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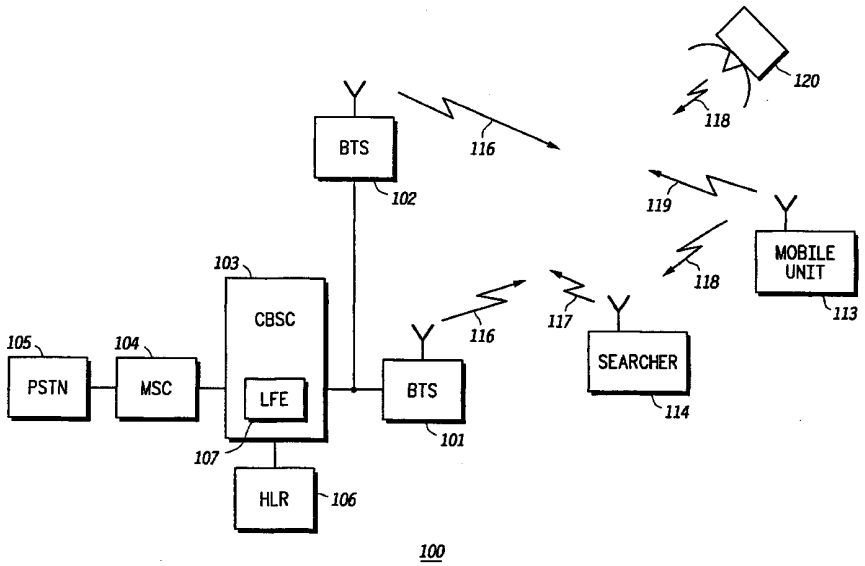

(57) Abstract: When a location of a mobile unit (113) is desired, a searcher (114) is dispatched to the local area where the mobile unit's location is anticipated. The searcher (114) is adapted to receive uplink transmissions from the mobile unit (113). Additionally, the searcher (114) has an independent position determining system (120). The mobile unit's (113) uplink transmission is also received by a first and a second base station (101, 102) and the searcher (114). The searcher (114) determines a location for the searcher (114) utilizing the independent position determining system (120), and analyzes an uplink signal (119) to determine mobile unit location information. The location of the searcher (114) and the mobile unit (113) location information is transmitted to location finding equipment (LFE) (107). LFE (107) utilizes location information transmitted to it by the searcher (114) to determine a location of the mobile unit (113).

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METHOD AND APPARATUS FOR LOCATING A MOBILE UNIT

Field of the Invention

The present invention relates generally to cellular location-finding systems and, in particular, to a method and apparatus for locating a mobile unit within a location-finding system.

Background of the Invention

Radio location techniques have been widely used in many mobile transmitter location systems (e.g., Loran-C). There are three primary methods used to achieve the location of a mobile unit within a location-finding system, namely the a) Time of Arrival (TOA), b) Time Difference of Arrival (TDOA) methods, and c) Angle of Arrival (AOA) methods.

TOA Method for Location: When the distances x_1 and x_2 between a mobile unit and a pair of fixed base stations are known, the position of the mobile unit may be computed by determining the point of intersection of two circles with radii $x_1$and x_2, each centered at one of the fixed base stations. If an error exists in either or both distance determinations, the true position of the mobile unit, P, will be displaced and observed to lie at the intersection P', of the perturbed radial arcs x_{11} and x_{12}. A third base station is typically needed to unambiguously locate each mobile unit at the unique point of intersection of the three circles. To accurately compute the mobile unit location using this method, it is necessary to know precisely the instant the signal is emitted from the base stations and the instant it arrives at the mobile unit. For this method to work properly, an accurate measurement of the total time delay along each of three mobile unit to base station signal paths is necessary.

TDOA Method for Location: For this method of location, the observed time difference between pairs of signals arriving at the mobile unit from three or more base stations are used to compute the location of the mobile unit. The mobile unit, by observing the time difference in arriving signals between base station pairs, can establish the hyperbolae or "lines of position" (LOPs'). In this method therefore, the location estimate can be obtained without knowledge of the

absolute arrival time of the signal from each base station at the mobile unit, only time differences in arrival are significant.

AOA Method for Location: AOA location is described in US Pat. No. 4,636,796, RADIO DIRECTION FINDING SYSTEM, by Imazeki and US Pat. No. 4,833,478, AUTOMATIC DIRECTION FINDER ANTENNA ARRAY, by Nossen. Both patents are incorporated by reference herein. According to such a method, the angle of arrival of a signal transmitted from a mobile unit is determined by analyzing the amplitude (or phase) differences between multiple antennas at a base site. Antennas in one sector will receive the mobile unit's signal at a different angle of arrival than antennas in other sectors. It is the difference in received amplitudes (or phases) of the mobile unit's signal at various antennas that is utilized in determining the angle of arrival of the signal. A look-up table may be used to equate the measured amplitude (or phase) difference to an angle of arrival.

In order to improve the accuracy of Location Finding Equipment (LFE), it is important to have as many base stations participate in locating the mobile unit as is possible. Although in urban areas it may be possible to involve an adequate number of base stations in locating a mobile unit, many rural areas do not lend themselves to locating a mobile unit with an adequate number of base stations. This results in a less-accurate location estimate. Because of this, a need exists for a method and apparatus for more accurately locating a mobile unit when a low number of base stations are available to perform location estimation.

Brief Description of the Drawings

FIG. 1 is a block diagram of a location-finding system in accordance with the preferred embodiment of the present invention.

FIG. 2 is a block diagram of the searcher of FIG. 1 in accordance with the preferred embodiment of the present invention.

FIG. 3 is a flow chart showing operation of the location-finding system of FIG. 1 in accordance with the preferred embodiment of the present invention.

FIG. 4 is a flow chart showing operation of the searcher of FIG. 1 in accordance with the preferred embodiment of the present invention.

Detailed Description of the Preferred Embodiments

To address the need for a method and apparatus for more accurately locating a mobile unit, the present invention provides for a searcher to aide in locating the mobile unit. When a location of a mobile unit is desired, the searcher is dispatched to the local area where the mobile unit's location is anticipated. The searcher is adapted to receive uplink transmissions from the mobile unit. Additionally, the searcher has an independent position determining system. The mobile unit's uplink transmission is also received by a first and a second base station. The searcher determines a location for the searcher utilizing the independent position determining system, and analyzes the mobile units uplink signal to determine mobile unit location information. The location of the searcher and the mobile unit location information is transmitted to location-finding equipment. Location-finding equipment utilizes location information transmitted to it by the searcher to determine a location of the mobile unit.

Because the searcher is providing location information on the mobile unit to location-finding equipment, the accuracy of any location estimate for the mobile unit is increased. Additionally, since the searcher is mobile, the searcher can change location and perform mobile unit location at the changed location. This allows the searcher to contribute multiple location estimates at various locations, greatly increasing the accuracy of the mobile unit's location estimate.

The present invention encompasses a method for locating a first mobile unit within a location-finding system. The method comprises the steps of receiving by a first base station, an uplink communication signal transmitted by the first mobile unit, receiving by a second base station, the uplink communication signal, and receiving by a second mobile unit, the uplink communication signal. Location information for the first and the second mobile units is transmitting by the second mobile unit to location finding equipment and the first mobile unit is located based on the transmitted information.

The present invention additionally encompasses a method for locating a first mobile unit. The method comprises the steps of receiving by a second mobile unit, an uplink communication signal transmitted by the first mobile unit and receiving by a third mobile unit, the uplink communication signal. Location information for the first and the second mobile unit is transmitting by the second

mobile unit to location finding equipment and location information for the first and the third mobile unit is transmitting by the third mobile unit to location finding equipment. Finally the first mobile unit is located based on the steps of transmitting by the second mobile unit and transmitting by the first mobile unit.

The present invention additionally encompasses a method for a first mobile unit to aide in locating a second mobile unit. The method comprises the steps of receiving a location request to locate the second mobile unit and receiving by the first mobile unit, an uplink communication signal transmitted by the second mobile unit. Location information is determined from the uplink communication signal and a location of the first mobile unit is determined via an independent location finding system. Finally, the location information and the location of the first mobile unit is transmitted via an uplink communication signal.

The present invention additionally encompasses a mobile unit comprising an independent position determining receiver outputting location information, a downlink receiver having an identification of a second mobile unit as an input, an uplink receiver having a signal from the second mobile unit as an input and outputting the received signal, and an uplink transmitter having the propagation delay as an input and transmitting the propagation delay and the location information.

Turning now to the drawings, where like numerals designate like components, FIG. 1 is a block diagram of location-finding system 100 in accordance with the preferred embodiment of the present invention. In the preferred embodiment of the present invention, location-finding system 100 utilizes a Code Division Multiple Access (CDMA) system protocol as described in Cellular System Mobile unit-Base Station Compatibility Standard of the Electronic Industry Association/Telecommunications Industry Association Interim Standard 95A (TIA/EIA/IS-95C). (EIA/TIA can be contacted at 2001 Pennsylvania Ave. NW Washington DC 20006). However, in alternate embodiments location-finding system 100 may utilize other digital or analog cellular communication system protocols such as, but not limited to, the next generation CDMA architecture as described in the UMTS Wideband cdma SMG2 UMTS Physical Layer Expert Group Tdoc SMG2 UMTS-L1 221/98 (UMTS 221/98), the next generation CDMA architecture as described in the cdma2000 International Telecommunication Union-Radiocommunication (ITU-R) Radio

Transmission Technology (RTT) Candidate Submission document, or the next generation Global System for Mobile Communications (GSM) protocol, the CDMA system protocol as described in "Personal Station-Base Station Compatibility Requirements for 1.8 to 2.0 GHz Code Division Multiple Access (CDMA) Personal Location-finding systems" (American National Standards Institute (ANSI) J-STD-008), or the European Telecommunications Standards Institute (ETSI) Wideband CDMA (W-CDMA) protocol.

Location-finding system 100 includes a number of network elements such as base station 101, base station 102, mobile unit 113, mobile unit (searcher) 114, Centralized Base Station Controller (CBSC) 103, independent position determining system 120, and Mobile Switching Center (MSC) 104. It is contemplated that network elements within location-finding system 100 are configured in well-known manners with processors, memories, instruction sets, and the like, which function in any suitable manner to perform the function set forth herein.

As shown, mobile unit 113 is communicating with base station 101, base station 102, and searcher 114 via uplink communication signals 119 and base station 101 is communicating with mobile unit 113 via downlink communication signals 116. In the preferred embodiment of the present invention, base stations 101 and 102 are suitably coupled to CBSC 103, and CBSC is suitably coupled to MSC 104, which is in turn coupled to Public Switched Telephone Network (PSTN) 105.

Operation of location-finding system 100 in accordance with the preferred embodiment of the present invention occurs as follows: When a location of a mobile unit is desired, searcher 114 is dispatched to the local area where the mobile unit's location is anticipated. For example, in a situation where a hiker is lost in the wilderness, searcher 114 would be dispatched to the region where the hiker is anticipated to be located. In the preferred embodiment of the present invention searcher 114 comprises a mobile unit similar to mobile unit 113, however, searcher 114 is adapted to receive uplink transmissions from other mobile units. In particular, prior-art mobile units have the capability to receive transmissions of only downlink communication signals. Unlike prior-art mobile units, searcher 114 is adapted to receive uplink transmissions from other mobile units as well. Additionally, searcher 114 has an independent (i.e., independent of

location-finding system 100) position determining system such as a Global Positioning System (GPS) receiver, Loran-C receiver, or any other suitable position determining system.

A location request is initiated, and base stations 101 and 102 use standard location-finding techniques (e.g., AOA, TOA, TDOA . . . etc.) to determine a location of mobile unit 113. In the preferred embodiment of the present invention the location request is initiated as described by Bruckert et al. in US. Pat. No. 5,903,844 METHOD AND APPARATUS FOR DETERMINING MOBILE UNIT LOCATION IN A COMMUNICATION SYSTEM which is incorporated by reference herein. Unlike prior-art location-finding techniques searcher 114 is also utilized in determining the location of mobile unit 113. More particularly, searcher 114, along with base stations 101 and 102 receive the location request containing carrier frequency and the spreading codes utilized by mobile unit 113. If other communication system protocols were being used by location-finding system 100, other information would be transmitted within the location request. For example, for analog systems it would be necessary to include a channel number, for Time-Division-Multiple-Access (TDMA) systems such as GSM or PDC it would be necessary to include channel number and timeslot information within the location request. The mobile unit's uplink transmission is also received by base station 101, base station 102, and searcher 114.

Searcher 114 determines a location for searcher 114 utilizing independent position determining system 120, and analyzes uplink signal 119 to determine mobile unit location information (e.g., TDOA information, TOA information, AOA information, . . . , etc.). The location of searcher 114 and mobile unit 113 location information is transmitted to base station 101 and/or 102, via uplink signal 117 and ultimately to Location Finding Equipment (LFE) 107. LFE 107 utilizes location information transmitted to LFE 107 by base stations 101 and 102, along with location information transmitted to LFE 107 by searcher 114, to determine a location of mobile unit 113. For example, if a TDOA technique is being utilized to locate mobile unit 113, LFE 107 utilizes a time difference in the received signal transmitted by mobile unit 113 as perceived by base station 101, base station 102, and searcher 114. Along with the time difference in the mobile unit's transmitted signal, LFE 107 would also utilize the geographic location of

base stations 101 and 102 and searcher 114 in determining a location estimate for mobile unit 114.

It is anticipated that the above procedure can take place any number of times, with searcher 114 changing location during each location attempt. For example, in the preferred embodiment of the present invention any location determined by LFT 107, is transmitted to base stations 101 and 102, and back to searcher 114. Searcher 114 utilizes this information to move closer to mobile unit 113. Each successive location attempt is made with searcher 114 moving closer to mobile unit 113, thus increasing the accuracy of successive location attempts.

Because searcher 114 is providing location information to LFE 107, the accuracy of any location estimate for mobile unit 113 is increased. Additionally, since the searcher is mobile, the searcher can change location and perform mobile unit location at the changed location. This allows the searcher to contribute multiple location estimates at various locations, greatly increasing the accuracy of the mobile unit's location estimate.

FIG. 2 is a block diagram of mobile unit 114 of FIG. 1 in accordance with the preferred embodiment of the present invention. Searcher 114 comprises independent position determining receiver 203, uplink receiver 205, downlink receiver 207, uplink transmitter 209, and controller 201. In the preferred embodiment of the present invention independent position determining receiver outputs location information to controller 201. Downlink receiver is adapted to receive downlink transmissions from base stations 101 and 102. Downlink transmissions comprise identification information of the mobile unit that is to be located as well as normal downlink communications associated with communication from base stations 101/102 to a standard mobile unit. Additionally, unlike mobile unit 113, uplink receiver is adapted to receive uplink transmissions within a frequency band that is utilized for uplink communication by mobile unit 113. The received signal is routed to controller 201. Controller 201 determines location information for the received signal. For example, if TDOA techniques are being utilized, controller 201 determines an arrival time for an uplink transmission from mobile unit 113. The location information along with the independently determined location of searcher 114 is transferred to uplink transmitter 209 to be transmitted to base station(s) 101 and/or 102.

It should be noted that searcher 114 comprises those elements of a standard mobile unit 113, except searcher 114 is adapted to determine its location independent of location-finding system 100. Additionally, searcher 114 is adapted to receive uplink transmissions within the frequency band normally used by mobile units to communicate with base stations. Finally, although transmitter 209 and receivers 203, 205, 207 are shown existing separately, one of ordinary skill in the art will recognize that many components among the receivers may be shared.

FIG. 3 is a flow chart showing operation of location-finding system 100 of FIG. 1 in accordance with the preferred embodiment of the present invention. The logic flow begins at step 301 where a location request is received by base station 101, base station 102, and a second mobile unit (searcher 114). In the preferred embodiment of the present invention the location request is transmitted by a base station via downlink communication signal 116, and received by downlink receiver 207. As discussed above, the location request comprises identification information on a mobile unit that is to be located (e.g., mobile unit 113). At step 303, an uplink communication signal (e.g., uplink communication signal 119) is transmitted by mobile unit 113 and received by a first base station (e.g., base station 101). The uplink communication signal is additionally received by a second base station (e.g., base station 102) and also received by the second mobile unit (i.e., searcher 114). At step 305, searcher 114 determines location information for mobile unit 113 by analyzing uplink communication signal 119. In the preferred embodiment of the present invention, where a TDOA location technique is being utilized, location information comprises a time-of-arrival for uplink communication signal 119.

Continuing, at step 307 location searcher 114 determines a location for searcher 114 via independent location finding equipment 120. In the preferred embodiment of the present invention searcher 114 determines its location via a constellation of GPS satellites, each transmitting downlink location signal 118. (FIG. 1 shows one such satellite in system 120). Searcher 114 utilizes receiver 203 to analyze location signals 118 (e.g., GPS signals 118), and utilizes standard location-finding techniques to determine the location of searcher 114. At step 309 searcher 114 transmits to location-finding equipment (via base station 101) the location information and the location of searcher 114. Finally, at step 311, mobile

unit 113 is located utilizing the location information and the location of searcher 114. The logic flow ends at step 313.

FIG. 4 is a flow chart showing operation of the searcher of FIG. 1 in accordance with the preferred embodiment of the present invention. The logic flow begins at step 401 where a first mobile unit (searcher 114) receives a request to locate a second mobile unit (mobile unit 113). In the preferred embodiment of the present invention the location request is transmitted to searcher 114 via downlink communication signal 116, and is received by downlink receiver 207. At step 403 uplink communication signal 119 transmitted by the second mobile unit is received by uplink receiver 205 existing within searcher 114. Location information for mobile unit 113 is determined by searcher 114 at step 405 by analyzing uplink communication signal 119. At step 407 searcher 114 determines a location for searcher 114 via independent positioning system 120. More particularly, in the preferred embodiment of the present invention a GPS system is utilized where GPS signal 118 is transmitted by a constellation of satellites, and is received by receiver 203. Searcher 114 determines its location from analysis of signal(s) 118. Finally, at step 409, searcher 114 transmits (via transmitter 209) the location of searcher 114 and the location information for mobile unit 113 to location finding equipment. The logic flow ends at step 411.

The descriptions of the invention, the specific details, and the drawings mentioned above, are not meant to limit the scope of the present invention. For example, although a single searcher (searcher 114) is shown in FIG. 1, multiple searchers may be utilized simultaneously to locate a mobile unit. In such a situation, the uplink communication signal transmitted by a mobile unit that is to be located would be received by a first and a second searcher. Each searcher then transmits location information for itself, along with location information received from the mobile unit. It is the intent of the inventors that various modifications can be made to the present invention without varying from the spirit and scope of the invention, and it is intended that all such modifications come within the scope of the following claims and their equivalents.

Claims

1. A method for locating a first mobile unit within a cellular location-finding system, the method comprising the steps of:

receiving by a first base station, an uplink communication signal transmitted by the first mobile unit;

receiving by a second base station, the uplink communication signal;

receiving by a second mobile unit, the uplink communication signal;

transmitting by the second mobile unit, to location finding equipment, location information for the first and the second mobile units; and

locating the first mobile unit based on the transmitted information.

2. The method of claim 1 further comprising the steps of:

changing a location of the second mobile unit;

receiving by the second mobile unit, the uplink communication signal;

transmitting by the second mobile unit, location information for the first mobile unit and updated location information for the second mobile unit; and

locating the first mobile unit based on the transmitted information.

3. The method of claim 1 wherein the step of transmitting by the second mobile unit, to location finding equipment comprises the step of transmitting by the second mobile unit, to the first base station, location information for the first and the second mobile units.

4. The method of claim 1 wherein the step of locating the first mobile unit based on the transmitted information comprises the step of locating the first mobile unit via a trilateration technique based on the location information for the first and the second mobile units.

5. The method of claim 1 wherein the step of transmitting by the second mobile unit, to location finding equipment, location information for the first and the second mobile units comprises the step of transmitting a location of the second mobile unit and a propagation delay time of the first mobile unit.

6. A method for locating a first mobile unit, the method comprising the steps of:

receiving by a second mobile unit, an uplink communication signal transmitted by the first mobile unit;

receiving by a third mobile unit, the uplink communication signal;

transmitting by the second mobile unit to location finding equipment, location information for the first and the second mobile unit;

transmitting by the third mobile unit to location finding equipment, location information for the first and the third mobile unit; and

locating the first mobile unit based on the steps of transmitting by the second mobile unit and transmitting by the first mobile unit.

7. The method of claim 6 further comprising the steps of:

changing a location of the second mobile unit;

receiving by the second mobile unit, the uplink communication signal;

transmitting by the second mobile unit, location information for the first mobile unit and the updated location information for the second mobile unit; and

locating the first mobile unit based on the steps of transmitting by the second mobile unit and transmitting by the first mobile unit.

8. The method of claim 6 wherein the step of transmitting by the second mobile unit, to location finding equipment, comprises the step of transmitting by the second mobile unit, to a first base station, location information for the first and the second mobile units.

9. The method of claim 6 wherein the step of locating the first mobile unit based on the transmitted information comprises the step of locating the first mobile unit via a trilateration technique based on the location information for the first, the second, and the third mobile units.

10. A mobile unit comprising:

an independent position determining receiver outputting location information;

a downlink receiver having an identification of a second mobile unit as an input;

an uplink receiver having a signal from the second mobile unit as an input and outputting the received signal; and

an uplink transmitter having the propagation delay as an input and transmitting the propagation delay and the location information.

5

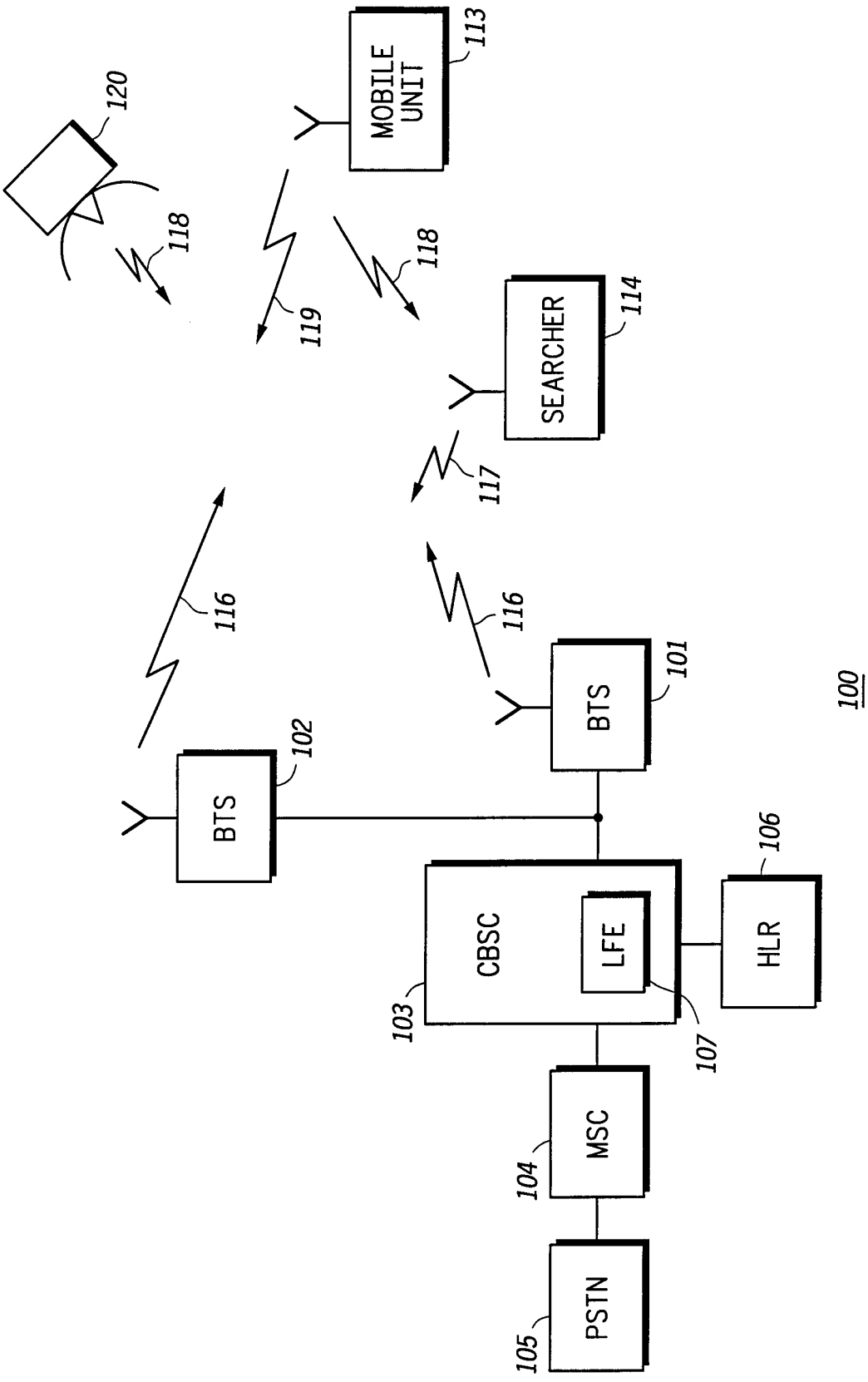
MOBILE UNIT
113
120
118
118
119
SEARCHER
114
117
116
116
BTS
101
BTS
102
100
CBSC
103
LFE
107
HLR
106
MSC
104
PSTN
105

FIG.1

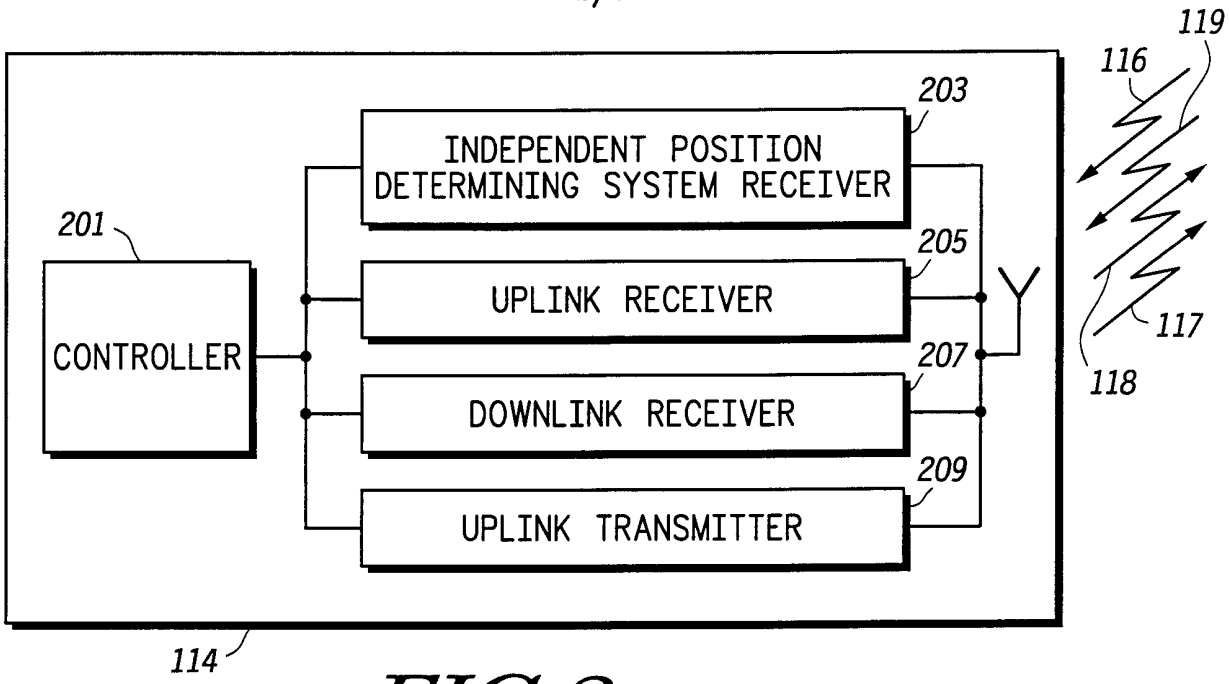
119
116
203
INDEPENDENT POSITION DETERMINING SYSTEM RECEIVER
201
205
UPLINK RECEIVER
CONTROLLER
207
DOWNLINK RECEIVER
209
UPLINK TRANSMITTER
117
118
114

FIG.2

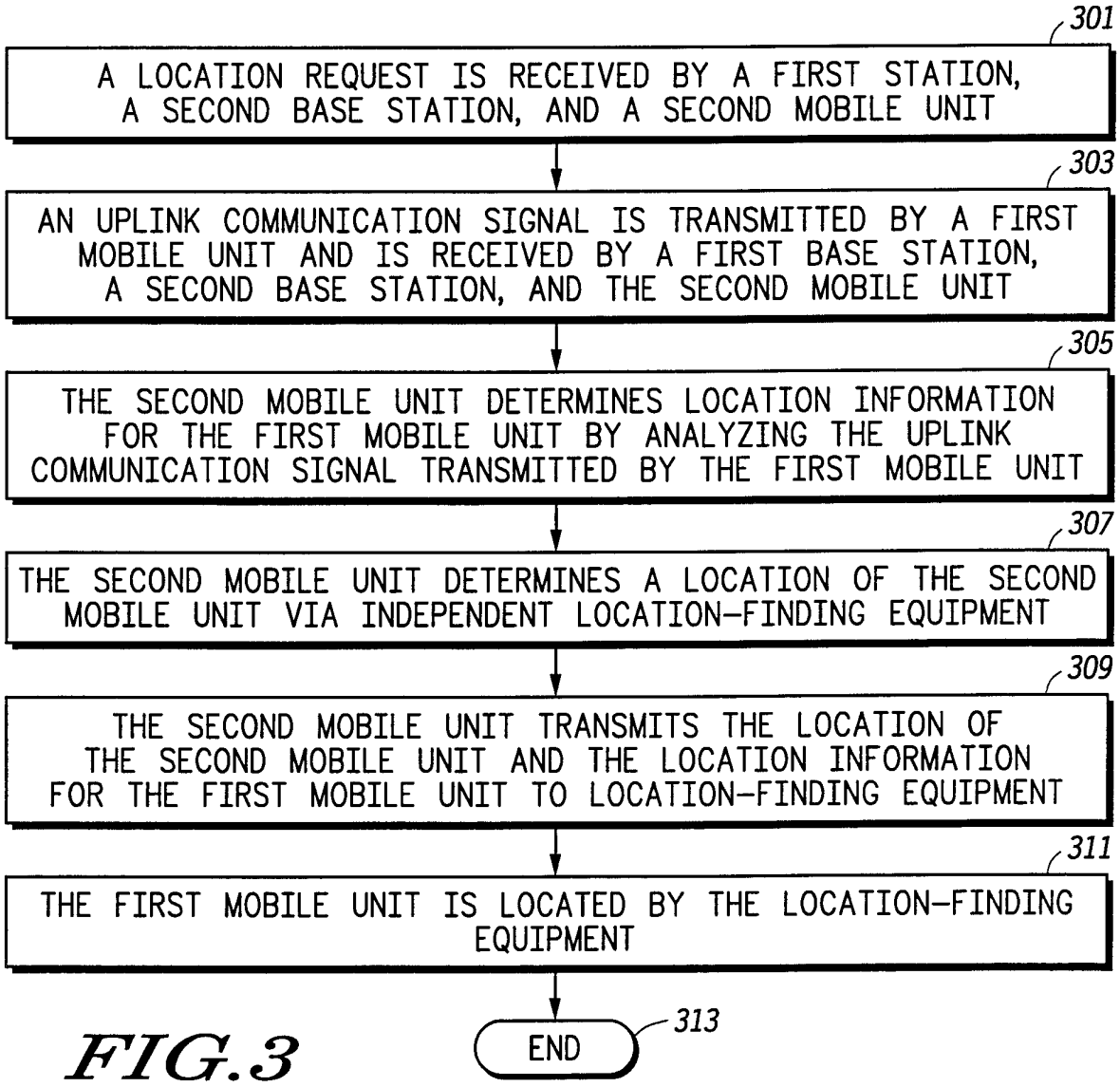
301
A LOCATION REQUEST IS RECEIVED BY A FIRST STATION, A SECOND BASE STATION, AND A SECOND MOBILE UNIT
303
AN UPLINK COMMUNICATION SIGNAL IS TRANSMITTED BY A FIRST MOBILE UNIT AND IS RECEIVED BY A FIRST BASE STATION, A SECOND BASE STATION, AND THE SECOND MOBILE UNIT
305
THE SECOND MOBILE UNIT DETERMINES LOCATION INFORMATION FOR THE FIRST MOBILE UNIT BY ANALYZING THE UPLINK COMMUNICATION SIGNAL TRANSMITTED BY THE FIRST MOBILE UNIT
307
THE SECOND MOBILE UNIT DETERMINES A LOCATION OF THE SECOND MOBILE UNIT VIA INDEPENDENT LOCATION-FINDING EQUIPMENT
309
THE SECOND MOBILE UNIT TRANSMITS THE LOCATION OF THE SECOND MOBILE UNIT AND THE LOCATION INFORMATION FOR THE FIRST MOBILE UNIT TO LOCATION-FINDING EQUIPMENT
311
THE FIRST MOBILE UNIT IS LOCATED BY THE LOCATION-FINDING EQUIPMENT
END
313

FIG.3

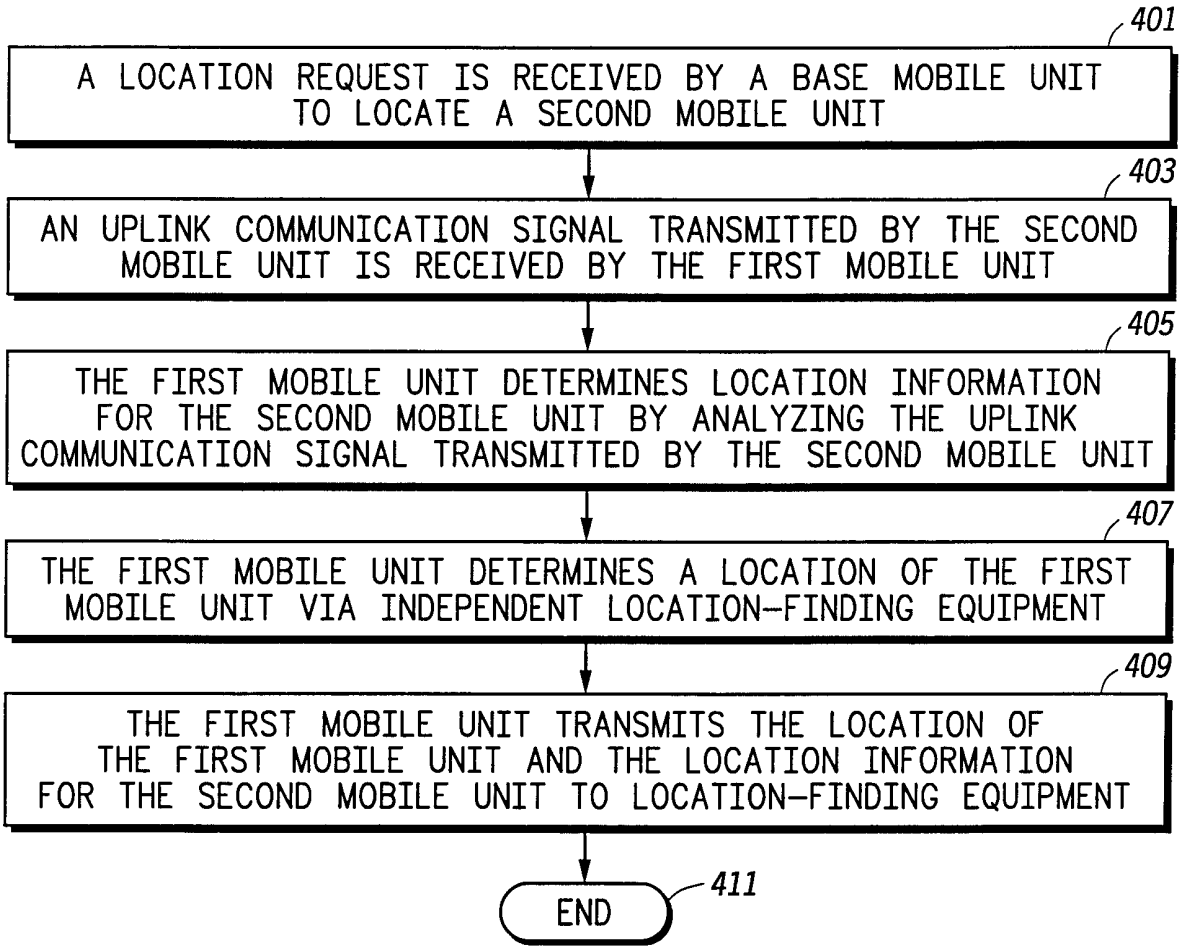
401
A LOCATION REQUEST IS RECEIVED BY A BASE MOBILE UNIT TO LOCATE A SECOND MOBILE UNIT
403
AN UPLINK COMMUNICATION SIGNAL TRANSMITTED BY THE SECOND MOBILE UNIT IS RECEIVED BY THE FIRST MOBILE UNIT
405
THE FIRST MOBILE UNIT DETERMINES LOCATION INFORMATION FOR THE SECOND MOBILE UNIT BY ANALYZING THE UPLINK COMMUNICATION SIGNAL TRANSMITTED BY THE SECOND MOBILE UNIT
407
THE FIRST MOBILE UNIT DETERMINES A LOCATION OF THE FIRST MOBILE UNIT VIA INDEPENDENT LOCATION-FINDING EQUIPMENT
409
THE FIRST MOBILE UNIT TRANSMITS THE LOCATION OF THE FIRST MOBILE UNIT AND THE LOCATION INFORMATION FOR THE SECOND MOBILE UNIT TO LOCATION-FINDING EQUIPMENT
411
END

FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/22634

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04B 7/185; H04Q 7/20;G01S 5/02

US CL : 455/466, 562;342/357.01, 357.06, 357.09, 457;701/213

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)

U.S. : 455/466, 562;342/357.01, 357.06, 357.09, 457;701/213

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,999,124 A (SHEYNBLAT) 07 DECEMBER 1999, ABSTRACT, FIG.4-5, COL. 10 LINES 34- COL. 12 LINES 51.	1-10
Y	US 5,982,322 A (BICKLEY ET AL.) 09 NOVEMBER 1999, ABSTRACT, FIG. 1, COL. 3 LINES 66 - COL. 5 LINES 6.	1-10
Y	US 5,842,130 A (OPRESCU-SURCOBE ET AL.) 24 NOVEMBER 1998, ABSTRACT, FIG. 1 AND 3, COL. 3 LINES 11-67.	1-10
Y	US 6,081,229 A (SOLIMAN ET AL.) 27 JUNE 2000, ABSTRACT, FIG. 1, COL. 2 LINES 18-35, COL. 4 LINES 35-60.	1-10

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

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier document published on or after the international filing date	"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
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search 19 NOVEMBER 2000	Date of mailing of the international search report 26 FEB 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer PABLO TRAN Telephone No. (703) 305-4700

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