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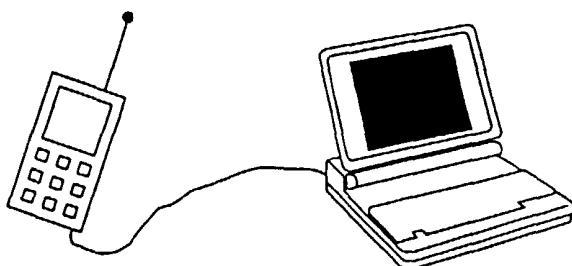
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(54) Title: A METHOD OF ESTIMATING THE LOCATION OF A DEVICE



(57) Abstract: Methods of providing an estimate of the location of a first device are disclosed comprising the steps of determining the location of a separately housed, second device located near to the first device; providing the location of the second device to the first device; and using the location of the second device as an estimate of the location of the first device. Either the second device is arranged to perform a function based on its location other than providing its location as an estimate of the location of the first device, or the location of the second device is provided to the first device using a wireless communications link.

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DESCRIPTION

A METHOD OF ESTIMATING THE LOCATION OF A DEVICE

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This invention relates to a method of providing an estimate of the location of a device.

Recent progress in the field of GPS has enabled GPS receivers to be produced relatively cheaply leading to their widespread adoption and use. However, providing GPS receivers in all devices which might wish to utilise a location based service or execute a location based function may lead to many GPS receivers being required for which the cumulative costs may be prohibitive.

15 For example, consider a home networking environment in which is provided a mobile telephone with GPS capability for providing its location to a cellular telephone network operator in the event of an emergency call; a TV with GPS capability for providing TV access control, say as described in US patent 5621793; and a personal computer with GPS and Internet capability for retrieving location specific information from a web site, say a local weather report. In such a home networking environment, 3 GPS receivers would be required, each returning substantially the same location.

25 In addition, should one GPS receiver be unable to return a location fix, for example if it is defective or can not see enough satellites, the other nearby GPS receivers are unable to provide back up or assistance.

It is therefore an object of the present invention to provide an enhanced method of providing an estimate of the location of a device which obviates or at least mitigate these problems.

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In accordance with a first aspect of the present invention, there is provided a method of providing an estimate of the location of a first device

comprising the steps of determining the location of a separately housed, second device located near to the first device; providing the location of the second device to the first device; and using the location of the second device as an estimate of the location of the first device, wherein the second device is
5 arranged to perform a function based on its location other than providing its location as an estimate of the location of the first device.

The method of the first aspect of the present invention provides more efficient use of location determining means such as GPS receivers whereby one location determining means is able to service at least two devices. NB. the
10 second device being arranged to perform a function based on its location other than providing its location as an estimate of the location of the first device is not intended to include an embodiment wherein the second device is a standalone location determining means whose sole purpose is to provide the first device with a location fix.

15 The location of the second device may be provided to the first device using a physical communications link such as a cable joining the first and second devices or, alternatively, using a wireless communications link such as a Bluetooth link.

In accordance with a second aspect of the present invention, there is
20 provided a method of providing an estimate of the location of a first device comprising the steps of determining the location of a separately housed, second device located near to the first device; providing the location of the second device to the first device; and using the location of the second device as an estimate of the location of the first device, wherein the location of the
25 second device is provided to the first device using a wireless communications link, again such as Bluetooth.

A method in accordance with either the first or second aspects of the present invention may further comprise the step of sending a request from the first device to the second device that the second device provide its location to
30 the first device. Where this is the case, and where the first device comprises location determining means to determine its location, the request may be sent when and preferably only when the location determining means is inoperative.

This would accommodate for a defective GPS receiver or a GPS receiver which was unable to acquire the GPS signals, say because of poor reception caused by signal obscuration in an urban environment.

Also provided in accordance with the present invention is combination
5 of first and second separately housed devices according to claims 12 to 24; and a device according to claims 25 to 34.

Yet further provided in accordance with the present invention is a method of providing an estimate of the location of a first device using second and third devices as claimed in claims 36 to 39.

10

The above and other features and advantages of the present invention will be apparent from the following description, by way of example, of an embodiment of a mobile cellular telephone comprising a GPS receiver for use in a cellular telephone network with reference to the accompanying drawings in
15 which:

Figure 1 shows, schematically, two mobile units MS1, MS2 according to the present invention;

Figure 2 shows, schematically, a mobile cellular telephone and a television according to the present invention; and

20 Figure 3 shows, schematically, a mobile cellular telephone and a portable computer according to the present invention.

Referring to figure 1, two substantially identical mobile units MS1, MS2 are shown, each comprising a communications transmitter (Comm Tx) and
25 receiver (Comm Rx) 11 connected to a communications antenna 10 and controlled by a communications microprocessor (Comm μ c) 12 for two-way Bluetooth communication.

In addition, each mobile unit MS1, MS2 further comprises a GPS receiver (GPS Rx) 14 connected to a GPS antenna 13 and controlled by a
30 GPS microprocessor (GPS μ c) 15 receiving GPS spread spectrum signals transmitted from orbiting GPS satellites. When operative, the GPS receiver 14 may receive NAVSTAR SPS GPS signal through an antenna 13 and pre-

process them, typically by passive bandpass filtering in order to minimise out-of-band RF interference, preamplification, down conversion to an intermediate frequency (IF) and analog to digital conversion. The resultant, digitised IF signal remains modulated, still containing all the information from the available
5 satellites, and is fed into a memory of the GPS microprocessor 15. The GPS signals may then be acquired and tracked for the purpose of deriving pseudorange information from which the location of the mobile telephone can be determined using conventional navigation algorithms. Such methods for GPS signal acquisition and tracking are well known, for example, see chapter
10 4 (GPS satellite signal characteristics) & chapter 5 (GPS satellite signal acquisition and tracking) of GPS Principles and Applications (Editor, Kaplan) ISBN 0-89006-793-7 Artech House. The GPS microprocessor 15 may be implemented in the form a general purpose microprocessor, optionally common with the communications microprocessor 12, or a microprocessor
15 embedded in a GPS application specific integrated circuit (ASIC).

In the event that the GPS receiver and GPS microprocessor of MS2 is unable to acquire the GPS signals, for example due to obscuration in a urban environment, the mobile MS2 is unit broadcasts a request to RF receivers in the vicinity requesting that they respond by providing their location. In this case
20 mobile unit MS1 which is able to determine its location replies sending its location whereupon the mobile unit MS2 receives the reply and uses the location determination of mobile unit MS1 as an estimate of its own location. Mobile unit MS1 may then convey this estimate to a user through a display. Where a short range RF communications link such as Bluetooth is used, it is
25 possible to assume a reasonable degree of accuracy unless of course the location determination of MS1 is inaccurate.

A second example is shown schematically in figure 2 in which a GPS enabled mobile cellular telephone MS3 communicates with a television using a short range communications link, i.e. separate from the communications
30 hardware required to communicate with base stations in a cellular telephone network. As with the mobile units of figure 1, a Bluetooth link would be appropriate.

The television and its integral receiver may use knowledge of its location to provide TV access control and to deter theft. For example, TV access control may be effected by receiving a location estimate from the nearby mobile telephone GPS receiver whereby only when the present
5 location is consistent with an authorised location are the incoming video signals decrypted and displayed. However, rather than comprising its own GPS receiver, the television is provided with a wireless link to communicate with the nearby mobile cellular telephone from which it receives an estimate of its location based on the location determination of the GPS receiver in the
10 mobile telephone.

A third example is shown schematically in figure 3 in which a NAVSTAR GPS enabled mobile cellular telephone MS3 is used with a laptop computer to remotely access using the Internet. When accessing web sites which provide location based services, the laptop requests from the mobile telephone its
15 location which is transmitted to the laptop and then supplied to a web site server, back through the mobile telephone.

In order to reduce the time to first fix, the GPS receiver of such a mobile telephone may be provided with base station assistance in order to acquire GPS signals more quickly. Such assistance may include the provision by the
20 base station to the receiver of a precision carrier frequency reference signal for calibrating the local oscillator used in the GPS receiver; the data message for up to date satellite almanac and ephemeris data from which Doppler shift for satellites in view can be determined; and the current PRN code phase. With such assistance, it is possible to sweep only a narrowed range of frequencies
25 and code phases in which the target PRN code is known to occupy, thereby reducing the number of code instances that need to be checked and thus reducing the time for code acquisition. Base station assistance is further described in US patents 5841396 and 5874914 which are incorporated herein by reference.

30 At present GPS is most notably associated with the Navigation System with Time and Ranging (NAVSTAR) GPS, an all weather, spaced based navigation system developed and operated by the US Department of Defense,

however, the general principles underlying GPS are universal and not merely limited to NAVSTAR. Accordingly, GPS refers to any positioning system comprising a plurality of radio transmitters at different locations and a receiver which determines its location based on the time of arrival of the transmissions
5 of the radio transmitters. In so far as a telephone is concerned, this would also include base station triangulation in which timing measurements were taken by the base stations and relayed back to the mobile telephone.

The invention is equally applicable to non-GPS location determining means such a fixed land based telephone having access to its subscriber
10 address and hence location, or a traditionally fixed device such as a central heating controller which can be told its position, say from a nearby GPS enabled mobile telephone, and then store it for future dissemination.

From a reading of the present disclosure, other modifications will be apparent to the skilled person skilled and may involve other features which are
15 already known in the design, manufacture and use of GPS receivers and component parts thereof and which may be used instead of or in addition to features already described herein. Although claims have been formulated in this application to particular combinations of features, it should be understood that the scope of the disclosure of the present application also includes any
20 novel feature or any novel combination of features disclosed herein either explicitly or implicitly, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or
25 combinations of such features during the prosecution of the present application or of any further application derived therefrom.

CLAIMS

1. A method of providing an estimate of the location of a first device comprising the steps of determining the location of a separately housed,
5 second device located near to the first device; providing the location of the second device to the first device; and using the location of the second device as an estimate of the location of the first device, wherein the second device is arranged to perform a function based on its location other than providing its location as an estimate of the location of the first device.
- 10 2. A method according to claim 1 wherein the location of the second device is provided to the first device using a physical communications link.
3. A method according to claim 2 wherein the physical
15 communications link is a cable joining the first and second devices.
4. A method according to claim 1 wherein the location of the second device is provided to the first device using a wireless communications link.
- 20 5. A method of providing an estimate of the location of a first device comprising the steps of determining the location of a separately housed, second device located near to the first device; providing the location of the second device to the first device; and using the location of the second device as an estimate of the location of the first device, wherein the location of the
25 second device is provided to the first device using a wireless communications link.
6. A method according to claim 4 or claim 5 wherein the wireless communications link is a Bluetooth link.
- 30 7. A method according to any of the preceding claims wherein the second device comprises a GPS receiver.

8. A method according to any of the preceding claims further comprising the step of sending a request from the first device to the second device that the second device provide its location to the first device.

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9. A method according to claim 8 wherein the first device comprises location determining means to determine its location; and wherein the request is sent when the location determining means is inoperative.

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10. A method according to claim 9 wherein the request is sent only when the location determining means is inoperative.

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11. A method of providing an estimate of the location of a device substantially as hereinbefore described with reference to the accompanying drawings.

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12. The combination of first and second separately housed devices for estimating of the location of the first device by a method according to any of the preceding claims.

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13. The combination of first and second separately housed devices for estimating of the location of the first device; wherein the second device comprises location determining means for determining the location of the second device and providing the location to the first device; wherein the first device uses the location of the second device as an estimate of its location; and wherein the second device is arranged to perform a function based on its location other than providing its location as an estimate of the location of the first device.

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14. A combination according to claim 13 wherein the location of the second device is provided to the first device using a physical communications link.

15. A combination according to claim 14 wherein the physical communications link is a cable joining the first and second devices.

5 16. A combination according to claim 15 wherein the location of the second device is provided to the first device using a wireless communications link.

10 17. The combination of first and second separately housed devices for estimating of the location of the first device; wherein the second device comprises location determining means for determining the location of the second device and providing the location to the first device; wherein the first device uses the location of the second device as an estimate of its location; and wherein the location of the second device is provided to the first device
15 using a wireless communications link.

18. A combination according to claim 16 or claim 17 wherein the wireless communications link is a Bluetooth link.

20 19. A combination according to any of claims 12 to 18 wherein the second device comprises a GPS receiver.

20. A combination according to any of claims 12 to 19 wherein the first device is arranged to send a request to the second device that the second
25 device provide its location to the first device.

21. A combination according to claim 20 wherein the first device comprises location determining means to determine its location; and wherein the request is sent when the location determining means is inoperative.

30

22. A combination according to claim 21 wherein the request is sent only when the location determining means is inoperative.

23. A combination of first and second separately housed devices according to claims 12 to 22 wherein the first and second devices are interchangeable such that they may reciprocate assistance provided by the other.

24. The combination of first and second separately housed devices for estimating of the location of the first device substantially as hereinbefore described with reference to the accompanying drawings.

25. A device comprising location determining means to determine its location and a receiver for receiving location information from a source external to the device, wherein, in use, the device uses received location information as an estimate of its own location.

26. A device according to claims 24 further comprising a transmitter wherein the device is arranged to send a request for location information to a recipient external to the device when the location determining means is inoperative.

27. A device according to claims 24 or claim 25 wherein the location determining means is a GPS receiver.

28. A device according to any of claims 24 to 26 wherein the receiver is for a wireless communications link.

29. A device comprising a receiver for a wireless communications link for receiving location information wherein, in use, the device uses received location information as an estimate of its own location.

30. A device according to claims 27 and 28 wherein the wireless communications link is a Bluetooth link.

31. A device comprises location determining means for determining the location of the device and a transmitter for sending information relating to its location to a recipient external to the device, wherein the device is arranged
5 to perform a function based on its location other than sending location information to a recipient external to the device.

32. A device according to claim 30 wherein the transmitter for sending location information to a recipient external to the device is for a
10 wireless communications link.

33. A device according to claim 30 or claim 31 wherein the wireless communications link is a Bluetooth link.

15 34. A device according to any of claims 30 to 32 wherein the location determining means is a GPS receiver.

35. A device according to any of claims 30 to 33 wherein the device is arranged to send information relating to its location to a recipient external to
20 the device upon receiving an appropriate request from external to the device.

36. A method of providing an estimate of the location of a first device comprising the steps of determining the location of a separately housed, second device; providing the location of the second device to a third device,
25 separately housed from the first and second devices; providing the determined location of the second device from the third device to the first device; and using the determined location of the second device provided by the third device as an estimate of the location of the first device.

30 37. A method according to claim 36 wherein the location of the second device is provided from the second device to the third device using a wireless communications link.

38. A method according to claim 36 or 37 wherein the location of the second device is provided from the third device to the first device using a wireless communications link.

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39. A method according to claims 36 to 38 wherein the location of the second device is recorded in the third device.

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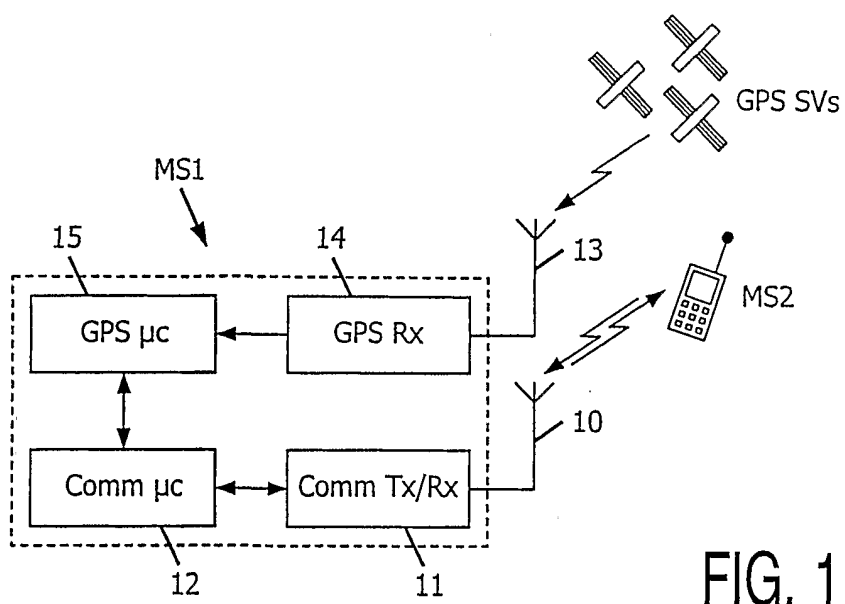


FIG. 1

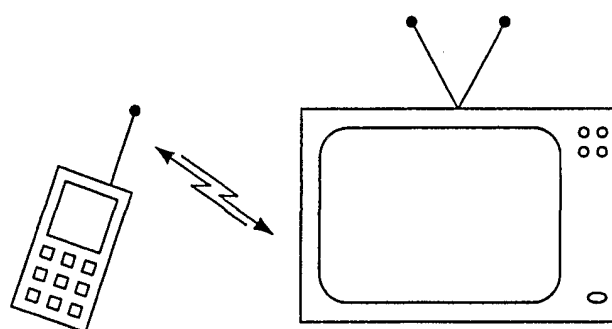


FIG. 2

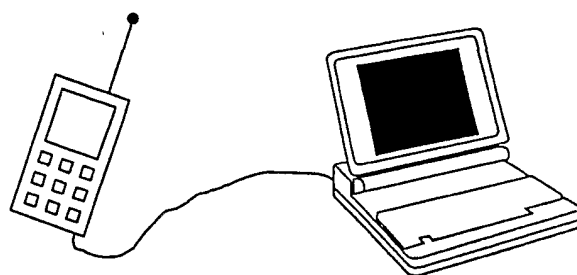


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/05260

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01S5/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01S

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 298 099 A (MICROMILL ELECTRONICS LTD) 21 August 1996 (1996-08-21)	1-5, 7, 12-17, 19, 29, 31, 32, 34
Y	abstract; figures	6, 18, 30, 33
A	page 5, line 26 - page 7, line 3 page 11, line 12 - line 25 ---	25, 36
X	EP 0 814 346 A (AT & T CORP) 29 December 1997 (1997-12-29) abstract; figures column 2, line 51 - column 3, line 21 column 3, line 41 - line 54 --- -/--	5, 7, 12, 17, 19, 29, 36-39

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	DE 198 01 519 A (ASAHI OPTICAL CO LTD) 23 July 1998 (1998-07-23) abstract; figures column 2, line 48 - line 66 column 7, line 62 - column 8, line 21 ----	31, 32, 34, 35 1, 5, 12, 13, 17, 25, 29, 36
Y	HAARTSEN J: "BLUETOOTH - THE UNIVERSAL RADIO INTERFACE FOR AD HOC, WIRELESS CONNECTIVITY" ERICSSON REVIEW, ERICSSON. STOCKHOLM, SE, no. 3, 1998, pages 110-117, XP000783249 ISSN: 0014-0171 abstract ----	6, 18, 30, 33
A	US 5 689 269 A (NORRIS ELWOOD G) 18 November 1997 (1997-11-18) abstract; figure 6 column 5, line 1 - line 11 column 5, line 39 - line 54 ----	1, 5, 12, 13, 17, 25, 29, 31, 36
A	EP 0 903 589 A (TRIMBLE NAVIGATION LTD) 24 March 1999 (1999-03-24) abstract; figure 11 paragraphs '0034!', '0035! ----	1, 5, 12, 13, 17, 25, 29, 31, 36
A	EP 0 748 085 A (GEN ELECTRIC) 11 December 1996 (1996-12-11) abstract; figures 1-3 page 3, line 9 - line 17 page 4, line 39 - page 5, line 9 -----	1, 5, 12, 13, 17, 25, 29, 31, 36

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 01/05260

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2298099 A	21-08-1996	GB 2334173 A, B	11-08-1999
EP 0814346 A	29-12-1997	US 5706014 A	06-01-1998
		CA 2197732 A	19-12-1997
		CN 1174331 A	25-02-1998
		JP 10070506 A	10-03-1998
DE 19801519 A	23-07-1998	JP 10206750 A	07-08-1998
		US 6233094 B	15-05-2001
US 5689269 A	18-11-1997	US 5952959 A	14-09-1999
		US 5781150 A	14-07-1998
EP 0903589 A	24-03-1999	US 6091358 A	18-07-2000
EP 0748085 A	11-12-1996	US 5691980 A	25-11-1997
		CA 2176869 A	08-12-1996
		IL 118285 A	22-12-1999
		JP 9171571 A	30-06-1997