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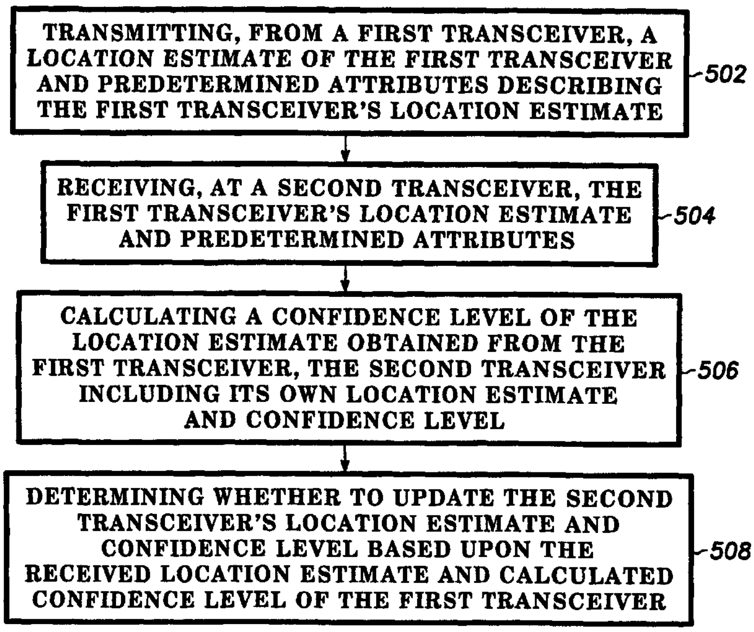
(54) **Title:** METHOD AND APPARATUS FOR TRANSFERRING LOCATION ESTIMATES FROM A FIRST TRANSCEIVER TO A SECOND TRANSCEIVER



(57) **Abstract:** A method and apparatus for transferring location estimates from a first transceiver (122) of a plurality of wireless transceivers (122) to a second transceiver (132) is disclosed. The present invention makes use of a low power short-range auxiliary communication link incorporated within networked devices to interact with nearby devices for obtaining location estimates of the current location of a device. Confidence estimates (504) are then assigned to the information obtained from the interactions with the nearby devices, and a determination (508) of whether to update the location estimate is made.

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METHOD AND APPARATUS FOR TRANSFERRING LOCATION ESTIMATES FROM A FIRST TRANSCEIVER TO A SECOND TRANSCEIVER

Field of the Invention

This invention relates in general to wireless communication systems, and more particularly, to a method and apparatus for transferring location estimates from a first transceiver of a plurality of wireless transceivers to a second transceiver.

Background of the Invention

Wireless communication systems for serving the connectivity needs of portable transceivers are rapidly evolving into linked, multi-speed wireless networks. For example, a wireless wide area network (WAN) may provide relatively low speed connectivity throughout a metropolitan area, while numerous wireless short range networks (SRNs) also may exist throughout the area for providing short range high speed connectivity where needed. Portable transceivers that are capable of peer-to-peer communications, e.g., Bluetooth devices, also can create ad hoc SRNs with one another that can operate independently of fixed portions of the wireless communications system.

Sometimes, a portable transceiver can develop a need for information that is available from a network server, or from another transceiver within the same network as the first transceiver. The information may be of many different types, and a good example is server assisted global positioning system (GPS) information, which can greatly enhance the sensitivity and accuracy of a GPS receiver that may be used by the portable transceiver for location determination. Typically, the network server has been centrally located, e.g., at the site of a central controller of the wireless communications system, and has been accessed through the wireless WAN. Accessing the network server for assisted location information can generate substantial traffic in the wireless WAN when a large number of the portable transceivers are GPS equipped. This traffic is undesirable, as it can increase system latency and potentially can overload the wireless WAN.

In addition, many transceivers will not have location finding capability, yet could benefit from location information either locally, or within a network. Thus, what is needed is a method and apparatus for transferring location estimates from a first transceiver of a plurality of transceivers to a second transceiver. Preferably, the method and apparatus will operate to substantially reduce the wireless WAN traffic required to seek and transfer the information.

Brief Description of the Drawings

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objects, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is an electrical block diagram of an exemplary wireless communication system in accordance with the present invention;

FIG. 2 is an electrical block diagram of an exemplary peer-to-peer mode of operation of the transceivers in accordance with the present invention;

FIG. 3 is an electrical block diagram of an exemplary transceiver in accordance with the present invention;

FIG. 4 is a flow diagram depicting the operation of the transceiver in accordance with the present invention; and

FIG. 5 is a flow diagram depicting the process of transferring a location estimate from a first transceiver of a plurality of wireless transceivers to a second transceiver according to the method and system of the present invention.

Detailed Description of the Invention

Referring to **FIG. 1**, an electrical block diagram depicts an exemplary wireless communication system in accordance with the present invention, comprising a fixed portion **102** including a controller **112** and a plurality of conventional base stations **116**, the communication system also including a plurality of transceivers **122**. The base stations **116** preferably communicate with the transceivers **122** utilizing conventional radio frequency (RF) techniques, and are coupled by conventional communication links **114** to the controller **112**, which controls the base stations **116**.

Each of the base stations **116** transmits RF signals to the transceivers **122** via an antenna **118**. The base stations **116** preferably each receive RF signals from the plurality of transceivers **122** via the antenna **118**. It will be appreciated by those skilled in the art that, alternatively, another wireless communication technology, such as infra red technology, can be used to comminute between the base stations **116** and the transceiver **122**.

The controller **112** is preferably coupled by telephone links **101** to a public switched telephone network (PSTN) **110** for receiving selected call message originations therefrom. Selective call originations comprising voice or data messages from the PSTN can be generated, for example, from a conventional telephone **111** or a conventional computer **117** coupled to PSTN **110**. It will be appreciated that, alternatively, other types of networks, e.g., a local area network (LAN), a wide area network (WAN), and the internet, to name a few, can be used for receiving selective call originations. The controller **112** is also coupled to a conventional network server **108** for providing information requested by the transceivers **122**. The network server **108** is preferably coupled to a GPS receiver **106** for cooperating with the network server **108** to provide server assisted GPS information to the transceivers **122**.

It will be appreciated by those skilled in the art that for peer-to-peer and short-range communications, many technologies and protocols, such as Bluetooth, Piano, IRDA, Home RF, and 802.11, may be utilized. It will further be appreciated by those skilled in the art that the present invention is applicable to many different types of wireless communications systems, including cellular telephone systems, trunked dispatch systems, and voice and data messaging systems, to name a few.

FIG. 2 illustrates an electrical block diagram of an exemplary peer-to-peer mode of operation of the transceivers **122** in accordance with the present invention. In this mode, the transceivers **122** form an ad hoc short-range network among themselves.

FIG. 3 is an electrical block diagram of an exemplary transceiver **122** in accordance with the present invention. The transceiver **122** comprises an antenna **304** for receiving an incoming call or message and for transmitting an outgoing call or message. The antenna **304** is preferably coupled to a conventional receiver **308** for receiving the incoming call or message and is coupled to a conventional transmitter **309** for transmitting the outgoing call or message. The receiver **308** and transmitter **309** are coupled to a processing system **306** for processing the incoming and outgoing call or messages and for controlling the transceiver **122** in accordance with the present invention. A user interface **314** may also be coupled to the processing system **306** for interfacing with a user. The user interface **314** may comprise a conventional telephone keypad **320** or a conventional keyboard for requesting that an operation be performed and for controlling the transceiving **122**, a conventional display **316**, and a conventional alert element **318** for alerting the user when an incoming call or message arrives. A conventional clock **307** is also coupled to the processing system **306** for supporting time keeping requirements of the transceiver **122**.

The processing system **306** comprises a conventional processor **310** and a conventional memory **312**. The memory **312** comprises software elements and data for programming the processing system **306** in accordance with the present invention. In the preferred embodiment, the memory **312** further comprises a message processing element **314** for programming the processing system **306** to process messages through well-known techniques. In addition, the memory **312** includes a location information processing program **316** for programming the processing system **306** to cooperate with the controller **312** to process location information through well known techniques, such as server assisted GPS techniques. In that embodiment, the transceiver **122** also includes a location receiver **334**, such as a GPS receiver, coupled to the processing system **306**.

FIG. 4 is a flow diagram depicting the operation of a transceiver in accordance with the present invention. The flow begins at reference numeral **402** wherein the step of detecting a need for a location estimate is performed. Next, at reference numeral **404**, the step of receiving a first transceiver's location estimate and predetermined attributes of the first transceiver's location estimate is performed. Thereafter, at reference numeral **406**, the step of receiving a calculated confidence level of the first transceiver's location estimate based upon the predetermined attributes is performed. Finally, at reference numeral **408**, the step of determining whether to update a second transceiver's location estimate and confidence level based upon the received location estimate and calculated confidence level of the first transceiver is performed.

FIG. 5 is a flow diagram depicting the process of transferring a location estimate from a first transceiver of a plurality of wireless transceivers to a second transceiver according to the method and system of the present invention. The flow begins at reference numeral **502**, wherein the step of detecting a need for a location estimate is performed. Next, at reference numeral **504**, the step of transmitting, from a first transceiver, a location estimate of the first transceiver and predetermined attributes of the first transceiver's location estimate is performed. Next, at reference numeral **506**, the step of calculating a confidence level of the location estimate of the first transceiver based upon the predetermined attributes is performed. Thereafter, at reference numeral **508**, the step of receiving , at a second transceiver, the first transceiver's location estimate and the calculated confidence level is performed. Finally, at reference numeral **510**, the step of determining whether to update the second transceiver's location estimate and confidence level based upon the received location estimate and calculated confidence level of the first transceiver is performed.

As described above, the present invention comprises a method and apparatus to obtain location estimates for a device by interacting with nearby devices. The nearby devices may use any number of means to make the location estimate. Confidence estimates are then assigned to the information obtained from the interactions with the nearby devices. A number of parameters may be used to establish a confidence level of the location estimate received from a nearby device, such that a confidence level may be determined from the following equation:

$$CL = c[CL(d1)]^{-bSEt}$$

where:

CL = the calculated confidence level of the new location estimate obtained from interaction with a nearby device

S = the attenuation in confidence level from being a second party to the estimate. Each generation of donor to recipient will see this attenuation in confidence level.

CL(d1) = the confidence level of the donor device using a predefined normalized scale which describes the estimated accuracy, time since a measurement occurred, type of estimate, signal strength, etc. For example, CL(d1) = 1 for a timely GPS reading; CL(d1) = 0.1 for a second generation reading, etc.

b = a scaling factor.

SE = the speed estimate of the device receiving the location estimate and calculating a confidence level. For example, SE = 0 for fixed devices, and increases in proportion to speed.

t = time in seconds.

As such, the confidence estimates assigned to the information obtained from the interactions with the nearby devices may be a function of the confidence level of the donated location estimate, time since the estimate was made, motion of the receiving unit, the method used to obtain the location estimate, the number of times the information may have been repeated from one device to another, the signal strength and quality of the communication signal, etc. In addition, fixed devices, such as desktop computers, printers, etc. may store an average location estimates with the highest confidence estimates to improve the base line location estimate for these devices.

It will be appreciated by those skilled in the art that selected ones of the transceivers can be positioned at fixed locations. As described above, an example is a transceiver serving as a wireless interface for a printer, facsimile machine, computer, etc. Such a fixed transceiver preferably is pre-programmed with location information describing the location at which the transceiver is placed. It will be further appreciated that, in response to having location information that is likely to be of interest to other transceivers, a transceiver can advertise the availability of the location information, e.g., through periodic transmissions of messages.

The foregoing description of a preferred embodiment of the invention has been presented for the purpose of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment was chosen and described to provide the best illustration of the principles of the invention and its practical application, and to enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

Claims

What is claimed is:

1. A method for transferring a location estimate from a first transceiver of a plurality of wireless transceivers to a second transceiver, the method comprising the steps of:

detecting a need for a location estimate;

transmitting, from a first transceiver, a location estimate of the first transceiver and predetermined attributes of the first transceiver's location estimate;

calculating a confidence level of the location estimate of the first transceiver based upon the predetermined attributes;

receiving, at a second transceiver, the first transceiver's location estimate and the calculated confidence level, the second transceiver having its own location estimate and confidence level; and

determining whether to update the second transceiver's location estimate and confidence level based upon the received location estimate and calculated confidence level of the first transceiver.

2. A method as recited in claim 1, including the step of adjusting a confidence level of a location estimate based upon one of

the lapsed time since receiving an updated location estimate;

an estimate of motion of a transceiver; and

the proximity of the first transceiver to the second transceiver.

3. A method as recited in claim 1, including the step of attenuating a confidence level with each generation of exchanging location estimates, thereby reducing the impact of second and third hand information.

4. A method as recited in claim 1, including the step of storing and averaging the location estimates from those transceivers with the highest confidence levels to improve the base line location estimate for those transceivers.

5. A method as recited in claim 1, including the step of utilizing a third transceiver to communicate the first transceiver's location estimate and confidence level to the second transceiver.

6. A method as recited in claim 1, further comprising the step of preprogramming fixed ones of the plurality of wireless transceivers with location information corresponding to a location at which each is placed.

7. A method for transferring a location estimate from a first transceiver of a plurality of wireless transceivers to a second transceiver, the method comprising the steps of:

detecting a need for a location estimate;

at a second transceiver having its own location estimate and confidence level and in response to the step of detecting:

receiving a first transceiver's location estimate and predetermined attributes of the first transceiver's location estimate;

receiving a calculated confidence level of the first transceiver's location estimate based upon the predetermined attributes; and

determining whether to update the second transceiver's location estimate and confidence level based upon the received location estimate and calculated confidence level of the first transceiver.

8. A method as recited in claim 7, including the step of adjusting a confidence level of a location estimate based upon one of

the lapsed time since receiving an updated location estimate;

an estimate of motion of a transceiver; and

the proximity of the first transceiver to the second transceiver.

9. A method as recited in claim 7, including the step of attenuating a confidence level with each generation of exchanging location estimates, thereby reducing the impact of second and third hand information.

10. A method as recited in claim 7, including the step of storing and averaging the location estimates from those transceivers with the highest confidence levels to improve the base line location estimate for those transceivers.

11. A method as recited in claim 7, including the step of utilizing a third transceiver to communicate the first transceiver's location estimate and confidence level to the second transceiver.

12. A method as recited in claim 7, further comprising the step of preprogramming fixed ones of the plurality of wireless transceivers with location information corresponding to a location at which each is placed.

13. An apparatus for transferring a location estimate from a first transceiver of a plurality of transceivers to a second transceiver, the second transceiver having its own location estimate and confidence level, the apparatus comprising:

a receiver adapted to receive the location estimate;

a transmitter adapted to transmit the location estimate; and

a processing system coupled to the receiver and coupled to the transmitter, the processing system programmed to:

detect a need for a location estimate;

receive the first transceiver's location estimate and predetermined attributes of the first transceiver's location estimate;

calculate a confidence level of the first transceiver's location estimate based upon the predetermined attributes; and

determine whether to update the second transceiver's location estimate and confidence level based upon the received location estimate and calculated confidence level of the first transceiver.

14. An apparatus as recited in claim 13, wherein the processing system is further programmed to adjust a confidence level of a location estimate based upon one of:

the lapsed time since receiving an updated location estimate;

an estimate of motion of a transceiver; and

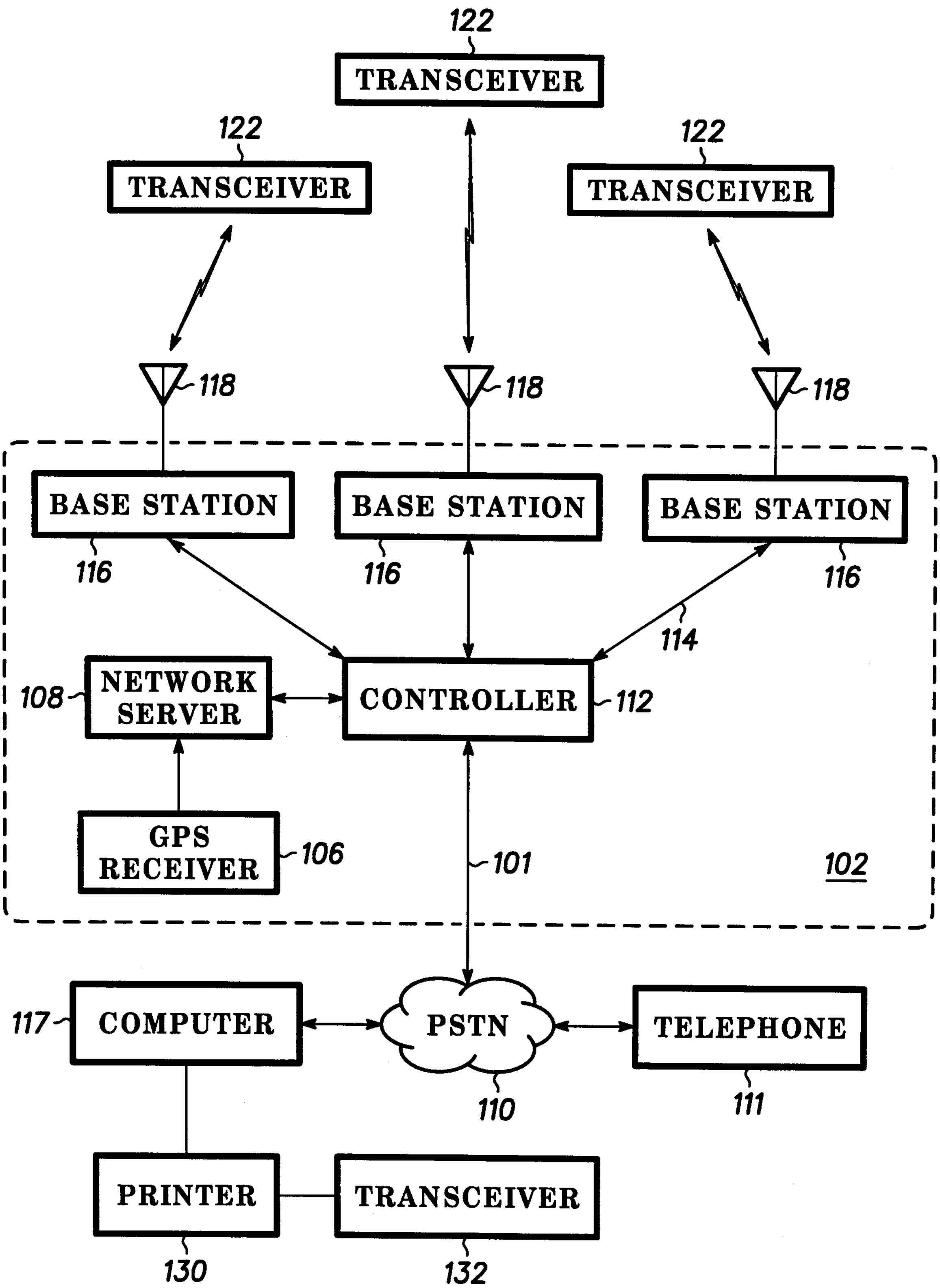
the proximity of the first transceiver to the second transceiver.

15. An apparatus as recited in 13, wherein the processing system is further programmed to attenuate a confidence level with each generation of exchanging location estimates, thereby reducing the impact of second and third hand information.

16. An apparatus as recited in claim 13, wherein the processing system is further programmed to store and averaging the location estimates from those transceivers with the highest confidence levels to improve the base line location estimate for those transceivers.

17. An apparatus as recited in claim 13, wherein the processing system is further programmed to utilize a third transceiver to communicate the first transceiver's location estimate and confidence level to the second transceiver.

18. An apparatus as recited in claim 13, wherein the processing system is further preprogrammed with location information corresponding to a location at which each one of fixed ones of the plurality of wireless transceivers is placed.



122
TRANSCEIVER
122
TRANSCEIVER
122
TRANSCEIVER
118
118
118
BASE STATION
BASE STATION
BASE STATION
116
116
116
114
NETWORK SERVER
108
CONTROLLER
112
GPS RECEIVER
106
101
102
COMPUTER
117
PSTN
110
TELEPHONE
111
PRINTER
130
TRANSCEIVER
132

FIG. 1

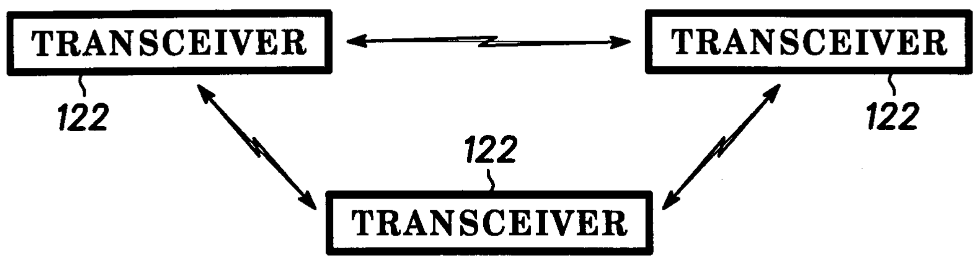

TRANSCEIVER
TRANSCEIVER
122
122
122
TRANSCEIVER

FIG. 2

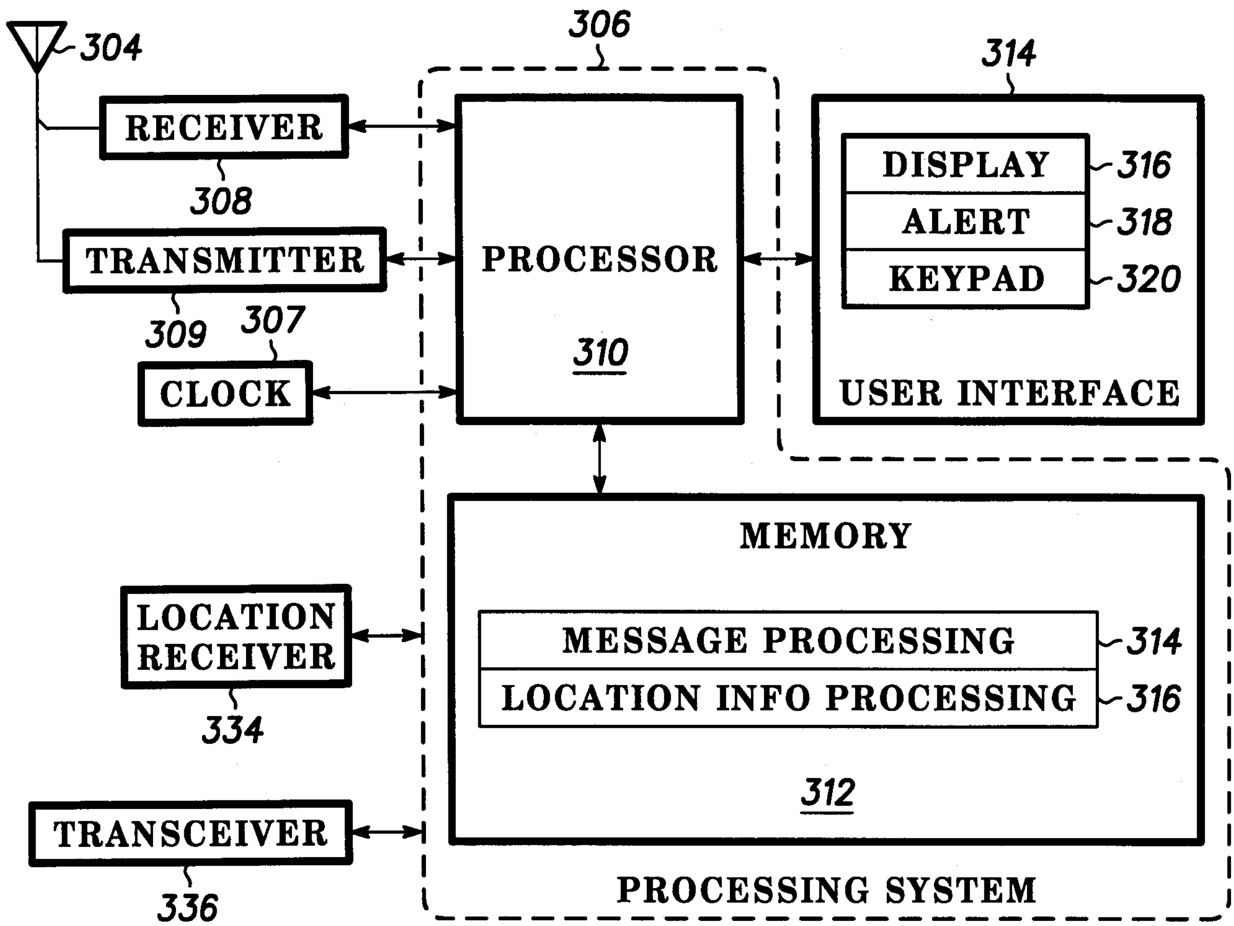

304
306
314
RECEIVER
308
TRANSMITTER
309
307
CLOCK
PROCESSOR
310
DISPLAY
316
ALERT
318
KEYPAD
320
USER INTERFACE
MEMORY
LOCATION RECEIVER
334
MESSAGE PROCESSING
314
LOCATION INFO PROCESSING
316
312
TRANSCEIVER
336
PROCESSING SYSTEM

FIG. 3

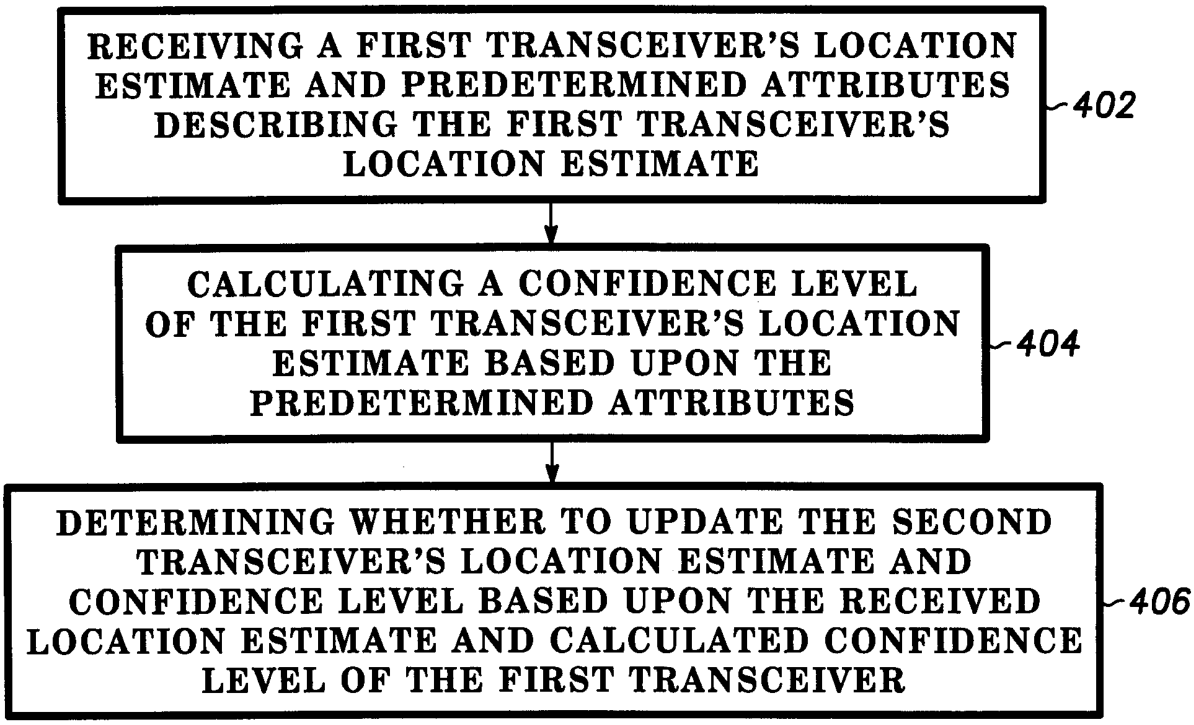

RECEIVING A FIRST TRANSCEIVER'S LOCATION ESTIMATE AND PREDETERMINED ATTRIBUTES DESCRIBING THE FIRST TRANSCEIVER'S LOCATION ESTIMATE
402
CALCULATING A CONFIDENCE LEVEL OF THE FIRST TRANSCEIVER'S LOCATION ESTIMATE BASED UPON THE PREDETERMINED ATTRIBUTES
404
DETERMINING WHETHER TO UPDATE THE SECOND TRANSCEIVER'S LOCATION ESTIMATE AND CONFIDENCE LEVEL BASED UPON THE RECEIVED LOCATION ESTIMATE AND CALCULATED CONFIDENCE LEVEL OF THE FIRST TRANSCEIVER
406

FIG. 4

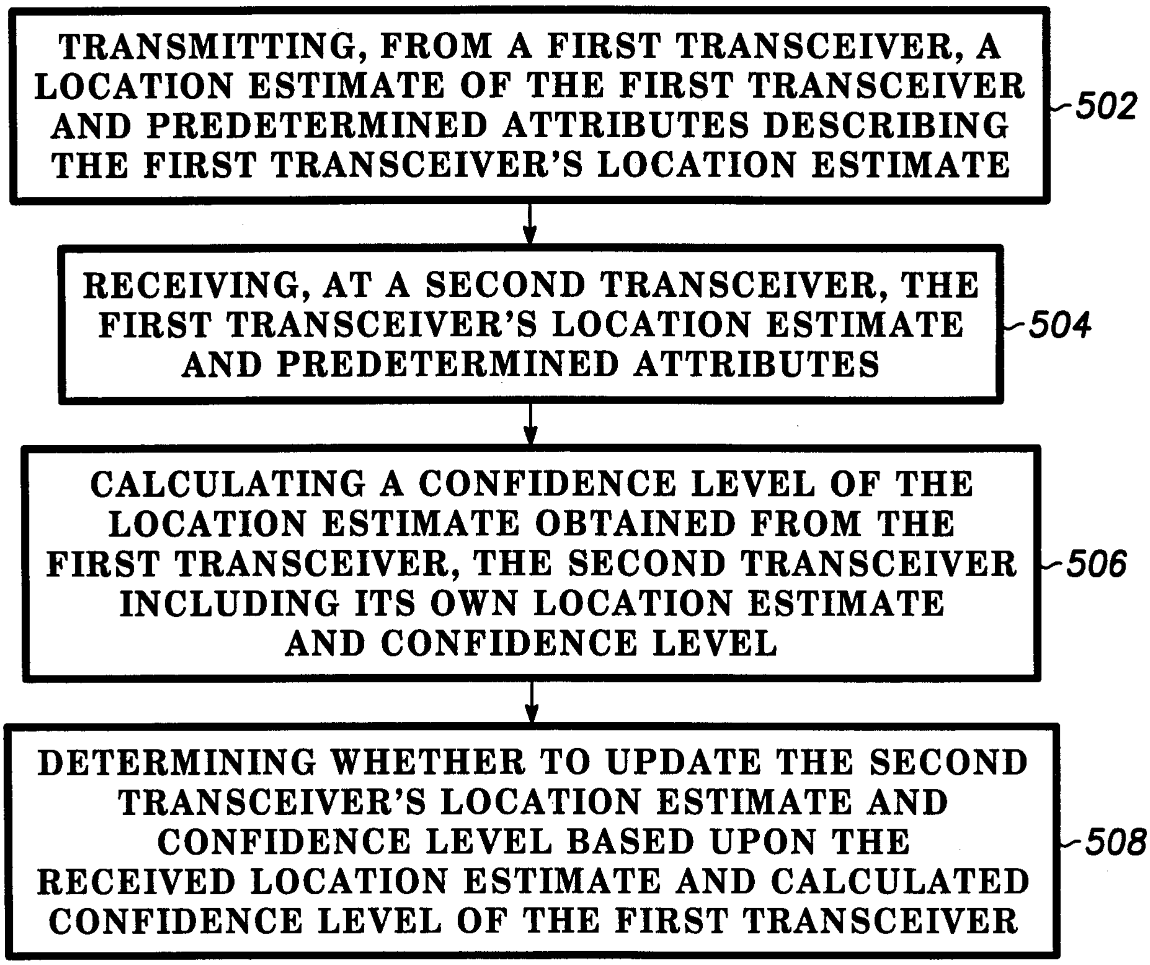

TRANSMITTING, FROM A FIRST TRANSCEIVER, A LOCATION ESTIMATE OF THE FIRST TRANSCEIVER AND PREDETERMINED ATTRIBUTES DESCRIBING THE FIRST TRANSCEIVER'S LOCATION ESTIMATE
502
RECEIVING, AT A SECOND TRANSCEIVER, THE FIRST TRANSCEIVER'S LOCATION ESTIMATE AND PREDETERMINED ATTRIBUTES
504
CALCULATING A CONFIDENCE LEVEL OF THE LOCATION ESTIMATE OBTAINED FROM THE FIRST TRANSCEIVER, THE SECOND TRANSCEIVER INCLUDING ITS OWN LOCATION ESTIMATE AND CONFIDENCE LEVEL
506
DETERMINING WHETHER TO UPDATE THE SECOND TRANSCEIVER'S LOCATION ESTIMATE AND CONFIDENCE LEVEL BASED UPON THE RECEIVED LOCATION ESTIMATE AND CALCULATED CONFIDENCE LEVEL OF THE FIRST TRANSCEIVER
508

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/26350

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01S 3/02
US CL : 455/456
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. : 455/456; 455/67.1; 455/457; 455/67.4; 455/422; 455/517; 455/524

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, E	US 5724660 A (KAUSER et al.) 03 March 1998, col. 7, line 9- col. 11, line 25; col. 12, lines 1-35; col. 5, line 25- col. 6, line 50.	1-18
Y, P	US 6061561 A (ALANARA et al.) 09 May 2000, abstract ; col. 4, line 1- col. 7, line 60; col. 2, line 15- col. 3, line 34.	1-18

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 November 2000 (03.11.2000)	09 JAN 2001

Name and mailing address of the ISA/US	Authorized officer
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