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[Continued on next page]

(54) Title: A LOCATING DEVICE

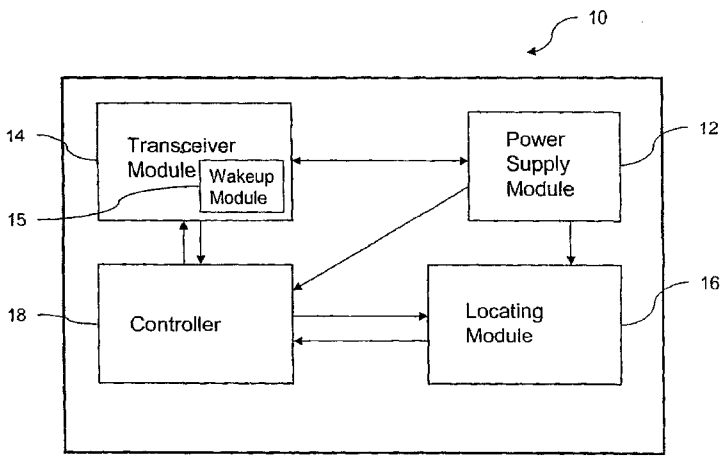

Figure 1

(57) Abstract: A locating device (10) for use in locating an item, the device comprises a power supply module (12), a transceiver module (14) adapted to receive and transmit signals via a mobile communications network, a locating module (16) adapted to acquire positioning data and determine location data for the device, and a controller (18). The controller is adapted to process signals received by the transceiver module, trigger the locating module to provide location data in response to a received location request and process the location data for transmission via the transceiver module over the mobile communications network. The locating device is adapted to normally operate in a standby state of lower power consumption and transition to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request. The device is suitable for embedding in an item such as a credit card or wallet, alternatively the device may be carried in a child's clothing or a pets collar to enable the child or pet to be located if they go missing.

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A LOCATING DEVICE

TECHNICAL FIELD

The present invention relates to a locating device, in particular, a device that can be attached to an object to locate that object.

BACKGROUND ART

Locating devices typically use satellite navigation systems, or Global Navigation Satellite Systems (GNSS), to provide geo-spatial global positioning and typically use a Global Positioning System (GPS). The GPS enables a receiver to determine its location in terms of longitude, latitude and altitude by measuring time signals transmitted from a constellation of at least three satellites. Land based locating devices are also known where the locating device can determine its position by the triangulation of signals from transmitting base stations.

Traditionally, GPS receivers have been used as locating devices in navigation applications. These devices are either carried in person, such as a hand held navigation device or a mobile phone device with an embedded GPS receiver, or attached to a vehicle, such as a car, truck or boat, to display to a user the present location of the device and therefore the present location of the user of the device. This determined location can then be used to plot a path to a destination or alert the user to available services in the vicinity of the determined location.

GPS receivers have also been attached to objects in military applications, such as targeting and search and rescue operations, and civilian applications, such as asset tracking. The assets previously tracked in civilian applications were generally large, high expense objects, such as boats, cars, trucks and heavy machinery. Locating devices attached to these objects often have access to the object's power supply to enable the location of the object to be determined on request. The power supplies of these assets are generally user serviceable and readily recharged to maintain power to the device.

There is therefore a need for an alternative locating device.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention there is provided a locating device comprising:

a power supply module;

a transceiver module adapted to receive and transmit signals via a mobile communications network;

a locating module adapted to acquire positioning data and determine location data for the device; and

a controller adapted to process signals received by the transceiver module, trigger the locating module to provide location data in response to a received location request and process the location data for transmission via the transceiver module over the mobile communications network, wherein the locating device is adapted to normally operate in a standby state of low power consumption and transition to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request.

Preferably, in the standby state, the controller and locating module are dormant.

Preferably, the controller stores the location data last determined and acquired by the locating module.

Preferably, the controller triggers the transceiver module to transmit stored location data when the locating module cannot acquire positioning data.

Preferably, the locating module includes a Global Positioning System (GPS) module adapted to acquire positioning data from satellites and determine location data for the device.

Preferably, the transceiver module includes a Subscriber Identity Module (SIM) to identify the device in a mobile communications network.

Preferably, a user identifies the device in a mobile communications network and transmits a signal as a location request for receipt by the transceiver module to transition the device from the stand-by state to the active state for the acquisition of positioning data and transmission of location data.

Preferably, the locating module further includes a wakeup module to trigger the power supply module to switch on power to activate the controller and locating module.

Preferably, the transceiver module transmits said location data as a Short Message Service (SMS) message to the user.

Preferably, the power supply module includes a photovoltaic module.

Preferably, a user is alerted if stored energy of the power supply module reaches a minimum threshold amount.

In another embodiment of the present invention, there is provided a method of locating an object using a locating device attached to the object, the method comprising the steps of:

receiving a location request via a mobile communications network at a transceiver module;

activating a dormant locating module to acquire positioning data and determine location data in response to the received location request; and

processing the location data for transmission by the transceiver module over the mobile communications network.

Preferably, the device is adapted to normally operate in a standby mode of low power consumption and the method further comprises the step of transitioning to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request.

Preferably, the step of processing location data for transmission by the transceiver module further comprises the step of transmitting location data to a sender of the location request.

Preferably, the method further comprises the steps of:

maintaining a standby state for the device whereby a controller and the locating module are dormant;

transitioning the device from the standby state to a wake-up state upon receipt by the transceiver module of a mobile communications network signal;

transitioning the device from the wake-up state to an active state to acquire positioning data and determine location data if the received signal is a location request;

transitioning the device from the wake-up state to the standby state if the received signal is not a location request; and

transitioning the device from the active state to the standby state when the location data is transmitted.

Preferably, the method further comprises the steps of:

storing the location data last determined and acquired by the locating module; and

transmitting the stored location data across the mobile communications network when the locating module cannot acquire positioning data.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments, incorporating all aspects of the invention, will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a block diagram of a locating device, in accordance with an embodiment of the present invention;

Figure 2 is a flow-chart of a method of locating an object attached to a locating device, in accordance with an embodiment of the present invention;

Figure 3 is a state diagram representing state transitions for the device while locating an object in accordance with the method of Figure 2;

Figure 4 is a state diagram representing state transitions for the device while locating an object in accordance with the method of Figure 2 having an additional wake-up state;

Figure 5 is a schematic representation of an embodiment of the locating device of Figure 1; and

Figure 6 is a top view of a credit card illustrating an embodiment of the locating device of Figure 1 attached.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Figure 1 illustrates a locating device 10 comprising a power supply module 12, a transceiver module 14, adapted to receive and transmit signals via a mobile communications network, a locating module 16, adapted to acquire positioning data and determine location data for the device, and a controller 18, adapted to process received signals and trigger the locating module. The locating module 16 is adapted to provide location data in response to a location request received by the transceiver module 14. The locating device processes the location data for transmission via the transceiver module 14 over the mobile

communications network.

The locating device 10 is adapted to normally operate in a standby state of low power consumption and transition to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request. For example, in a standby state the controller and locating module can be turned off or lie dormant such that in the standby state of low power consumption the device minimises the amount of energy required hence prolonging the effective life of the device where stored energy is required for operation. The modules are in a dormant state when they are off or in a state of lower power consumption. To further enhance the longevity of the device, a reduced current is supplied to the transceiver module 14 in the standby state and a full current is supplied when a mobile communications network signal by way of a location request is received.

In a preferred embodiment, the transceiver module 14 includes a wakeup module 15 which, upon receipt of a signal by the transceiver module 14, triggers the power supply 12 to provide power to wake up the controller 18. In this example, the device is in the standby state with the transmitting portion of the transceiver module 14 always on. Upon receipt of a signal, the wakeup module 15 is activated and triggers the power supply 12 to supply power to wake up, or activate, the controller 18 and transition the transceiver module 14 to a full powered state. The received signal is then processed to determine if it is a location request and if so, the controller then triggers the power supply module to wake up, or activate, the locating module 16 and acquire positioning data. This data is then translated into location data and packaged by the controller 18 in a form ready to be transmitted by the transceiver module 14. In one embodiment, the wakeup module may be a switching circuit adapted to connect power and locating module selectively in response to the received signal.

The power supply module is typically an energy storage device, such as a battery. In a further embodiment, the power supply module may include recharging capabilities to further prolong the battery life and enhance the device's ability to remain in a standby state awaiting a location inquest. By way of an example, a photovoltaic module, including a solar cell, could be used to trickle charge the battery. In an alternative embodiment induced or direct current

may be provided to recharge the battery.

The device 10 can be attached to an object, such as a personal asset, person or animal. Alternatively, the device 10 can be embedded in an object such as a wallet lining, ball or credit card. The increased longevity of the device, through reduced power consumption in the standby state, in turn, enhances the device's long term ability to locate the object attached thereto.

The reduced power requirements and increased longevity of the device enable it to be used with, and attached to, objects that otherwise would not be readily located using traditional locating devices. In particular, objects without an inherent power source.

The locating module 16 of the preferred embodiment of the device is a satellite navigation system, or Global Navigation Satellite Systems (GNSS). However, a land based system using triangulation of base stations is envisaged. In the preferred embodiment, the satellite navigation system is a Global Positioning System (GPS) and the locating module 16 acquires positioning data from a constellation of at least three GPS satellites. The GPS provides the advantage of being globally accessible and the small size and low power requirements of GPS chipsets enable the device to be applied across a wide range of objects. It is envisaged that the device can be applied to personal assets such as, but not limited to, portable computing devices, handbags, keys, wallets, bicycles, golf balls, pet collars, children's clothing, bank cards and credit cards.

The device can also be used in person and animal tracking applications. In particular, tracking of persons/passengers and cargo freight in air and rail logistics applications. The locating device 10 may be attached, or adhered, to the desired object or be integrally formed with the object.

In one embodiment, the transceiver module 14 receives a location request which activates the controller 18 to trigger the location module 16 to acquire position data, such as longitude, latitude and altitude, of the device 10. This can be used to determine location data consisting of the device's location, speed, and direction of travel, at a particular time. The location data is sent to the controller 18 for processing into a form suitable to be transmitted by the transceiver module 14.

In a preferred embodiment, the transceiver module operates in the mobile communications network and typically within the 900MHz range for use with the GSM network. Thus, the device can be used globally. The transceiver module of the preferred embodiment includes a Subscriber Identity Module (SIM) to identify the device within the mobile communications network. Also, it enables a user to send a location request to the locating device using a GSM device, such as a mobile phone, and retrieve transmitted location data of the locating device with the GSM device. For example, it is envisaged that a location request can be sent to the device using its identity in the GSM network, by a SMS message or a call.

Once the location data is acquired and processed it can be sent as a Short Message Service (SMS) message to the user. Also, the SIM may be used to identify the device on other mobile communications frequencies.

It is also envisaged that an alert can be sent to a user over the mobile communications network that the power module has reached a minimum threshold energy storage level. If this occurs, the last determined location of the device can be transmitted to the user along with the alert.

Figure 2 illustrates the method of locating an object using the locating device 10 attached to the object. The location request is received 20 by the transceiver module 14 via a mobile communications network. In response to the location request, the locating module 16 is activated 22 to acquire positioning data 24 and determine location data 25. The device processes the location data 26 for transmission 27 by the transceiver module over the mobile communications network.

The device 10 acquires positioning data from satellites in the case of satellite navigation systems or GPS, or from transmitting base stations in land based positioning systems. In the preferred embodiment, the locating module 16 acquires positioning data 24 in the form of longitude, latitude, and altitude measurements by measuring the time delay of signals sent and received from a constellation of at least three GPS satellites. The device's position is determined using triangulation, or trilateration, of the device and the constellation of satellites. The longitude and latitude measurements are then translated into a street address so that the location can be readily determined 25 by a user.

The device then processes the determined location data 25 for transmission in a user selected and user accessible form. For example, the acquired street address of the locating device may be packaged as an SMS message, a synthetic voice message, email, text, or a computer readable file. The packaged location data is then transmitted across a mobile communications network 27 for receipt by a user or a designated 3rd party. It is envisaged that the user or 3rd party can request the desired format of receipt of location data and that the device can be adapted to transmit in more than one format, such as dialling and transmitting a synthetic voice message to the origin of a location request, or emailing location data to a user's blackberry or PDA.

In one embodiment, the received location request is processed by the controller 18 and the locating module 16 is triggered to acquire positioning data and store it. The method of locating an object using the locating device 10 can also comprise the step of determining and transmitting the location of the device using this stored positioning data when further positioning data cannot be acquired. In another embodiment, the method further comprises the step of the controller 18 activating the locating module 16 and waiting 120 seconds before requesting location data determined from the acquired positioning data by the locating module. The location data is then stored by the controller and processed for transmission.

Figure 3 illustrates a state diagram representing the state transitions of the device while locating an object. Shown in this example is the device 10 normally operating in the standby state 28, where only the receiver portion of the transceiver module 14 is activated and receiving power from the power supply module 12. Upon receipt of a location request 30, the device enters the active state 32 whereby the transceiver module is able to both transmit and receive signals and the locating module 14 is activated to acquire the location data for transmission. After a successful transmission 34 of the location of the device by the transceiver module, the device then reverts back to the standby state 28 awaiting a further location request.

Figure 4 illustrates a state diagram representation of alternative state transitions for the device while locating an object. Shown in this example is the device 10 in the standby state 36 where only the receiver portion of the

transceiver module 14 is activated and receiving power from the power supply module 12. A mobile communications network signal is received by the transceiver module 14 and the device transitions to a wake up state 40 wherein the controller is activated to process the received signal but the locating module is still dormant. The controller then determines whether the received signal is a location request and if not 42, the device 10 reverts to the standby state 36 awaiting the next mobile communications signal. If the signal is a location request, 44, the device enters the active state 46, whereby the locating module 16 is activated and the transceiver module 14 is activated to transmit the location of the device processed by the activated controller 18 and acquired and determined by the activated locating module 16. Again, following a successful transmission of location data 48, the device returns to the standby state 36. Also, it is envisaged that if a successful location acquisition and transmission has not occurred, the device will time-out and return to the standby state.

Figure 5 illustrates a schematic representation of one embodiment of the locating device 10. The transceiver module 16 is shown as a transceiver unit 50, activated by the controller 18. The controller includes a microprocessor 52 to activate the transceiver unit by the receipt and transmission of signals. The controller also activates a locating module 16 shown in this embodiment as a GPS chipset 54 which is used to acquire positioning data via the GPS antenna 56. The GPS chipset determines the location of the device using the acquired positioning data. The power supply module is shown as a battery, typically a 3.7V ion-lithium battery operating at 100mAH, which initially sends current only to the transceiver unit 50. The remainder of the circuit is dormant and riot receiving current until receipt of a signal by the transceiver unit.

Figure 6 shows an example of the locating device 10 being attached to a credit card 60 to enable locating of the credit card should its location be requested.

In the claims which follow and in the preceding description, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in

various embodiments of the invention.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in any country.

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CLAIMS:

1. A locating device comprising:

a power supply module;

a transceiver module adapted to receive and transmit signals via a mobile communications network:

a locating module adapted to acquire positioning data and determine location data for the device; and

a controller adapted to process signals received by the transceiver module, trigger the locating module to provide location data in response to a received location request and process the location data for transmission via the transceiver module over the mobile communications network,

wherein the locating device is adapted to normally operate in a standby state of low power consumption and transition to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request.

2. The locating device of claim 1 wherein in the standby state the controller and locating module are dormant.

3. The locating device of claim 1 wherein reception of a signal by the transceiver module triggers a transition from the stand-by state to a wake-up state wherein the controller is activated by the signal and the device is adapted to return to the standby state if the signal is not a location request.

4. The locating device of claim 3 wherein the device is adapted to transition from the wake-up state to the active state when the received signal is a location request.

5. The locating device of claim 1 wherein the device is further adapted to transition from the active state to the stand-by state following the acquisition of positioning data and transmission of location data in response to receipt of the location request.

6. The locating device of claim 1 wherein the locating module further includes a wakeup module to trigger the power supply module to switch on power to activate the controller and locating module.

7. The locating device of claim 1 wherein the controller stores the location data last determined and acquired by the locating module.

8. The locating device of claim 7 wherein the controller triggers the transceiver module to transmit stored location data when the locating module cannot acquire positioning data.

9. The locating device of claim 1 wherein the locating module includes a Global Positioning System (GPS) module adapted to acquire positioning data from satellites and determine location data for the device.

10. The locating device of claim 1 wherein the transceiver module includes a Subscriber Identity Module (SIM) to identify the device in a mobile communications network.

11. The locating device of claim 10 wherein a user identifies the device in a mobile communications network and transmits a signal as a location request for receipt by the transceiver module to transition the device from the stand-by state to the active state for the acquisition of positioning data and transmission of location data.

12. The locating device of claim 11 wherein the transceiver module transmits said location data as a Short Message Service (SMS) message to the user.

13. The locating device of claim 1 wherein the power supply module includes an energy storage device.

14. The locating device of claim 1 wherein the power supply module includes a photovoltaic module.

15. The locating device of claim 13 wherein a user is alerted if stored energy of the energy storage device reaches a minimum threshold amount.

16. A method of locating an object using a locating device attached to the object, the method comprising the steps of:

receiving a location request via a mobile communications network at a transceiver module:

activating a dormant locating module to acquire positioning data and determine location data in response to the received location request: and

processing the location data for transmission by the transceiver module over the mobile communications network.

17. The method of claim 16 wherein the device is adapted to normally operate in a standby mode of low power consumption and the method further comprises the step of transitioning to an active state for acquisition of positioning data and transmission of location data in response to receipt of the location request.

18. The method of claim 16 wherein the step of processing location data for transmission by the transceiver module further comprises the step of transmitting location data to a sender of the location request.

19. The method of claim 16 further comprising the steps of:

maintaining a standby state for the device whereby a controller and the locating module are dormant;

transitioning the device from the standby state to a wake-up state upon receipt by the transceiver module of a mobile communications network signal;

transitioning the device from the wake-up state to an active state to acquire positioning data and determine location data if the received signal is a location request;

transitioning the device from the wake-up state to the standby state is the

received signal is not a location request; and

transitioning the device from the active state to the standby state when the location data is transmitted.

20. The method of claim 16 further comprising the steps of:

storing the location data last determined and acquired by the locating module; and

transmitting the stored location data across the mobile communications network when the locating module cannot acquire positioning data.

21. The method of claim 16 wherein the step of processing location data for transmission by the transceiver module further comprises processing location data as a Short Message Service (SMS) message for transmission over the mobile communications network.

22. The method of claim 16 further comprising the step of transmitting an alert over the mobile communications network when energy storage levels of the device reach a minimum threshold amount.

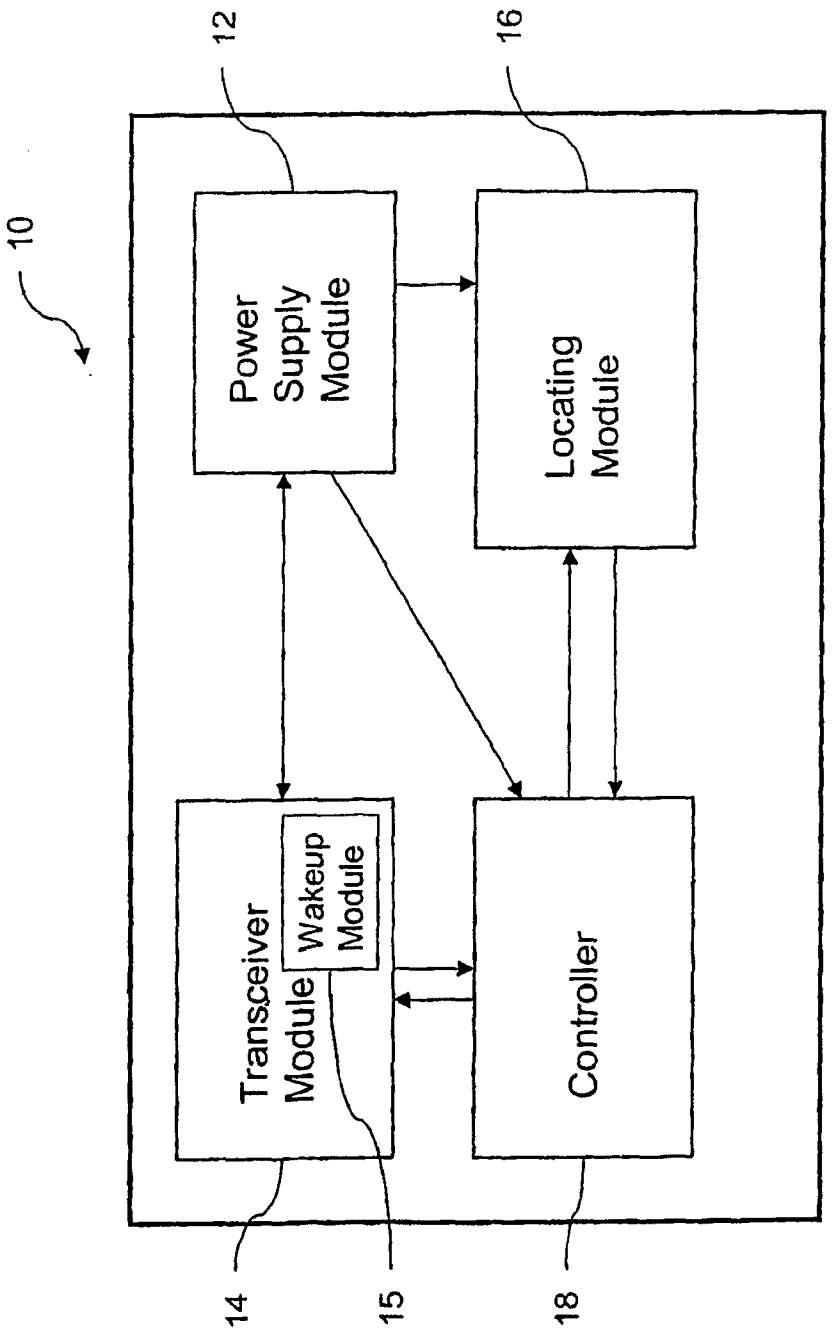
10
12
16
Power Supply Module
Locating Module
Transceiver Module
Wakeup Module
Controller
14
15
18

Figure 1

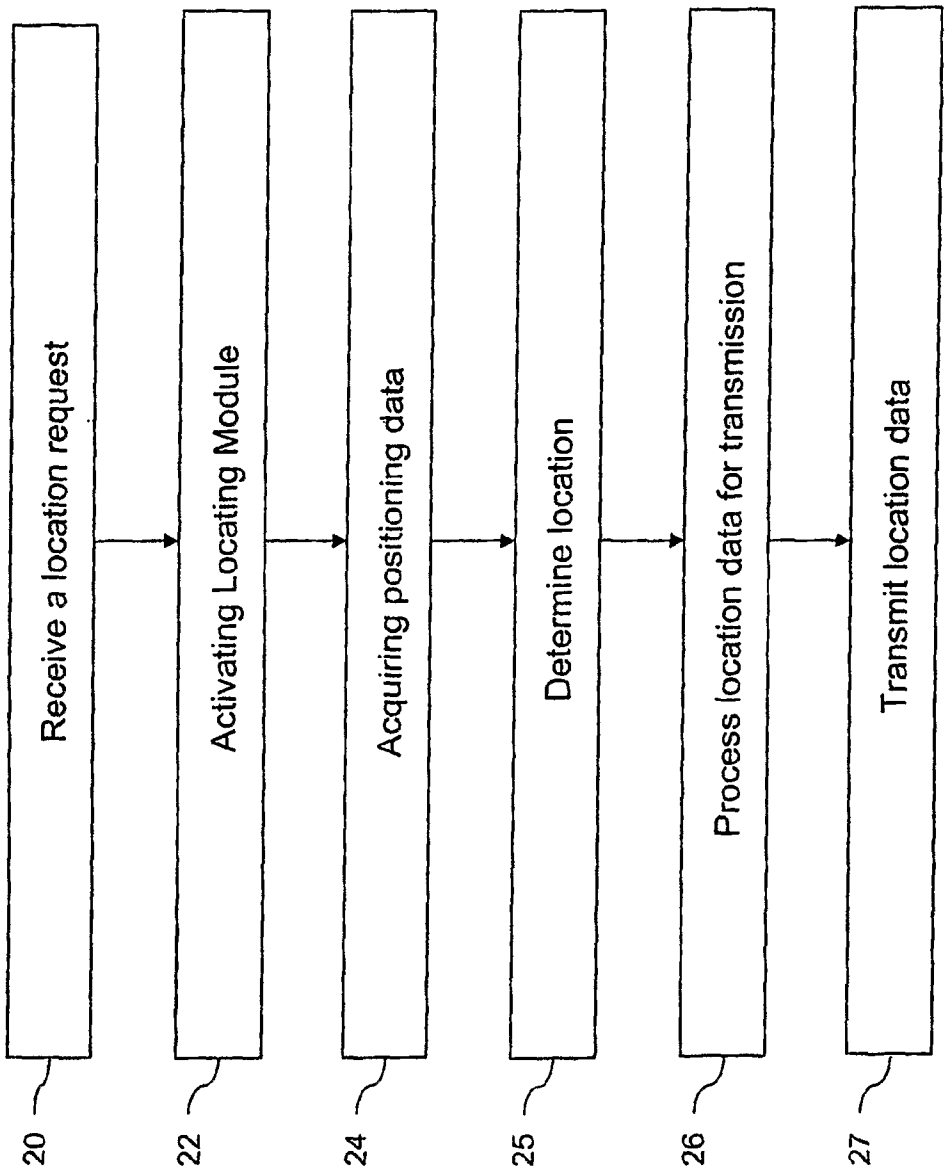
Receive a location request
Activating Locating Module
Acquiring positioning data
Determine location
Process location data for transmission
Transmit location data
20
22
24
25
26
27

Figure 2

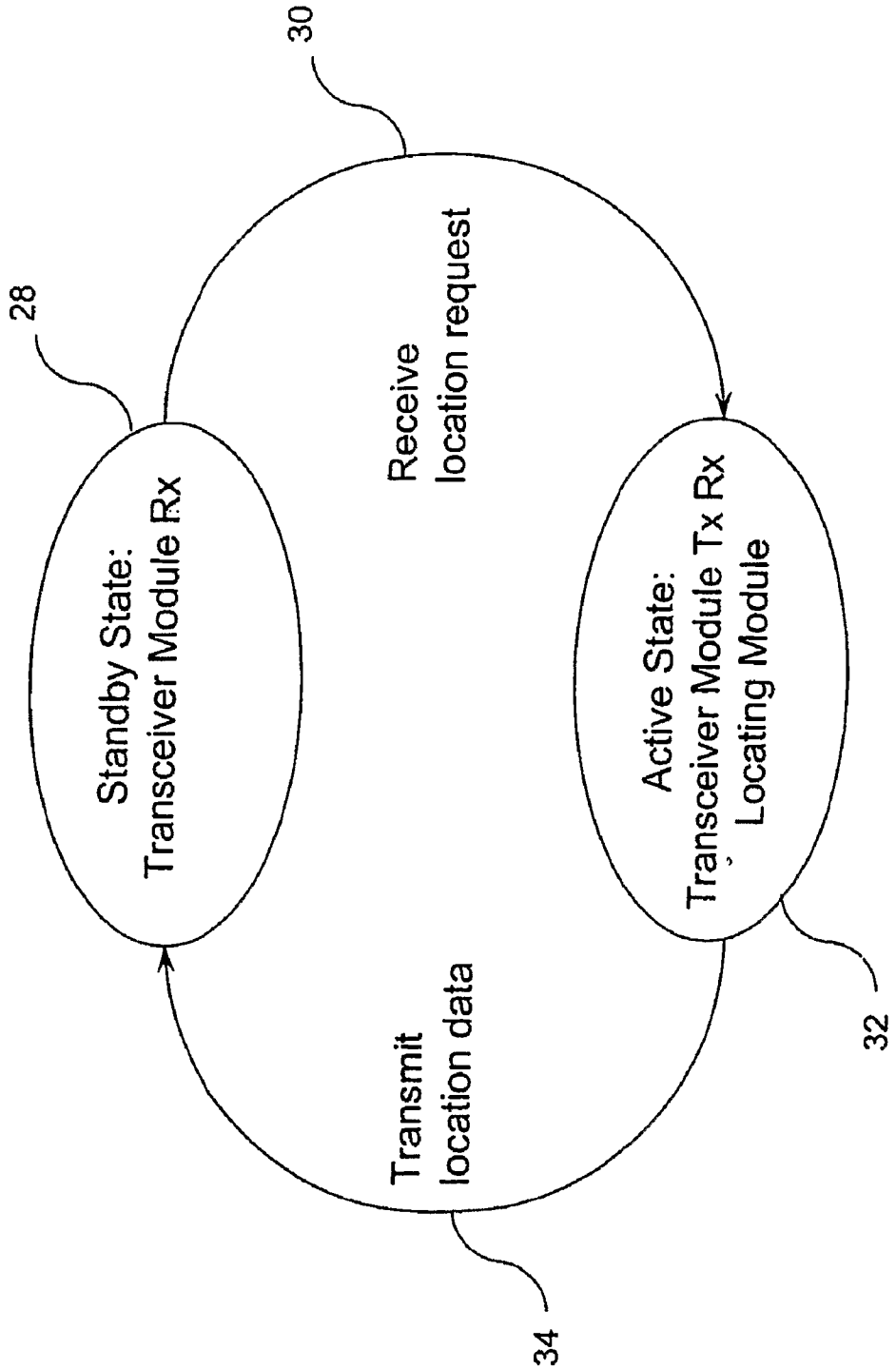
30
28
Receive
location request
Standby State:
Transceiver Module Rx
Active State:
Transceiver Module Tx Rx
Locating Module
32
Transmit
location data
34

Figure 3

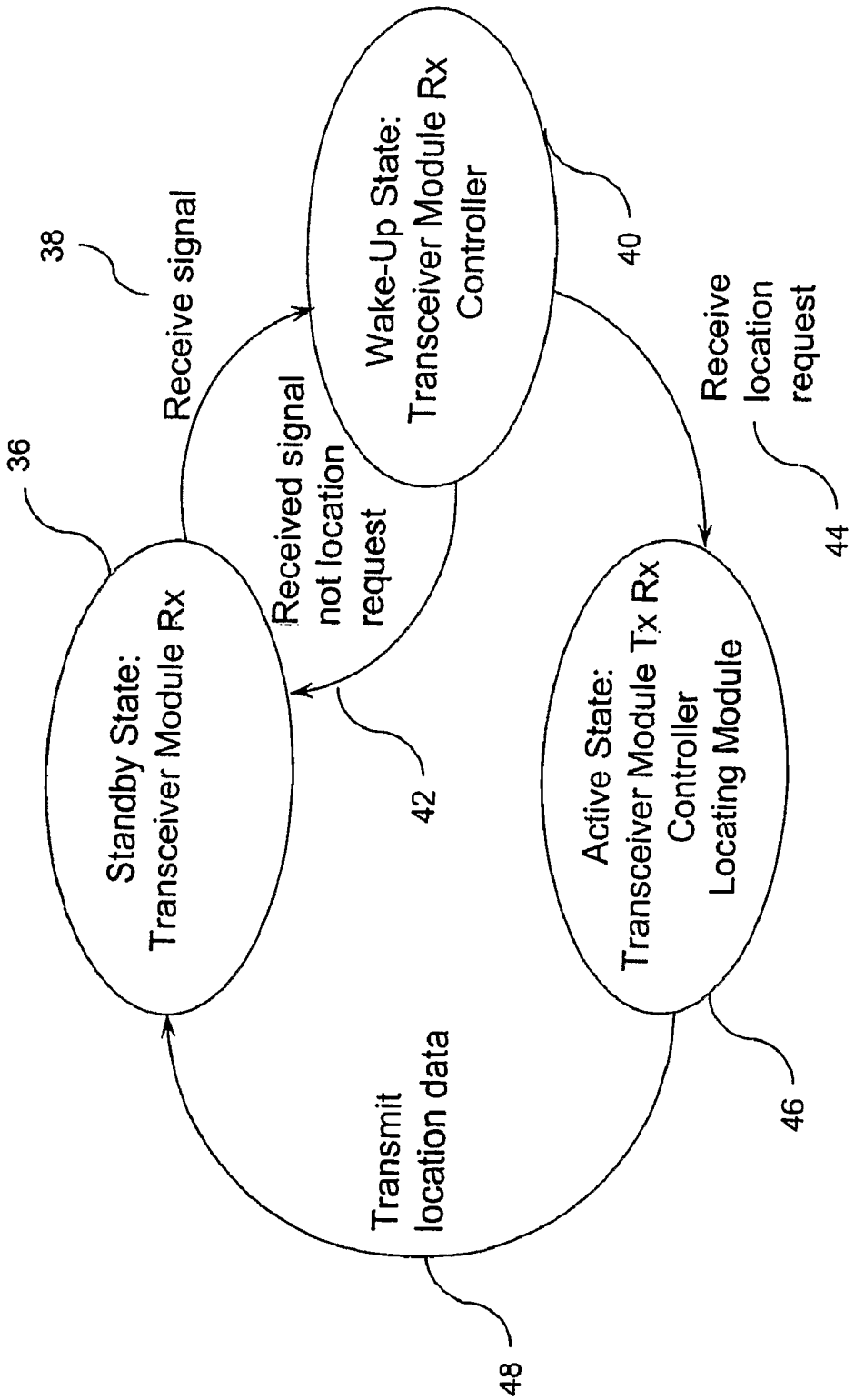
Standby State:
Transceiver Module Rx
Wake-Up State:
Transceiver Module Rx
Controller
Active State:
Transceiver Module Tx Rx
Controller
Locating Module
Receive signal
Received signal
not location
request
Receive
location
request
Transmit
location data
36
38
40
42
44
46
48

Figure 4

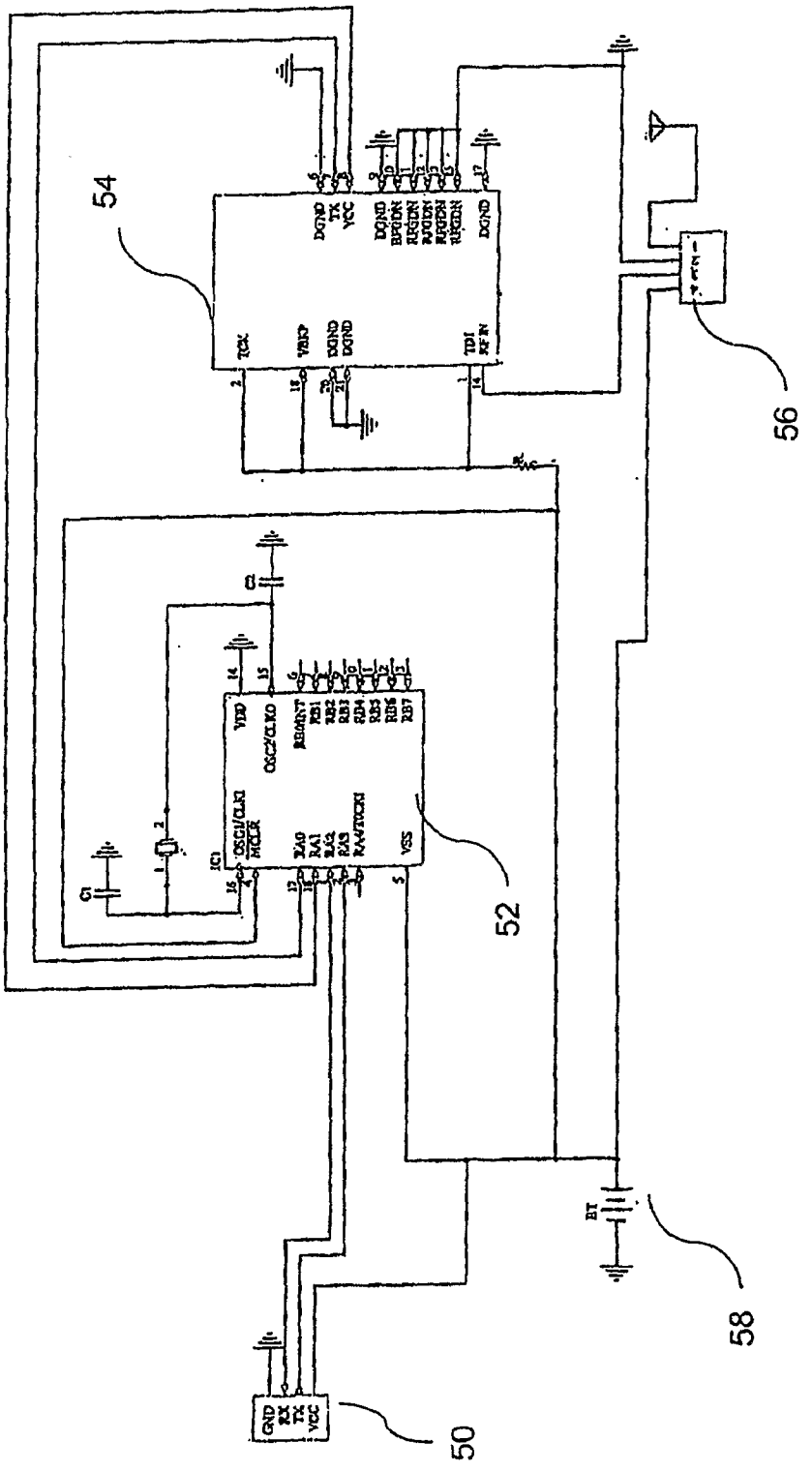

Figure 5

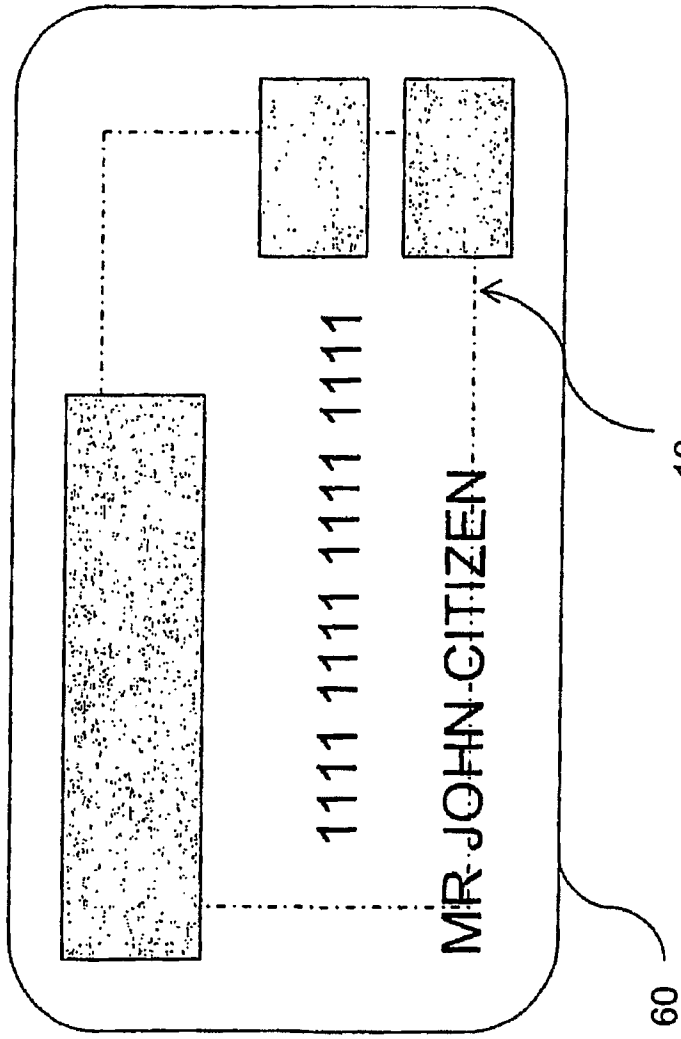

Figure 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/001629

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G01S 3/02 (2006.01)

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)

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)
Epoque: location, mobile, network, request, standby and similar terms; Google Patents, Esp@ce: gps, locate, mobile, call and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,693,585 B1 (MACLEOD) 17 February 2004 figure 3; figure 7; column 2 lines 24-27; column 9, lines 46-49; column 11, lines 50-67	1-7,9-13,16-19,21
Y		15,22
X	US 6,069,570 A (HERRING) 30 May 2000 column 1 lines 34-59; figure 1; column 2 line 3-42	1,2,5-7, 9,13, 14, 16-18
Y		15,22
Y	US 5,742,233 A (HOFFMAN et al.) 21 April 1998 figure 5; column 10 lines 15-17 and column 11 lines 51-52 US '233 can be combined with either of US '585 or US '570 for inventive step.	15,22

☐ 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

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"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
11 December 2008	19 DEC 2008
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **JAMES WILLIAMS** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2599

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2008/001629

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6693585	NONE					
US	6069570	CA	2221957	WO	9812862		
US	5742233	AU	59223/98	CA	2278242	EP	1010150
		US	6239700	US	6624754	US	7038590
		US	2004014478	US	2004021573	US	2007243855
		WO	9832105				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001..

END OF ANNEX