step S708. In step S710, the candidate communication terminal checks whether the second password is valid based on information on the second password stored therein. If the second password is valid, the candidate communication terminal sends a command signal that cancels the designation of at least one communication terminal as a manager communication terminal to the current manager communication terminal. In step S714, the candidate communication terminal newly sets its role information so that it can serve as a new manager communication terminal. If no communication terminal has been designated as a manager communication terminal in step 706, the method directly proceeds to S714. If the first or second password is determined as being invalid in step S702 or S710, the method is complete. In step S702 or S710, the validity of the first or second password is determined using another password. However, the validity of the first or second password may be determined in various manners, for example, through recognition of the user's fingerprints or iris.

FIG. 7B is a flowchart of a method of setting central and local server point information in each communication terminal according to a preferred embodiment of the present invention. Referring to FIG. 7B, each communication terminal receives central or local server point information in step S720. In step S722, each communication terminal checks which communication terminal has sent the central or local server point information by analyzing serial code information and role information of the communication terminal that has sent the central and local server point information. If the communication terminal that has sent the central or local server point information is the manager communication terminal, each communication terminal stores the received central or local server point information in step S724. Otherwise, each communication

terminal transmits error information to the communication terminal that has sent the central or local server point information in step S726. In this case, each communication terminal abandons the received central or local server point instead of storing it.

FIG. 7C is a flowchart of a method of designating a communication terminal as a central or local server according to a preferred embodiment of the present invention. Hereinafter, a communication terminal that attempts to designate itself as a central or local server will be called candidate communication terminal.

Referring to FIG. 7C, a candidate communication terminal obtains its coordinates using GPS signals in step S730 and transmits the obtained coordinates and its role information indicating that it currently serves as a regular communication terminal to communication terminals adjacent thereto in step S732. In step S734, the candidate communication terminal receives serial codes (IDs), role information, and location information of the adjacent communication terminals and records them in an adjacent communication terminal information table. In step S736, the candidate communication terminal checks whether a communication terminal that currently serves as a central server exists among the adjacent communication terminals by searching the adjacent communication terminal information table. If the communication terminal that currently serves as a central server does not exist among the adjacent communication terminals, the candidate communication terminal checks, in step S738, whether it is currently located nearest to a central server point by comparing its location information with the location information of the adjacent communication terminals stored in the adjacent communication terminal information table. If the candidate communication terminal is currently the nearest one to the central server point, it resets its role information, in step S740, so that it can serve as a central server.

If the communication terminal that currently serves as a central server is determined to exist among the adjacent communication terminals in step S736 or if the candidate communication terminal is determined not to be the nearest one to the central server point in step S738, the candidate communication terminal selects communication terminals belonging to the same communication region as it does from a list of the adjacent communication terminals stored in the adjacent communication terminal information table in step S742. In step S744, the candidate communication terminal checks whether there is a communication terminal that currently serves as a

local server in the communication region of the candidate communication terminal among the selected communication terminals. If no communication terminal currently serves as a local server in the communication region of the candidate communication terminal, the candidate communication terminal checks, in step S746, whether it is the nearest one to a local server point based on its location information and the location information of the communication terminals selected in step S742. If the candidate communication terminal is the nearest one to the local server point, it resets its role information, in step S748, so that it can serve as a local server. Otherwise, the entire process of designating a communication terminal as a local server is complete.

FIG. 7D is a flowchart of a method of switching central or local servers according to a preferred embodiment of the present invention. More specifically, FIG. 7D illustrates a method of replacing a current central or local server terminal, which is determined using the method of FIG. 7C, with a new one by designating a communication terminal located nearest to a central or local server point as the new central or local server terminal in a case where the current central or local server terminal moves away from the central or local server point. Hereinafter, a communication terminal that used to serve as a central or local server but currently serves as a regular communication terminal will be called old server, and a communication terminal that used to serve as a regular communication terminal but currently serves as a central or local server will be called new server.

Referring to FIG. 7D, in step S750, an old server receives location information of communication terminals adjacent thereto periodically or in real time, stores the received location information of the adjacent communication terminals in an adjacent communication terminal information terminal, and manages the stored location information of the adjacent communication terminals. In step S752, the old server compares its location information with the received location information of the adjacent communication terminals and checks based on the comparison result whether it is still the nearest one to a central or local server point. If there is a communication terminal that is located nearer than the old server to the central or local server point among the adjacent communication terminals, the old server designates the corresponding communication terminal as a new server in step S754. In step S756, the old server transmits server designation information, which requests the new server to reset its role information to be compatible with its new role as a server, and server management

information, such as information on the adjacent communication terminals, central server information (if the old server is a local server), or uppermost manager terminal information (if the old server is a central server), to the new server. Steps 754 and 756 are performed only if the communication terminal that is currently located nearer than the old server and the rest of the adjacent communication terminals to the central or local server point maintains the nearest position to the central or local server point for a predetermined amount of time.

In step S758, the old server resets its role information so that it can serve as a regular communication terminal. In step S760, the old server transmits its reset role information and location information to the adjacent communication terminals. In step S762, the new server converts its role information into the one compatible with its new role as a central or local server and stores the server management information received from the old server. In step S764, the new server transmits its converted role information and location information to the old server and the rest of the adjacent communication terminals.

In the meantime, if the old server is destroyed or abruptly breaks down so that it cannot perform the above-described method, a new central or local server is determined using the method of FIG. 7C.

A process of estimating the location of the terminal 5 of FIG. 6 in a case where the terminal 5 moves from the local server point 9 in which the terminal 2 is designated as a local server to the locals server point 10 in which the terminal 4 is designated as a local server will now be described in greater detail.

Communication terminals transmit their respective IDs, location information, and role information to one another and to their local server periodically or in real time. In addition, when the communication terminals have moved by a predetermined distance for a predetermined amount of time, they transmit their updated location information to one another and to their local server. The local server terminal receives information, i.e., the IDs, location information and role information of the communication terminals under its control, stores the received information in an adjacent communication terminal information table, and transmits the received information to a central server. The central server stores the information received from the local server and transmits the received information to a manager terminal.

In a wireless communication network, to which the present invention is applied,

data is transmitted from a sending terminal to a receiving terminal by using location information of the sending terminal. In other words, if the receiving terminal is located within a communication range of the sending terminal, the sending terminal directly transmits data to the receiving terminal. Otherwise, the sending terminal transmits the data and a data relay requesting message to a local server located in the direction of the coordinates of the receiving terminal. If the receiving terminal is located within a communication range of the local server, the local server directly transmits the data received from the sending terminal to the receiving terminal. Otherwise, the local server transmits a data relay requesting message and the received data to another local server located in the direction of the coordinates of the receiving terminal. By doing so, the sending terminal can communicate with the receiving terminal regardless of whether the receiving terminal is within the communication range of the sending terminal.

Therefore, in order for the sending terminal to transmit data to the receiving terminal, the sending terminal must know of location information of the receiving terminal. In order to obtain the location information of the receiving terminal, the sending terminal searches its adjacent communication terminal information table for the location information of the receiving terminal. If there is no match for the location information of the receiving terminal in the adjacent communication terminal information table of the sending terminal, the sending terminal issues a request for the location information of the receiving terminal to its local server. If the local server does not know of the location information of the receiving terminal, it issues a request for the location information of the receiving terminal to a central server. In addition, the local server can estimate a direction, for which the receiving terminal is heading, or a current location of the receiving terminal by using previous location information of the receiving terminal. Moreover, the local server issues a request for the location information of the receiving terminal to another local server, which is located in the direction for which the receiving terminal is heading or is currently in charge of the receiving terminal.

The local server searches its own adjacent communication terminal information table for the location information of the receiving terminal. If the location information of the receiving terminal is searched for and the searched location information is as old as less than a predetermined amount of time, the local server directly transmits the data received from the sending terminal to the receiving terminal. However, if the searched

location information of the receiving terminal is as old as more than the predetermined amount of time, the local server searches again for location information of the receiving terminal, which is prior to the searched location information of the receiving terminal. Accordingly, the local server obtains two pairs of location and time information of the receiving terminal. The local server can calculate a direction, for which the receiving terminal is heading, and the velocity of the receiving terminal using the two pairs of location and time information of the receiving terminal, and estimate the current location of the receiving terminal using the calculated direction and velocity.

The local server transmits the received data to a local server which is currently in charge of the receiving terminal by using the estimated location of the receiving terminal. For example, it is assumed that the receiving terminal is located at (35°8', 127°1') at 17:20:51 and at (35°8', 127°2') at 17:20:51. Since the receiving terminal has moved by 1' to the east for 30 seconds, the velocity of the receiving terminal is estimated to be 216 Km/h. Here, it is assumed that a longitude of 1' amounts to about 1.8 Km. Therefore, if the time when the sending transmits data to the receiving terminal is 17:20:21, the receiving terminal is estimated to be located at (35°8', 127°3') at 17:20:21. Consequently, the sending terminal is required to transmit the data to a local server which has (35°8', 127°3') under its control.

Referring to FIG. 6, the terminal 2, which serves as a local server, receives location information of the terminal 5, which is currently on the move, periodically or in real time and stores the received location information of the terminal 5 in its adjacent communication terminal information table. Thereafter, the terminal 5 finally escapes from the communication range of the terminal 2. In this case, if the terminal 1 or 3 issues a request for the location information of the terminal 5 to the terminal 2 to transmit data to the terminal 5, the terminal 2 estimates a current location of the terminal 5 by using the location information of the terminal 5 stored therein. Accordingly, the terminal 2 issues a request for the location information of the terminal 5 to the terminal 4. Even though it has been described that only a local server is capable of performing the above-described process of estimating the location of a receiving communication terminal, a regular communication terminal can also estimate the location of the receiving communication terminal.

In the meantime, if not enough information to estimate the location of the terminal 5 has been obtained from the terminal 4, the terminal 2 can issue a request for

the location information of the terminal 5 to a central server.

FIG. 8A is a flowchart of a communication method between a regular communication terminal and a local server according to a preferred embodiment of the present invention. Referring to FIG. 8A, a sending terminal searches its adjacent communication terminal information table for most recent location information of a receiving terminal in step S800. If the location information of the receiving terminal is searched for in step S805, the sending terminal determines whether the searched location information of the receiving terminal is as old as less than a predetermined amount of time in step S810. If the searched location information of the receiving terminal is as old as less than the predetermined amount of time, the sending terminal transmits data to the receiving terminal by using the searched location information of the receiving terminal in step S815.

If the location information of the receiving terminal searched for in step S810 is as old as more than the predetermined amount of time, the sending terminal searches for second most recent location information of the receiving terminal in step S820. In step S825, the sending terminal checks whether the second most recent location information of the receiving terminal exists in the adjacent communication terminal information table of the sending terminal. If the second most recent location information of the receiving terminal is searched for, it estimates a direction, for which the receiving is currently heading, and a current location of the receiving terminal by using the most recent and second most recent location information of the receiving terminal in step S830. In S835, the sending terminal subtracts 1 from a predetermined routing number. In step S840, the sending terminal determines whether the subtraction result is larger than a predetermined reference value. In step S845, the sending terminal determines whether there is a local server in charge of the estimated location of the receiving terminal if the subtraction result is larger than the predetermined reference number. If there is a local server in charge of the estimated location of the receiving terminal, the sending terminal transmits data to the local server via its local server in step S850. Here, it is assumed that the sending terminal, which performs the entire process of estimating the current location of the receiving terminal, is a regular communication terminal.

If the most recent location information of the receiving terminal is not searched for in step S805, if the second most recent location information of the receiving terminal

is not searched for in step S825, if the subtraction result is smaller than the predetermined reference number, or if no local server is in charge of the estimated location of the receiving terminal, the sending terminal transmits data to a central server via its local server in step S855.

FIG. 8B is a flowchart of a communication method of a central server according to a preferred embodiment of the present invention in a case where a sending terminal transmits data to the central server, as shown in FIG. 8A.

The central server receives a message to be transmitted to a receiving terminal from a local server in step S860 and searches its adjacent communication terminal information table for location information of the receiving terminal in step S865. If the location information of the receiving terminal exists in the adjacent communication terminal information table of the central server in step S870, the central server transmits the received message to a local server in charge of the searched location of the receiving terminal in step S875. Otherwise, the central server transmits an error message to the sending terminal in step S880.

FIG. 9A is a block diagram of a communication terminal according to a preferred embodiment of the present invention, which is capable of designating a communication terminal located nearest to a server point as a relay terminal. Referring to FIG. 9A, the communication terminal includes a transmitting/receiving unit 901, a communication terminal location information management unit 902, an adjacent communication terminal information management unit 903, a basic setting information management unit 904, and a relay server setting unit 905, an input/output unit 906, and a data transmission controlling unit 907.

The transmitting/receiving unit 901 transmits/receives signals from adjacent communication terminals in a wireless manner. The communication terminal location information management unit 902 receives GPS signals, creates current location information of the corresponding communication terminal by using the received GPS signals, and stores the current location information of the receiving terminal in a basic setting information table. The adjacent communication terminal information management unit 903 stores information received from the adjacent communication terminals via the transmitting/receiving unit 901, such as their IDs, location information, role information, and routing number information in an adjacent communication terminal information table of FIG. 9C or 9D and manages the stored information.

The basic setting information management unit 904 manages information of the corresponding communication terminal, such as a communication group ID, a communication terminal ID, a communication region ID, role information, a manager terminal ID, manager terminal location information, a central server point, a central server ID, central server current location, a local server point, a local server ID, and local server current information shown in FIG. 9B. The basic setting information management unit 904 receives the communication group ID and communication terminal ID of the corresponding communication terminal from a user. The communication region ID of the corresponding communication terminal is created based on local server point information, and the role information of the corresponding communication terminal is created by the relay server setting unit 905. In addition, the basic setting information management unit 904 receives the manager terminal ID, manager terminal location information, central server point, and local server point of the corresponding communication terminal from a manager terminal and stores the received information. Moreover, the basic setting information management unit 904 receives the central server ID and central server current location of the corresponding communication terminal from a central server and stores the received information. Finally, the basic setting information management unit 904 receives the local server ID and local server current location of the corresponding communication terminal from a local server and stores the received information.

The relay server setting unit 905 designates a predetermined communication terminal as a central or local server by using the method of FIG. 7C. The input/output unit 906 provides various information set in the corresponding communication terminal and a message received from another communication terminal to the user and receives a message to be transmitted to another communication terminal from the user. The data transmission controlling unit 907 estimates the location of the receiving terminal by using the method of FIG. 8A and sets up a path along which the message received from the user is to be transmitted to the receiving terminal.

FIG. 9B illustrates an example of the basic information table stored in the basic setting information management unit 904 of FIG. 9A. Referring to FIG. 9B, the communication group ID is an identification code for a group of communication terminals controlled by a given manager terminal. The terminal ID is an identification code that distinguishes one in the group of communication terminals from the others.

The communication region ID is an identification code that distinguishes a communication region of a given local server from other communication regions. The communication region ID may be the same as, for example, a local server point value. Communication terminals may be classified into four categories, i.e., regular terminals, local servers, central servers, and manager terminals, based on their roles. However, if necessary, the number of categories of the communication terminals may be larger than 4. The manager terminal ID is an identification code for a communication terminal designated as a manager terminal. The manager terminal ID may be set so that it can only be stored in a central server. The manager terminal location information indicates location information of the manager terminal, which can only be stored in the central server.

The central server point indicates location information of the central server set by the manager terminal. The central server ID indicates an ID of a communication terminal that currently serves as the central server because it is the nearest one to the central server point. The central server current location indicates current location information of the communication terminal that currently serves as the central server. The local server point indicates location information of a local server set by the manager terminal, i.e., how far the local server is located apart from the central server point latitudinally and longitudinally. The local server ID is a communication terminal that currently serves as a local server because it is currently the nearest one to a local server point. The local server current location indicates current location information of the communication terminal that currently serves as the local server.

FIG. 9C illustrates an example of the adjacent communication terminal information table stored in the adjacent communication terminal information management unit 903 of FIG. 9A. Referring to FIG. 9C, a terminal ID and role information are the same as their respective counterparts of FIG. 9B. Routing number information indicates via how many relay terminals the communication terminal of FIG. 9A can eventually communicate with a given communication terminal. The routing number information can be obtained by checking via how many relay terminals the communication terminal of FIG. 9A has received location information of the given communication terminal. In addition, the number of times the received location information of the given communication terminal has been relayed can be obtained by comparing a routing number of the received location information of the given

communication terminal with an initially set routing number.

FIG. 9D illustrates another example of the adjacent communication terminal information table stored in the adjacent communication terminal information management unit 903. In FIGS. 9C and 9D, the coordinates of each communication terminal is represented by abstracting a predetermined rational number from the latitude and longitude of each communication terminal.

FIG. 10 is a block diagram of a wireless communication terminal 1000 according to a preferred embodiment of the present invention. Referring to FIG. 10, the wireless communication terminal 1000 includes a first communication unit 1010, a second communication unit 1020, a table storage unit 1030, a communication means designation unit 1040, a table renewal unit 1050, an information searching unit 1060, a transmitting/receiving unit 1070, a location receiving unit 1080, and a call management unit 1090.

The first communication unit 1010 sets up a communication path between the wireless communication terminal 1000 and another wireless communication terminal (hereinafter, referred to as "destination communication terminal"). The first communication unit 1010 uses a frequency band, such as an industrial, scientific, medical (ISM) band, which is different from a frequency band that the second communication unit 1020 uses. The second communication unit 1020 uses a frequency band that is widely used in commercial networks. For example, the second communication unit 1020 may be a CDMA or GSM module that uses a frequency of about 1.8 GHz.

A routing table is stored in the table storage unit 1030. FIG. 11 illustrates an example of the routing table. Referring to FIG. 11, the routing table has five categories, i.e., communication terminal identification information, location information, distance information, routing hop number, and provided information. The communication terminal identification information, location information, and the provided information are communication terminal information received other communication terminals. The communication terminal information is received from the other communication terminals via the first communication unit 1010 or via relay equipment installed on the ground or a satellite. Each of the other communication terminals periodically transmits its own information.

The communication means designation unit 1040 searches the routing table for

identification information of the destination communication terminal received from a user. If there is a match for the identification information of the destination communication terminal in the routing table, the communication means designation unit 1040 designates the first communication unit 1010 as a communication means. Otherwise, the communication means designation unit 1040 designates the second communication unit 1020 as the communication means. Even if there is a match for the identification information of the destination communication terminal in the routing table, the communication means designation unit 1040 may designate the second communication unit 1020 as the communication means if the number of hops on the communication path set up between the wireless communication terminal 1000 and the destination communication terminal is larger than a reference hop number.

In a case where the first communication unit 1010 is designated as the communication unit, it designates one of communication terminals within a communication range of the wireless communication terminal 1000 as a relay terminal based on the distance or the number of hops between the wireless communication terminal 1000 and each of the communication terminals within the communication range of the wireless communication terminal 1000 and sets up a communication path between the wireless communication terminal 1000 and the destination communication terminal via the relay terminal. In other words, the first communication unit 1010 may designate a communication terminal located nearest to the destination communication terminal as a relay terminal and set up a communication path between the wireless communication terminal 1000 and the destination communication terminal via the relay terminal. Alternatively, the first communication unit 1010 may designate a communication terminal having a smallest number of hops from the wireless communication terminal thereto as a relay terminal by referring to the routing table and sets up a communication path between the wireless communication terminal between the wireless communication terminal 1000 and the destination communication terminal via the relay terminal. The distance and the number of hops between a given communication terminal and the destination communication terminal are obtained using the location information and communication range of the given communication terminal and stored in the routing table.

In a case where the second communication unit 1020 is designated as the communication unit, it sets up a communication path between the wireless

communication terminal 1000 and the destination communication terminal via a public communication network comprising the relay equipment installed on the ground and switches. The public communication network may use a satellite as a communication relay means. Once a communication path between the wireless communication terminal 1000 and the destination communication terminal is established by the second communication unit 1020, information on the destination communication terminal is received via the established communication path. The table management unit 1050 updates the routing table by recording the received information on the destination communication terminal in the routing table. In this case, the first communication unit 1010 selects which communication terminals are to be relay terminals between the wireless communication terminal 1000 and the destination communication terminal and a communication path between the wireless communication terminal 1000 and the destination communication terminal via the selected relay terminals. Once the communication path between the wireless communication terminal 1000 and the destination communication terminal is established by the first communication unit 1010, the communication means designation unit 1040 cancels the communication path established by the second communication unit 1020, designates the first communication unit 1010 as the communication means, and enables the wireless communication terminal 1000 and the destination communication terminal to communicate with each other using the communication path established by the first communication unit 1010.

The table management unit 1050 records information on other communication terminals that the wireless communication terminal 1000 periodically receives from the other communication terminals in the routing table. The information on the communication terminals may be received from the other communication terminals via the first communication unit 1010 or may be received from a manager server via a commercial network.

The table management unit 1050 calculates the distance or the number of hops between the wireless communication terminal 1000 and each of the other communication terminals based on location information of each of the other communication terminals. Since the location information of each of the other communication terminals is represented by latitude and longitude coordinates, the table management unit 1050 can calculate the distance between the wireless communication

terminal 1000 and each of the other communication terminals by comparing location information of the wireless communication terminal received from the location receiving unit 1080 with the location information of each of the other communication terminals. In addition, the table management unit 1050 can calculate the number hops between the wireless communication terminal 1000 and each of the other communication terminals by the above-described method of designating a communication terminal as a relay terminal. Moreover, since the table management unit 1050 has information on coordinates of a relay point, such as a central or local server point, it can calculate the number of hops between the wireless communication terminal 100 and each of the other communication terminals based on the location information of each of the other communication terminals and the coordinates of the relay point. The table management unit 1050 records the calculated distance and the calculated number hops between the wireless communication terminal 1000 and each of the other communication terminals in a distance field and a hopping number field, respectively, in association with the identification information of each of the other communication terminals. The table management unit 1050 only records information on communication terminals in a predetermined range of the wireless communication terminal 1000 in the routing table. The predetermined range is set to be wider than the communication range of the wireless communication terminal 1000.

The information searching unit 1060 searches for a communication terminal that provides information requested by a user by referring to the provided information recorded in the routing table. In order to reduce the storage capacity of the wireless communication terminal 1000, the provided information is preferably recorded in the routing table as predetermined codes. The provided information may be divided into five classes, i.e., large categories, medium categories, small categories, detailed categories, and lowermost categories, and 1 byte is allotted to each of the five classes. Then, the provided information can be represented by a code with a total of 5 bytes. An example of such classifications of the provided information is as follows.

[Large Categories] 1: File Sharing, 2: Hobbies, 3: Types of Industries, ...

[Medium Categories of the Large Category 3, i.e., 'Types of Industries'] 1: Food 2: Transportation, 3: Home Appliances, ...

[Small Categories of the Medium Category 2, i.e., 'Transportation'] 1: Buses, 2:

Taxis, 3: Subway, ...

[Detailed Categories of the Small Category 2, i.e., 'Taxis'] 1: Deluxe Taxis 2: Regular Taxis

[Lowermost Categories of the Detailed Category 1, i.e., 'Deluxe Taxis'] 1: Seoul, 2: Kyonggi Province, 3: Kangwon Province, ...

The provided information is recorded in a provided information field of the routing table of FIG. 11 as codes. For example, a communication terminal whose identification information is 01912345678 has provided information represented by a code 32211, which indicates information on deluxe taxis services in Seoul because 3, 2, 2, 1, and 1 are respectively translated into 'Types of Industries', 'Transportation', 'Taxis', 'Deluxe Taxis', and 'Seoul'.

If a user selects an information search menu using a user interface means (not shown), such as a button equipped with the wireless communication terminal 1000, an output means (not shown) of the wireless communication terminal 1000 outputs the classifications of the provided information in a tree structure. Once the user selects one of the large categories of the provided information, one of the medium categories of the selected large categories, one of the small categories of the selected medium category, one of the detailed categories of the selected small category, and one of the lowermost categories of the selected detailed category and orders a provided information item corresponding to what he/she has selected to be provided, the provided information item is codified and then broadcasted to another communication terminal together with the identification information and location information of the wireless communication terminal 1000. A technique of codifying search words and provided information items is obvious to those skilled in the art to which the present invention pertains, and thus its description will be omitted.

The transmitting/receiving unit 1070 provides an interface means to enable the wireless communication terminal 1000 to communicate with external devices, such as other communication terminals or a manager server. The location receiving unit 1080 receives the location information of the wireless communication terminal 1000 from GPS satellites or from a base station, which is an element of a public communication network. The location receiving unit 1080 provides the received location information of the wireless communication terminal 1000 to the table management unit 1050.

The call management unit 1090 receives a communication request issued by another communication terminal via the transmitting/receiving unit 1070. If the communication request is directed to the wireless communication terminal 1000, the call management unit 1090 transmits the received communication request to the first or second communication unit 1010 or 1020 so that the first or second communication unit 1010 or 1020 can set up a communication path between the wireless communication terminal 1000 and the communication terminal that has issued the communication request. Otherwise, the wireless communication terminal 1000 serves as a relay terminal between the communication terminal that has issued the communication request and the destination communication terminal to which the communication request is supposedly directed.

The call management unit 1090 recognizes the destination communication terminal by using the identification information of the destination communication terminal included in the received communication request. In a case where the wireless communication terminal 1000 serves as a relay terminal between the communication terminal that has issued the communication request and the destination communication terminal, the call management unit 1090 transmits a serial number of the destination communication terminal included in the received communication request to the communication means designation unit 1040. The communication means designation unit 1040 searches the routing table for the serial number of the destination terminal received from the call management unit 1090, establish a communication path between the wireless communication terminal 1000 and the destination communication terminal by performing the above-described process of designating the first or second communication unit 1010 or 1020 as the communication means, and transmits the received communication request to the destination communication terminal via the established communication path.

FIG. 12 is a diagram illustrating the structure of a communication network comprising wireless communication terminals according to a preferred embodiment of the present invention. Hereinafter, a communication terminal that issues a communication request to another communication terminal will be called a source terminal, the communication terminal that the communication request issued by the source terminal is directed to will be called a destination terminal, and a communication terminal that relays data from the source terminal to the destination terminal will be

called a relay terminal.

In a case where a destination terminal 1270 is located within a predetermined range of a source terminal 1210, for example, within a radius R1 of the source terminal 1210, the source terminal 1210 checks whether identification information of the destination terminal 1270 exists in its routing table. In the routing table of the source terminal 1210, information on communication terminals within the predetermined range (i.e., the radius R1) of the source terminal 1210 is recorded. Since the destination terminal 1270 is within the predetermined range of the source terminal 1210, the source terminal 1210 establishes a communication path therefrom to the destination terminal 1270 using the first communication terminal 1010. If the destination terminal 1270 is located within a communication range of the source terminal 1210, the source terminal 1210 can directly communicate with the destination terminal 1270 without the help of a relay terminal. However, if the destination terminal 1270 is beyond the communication range of the source terminal 1210, the source terminal 1210 needs a relay terminal to communicate with the destination terminal 1270. Processes of designating communication terminals as relay terminals between the source terminal 1210 and the destination terminal 1270 and relaying data from the source terminal 1210 to the destination terminal 1270 with the use of the relay terminals have already been described above, and thus their descriptions will not be repeated here.

On the other hand, in a case where a destination terminal 1230 is beyond the predetermined range (i.e., the radius R1) of the source terminal 1210, the source terminal 1210 checks whether identification information of the destination terminal 1230 exists in its routing table. Since the destination terminal 1230 is beyond the radius R1 of the source terminal 1210, the identification information of the destination terminal 1230 is not recorded in the routing table of the source terminal 1210. Therefore, the source terminal 1210 uses the second communication unit 1020 to establish a communication path therefrom to the destination terminal 1230. Accordingly, the second communication unit 1020 may establish a communication path from the source terminal 1210 and the destination terminal 1270 via a first relay device 1280-1 fixed on the ground, a switch 1290-1, and a second relay device 1280-2 or a communication path therebetween via a satellite 1290-2 and the switch 1290-1.

Once the communication path between the source terminal 1210 and the destination terminal 1230 is established by the second communication unit 1020, the

source terminal 1210 receives information on the destination terminal 1230. The received information on the destination terminal 1230 is recorded in the routing table of the source terminal 1210, and the first communication unit 1010 establishes another communication path between the source terminal 1210 and the destination terminal 1230 based on the received information on the destination terminal 1230. Processes of establishing the communication path between the source terminal 1210 and the destination terminal 1230 with the use of the first communication unit 1010 and designating communication terminals as relay terminals between the source terminal 1210 and the destination terminal 1230 have already been described above, and their descriptions will not be repeated. Communication terminals 1220 and 1240 may be designated as relay terminals between the source terminal 1210 and the destination terminal 1230 by taking into consideration how much they are respectively apart from the destination terminal 1230. Alternatively, communication terminals 1250 and 1260 may be designated as relay terminals between the source terminal 1210 and the destination terminal 1230 by taking into consideration how much they are respectively apart from a predetermined server point. In FIG. 12, reference numerals R2 and R3 represent regions respectively set for the communication terminals 1220 and 1240. As described above, relay terminals between the source terminal 1210 and the destination terminal 1230 may be set by referring to the number of hops between each communication terminal and the destination terminal 1230, which is recorded in the routing table. In this case, if the number of hops between each communication terminal and the destination terminal 1230 is larger than a reference hop number, the second communication unit 1020 is designated as the communication means so that it can perform the above-described communication processes.

FIG. 13 is a flowchart of a method of establishing a communication path between wireless communication terminals in the communication network of FIG. 12A or 12B, according to a preferred embodiment of the present invention. Referring to FIG. 13, a source terminal searches its routing table for information on a destination terminal by using identification information of the destination terminal in step S1300. If the information on the destination terminal exists in the routing table of the source terminal, the source terminal checks whether the number of hops between the source terminal and the destination terminal is smaller than a reference hop number or whether a distance between the source terminal and the destination terminal is smaller than a

reference distance, in step S1310. If the number of hops between the source terminal and the destination terminal is smaller than the reference hop number or if the distance between the source terminal and the destination terminal is smaller than the reference distance, the source terminal designates, as a relay terminal, a communication terminal that is currently located nearest to the destination terminal in step S1330. If the destination terminal is located outside a communication range of the source terminal, the source terminal may designate a communication terminal that is currently located nearest to a nearest server point to the destination terminal as a relay terminal in step S1330. In step S1340, the source terminal issues a communication relay request to the communication terminal designated as a relay terminal in step S1330 in an ad-hoc manner by using the first communication unit 1010. Then, the relay terminal establishes a communication path by referring to its routing table to designate another communication terminal as another relay terminal. Alternatively, the relay terminal may directly establish a communication path therefrom to the destination terminal. Therefore, in step S1350, a communication path between the source terminal and the destination terminal is completed so that the source terminal and the destination terminal can communicate with each other.

However, if the information on the destination terminal does not exist in the routing table of the source terminal, if the number of hops between the source terminal and the destination terminal is larger than the reference hop number, or if the distance between the source terminal and the destination terminal is larger than the reference distance, the second communication unit 1020 is designated as a communication means, and a communication path between the source terminal and the destination terminal is established via a commercial network in step S1360. Once the communication path between the source terminal and the destination terminal is established by the second communication unit 1020, the source terminal receives information on the destination terminal via the established communication path and records location information of the destination terminal in its routing table in step S1370.

Thereafter, since the destination terminal is located outside the communication range of the source terminal, the source terminal designates, as a relay terminal, a communication terminal in its communication range that is currently located nearest to the destination terminal or a communication terminal in its communication range that is currently located nearest to a nearest server point to the destination terminal as a relay

terminal in step S1380. The source terminal issues a communication relay request to the communication terminal designated as a relay terminal in step S1380 in an ad-hoc manner by using the first communication unit 1010. Then, the relay terminal establishes a communication path by referring to its routing table to designate another communication terminal as another relay terminal. Alternatively, the relay terminal may directly establish a communication path therefrom to the destination terminal. Therefore, in step S1390, the communication path between the source terminal and the destination terminal established by the second communication unit 1020 is cancelled.

FIG. 14 is a flowchart of an information search method of a wireless communication terminal in the communication network of FIG. 12A or 12B, according to a preferred embodiment of the present invention. Referring to FIG. 14, in step S1400, a user inputs a search word related to information that he/she desires to search for into a source terminal by using a user interface unit of the source terminal. In step S1410, an information search unit 1060 of the source terminal searches a provided information field of a routing table for a communication terminal that provides information corresponding to the input search word by referring to the input search word. If there is a communication terminal that provides the information corresponding to the input search word in step S1420, the corresponding communication terminal is designated as a destination terminal in step S1430. A communication path between the source terminal and the destination terminal is established in step S1440 by performing steps S1300 through S1390 of FIG. 13. Once the communication path between the source terminal and the destination terminal is established, the source terminal receives the information corresponding to the input search word from the destination terminal in step S1450.

The method of FIG. 14 can be used for, for example, calling a taxi. More specifically, a user who desires to get a taxi inputs 'taxis currently in service in a predetermined area' as search words by using a user interface unit of a source terminal. Then, the source terminal searches a provided information field of its routing table for identification information of communication terminals that provide information corresponding to the input search words and outputs the search result to the user via the user interface unit. Here, the source terminal may inform the user of the locations of the communication terminals that provide the information corresponding to the input search words by marking the locations of the corresponding communication terminals

on a predetermined map based on location information of the corresponding communication terminals. If the user selects one of the communication terminals that provide the information corresponding to the input search words, the selected communication is designated as a destination terminal, and a communication path is established between the source terminal and the destination terminal by using the above-described method. Here, the destination terminal may be installed in a taxi or carried by a taxi driver. If the destination terminal receives a communication request from the source terminal, identification information and location information of the source terminal are output via a user interface unit of the destination terminal.

The present invention can be realized as a computer-readable codes written on a computer-readable recording medium. The computer-readable recording medium includes nearly all kinds of recording devices on which data can be written in a computer-readable manner. For example, the computer-readable recording medium includes a ROM, a RAM, a CD-ROM, a magnetic tape, a hard disk, a floppy disk, a flash memory, an optical data storage device, or a carrier wave (i.e., data transmission through the Internet). In addition, the computer-readable recording medium can be distributed over a plurality of computer systems connected to one another in a network so that data written thereon can be executed in a decentralized manner.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A wireless communication terminal comprising:

a table storage unit, which stores a routing table in which identification information and location information of other communication terminals in a predetermined set region are recorded;

a first communication unit, which establishes a communication path between the wireless communication terminal and a destination communication terminal by using a first frequency band;

a second communication unit, which establishes a communication path between the wireless communication terminal and a destination communication terminal by using a second frequency band; and

a communication means designation unit, which designates the first communication unit as a communication means if identification information of the destination terminal exists in the routing table and designates the second communication unit as the communication means if the identification information of the destination terminal does not exist in the routing table.

2. The wireless communication terminal of claim 1, wherein the first communication unit designates, as a relay terminal, one of the communication terminals listed in the routing table that is currently a nearest communication terminal to the destination terminal in a communication range of the wireless communication terminal and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal, and the second communication unit establishes a communication path between the wireless communication terminal and the destination terminal via relay equipment installed on the ground or a satellite.

3. The wireless communication terminal of claim 1, wherein the first communication unit detects, from the routing table, a communication terminal that is located on a communication path having a smallest number of hops from the wireless communication terminal to the destination terminal, designates the detected communication terminal as a relay terminal, and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal, and the second communication unit establishes a communication path

between the wireless communication terminal and the destination terminal via relay equipment installed on the ground or a satellite.

4. The wireless communication terminal of claim 2 or 3, wherein the predetermined set region is wider than the communication range of the wireless communication terminal.

5. The wireless communication terminal of claim 2 or 3, wherein the relay terminal is a communication terminal that is currently located nearest to a predetermined relay point.

6. The wireless communication terminal of claim 1, further comprising:

a table renewal unit, which renews the routing table by using the identification information and location information of the other communication terminals received through the first or second communication unit.

7. The wireless communication terminal of claim 1, further comprising:

a table management unit, which renews the routing table by using the identification information and location information of the destination terminal received through the first or second communication unit,

wherein once the routing table is renewed by the table management unit after the communication path between the wireless communication terminal and the destination terminal is established by the second communication unit, the first communication unit designates, as a relay terminal, one of the communication terminals listed in the routing table that is currently a nearest communication terminal to the destination terminal in the communication range of the wireless communication terminal and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal, and the communication means designating unit cancels the communication path established by the second communication unit and designates the first communication unit as the communication means.

8. The wireless communication terminal of claim 1, further comprising:

a table management unit, which renews the routing table by using the identification information and location information of the destination terminal received through the first or second communication unit,

wherein once the routing table is renewed by the table management unit after the communication path between the wireless communication terminal and the destination terminal is established by the second communication unit, the first communication unit detects, from the routing table, a communication terminal that is located on a communication path having a smallest number of hops from the wireless communication terminal to the destination terminal, designates the detected communication terminal as a relay terminal, and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal, and the communication means designating unit cancels the communication path established by the second communication unit and designates the first communication unit as the communication means.

9. The wireless communication terminal of claim 7 or 8, wherein the relay terminal is a communication terminal that is currently located nearest to a predetermined relay point.

10. The wireless communication terminal of claim 1, wherein the wireless communication terminal receives first terminal information or location information of a predetermined relay point via the first or second communication unit and transmits second terminal information and location information thereof, the first terminal information comprising the identification information and location information of the other communication terminals, the second terminal information comprising the identification information of the wireless communication terminal.

11. The wireless communication terminal of claim 1, wherein if identification information of a communication terminal that has issued a request for establishing a communication path does not match with its own identification information, the first communication unit designates, as a relay terminal, one of the communication terminals listed in the routing table that is currently a nearest communication terminal to the destination terminal in the communication range of the wireless communication terminal

and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal.

12. The wireless communication terminal of claim 1, wherein if identification information of a communication terminal that has issued a request for establishing a communication path does not match with its own identification information, the first communication unit detects, from the routing table, a communication terminal that is located on a communication path having a smallest number of hops from the wireless communication terminal to the destination terminal, designates the detected communication terminal as a relay terminal, and establishes a communication path between the wireless communication terminal and the destination terminal via the relay terminal.

13. The wireless communication terminal of claim 11 or 12, wherein the relay terminal is a communication terminal that is currently located nearest to a predetermined relay point.

14. The wireless communication terminal of claim 1, wherein if the first communication unit is currently designated as the communication means and the number of hops from the wireless communication terminal to the destination terminal is larger than a predetermined reference hop number, the communication means designation unit designates the second communication unit as the communication means.

15. The wireless communication terminal of claim 1 further comprising:

an information search unit, which searches the routing table for information that matches with search information input by a user and provides the searched information to the user,

wherein in the routing table, serial numbers of the other communication terminals and information provided by each of the other communication terminals are recorded, the information comprises at least one of information on sharing of files linked to each of the other communication terminals, hobbies, and types of industries, and the destination terminal is a communication terminal searched for by the information search

unit.

16. The wireless communication terminal of claim 15, wherein the information provided by each of the other communication terminals is classified into a predetermined number of groups according to the type thereof, each of the groups is represented by a classification code comprised of a predetermined number of bits, and the information search unit converts the searched information into a corresponding classification code and searches the routing table by referring to the corresponding classification code.

17. A wireless communication method comprising:

enabling a source terminal to receive identification information and location information of communication terminals in a predetermined set region and to form a routing table based on the received identification information and location information of the communication terminals;

receiving identification information of a designation terminal that a user wishes to access from the user;

checking whether the identification information of the destination terminal exists in the routing table; and

establishing a communication path between the source terminal and the destination terminal via a first frequency band if the identification information of the destination terminal exists in the routing table and establishing the communication path between the source terminal and the destination terminal via a second frequency band if the identification information of the destination terminal does not exist in the routing table.

18. The wireless communication method of claim 17, wherein the first frequency band is an ISM frequency band, and the second frequency band is a frequency band used by a public communication network that comprises relay equipment installed on the ground or satellites.

19. The wireless communication method of claim 17, wherein the predetermined set region is set wider than a communication range of the source

terminal by using the first frequency band.

20. The wireless communication method of claim 17, wherein if the identification information of the destination terminal does not exist in the routing table, one of the communication terminals listed in the routing table that is currently a nearest communication terminal to the destination terminal in the communication range of the wireless communication terminal is designated as a relay terminal and a communication path is established between the source terminal and the destination terminal via the relay terminal.

21. The wireless communication method of claim 17, wherein if the identification information of the destination terminal does not exist in the routing table, a communication terminal that is located on a communication path having a smallest number of hops from the source terminal to the destination terminal is detected from the routing table and then designated as a relay terminal, and a communication path is established between the source terminal and the destination terminal via the relay terminal.

22. The wireless communication method of claim 20 or 21, wherein the relay terminal is a communication terminal that is currently located nearest to a predetermined relay point.

23. The wireless communication method of claim 17 further comprising:

renewing the routing table by using the identification information and location information of the other communication terminals received through the first or second frequency band.

24. The wireless communication method of claim 17 further comprising:

renewing the routing table by using the identification information and location information of the destination terminal received through the first or second frequency band after establishing the communication path between the source terminal and the destination terminal by using the second frequency band;

designating, as a relay terminal, one of the communication terminals listed in the

routing table that is currently a nearest communication terminal to the destination terminal in the communication range of the source terminal;

establishing a communication path between the source terminal and the destination terminal via the relay terminal by using the first frequency band; and

canceling the communication path established by the second frequency band.

FIG. 1

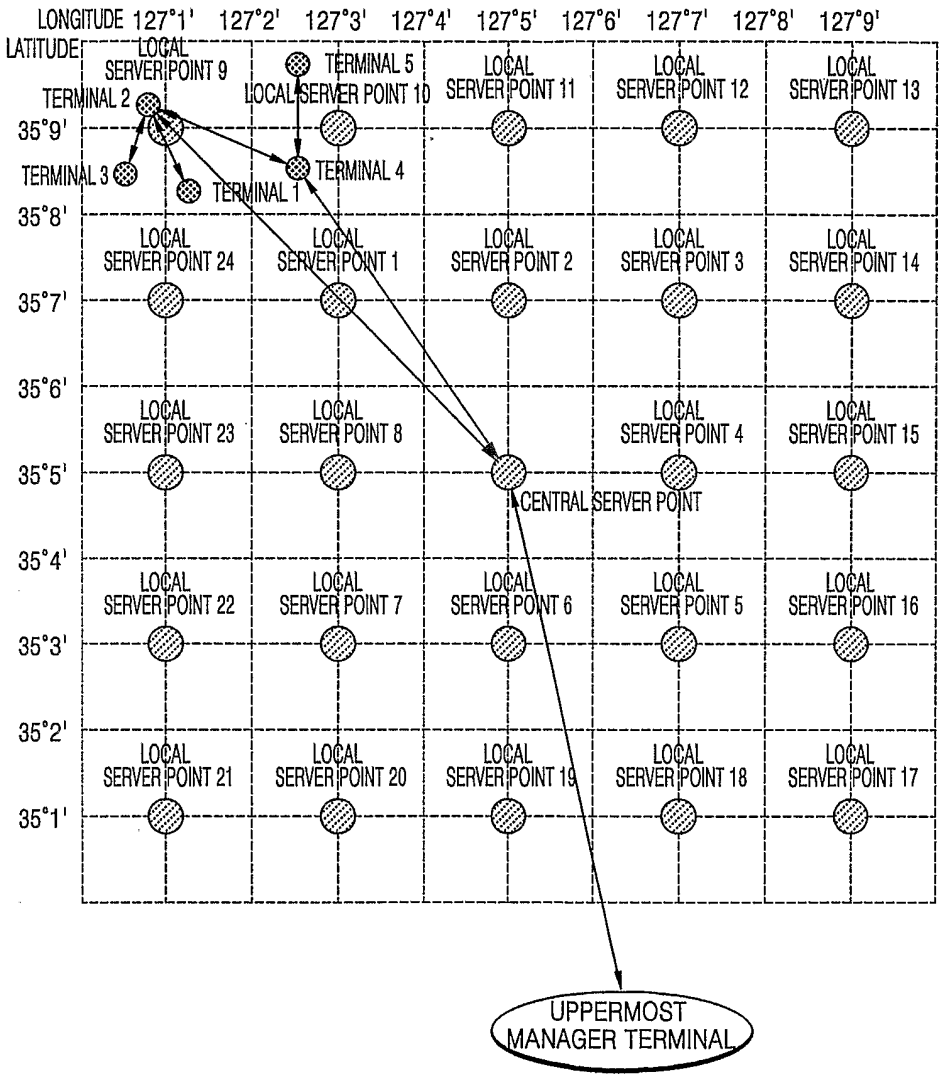

LONGITUDE 127°1' 127°2' 127°3' 127°4' 127°5' 127°6' 127°7' 127°8' 127°9'
LATITUDE
35°9'
35°8'
35°7'
35°6'
35°5'
35°4'
35°3'
35°2'
35°1'
LOCAL SERVER POINT 9
TERMINAL 5
LOCAL SERVER POINT 10
LOCAL SERVER POINT 11
LOCAL SERVER POINT 12
LOCAL SERVER POINT 13
TERMINAL 2
TERMINAL 3
TERMINAL 4
TERMINAL 1
LOCAL SERVER POINT 24
LOCAL SERVER POINT 1
LOCAL SERVER POINT 2
LOCAL SERVER POINT 3
LOCAL SERVER POINT 14
LOCAL SERVER POINT 23
LOCAL SERVER POINT 8
LOCAL SERVER POINT 4
LOCAL SERVER POINT 15
CENTRAL SERVER POINT
LOCAL SERVER POINT 22
LOCAL SERVER POINT 7
LOCAL SERVER POINT 6
LOCAL SERVER POINT 5
LOCAL SERVER POINT 16
LOCAL SERVER POINT 21
LOCAL SERVER POINT 20
LOCAL SERVER POINT 19
LOCAL SERVER POINT 18
LOCAL SERVER POINT 17
UPPERMOST MANAGER TERMINAL

FIG. 2

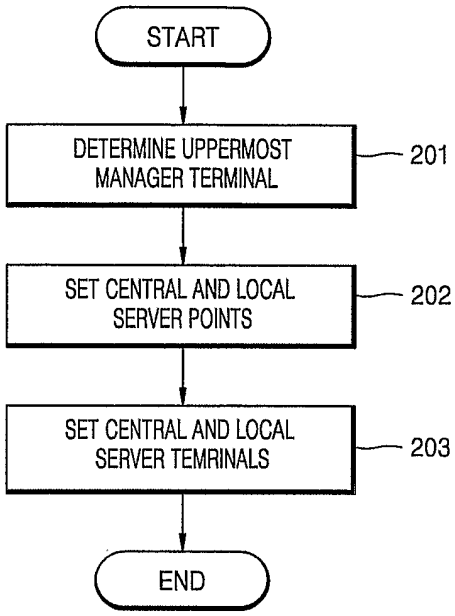

START
DETERMINE UPPERMOST MANAGER TERMINAL
201
SET CENTRAL AND LOCAL SERVER POINTS
202
SET CENTRAL AND LOCAL SERVER TEMRINALS
203
END

FIG. 3

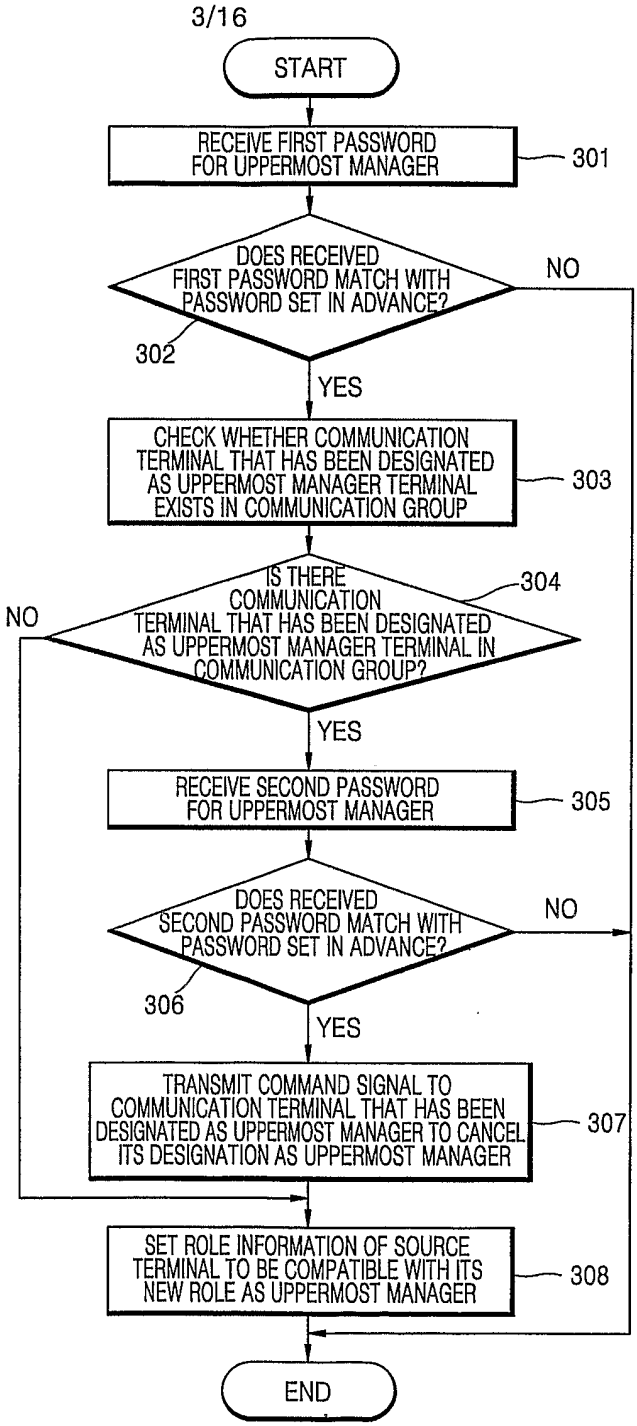

3/16
START
RECEIVE FIRST PASSWORD FOR UPPERMOST MANAGER
301
DOES RECEIVED FIRST PASSWORD MATCH WITH PASSWORD SET IN ADVANCE?
302
NO
YES
CHECK WHETHER COMMUNICATION TERMINAL THAT HAS BEEN DESIGNATED AS UPPERMOST MANAGER TERMINAL EXISTS IN COMMUNICATION GROUP
303
IS THERE COMMUNICATION TERMINAL THAT HAS BEEN DESIGNATED AS UPPERMOST MANAGER TERMINAL IN COMMUNICATION GROUP?
304
NO
YES
RECEIVE SECOND PASSWORD FOR UPPERMOST MANAGER
305
DOES RECEIVED SECOND PASSWORD MATCH WITH PASSWORD SET IN ADVANCE?
306
NO
YES
TRANSMIT COMMAND SIGNAL TO COMMUNICATION TERMINAL THAT HAS BEEN DESIGNATED AS UPPERMOST MANAGER TO CANCEL ITS DESIGNATION AS UPPERMOST MANAGER
307
SET ROLE INFORMATION OF SOURCE TERMINAL TO BE COMPATIBLE WITH ITS NEW ROLE AS UPPERMOST MANAGER
308
END

FIG. 4

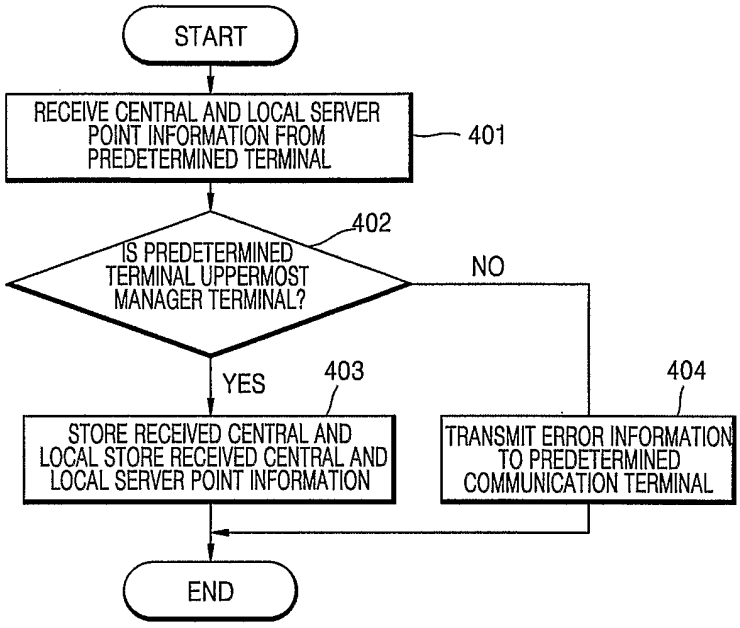

START
RECEIVE CENTRAL AND LOCAL SERVER POINT INFORMATION FROM PREDETERMINED TERMINAL
401
IS PREDETERMINED TERMINAL UPPERMOST MANAGER TERMINAL?
402
NO
YES
403
STORE RECEIVED CENTRAL AND LOCAL STORE RECEIVED CENTRAL AND LOCAL SERVER POINT INFORMATION
404
TRANSMIT ERROR INFORMATION TO PREDETERMINED COMMUNICATION TERMINAL
END

FIG. 5A

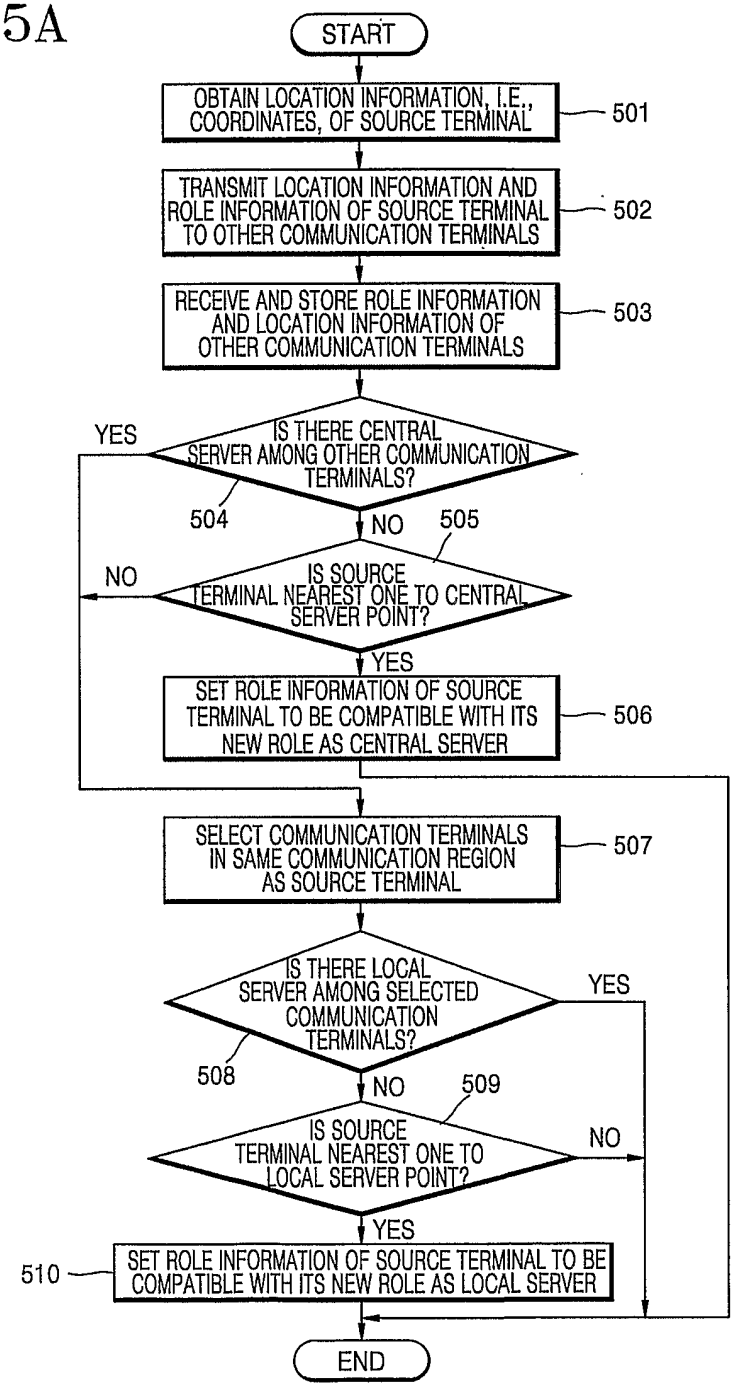

START
OBTAIN LOCATION INFORMATION, I.E., COORDINATES, OF SOURCE TERMINAL
501
TRANSMIT LOCATION INFORMATION AND ROLE INFORMATION OF SOURCE TERMINAL TO OTHER COMMUNICATION TERMINALS
502
RECEIVE AND STORE ROLE INFORMATION AND LOCATION INFORMATION OF OTHER COMMUNICATION TERMINALS
503
IS THERE CENTRAL SERVER AMONG OTHER COMMUNICATION TERMINALS?
504
YES
NO
505
IS SOURCE TERMINAL NEAREST ONE TO CENTRAL SERVER POINT?
NO
YES
SET ROLE INFORMATION OF SOURCE TERMINAL TO BE COMPATIBLE WITH ITS NEW ROLE AS CENTRAL SERVER
506
SELECT COMMUNICATION TERMINALS IN SAME COMMUNICATION REGION AS SOURCE TERMINAL
507
IS THERE LOCAL SERVER AMONG SELECTED COMMUNICATION TERMINALS?
508
YES
NO
509
IS SOURCE TERMINAL NEAREST ONE TO LOCAL SERVER POINT?
NO
YES
510
SET ROLE INFORMATION OF SOURCE TERMINAL TO BE COMPATIBLE WITH ITS NEW ROLE AS LOCAL SERVER
END

FIG. 5B

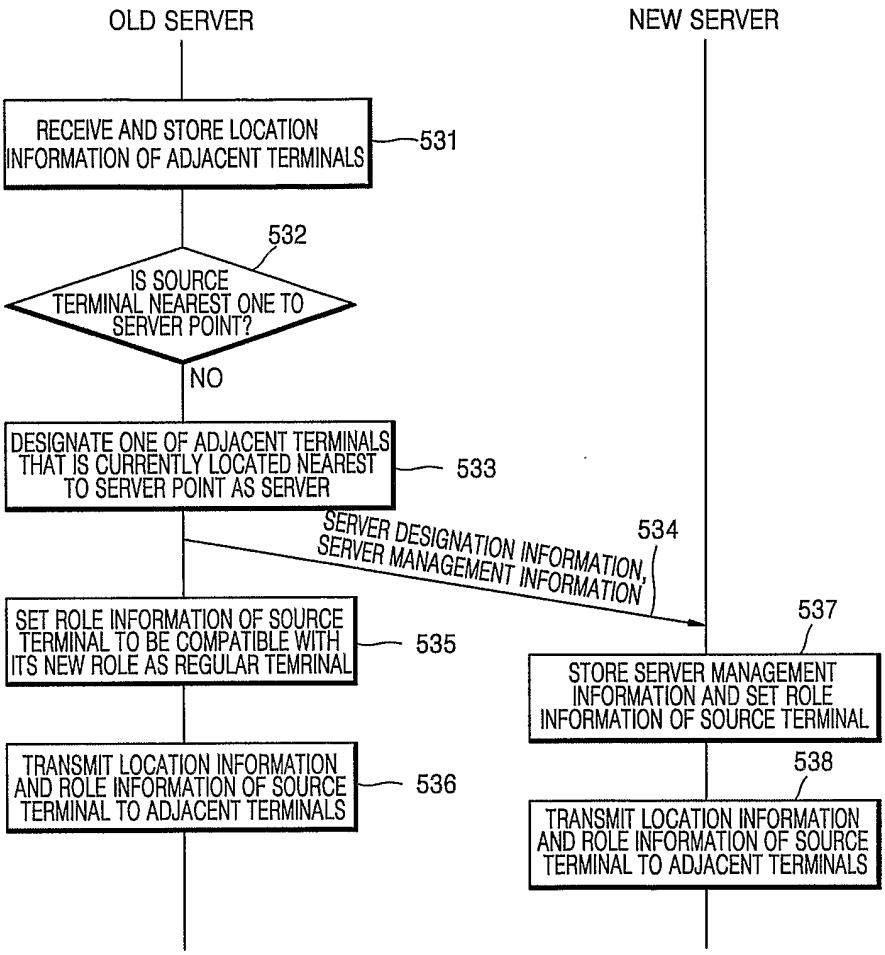

OLD SERVER
NEW SERVER
RECEIVE AND STORE LOCATION INFORMATION OF ADJACENT TERMINALS
531
532
IS SOURCE TERMINAL NEAREST ONE TO SERVER POINT?
NO
DESIGNATE ONE OF ADJACENT TERMINALS THAT IS CURRENTLY LOCATED NEAREST TO SERVER POINT AS SERVER
533
SERVER DESIGNATION INFORMATION, SERVER MANAGEMENT INFORMATION
534
SET ROLE INFORMATION OF SOURCE TERMINAL TO BE COMPATIBLE WITH ITS NEW ROLE AS REGULAR TEMRINAL
535
537
STORE SERVER MANAGEMENT INFORMATION AND SET ROLE INFORMATION OF SOURCE TERMINAL
TRANSMIT LOCATION INFORMATION AND ROLE INFORMATION OF SOURCE TERMINAL TO ADJACENT TERMINALS
536
538
TRANSMIT LOCATION INFORMATION AND ROLE INFORMATION OF SOURCE TERMINAL TO ADJACENT TERMINALS

FIG. 6

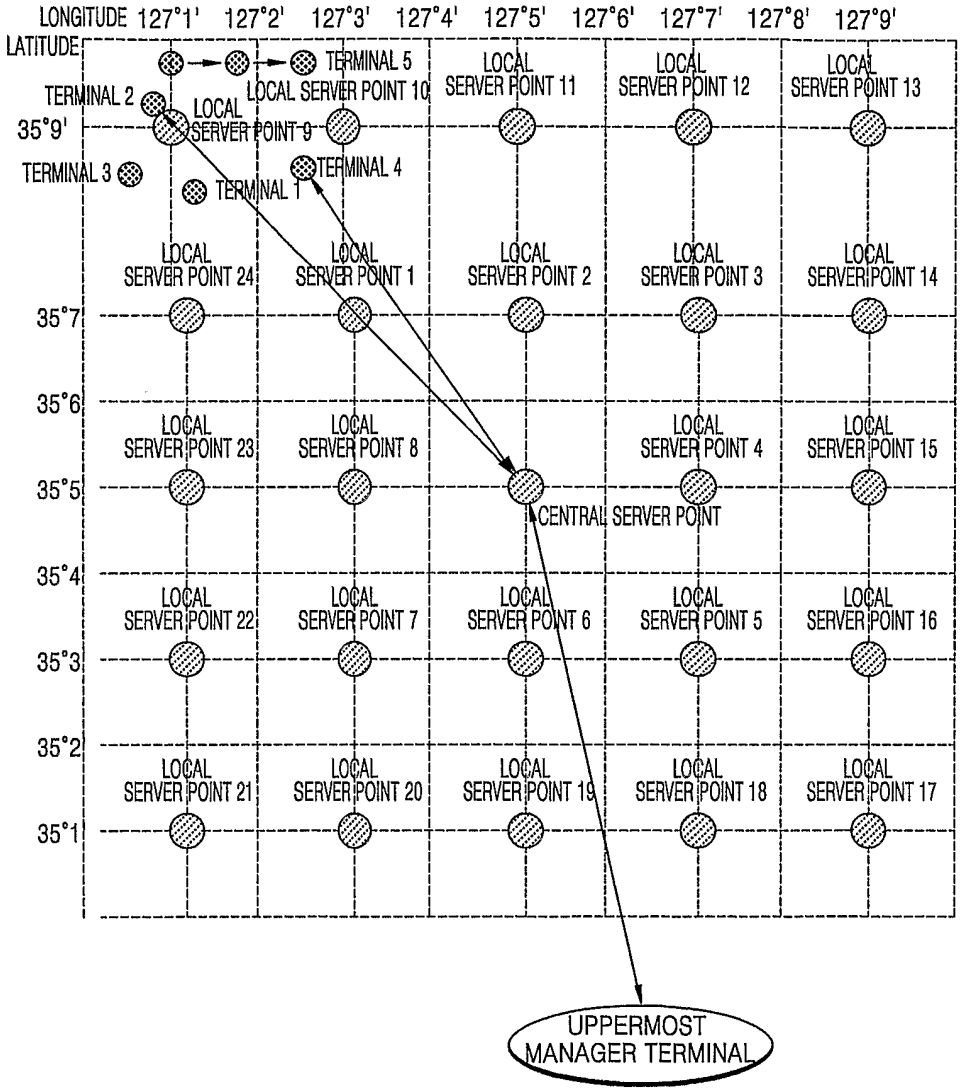

LONGITUDE 127°1' 127°2' 127°3' 127°4' 127°5' 127°6' 127°7' 127°8' 127°9'
LATITUDE
TERMINAL 5
LOCAL SERVER POINT 10
LOCAL SERVER POINT 11
LOCAL SERVER POINT 12
LOCAL SERVER POINT 13
TERMINAL 2
LOCAL SERVER POINT 9
35°9'
TERMINAL 3
TERMINAL 4
TERMINAL 1
LOCAL SERVER POINT 24
LOCAL SERVER POINT 1
LOCAL SERVER POINT 2
LOCAL SERVER POINT 3
LOCAL SERVER POINT 14
35°7
35°6
LOCAL SERVER POINT 23
LOCAL SERVER POINT 8
LOCAL SERVER POINT 4
LOCAL SERVER POINT 15
35°5
CENTRAL SERVER POINT
35°4
LOCAL SERVER POINT 22
LOCAL SERVER POINT 7
LOCAL SERVER POINT 6
LOCAL SERVER POINT 5
LOCAL SERVER POINT 16
35°3
35°2
LOCAL SERVER POINT 21
LOCAL SERVER POINT 20
LOCAL SERVER POINT 19
LOCAL SERVER POINT 18
LOCAL SERVER POINT 17
35°1
UPPERMOST MANAGER TERMINAL

FIG. 7A

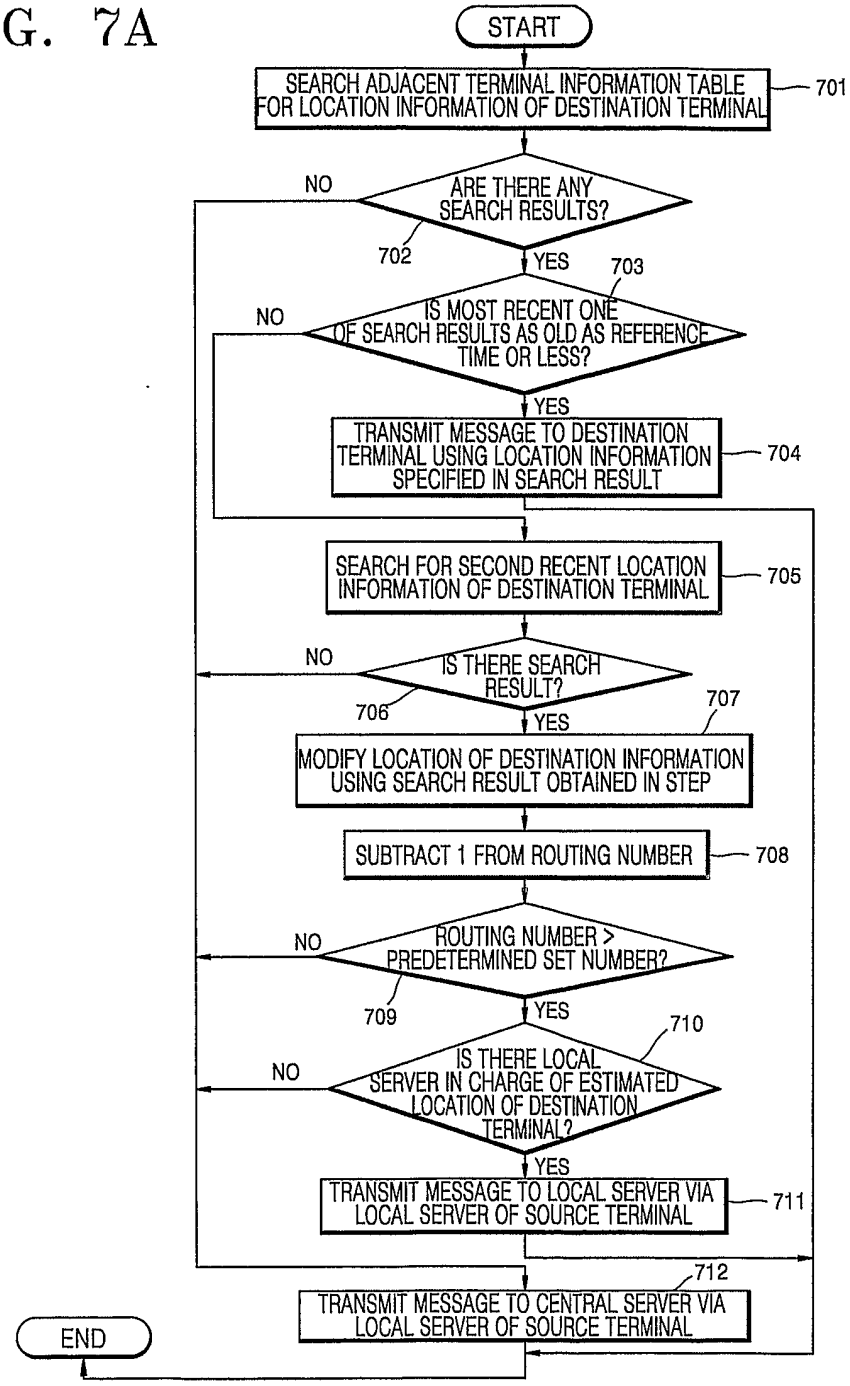

START
SEARCH ADJACENT TERMINAL INFORMATION TABLE FOR LOCATION INFORMATION OF DESTINATION TERMINAL
701
ARE THERE ANY SEARCH RESULTS?
NO
YES
702
IS MOST RECENT ONE OF SEARCH RESULTS AS OLD AS REFERENCE TIME OR LESS?
703
NO
YES
TRANSMIT MESSAGE TO DESTINATION TERMINAL USING LOCATION INFORMATION SPECIFIED IN SEARCH RESULT
704
SEARCH FOR SECOND RECENT LOCATION INFORMATION OF DESTINATION TERMINAL
705
IS THERE SEARCH RESULT?
NO
YES
706
MODIFY LOCATION OF DESTINATION INFORMATION USING SEARCH RESULT OBTAINED IN STEP
707
SUBTRACT 1 FROM ROUTING NUMBER
708
ROUTING NUMBER > PREDETERMINED SET NUMBER?
NO
YES
709
IS THERE LOCAL SERVER IN CHARGE OF ESTIMATED LOCATION OF DESTINATION TERMINAL?
710
NO
YES
TRANSMIT MESSAGE TO LOCAL SERVER VIA LOCAL SERVER OF SOURCE TERMINAL
711
TRANSMIT MESSAGE TO CENTRAL SERVER VIA LOCAL SERVER OF SOURCE TERMINAL
712
END

FIG. 7B

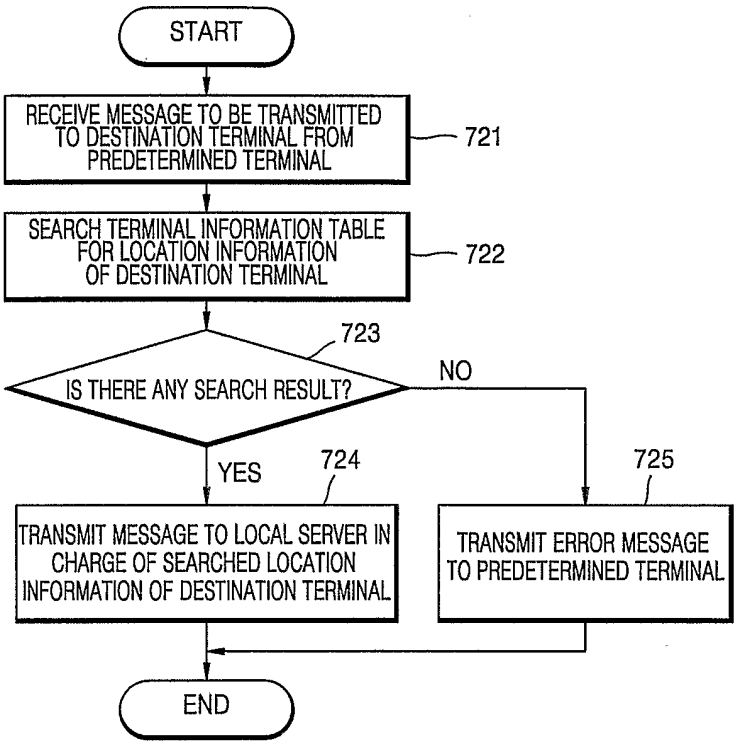

START
RECEIVE MESSAGE TO BE TRANSMITTED TO DESTINATION TERMINAL FROM PREDETERMINED TERMINAL
721
SEARCH TERMINAL INFORMATION TABLE FOR LOCATION INFORMATION OF DESTINATION TERMINAL
722
723
IS THERE ANY SEARCH RESULT?
NO
YES
724
725
TRANSMIT MESSAGE TO LOCAL SERVER IN CHARGE OF SEARCHED LOCATION INFORMATION OF DESTINATION TERMINAL
TRANSMIT ERROR MESSAGE TO PREDETERMINED TERMINAL
END

FIG. 8A

NAME OF MANAGEMENT INFORMATION	MANAGEMENT INFORMATION
COMMUNICATION GROUP ID	COMMUNICATION GROUP 1
TERMINAL ID	TERMINAL 1
COMMUNICATION REGION ID	35°9', 127°1'
TERMINAL ROLE	REGULAR
UPPERMOST MANAGER ID	xxxx
UPPERMOST MANAGER LOCATION INFORMATION	xxxx
CENTRAL SERVER POINT	35°5', 127°5'
CENTRAL SERVER ID	TERMINAL 0
CENTRAL SERVER CURRENT LOCATION	35°5', 127°5'
LOCAL SERVER POINT	35°9', 127°1'
LOCAL SERVER ID	TERMINAL 2
LOCAL SERVER CURRENT LOCATION	35°9'10", 127°59'50"

FIG. 8B

TERMINAL ID	ROLE	ROUTING NUMBER	FINAL COORDINATES	FINAL RECORDING TIME	PREVIOUS COORDINATES	PREVIOUS RECORDING TIME
TERMINAL 2	LOCAL SERVER	1	541,9	17:20:31	541,8	17:20:21
TERMINAL 3	REGULAR	1	537,8	17:20:29	536,7	17:20:19
TERMINAL 4	LOCAL SERVER	2	538,17	17:20:26	538,17	17:19:16
TERMINAL 5	REGULAR	1	544,14	17:20:23	544,10	17:20:13
⋮	⋮	⋮	⋮	⋮	⋮	⋮

FIG. 8C

TERMINAL ID	ROLE	ROUTING NUMBER	COORDINATES	FINAL RECORDING TIME
TERMINAL 2	LOCAL SERVER	1	541,9	17:20:31
TERMINAL 3	REGULAR	1	537,8	17:20:29
TERMINAL 4	LOCAL SERVER	2	538,17	17:20:26
TERMINAL 5	REGULAR	1	544,14	17:20:23
TERMINAL 2	LOCAL SERVER	1	541,8	17:20:21
TERMINAL 3	REGULAR	1	536,7	17:20:19
TERMINAL 4	LOCAL SERVER	2	538,17	17:20:16
TERMINAL 5	REGULAR	1	544,10	17:20:13
⋮	⋮	⋮	⋮	⋮

FIG. 9

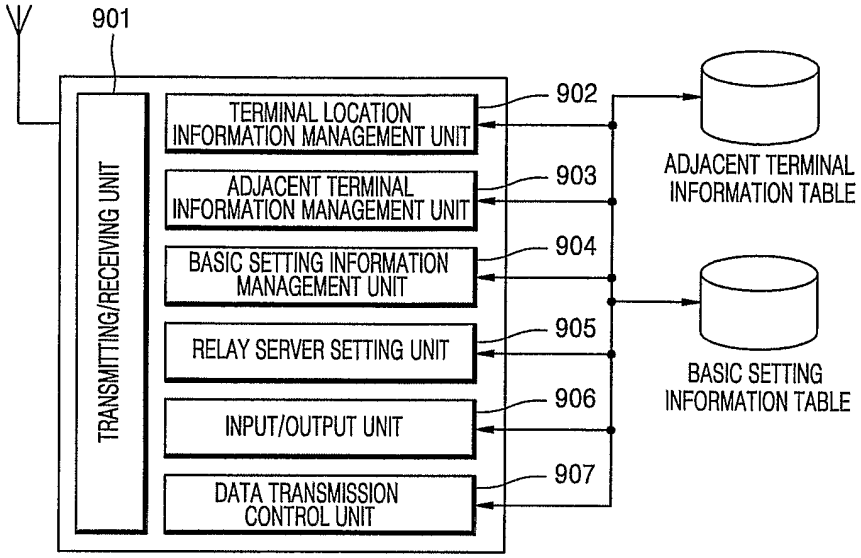

901
TRANSMITTING/RECEIVING UNIT
TERMINAL LOCATION INFORMATION MANAGEMENT UNIT
902
ADJACENT TERMINAL INFORMATION MANAGEMENT UNIT
903
BASIC SETTING INFORMATION MANAGEMENT UNIT
904
RELAY SERVER SETTING UNIT
905
INPUT/OUTPUT UNIT
906
DATA TRANSMISSION CONTROL UNIT
907
ADJACENT TERMINAL INFORMATION TABLE
BASIC SETTING INFORMATION TABLE

FIG. 10

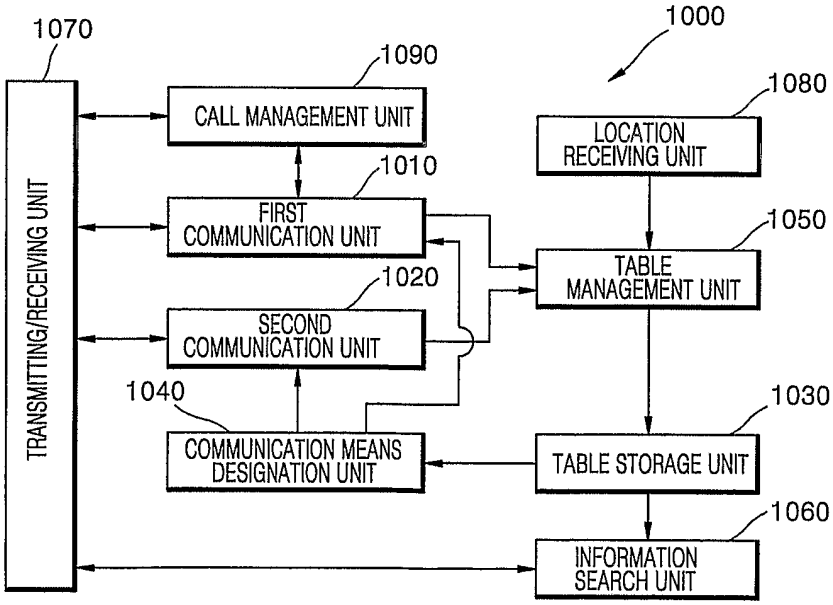

1070
TRANSMITTING/RECEIVING UNIT
1000
1090
CALL MANAGEMENT UNIT
1080
LOCATION RECEIVING UNIT
1010
FIRST COMMUNICATION UNIT
1050
TABLE MANAGEMENT UNIT
1020
SECOND COMMUNICATION UNIT
1040
COMMUNICATION MEANS DESIGNATION UNIT
1030
TABLE STORAGE UNIT
1060
INFORMATION SEARCH UNIT

FIG. 11

TERMINAL IDENTIFICATION INFORMATION	LOCATION INFORMATION	DISTANCE INFORMATION	HOP NUMBER	PROVIDED INFORMATION
011 1234 5678	35,56,127,48	700	1	12345
017 1234 5678	35,60,127,45	650	1	12333
019 1234 5678	35,62,127,25	550	1	32211
011 1234 5679	35,76,127,06	2000	0	11555

FIG. 12

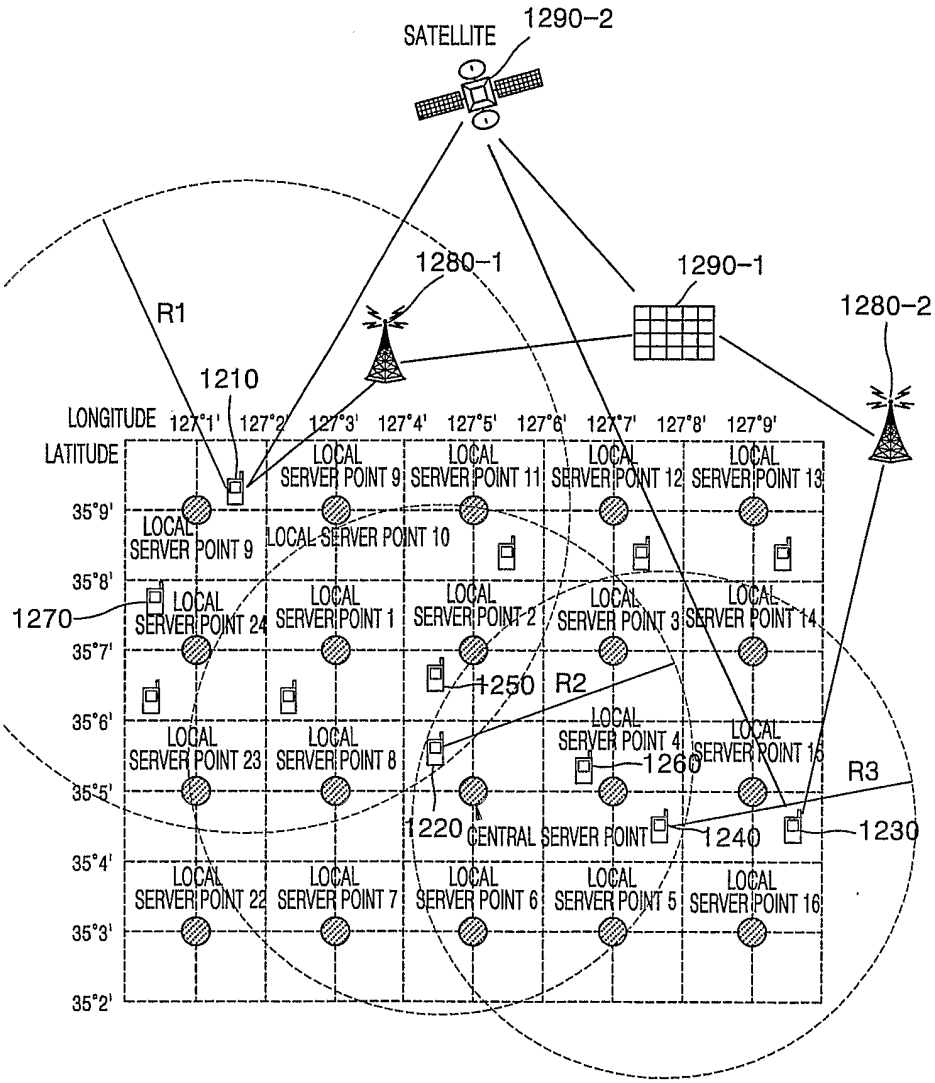

SATELLITE
1290-2
1280-1
1290-1
1280-2
R1
1210
LONGITUDE
127°1'
127°2'
127°3'
127°4'
127°5'
127°6'
127°7'
127°8'
127°9'
LATITUDE
35°9'
35°8'
35°7'
35°6'
35°5'
35°4'
35°3'
35°2'
LOCAL SERVER POINT 9
LOCAL SERVER POINT 11
LOCAL SERVER POINT 12
LOCAL SERVER POINT 13
LOCAL SERVER POINT 9
LOCAL SERVER POINT 10
1270
LOCAL SERVER POINT 24
LOCAL SERVER POINT 1
LOCAL SERVER POINT 2
LOCAL SERVER POINT 3
LOCAL SERVER POINT 14
1250
R2
LOCAL SERVER POINT 23
LOCAL SERVER POINT 8
LOCAL SERVER POINT 4
LOCAL SERVER POINT 15
1260
R3
1220
CENTRAL SERVER POINT
1240
1230
LOCAL SERVER POINT 22
LOCAL SERVER POINT 7
LOCAL SERVER POINT 6
LOCAL SERVER POINT 5
LOCAL SERVER POINT 16

FIG. 13

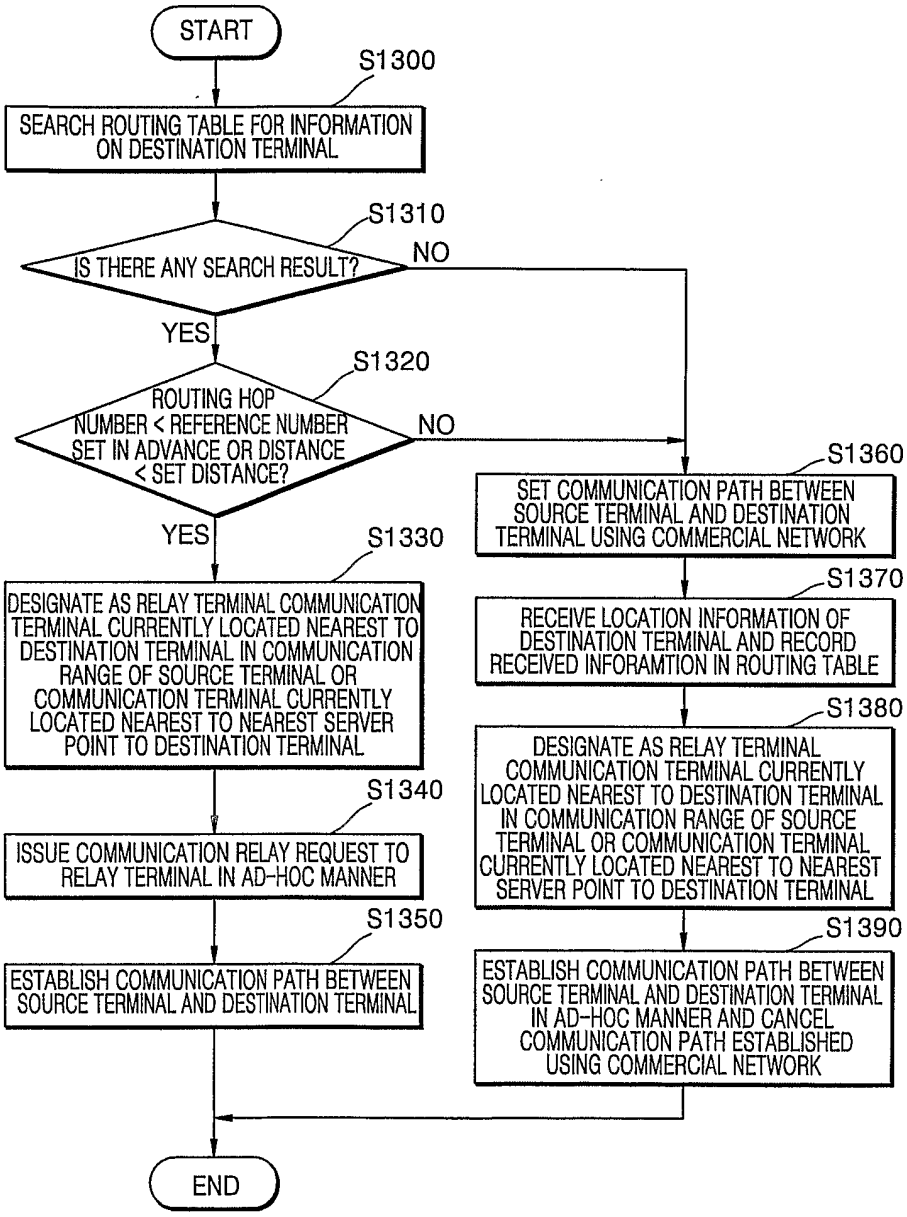
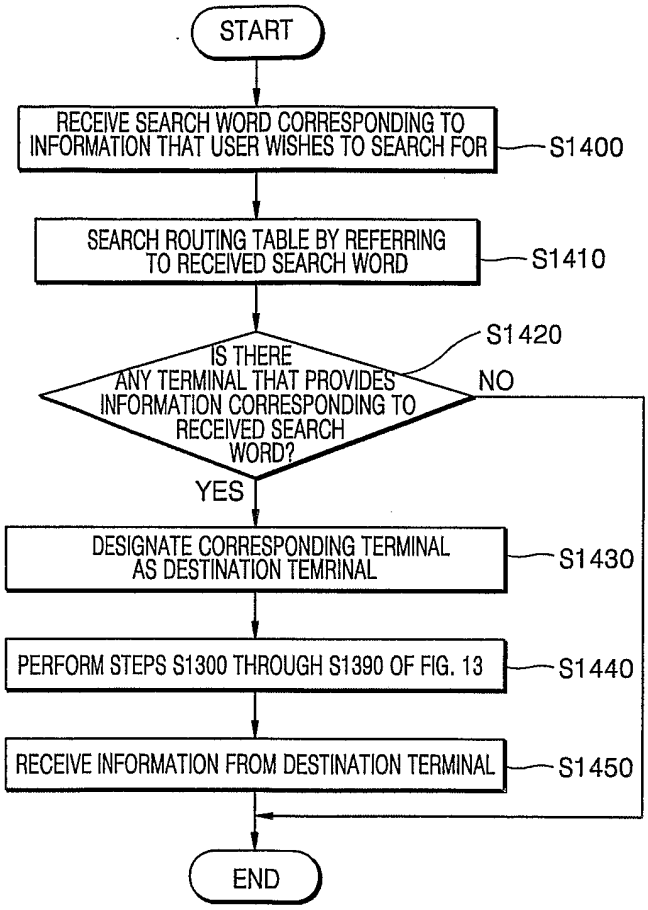

START
S1300
SEARCH ROUTING TABLE FOR INFORMATION ON DESTINATION TERMINAL
S1310
IS THERE ANY SEARCH RESULT?
NO
YES
S1320
ROUTING HOP NUMBER < REFERENCE NUMBER SET IN ADVANCE OR DISTANCE < SET DISTANCE?
NO
YES
S1330
DESIGNATE AS RELAY TERMINAL COMMUNICATION TERMINAL CURRENTLY LOCATED NEAREST TO DESTINATION TERMINAL IN COMMUNICATION RANGE OF SOURCE TERMINAL OR COMMUNICATION TERMINAL CURRENTLY LOCATED NEAREST TO NEAREST SERVER POINT TO DESTINATION TERMINAL
S1340
ISSUE COMMUNICATION RELAY REQUEST TO RELAY TERMINAL IN AD-HOC MANNER
S1350
ESTABLISH COMMUNICATION PATH BETWEEN SOURCE TERMINAL AND DESTINATION TERMINAL
S1360
SET COMMUNICATION PATH BETWEEN SOURCE TERMINAL AND DESTINATION TERMINAL USING COMMERCIAL NETWORK
S1370
RECEIVE LOCATION INFORMATION OF DESTINATION TERMINAL AND RECORD RECEIVED INFORAMTION IN ROUTING TABLE
S1380
DESIGNATE AS RELAY TERMINAL COMMUNICATION TERMINAL CURRENTLY LOCATED NEAREST TO DESTINATION TERMINAL IN COMMUNICATION RANGE OF SOURCE TERMINAL OR COMMUNICATION TERMINAL CURRENTLY LOCATED NEAREST TO NEAREST SERVER POINT TO DESTINATION TERMINAL
S1390
ESTABLISH COMMUNICATION PATH BETWEEN SOURCE TERMINAL AND DESTINATION TERMINAL IN AD-HOC MANNER AND CANCEL COMMUNICATION PATH ESTABLISHED USING COMMERCIAL NETWORK
END

FIG. 14


START
RECEIVE SEARCH WORD CORRESPONDING TO INFORMATION THAT USER WISHES TO SEARCH FOR
S1400
SEARCH ROUTING TABLE BY REFERRING TO RECEIVED SEARCH WORD
S1410
IS THERE ANY TERMINAL THAT PROVIDES INFORMATION CORRESPONDING TO RECEIVED SEARCH WORD?
S1420
NO
YES
DESIGNATE CORRESPONDING TERMINAL AS DESTINATION TEMRINAL
S1430
PERFORM STEPS S1300 THROUGH S1390 OF FIG. 13
S1440
RECEIVE INFORMATION FROM DESTINATION TERMINAL
S1450
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/000465

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04B 7/00

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)
IPC7 H04B, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP : as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)
KIPONET "wireless & mobile & station & rout & destination"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO9946899 A (SWISSCOM) SEP 16, 1999 See abstract and drawings	1
Y	US 5890054 A (TELXON CORP) NOV 14, 1996 See abstract and drawings	1
A	EP1011243 A (Lucent Tech) JUN 21, 2000 See abstract and drawings	1
A	EP1009141 A (Lucent Tech) JUN 14, 2000 See abstract and drawings	1

☐ 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 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
29 MARCH 2004 (29.03.2004)	29 MARCH 2004 (29.03.2004)

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