



(51) International Patent Classification:

H04W 64/00 (2009.01) *G01S 5/12* (2006.01)
G01S 5/02 (2010.01) *G06F 17/30* (2006.01)
G01S 1/08 (2006.01)

(21) International Application Number:

PCT/IB201 1/055577

(22) International Filing Date:

9 December 2011 (09.12.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(71) Applicant (for all designated States except US): **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, 02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **JENSEN, Henning, Steensgaard** [DK/DK]; Vestre Grønsevej 18, 2680 Solrød Strand (DK). **KRISTOFFERSEN, Jens, Finn** [DK/DK]; Krogsbølvej 27, 4000 Roskilde (DK).

(74) Agent: **WALKE, Christoph**; Cohausz & Florack, Bleichstraße 14, 40211 Düsseldorf (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: POSITIONING BASED ON COVERAGE AREA POSITION INFORMATION LOCALLY STORED IN A TERMINAL

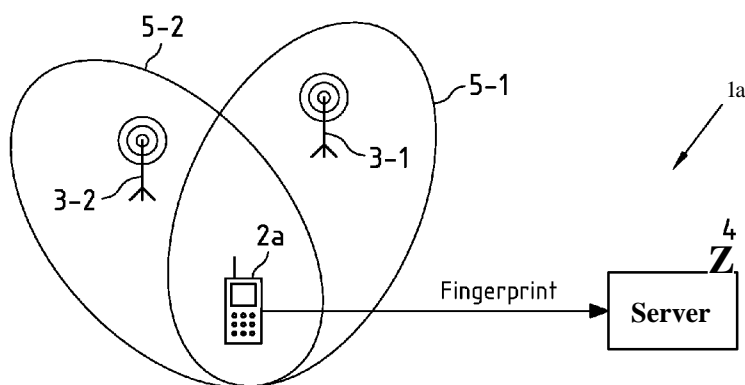


Fig. 1a

(57) Abstract: It is inter alia disclosed to determine respective coverage area identification information of one or more coverage areas (5-1, 5-2) associated with a terminal (2c). From a database locally stored in a memory of the terminal (2c) and at least based on the determined coverage area identification information, respective coverage area position information of one or more coverage areas of the one or more coverage areas (5-1, 5-2) associated with the terminal (2c) is obtained. A position estimate for the terminal (2c) is determined at least based on the obtained coverage area position information. It is further disclosed to retrieve database information from a database or an entity connected to the database according to a specification defining which database information shall be retrieved. The database comprises, for a plurality of coverage areas (5-1, 5-2), respective coverage area identification information and respective coverage area position information. The specification defines for which coverage areas (5-1, 5-2) respective information shall be contained in the database information. The retrieved database information is stored or provided.



Positioning based on Coverage Area Position Information Locally Stored in a TerminalFIELD

Embodiments of this invention relate to the field of positioning, in particular to positioning that is based on identification of wireless beacons and processing of related position information.

BACKGROUND

As an alternative or add-on to satellite-based positioning systems, positioning systems in which a present position of a terminal is estimated based on an identification of one or more coverage areas (a terminal is currently associated with and a database that stores respective position information) for a plurality of coverage areas have gained recent interest. A terminal may for instance be associated with a coverage area if it is able to "hear" signals sent by an entity (such as for instance a wireless beacon, e.g. a base station of a cellular communication system or a Wireless Local Area Network (WLAN) access point) that provides the coverage area. In such positioning systems, information on the coverage areas that have been determined to be associated with the terminal (and optionally further information such as for instance information on the Received Signal Strengths (RSSs) of the respective signals received from the respective coverage providing entities of these coverage areas) can then be provided to a server that retrieves respective coverage area position information (e.g. a position of the beacon providing the coverage area and/or - more advanced - a description of the position and extent of the coverage area) from a database. This retrieved coverage area position information (and optionally further information provided by the terminal) can then be processed by the server to determine a position estimate for the terminal, which position estimate is then returned to the terminal to be used in various location-based services, such as for instance navigation services.

SUMMARY OF SOME EMBODIMENTS OF THE INVENTION

The above-described positioning based on identified coverage areas is inter alia useful for, but of course not limited to, terminals that, for instance for cost reduction reasons, do not comprise hardware for satellite-based positioning (such as for instance a Global Navigation Satellite System (GNSS) receiver). It is then still possible to satisfy a wish/need for location-based services (such as maps, navigation, buddy finding, etc.).

However, providing information on coverage areas that have been determined to be associated with the terminal from the terminal to the server and receiving a position estimate for the terminal from the server at the terminal requires a data connection between the terminal and the server.

When now exemplarily considering a terminal that is operable in a cellular mobile communications system and has, for instance due to lack of satellite-based positioning capabilities, to use the data transmission services (e.g. a General Packet Radio Service, GPRS) of the cellular mobile communications system to implement at least a part of the data connection between the terminal and the server as a prerequisite for positioning, at least the following problems arise:

Many user of terminals, in particular of low-end terminals, are cost-constrained and either do not have any data subscription on their Subscriber Identity Module (SIM) card, or they are so cost aware that they do not want to pay the data costs for using the data transmission services for positioning purposes. As a consequence, these consumers then get no positioning service.

Furthermore, in many countries, in particular in emerging countries, often the establishment of data connections in cellular mobile communications systems simply fails due to unstable operator networks. Data connections might work in one moment, but in the next, they may no longer work. Similarly, the data connection may work in some cities but does not work in some other cities.

Finally, the time it takes for an application (for example when pressing a "MyPosition" icon in a map application) to get a current position is very much impacted by the time it takes to establish the data connection. In some countries, e.g. in developed countries, this time is typical approx. 5-10 seconds, whereas in other countries, such as for instance in emerging countries, this time is often much longer. This is a very important parameter affecting the end user experience of the service.

In view of the above, an embodiment of the invention thus comprises:

- determining respective coverage area identification information of one or more coverage areas associated with a terminal,
- obtaining, from a database locally stored in a memory of the terminal and at least based on the determined coverage area identification information, respective coverage area position information of one or more coverage areas of the one or more coverage areas associated with the terminal, and
- determining a position estimate for the terminal at least based on the obtained coverage area position information.

According to embodiments of the invention, the coverage area position information for determining the position estimate of the terminal is contained in a database that is locally stored on the terminal, rather than in a server or other network node. Thus the position estimate of the terminal can be determined by the terminal without requiring a data connection between the terminal and a server (or network node) storing or having access to the database. The database may for instance be

stored on a removable memory (e.g. an SD card) that can be purchased and inserted into the terminal, may be stored in a memory of the terminal by the manufacturer (e.g. already during manufacturing of the terminal) or retailer, or the database may be downloaded and stored in a memory of the terminal via a wireless or wired connection to a personal computer that may for instance be connected to a network to which also the server holding information on the database is connected. Embodiments of the invention thus allow for an "offline" positioning (which may for instance be understood as a positioning that does not require any data connection between the terminal and a server (or network node) that holds position-related information, such as for instance a server (or network node) holding a database with the coverage area position information).

In this offline positioning, the terminal nevertheless has to use its transceiver circuitry to determine which beacons can presently be heard, in order to determine which coverage areas are currently associated with the terminal. This activity may however be constrained to passively listening to signals emitted by the beacons. The offline positioning mode may be provided by the terminal in addition to an online positioning mode in which information on coverage areas associated with the terminal is provided to a server to enable the server to return associated coverage area position information for positioning to the terminal or to already return a position estimate to the terminal. The offline positioning mode may be selected by a user of the terminal as positioning mode to be always used by the terminal, or to be at least used in case that a data connection is not available or not available with a pre-defined quality. The offline positioning mode may be automatically selected by the terminal in case that a data connection is not available or not available with a pre-defined quality or has been deactivated.

A further embodiment of the invention comprises

- retrieving database information from a database or an entity connected to the database according to a specification defining which database information shall be retrieved, wherein the database comprises, for a plurality of coverage areas, respective coverage area identification information and respective coverage area position information, and wherein the specification defines for which coverage areas respective information shall be contained in the database information; and
- storing or providing the retrieved database information.

The retrieved database information may for instance constitute the database that is locally stored in the memory of the terminal for the offline positioning described above. This database information may for instance not be retrieved via a high-cost data connection, but may rather be retrieved in a low-cost or even cost-free manner. For instance, the database information may not be retrieved via a data connection of a mobile cellular communications system, but may rather be retrieved via a wired or wireless connection between the terminal that is to use the retrieved database information

and a personal computer that is connected to both the terminal and the Internet (and thus to a source of the database information).

Embodiments of the invention thus adequately address the problems described above. In some
5 embodiments, positioning of the terminal becomes possible without a need for establishing or
using a data connection after a need for positioning of the terminal has come up. In some em-
bodiments, the positioning service can become free of costs for the user of the terminal, for in-
stance if the database stored locally in the device can be obtained free of charge. In some
embodiments, the time it takes to estimate the current position can be brought down to typically 1-2
10 seconds owing to fast access to the positioning information in the locally stored database.

Further advantageous embodiments of the invention are described by the attached dependent
claims and by the detailed description presented hereinafter in conjunction with the accompanying
drawings. It is to be understood, however, that the drawings are designed solely for purposes of
15 illustration and not as a definition of the limits of the invention, for which reference should be made
to the appended claims. It should further be understood that the drawings are not drawn to scale and
that they are merely intended to conceptually illustrate the structures and procedures described
therein. In particular, presence of features in the drawings should not be considered to render these
features mandatory for the invention.

BRIEF DESCRIPTION OF THE FIGURES

In the figures show:

Fig. 1a: An example of a system for setting up a radiomap database;

Fig. 1b: an example of a system in which online positioning is performed;

Fig. 1c: an example of a system in which offline positioning according to a first embodiment
of the invention is performed;

Fig. 2: a schematic block diagram of an example of an apparatus according to the first em-
bodiment of the invention, which is of forms part of a terminal;

Fig. 3: a schematic presentation of an example of a tangible storage medium according to the
first embodiment of the invention;

Fig. 4: a flowchart of an example of a method according to the first embodiment of the invention;

Fig. 5a: a flowchart of an example of a method for selecting an online/offline positioning mode according to a fifth embodiment of the invention;

Fig. 5b: a flowchart of a further example of a method for selecting an online/offline positioning mode according to a third embodiment of the invention;

Figs. 6a-6c: schematic presentations of systems for retrieving aradiomap database from a database according to embodiments of the invention;

Fig. 7: a schematic block diagram of an example of an apparatus according to the thirteenth embodiment of the invention;

Fig. 8: a flowchart of an example of a method for retrieving database information from a database according to the thirteenth embodiment of the invention; and

Fig. 9: a flowchart of an example of a method for determining a specification for retrieving database information according to the thirteenth embodiment of the invention;

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Embodiments of the present invention pertain to fingerprint-based positioning of terminals, such as for instance terminals that communicate in cellular mobile communications systems or use wireless access points (e.g. WLAN or WiMAX access points) for communication/data transfer, and propose to move the positioning capabilities of backend positioning servers into the terminal. In embodiments of the invention, this requires that a subset of the positioning information normally stored in the backend positioning servers is stored locally in the terminal, and that the positioning algorithms normally run on the backend servers are implemented in the terminal.

A method according to a first embodiment of the invention thus comprises (see the flowchart 400 of Fig. 4):

- determining respective coverage area identification information of one or more coverage areas associated with a terminal (step 401),
- obtaining, from a database locally stored in a memory of the terminal and at least based on the determined coverage area identification information, respective coverage area position in-

formation of one or more coverage areas of the one or more coverage areas associated with the terminal (step 402), and

- determining a position estimate for the terminal at least based on the obtained coverage area position information (step 403).

5

This method (and also the methods according to the further embodiments of the invention described below) may for instance be performed by an apparatus (e.g. a processor), which may for instance be the terminal or a component thereof.

10 Further features of the first embodiment of the invention are as follows.

The terminal may for instance be capable of operating in (e.g. communicating according to) one or more cellular mobile communications systems (such as for instance the Global System for Mobile Communications, GSM; the Universal Mobile Telecommunications System, UMTS; and/or the
 15 Long-Term Evolution (LTE) system or mobile WiMAX system, to name but a few examples) and/or exchanging data with one or more non-cellular wireless access points (e.g. WLAN access points operating according to a standard of the IEEE 802.11 family, for instance those certified as WiFi access points, and/or one or more fixed WiMAX access points operating according to a standard of the IEEE 802.16 family). Therein, a non-cellular wireless access point is understood as
 20 an access point (or beacon) of a non-cellular communication system, such as for instance a communication system that does not support handover between different access points. WLAN access points and fixed WiMAX access points (IEEE 802.16-2004, in contrast to mobile WiMAX access points according to IEEE 802.16e-2005) are understood as embodiments of such non-cellular wireless access points.

25

The terminal may thus for instance be a mobile terminal. The terminal may for instance be a mobile phone (that is for instance capable to operate in one or more of the communications systems listed above), a personal digital assistant or a portable computer (e.g. a laptop or tablet computer). The terminal may not have a Global Navigation Satellite System (GNSS) receiver and may thus not be
 30 able to determine its position based on received GNSS signals. The terminal may for instance be a low-end terminal.

The terminal for which a position estimate is to be determined is associated with one or more coverage areas. Therein, a coverage area may for instance be understood as a (geographical) area in
 35 which one or more coverage providing entities (for instance one or more cellular base stations, i.e. base stations of cellular mobile communications systems), one or more non-cellular wireless access points, or one or more radio/television broadcast stations, to name but a few examples)

provide coverage, for instance radio coverage. Coverage may for instance be understood to be provided if a terminal can "hear" the coverage providing entity or entities of the coverage area. A terminal may for instance be considered to hear a coverage providing entity if it is able to receive one or more signals (e.g. a broadcast channel), which are sent by the coverage providing entity, with a pre-defined minimum quality (for instance defined in terms of a signal-to-noise ratio or a signal-to-noise and interference ratio), or if the terminal is capable of at least partially receiving and correctly decoding one or more signals sent by the coverage providing entity (e.g. a broadcast channel), or if the terminal is able to receive and correctly decode a coverage providing entity identifier (for instance a Medium Access Control (MAC) address or another identifier).

A terminal may for instance be considered to be associated with a coverage area if it is able to hear the coverage providing entity or entities of the coverage area. A terminal may be associated with more than one coverage area at a time, for instance with a coverage area that represents a serving cell of a cellular radio communication system and one or more coverage areas that represent neighboring cells with respect to the serving cell.

For the one or more coverage areas, respective position information exists. The position information may for instance comprise information on a position of a representation of the coverage area, such as for instance the position of a coverage area model. This position information may further comprise information on an extent of the representation of the coverage area. For instance, the representation of the coverage area may be a circular or elliptical representation of the coverage area, and the position information may then comprise at least the centre coordinates (for instance in geodetic coordinates) of the elliptical model. Further information such as the length of the semi-major and semi-minor ellipses and/or the orientation of the ellipse may also be comprised in the position information. As a further example, a coverage area may be represented by its coverage providing entity only, and then the position information may only comprise a position of this coverage providing entity (e.g. a non-cellular wireless access point such as a WLAN access point). It is to be noted that a representation of a coverage area may represent the coverage area with hard (physical) boundaries or with soft (statistical) boundaries (for instance by means of a probability (density) function, such as for instance a multi-normal distribution).

Position information for a plurality of coverage areas is stored (or contained) in the database, for instance together with respective identifiers for the coverage areas. The database may for instance, for a plurality of coverage areas, comprise respective coverage area position information and respective coverage area identification information (and also for instance further information, such as for instance a type of the coverage area, a version number or timestamp of the information, etc.). The identifiers may for instance serve as an index into the database. The database may for instance

comprise respective coverage area position information of at least one coverage area that is provided by a beacon of a cellular mobile communication system (for instance the cellular mobile communication system according to which the terminal communicates), and/or respective coverage area position information of at least one coverage area that is provided by a non-cellular wireless (e.g. WLAN or WiMAX) access point. The database may for instance comprise information on coverage areas of one or more cellular communications systems and/or one or more non-cellular wireless (e.g. WLAN or WiMAX) access points. The database may only contain information on coverage areas of one or more cellular communications systems, and may not contain information on coverage areas of non-cellular wireless (e.g. WLAN or WiMAX) access points. The database may only contain information on coverage areas of non-cellular wireless (e.g. WLAN or WiMAX) access points, but may not comprise information on coverage areas of cellular communications systems. The database may for instance be a radiomap database. The database is locally stored in a removable or fixedly installed memory of the terminal. This enables the terminal to directly access position information from the database for positioning purposes. Various ways how to provide the database locally in the terminal will be described in detail below inter alia with reference to Figs. 6a-6c.

The database locally stored in the memory of the terminal may for instance be retrieved from a database at (or connected to) a server of a positioning-data gathering service that compiles the coverage area position information, as will be discussed with reference to Figs. 1a and 8 below. The database locally stored in the memory of the terminal may furthermore also contain street map information and/or further map information to be used by map applications, but also may not comprise any street map information at all.

The terminal (for instance a functional unit thereof) determines coverage area identification information that comprises identification information for the one or more coverage areas associated with the terminal. Identification information for a coverage area may for instance be an identifier of the coverage area. A non-limiting example of such an identifier is an identifier of a coverage providing entity (e.g. an identifier of a base station of a cellular radio communication system or a non-cellular wireless (e.g. WLAN or WiMAX) access point (e.g. a Medium Access Control (MAC) address)), for instance for cases where each coverage area is provided by a single coverage providing entity. A further non-limiting example of such an identifier is a Location Area Code (LAC) of a cellular radio communication system (e.g. a Global System for Mobile Communication (GSM) system) that then may pertain to several coverage providing entities.

At least (or solely) based on the determined coverage area identification information, respective coverage area position information of one or more coverage areas is obtained from the database.

For instance, for each identified coverage area, respective position information may be obtained from the database. However, the case may occur that no position information is available in the database for one or more identified coverage areas, and then only position information for those identified coverage areas for which position information is available in the database is obtained.

5

At least based on the obtained coverage area position information, a position estimate for the terminal is obtained. The position estimate may for instance be determined under further consideration of information provided by the terminal and related to the respective distances towards one or more of the coverage providing entities, such as for instance the RSS, a timing in advance parameter, or similar parameters. For instance, if the coverage areas are provided by wireless access points, the coverage area position information may comprise positions of the wireless access points, and the position estimate for the terminal may then be determined based on triangulation, for instance also taking RSS information into account. The position estimate may for instance be determined further based on GNSS signals received via a GNSS receiver of the terminal.

10

15

It should be noted that the method according to the first embodiment of the invention can be considered as a process of transforming determined coverage area identification information into a position estimate.

20

A computer program according to the first aspect of the invention comprises program code for performing at least the operations of the method according to the first embodiment of the invention presented above when the computer program is executed on a processor. The computer program may for instance be distributable via a network, such as for instance the Internet. The computer program may for instance at least partially represent software and/or firmware of a processor.

25

The computer program may for instance be storable and/or encodable in a computer-readable medium. The computer-readable medium may for instance be embodied as an electric, magnetic, electro-magnetic, optic or other storage medium, and may either be a removable medium or a medium that is fixedly installed in an apparatus or terminal. Non-limiting examples of such a computer-readable medium are a Random- Access Memory (RAM) or a Read-Only Memory (ROM). The computer-readable medium may for instance be a tangible medium, for instance a tangible storage medium (see Fig. 4). A computer-readable medium is understood to be readable by a computer, such as for instance a processor.

30

An apparatus according to the first embodiment of the invention is configured to perform or comprises respective means for realizing at least the operations (or steps) of the method according

to the first embodiment of the invention presented above. The means of this apparatus can be implemented in hardware and/or software. They may comprise for instance a processor (see for instance processor 21 of Fig. 2) for executing program code for realizing the required functions, a memory (see for instance program memory 22 of Fig. 2) storing the program code, or both. Alternatively, they could comprise for instance a circuitry that is designed to realize the required functions, for instance implemented in a chipset or a chip, like an integrated circuit. Further alternatively, the means could be functional modules of a computer program code.

Another apparatus according to the first embodiment of the invention comprises at least one processor (see for instance processor 21 of Fig. 2) and at least one memory (see for instance program memory 22 of Fig. 2) including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to perform the operations of the method according to the first embodiment of the invention presented above. The computer program code included in the memory may for instance at least partially represent software and/or firmware for the processor.

These apparatuses according to the first embodiment of the invention may for instance at least be a part of the terminal for which a position estimate is to be determined. These apparatuses may comprise further components such as user interfaces or communication interfaces, as will be discussed with reference to Fig. 2 below. The database may for instance already be stored in a (removable or non-removable) memory of these apparatuses during their production. This (initial) database may for instance later be updated. Alternatively, the database is not stored in a memory of these apparatuses during their production.

Advantages that may arise from this first embodiment of the invention have already been described above in the "SUMMARY" section.

In the following, examples of systems (Fig. 1c) and apparatuses (Fig. 2) according to the first embodiment of the invention are presented. With respect to Fig. 3, an example of a tangible storage medium according to the first aspect of the present invention is described. Then, an example of a method according to the first embodiment of the invention will be discussed with respect to Fig. 4.

Fig. 1a shows an example of a system 1a for setting up a radiomap database to be at least partially used by the first embodiment of the invention. The system 1a comprises a collector terminal 2a, which may for instance be a terminal that is capable of operating in one or more radio communication systems and of determining its own position, for instance based on GNSS signals received by terminal 2a via an GNSS receiver of terminal 2a, and a plurality of coverage providing entities

of these one or more communication systems, of which only two coverage providing entities 3-1 and 3-2 are shown. Fig. 1a also illustrates the coverage areas 5-1 and 5-2 respectively provided by coverage providing entities 3-1 and 3-2. In the present example, these coverage areas 5-1 and 5-2 are of elliptical shape. Collector terminal 2a, for instance in periodic intervals, determines its current position and also determines the coverage areas it is currently associated with. In the present example of Fig. 1a, collector terminal 2a is associated with a coverage area if it is able to hear the coverage providing entity of the coverage area. This information is assembled into a fingerprint that is then sent to server 4. Server 4 receives a plurality of such fingerprints from a plurality of collector terminals and thus is able to extract from these fingerprints information on the respective position/extent of coverage areas. This respective position information (e.g. in the form of an elliptical coverage area model), is stored together with respective identification information for the coverage areas in a so-called radiomap database to be used for positioning terminals. This approach of gathering information on coverage area is sometimes referred to as "warwalking" or, if collector terminal 2a is mounted on a car, "wardriving".

Fig. 1b shows a system 1b in which a terminal 2b to be positioned determines to which coverage providing areas 5-1, 5-2 (respectively provided by coverage providing entities 3-1 and 3-2) it is associated and transmits related coverage area identification information to server 4'. At server 4', which holds a radiomap database, then respective coverage area position information is obtained, and based on this coverage area position information, a position estimate for the terminal 2b is determined. This position estimate is then transmitted to terminal 2b. In system 1b, transfer of the coverage area identification information and of the position estimate requires the terminal 2b to support a data connection, to be able to communicate with server 4'. This connection may for instance be established based on the data transmission services (like for instance GPRS) of a cellular mobile communications system. This data connection may for instance enable terminal 2b to communicate with a network node of the cellular mobile communications system, which may in turn be connected via a network to server 4'. Alternatively, server 4' may be this network node. In the following, a positioning mode in which a data connection between a terminal and a server holding an according database is required to determine a position estimate for the terminal at the time when the position estimate is to be determined will be referred to as an "online" positioning mode. The online positioning mode also denotes the case where the server does not determine the position estimate, but only returns coverage area position information matching the coverage area identification information provided by the terminal to the terminal, to enable the terminal to determine the position estimate.

Embodiments of the invention target avoiding the necessity of communicating with a server for positioning purposes. Nevertheless, in some embodiments of the invention, the terminal may well

be capable of using the online positioning services of server 4' as described with reference to Fig. 1b, and may use offline positioning - i.e. positioning that does not require a data connection at the time when the position estimate is to be determined - based on a database locally stored on terminal 2b as fallback solution, for instance for situations where no data connection is available. This will be discussed in further detail with respect to Figs. 5a and 5b below.

Fig. 1c shows a system 1c according to the first embodiment of the invention in which a terminal 2c determines an estimate of its position based on coverage area identification information, which is generated by terminal 2c by determining to which coverage areas 5-1 and 5-2 (respectively provided by coverage providing entities 3-1 and 3-2) it is associated. Based on this information, terminal 2c enters a radiomap database locally stored in terminal 2c to obtain respective coverage area position information, and uses this coverage area position information to estimate its position. The steps of this offline positioning are illustrated in the flowchart 400 of Fig. 4.

Fig. 2 is a schematic block diagram of an example of an apparatus 20 according to the first embodiment of the invention. Apparatus 20 is or forms a part of terminal 2c of Fig. 1c.

Apparatus 20 comprises a processor 21, which may for instance be embodied as a microprocessor, Digital Signal Processor (DSP) or Application Specific Integrated Circuit (ASIC), to name but a few non-limiting examples. Processor 21 executes a program code stored in program memory 22 (for instance program code implementing the flowchart of Figs. 4, 5a and/or 5b). An embodiment of program memory 22 will be discussed below with respect to Fig. 3. Processor 21 further interfaces with a main memory 23. It may for instance be embodied as Read-Only Memory (ROM) or as memory with restricted write access. For instance, only authorized program updates may be possible in program memory 22. Main memory 23 may for instance serve as working memory for processor 21. It may for instance be embodied as Random Access Memory (RAM).

Apparatus 20 further comprises a removable memory 26 and/or an internal memory 27. It may for instance be the primary purpose of these memories 26 and 27 to locally store the radiomap database at apparatus 20. Memories 26 and 27 may for instance also store further information, such as for instance user application data such as for instance multimedia content such as pictures, audio clips etc. Internal memory 27 may for instance be fixedly installed in apparatus 20, for instance as flash memory. Removable memory 26 can (frequently) be connected to and removed from apparatus 20. It may for instance be embodied as memory card or memory stick. Exemplary implementations of removable memory 26 comprise Secure Digital (SD) cards or Universal Serial Bus (USB) sticks. A further example of a removable memory 26 is a Subscriber Identity Module (SIM). Apparatus 20 then provides according connection interfaces for connecting removable memory 26.

Processor 21 further controls a communication interface 24 configured to receive and/or output information. Communication interface 24 may thus for instance comprise circuitry such as modulators, filters, mixers, switches and/or one or more antennas to allow transmission and/or reception of signals. For instance, communication interface 24 may be configured to exchange information with coverage providing entities 3-1, 3-2 of Fig. 1c or at least receive information from these coverage providing entities 3-1, 3-2, for instance according to one or more 2G/3G/4G cellular mobile communication systems and/or WLAN/WiMAX non-cellular wireless access points.

Communication interface 24 may in particular enable apparatus 20 to determine if it is associated with coverage areas, i.e. if it can hear the respective coverage providing entities of these coverage areas. This may for instance at least require receiving a broadcast signal (or another signal carrying identification information) of a coverage providing entity, for instance at least with a pre-defined signal strength or with at least a pre-defined SNR or SNIR to be able to identify the coverage providing entity. Of course, if apparatus 20 is part of a mobile telephone as an embodiment of terminal 2c, communication interface 24 may be further configured to allow at least circuit-switched calls. In embodiments of the invention, also packet-switched data connections may be supported by communication interface 24, these may however be deactivated by a user of apparatus 20 or may not be available (or not be available with a sufficient quality of service) in communication networks in which apparatus 20 is deployed.

If apparatus 20 is also capable of online positioning, communication interface 24 further has to be configured to provide a data connection to enable two-way information exchange between terminal 2b and server 4' as explained with reference to Fig. 1b above. This transmission may take place via one or more further communication entities, such as for instance a gateway, and may at least partially be wireless and/or wire-bound. Therein, a wireless transmission (for instance between terminal 2b and a first communication entity in this transmission path) may for instance be according to a communication system according to which one or more of the coverage providing entities 3-1, 3-2 operate, or according to another communication system.

In some embodiments of the invention (as will be described with reference to Figs. 5a and 5b below), communication interface 24 is further configured to receive GNSS signals from satellites of a GNSS (for instance a Global Positioning System (GPS) or a Galileo system). This functionality may however not be required by the majority of the other embodiments of the invention.

In some embodiments of the invention (as will be described with reference to Figs. 6a and 6b below), communication interface 24 is further configured to receive database information via a wired connection (e.g. a USB connection) or a wireless connection (e.g. WLAN, Bluetooth, IrDA,

NFC, etc.) from a computer or via a wireless connection (e.g. a WLAN-based connection) from a WLAN (or WiMAX) access point or via a cellular connection from an entity of a cellular mobile communications network.

- 5 Processor 21 further controls a user interface 25 configured to present information to a user of apparatus 20 and/or to receive information from such a user. Information presented to the user may for instance comprise information on a position estimate determined by positioning based on heard coverage providing entities and the radiomap database. The position estimate may for instance be presented to the user via user interface 25 as textual information or may be shown on a map, to
- 10 name but a few examples. User interface 25 may for instance be the standard user interface via which a user of terminal 2c of Fig. 1c interacts with terminal 2c to control other functionality of terminal 2c, such as making phone calls, browsing the Internet, etc.

- It is to be noted that the circuitry formed by the components of apparatus 20 may be implemented
- 15 in hardware alone, partially in hardware and in software, or in software only, as further described at the end of this specification.

- Fig. 3 is a schematic presentation of an example of a tangible storage medium 30 according to the first embodiment of the invention. This tangible storage medium 30, which may in particular be a
- 20 non-transitory storage medium, comprises a program 31, which in turn comprises program code 32 (for instance a set of instructions). Realizations of tangible storage medium 30 may for instance be program memory 22 of Fig. 2. Consequently, program code 32 may for instance implement the flowcharts of Figs. 4, 5a and 5b that will be discussed below.

- 25 Fig. 4 is a flowchart 400 of the method according to the first embodiment of the present invention and has already been discussed in detail above. This method may for instance be performed by terminal 2c of Fig. 1c (and/or apparatus 20 of Fig. 2) to perform offline positioning.

- According to a second embodiment of the invention, the first embodiment of the invention has the
- 30 further features that the terminal (e.g. the terminal 2b/2c of Fig. 1b/1c, e.g. comprising the apparatus 20 of Fig. 2) supports at least two positioning modes. A first positioning mode of the at least two positioning modes comprises the obtaining of the respective coverage area position information of the one or more coverage areas of the one or more coverage areas associated with the terminal from the database at least based on the determined coverage area identification information
- 35 tion (see step 402 of Fig. 4), and the determining of the position estimate for the terminal at least based on the obtained coverage area position information (see step 403 of Fig. 4). A second positioning mode of the at least two positioning modes comprises providing the determined coverage

area identification information to a server and receiving information obtained or determined at least based on the determined coverage area identification information from the server.

The first positioning mode may for instance be the offline positioning mode described with reference to Fig. 1c above, and the second positioning mode may for instance be the online positioning mode described with reference to Fig. 1b above. The first positioning mode may of course also comprise the step of determining the respective coverage area identification information (step 401 of Fig. 4).

In this second embodiment of the invention, the second positioning mode may for instance comprise either of the following:

1. Providing the determined coverage area identification information to the server (e.g. server 4' of Fig. 1b) to enable the server to determine, at least based on the determined coverage area identification information or a part thereof, a position estimate for the terminal, and receiving the position estimate from the server. The position estimate then constitutes the information determined at least based on the determined coverage area identification information.
2. Providing the determined coverage area identification information to the server (e.g. server 4' of Fig. 1b) to enable the server to obtain, from a database and at least based on the determined coverage area identification information, respective coverage area position information of one or more coverage areas of the one or more coverage areas associated with the terminal, receiving the obtained coverage area position information, and determining, at least based on the obtained coverage area position information, a position estimate for the terminal. Here, the obtained coverage area position information constitutes the information obtained at least based on the determined coverage area identification information.

According to a third embodiment of the invention, the second embodiment of the invention further comprises the features that in the second (e.g. online) positioning mode, the determined coverage area identification information is provided to the server and the information derived from the determined coverage area identification information is received from the server via a data connection, and that the first positioning mode is automatically selected by the terminal (e.g. the terminal 2b/2c of Fig. 1b/1c, e.g. comprising the apparatus 20 of Fig. 2) if the data connection is not available or not available with a pre-defined quality or deactivated by a user (for instance at a time when a position estimate is required at the terminal).

In this third embodiment of the invention, the first (offline) positioning mode thus serves as a fallback solution for the case that the second (online) positioning mode can or shall not be used, for instance because the user of the terminal has deactivated the data connection (for instance to save

costs), or because a proper data connection (for instance with an acceptable delay as a quality of service criterion) cannot be provided by a communications system, as it may sometimes be the case in emerging countries.

5 Fig. 5b is a flowchart 510 of an example of a method according to the third embodiment of the invention. The steps of this flowchart may for instance be performed by terminal 2b/2c of Fig. 1b/1c (and/or apparatus 20 of Fig. 2) to perform online and/or offline positioning.

10 In a step 511, it is continuously checked if a positioning request has been received (internally in the terminal). This may for instance be the case when a user of the terminal presses a "MyPosition" button in an application running on the terminal.

If a positioning request is received, i.e. at a time when the position estimate for the terminal is to be determined, it is checked in step 512 if a data connection can be used by the terminal. This may for instance be the case if the terminal is connected to or can connect to a communication system that provides a data connection service in the region of the terminal, for instance at least with a (for instance pre-defined) quality. A measure for this quality may for instance be the maximum or average transmission delay encountered when transmitting/receiving data. The communication system providing the data connection service may for instance be a cellular mobile communications system (e.g. a GPRS or E-GPRS data connection in a GSM system or e.g. a UMTS or LTE data connection). Nevertheless, it may also be possible to use a data connection via a non-cellular wireless access point, such as for instance a WLAN or WiMAX access point, to establish a data connection and retrieve positioning related information (such as for instance a position estimate or coverage area position information) from a server. Use of a data connection by the terminal may however have been prevented by a user, e.g. by not subscribing to a data connection service of a communication system and/or by deactivating the data connection at the terminal, for instance via a configuration menu of the terminal. This may have to be considered in the checking of step 512 as well.

30 If it is found in step 512 that a data connection can be used by the terminal, online positioning (i.e. involving a radiomap database stored at a server with which the terminal communicates) is performed in step 516. Otherwise, in optional step 513, it is checked if a local radiomap database is available in the terminal. If this is not the case, an error message is output in step 514. In step 514, a user of the terminal may furthermore be assisted in obtaining a local database (as will be described with reference to Figs. 6a-6c below). If the check in optional step 513 is positive (and also if step 513 is not performed at all), offline positioning is performed based on the radiomap database locally stored in the terminal, as for instance shown by the steps of flowchart 400 of Fig. 4.

According to a fourth embodiment of the invention, the second embodiment or the third embodiment of the invention further comprise the features that the terminal (e.g. the terminal 2b/2c of Fig. 1b/lc, e.g. comprising the apparatus 20 of Fig. 2) further supports a third positioning mode that is based on GNSS signals received at the terminal via a GNSS receiver, that the second positioning mode is automatically selected by the terminal if the third positioning mode is not available or not available with a pre-defined quality or deactivated by a user, that in the second positioning mode, the determined coverage area identification information is provided to the server and the information derived from the determined coverage area identification information is received from the server via a data connection, and that the first positioning mode is automatically selected by the terminal if both (i) the third positioning mode is not available or not available with a pre-defined quality or deactivated by a user and (ii) the data connection is not available or not available with a pre-defined quality or deactivated by a user.

In this fourth embodiment of the invention, a GNSS-based positioning mode is thus generally preferred, for instance optionally in combination with the online positioning mode. If the GNSS-based positioning mode is not available/not available with a pre-defined quality/deactivated, the online positioning mode serves as fallback solution. If, however, this online positioning mode is also not available/available with a pre-defined quality/deactivated, the offline positioning mode is automatically selected by the terminal. In this way, a user of the terminal can be provided with a positioning service in various types of environments. For instance, in indoor scenarios, where GNSS signals are generally hard to receive, the online positioning mode can still be used, and if in addition no data connection should be available, still the offline positioning mode can be used.

In the flowchart 510 of Fig. 5b, the fourth embodiment of the invention can be simply integrated by adding a check box between the check boxes 511 and 512, which determines if a GNSS positioning mode is available/available with a pre-defined quality/deactivated. If this is false, this check box proceeds to step 512. Otherwise, a GNSS positioning would be performed, either exclusively (after the GNSS positioning, the flowchart 510 would then proceed to the end of flowchart 510) or in combination with the online/offline positioning (after the GNSS positioning, the flowchart 510 would then proceed to step 512).

According to a fifth embodiment of the invention, the second embodiment or the third embodiment of the invention further comprise the feature that a selection of which of the at least two positioning modes shall be used by the terminal (e.g. the terminal 2b/2c of Fig. 1b/lc, e.g. comprising the apparatus 20 of Fig. 2) is made by a user of the terminal.

Therein, selecting the first positioning mode may only be permitted by the terminal if a local database is available in the terminal. The terminal may perform an according check and inform the user accordingly.

5

Fig. 5a is a flowchart 500 of an example of a method according to the fifth embodiment of the invention. The steps of this flowchart may for instance be performed by terminal 2b/2c of Fig. 1b/lc (and/or apparatus 20 of Fig. 2) to perform online and/or offline positioning.

10 In a step 501, it is continuously checked if a positioning request has been received (internally in the terminal). This may for instance be the case when a user of the terminal presses a "MyPosition" button in an application running on the terminal.

15 If a positioning request is received, i.e. at a time when the position estimate for the terminal is to be determined, it is checked in step 502 if a user has selected the offline (first) positioning mode as a default positioning mode. This may for instance have been performed by the user to save costs for a data connection in online positioning. To this, an apparatus according to the fifth embodiment of the invention may be configured to allow a user to perform this selection or may comprise according selection means allowing a user to perform this selection. For instance, a selection menu
20 may be provided to the user where a preferred positioning mode can be selected.

If the check in step 502 is positive, optional step 503 is entered and it is checked if a local radiomap database is available in the terminal. If this is not the case, an error message is output in step 504. In step 504, a user of the terminal may furthermore be assisted in obtaining a local database (as will be
25 described with reference to Figs. 6a-6c below). If the check in optional step 503 is positive (and also if step 503 is not performed at all), offline positioning is performed based on the radiomap database locally stored in the terminal, as for instance shown by the steps of flowchart 400 of Fig. 4.

30 If the check in step 502 is negative, it is checked in step 506 if a data connection can be used, i.e. if it is available (or available with sufficient quality (as for instance indicated by a pre-defined quality measure)) and has not been deactivated by a user, as described with reference to step 512 of Fig. 5b above. If this is the case, online positioning is performed in step 507. Otherwise, a failover to the offline positioning branch is made by branching to optional step 503 (or step 505, if step 503 is not
35 performed).

Similar as in the fourth embodiment, also a GNSS-based positioning mode can be considered here as well. The GNSS-based positioning mode (which may for instance be free of costs), may for instance be primarily used for positioning, either alone or in combination with the online or offline positioning mode. The user's selection among the online and offline positioning mode may then for instance only take effect if the GNSS-based positioning is not available (for instance indoors), or if the GNSS-based positioning is performed in addition to the online or offline positioning mode.

This may be reflected in the flowchart 500 of Fig. 5a by adding a check box between the check boxes 501 and 502, which determines if a GNSS positioning mode is available/available with a pre-defined quality/deactivated. If this is false, this check box proceeds to step 502. Otherwise, a GNSS positioning would be performed, either exclusively (after the GNSS positioning, the flowchart 500 would then proceed to the end of flowchart 500) or in combination with the online/offline positioning (after the GNSS positioning, the flowchart 500 would then proceed to step 502).

In the following, embodiments pertaining to the way how the database is locally stored in the memory of the terminal to allow for the offline positioning will be described.

According to a sixth embodiment of the invention, the first embodiment of the invention has the further features that the database has not been retrieved for storage in the memory via a data connection provided to the terminal by a cellular mobile communication system. This data connection may for instance be a circuit-switched data connection or a packet-switched data connection (like for instance a GPRS connection in a GSM system). The terminal may for instance use the cellular mobile communication system for circuit-switched voice calls, but may not use data connection services of this cellular mobile communication system for retrieving - for instance not even parts of - the database. It may thus in particular not be envisaged that the terminal downloads at least a part of the database (or even the entire database) from a server via a data connection of the cellular mobile communication system, for instance when entering a new geographic region and/or when setting up the terminal after purchase of the terminal.

It may additionally or alternatively also be the case that the database has not been retrieved for storage in the memory via a data connection between the terminal and a non-cellular wireless access point (such as for instance a WLAN or WiMAX access point).

According to a seventh embodiment of the invention, the first embodiment of the invention has the further features at least some information of said database has been loaded into said memory during production of said terminal. For instance, an initial version of said database may have been stored

in the memory (removable or non-removable) of the terminal by a producer of the terminal. This initial version of the database may later be updated, for instance by means of updates (e.g. firmware updates) offered, controlled or enforced by the producer or by a service provider. Updates may also be performed by a user of the terminal, for instance by one of the methods described with respect to
5 Figs. 6a-6c below.

According to a eighth embodiment of the invention, the first embodiment of the invention has the further features that at least some information of the database has been loaded into the memory by a user of the terminal. For instance, an initiative for storing the database (or at least parts thereof)
10 into the memory of the terminal may be started by the user of the terminal. The storage of the database (or parts thereof) may thus for instance not be automated in any way.

According to an ninth embodiment of the invention, the first embodiment of the invention has the further feature that at least some information of the database has been retrieved for storage in the
15 memory before the respective coverage area identification information of the one or more coverage areas associated with the terminal is determined. Said information of the database (for instance the entire database) is thus retrieved and stored in the memory of the terminal before the offline positioning is started (since the determined of the identification information constitutes the first step of the offline positioning). The information of the database may for instance be retrieved and stored in
20 the memory of the terminal a long time before an actual offline positioning is performed.

In the ninth embodiment of the invention, the information of the database may for instance be retrieved via a data connection provided to the terminal by a cellular mobile communication system or via a data connection provided to the terminal by a non-cellular wireless access point. This
25 example is illustrated in Fig. 6c discussed below. This may for instance be advantageous if there exist no other possibilities of providing the database for storage in the memory of the terminal. The (initial) retrieval of the database via the data connection may for instance be offered by a provider of the cellular mobile communication system free of charge, whereas use of a data connection for positioning purposes (in particular for online positioning) may not be cost-free.

According to an tenth embodiment of the invention, the first embodiment of the invention has the further features that at least some information of the database has been retrieved for storage in the memory at least via a wired or wireless data connection between a personal computer and the
terminal. Said computer may for instance be a computer of the user of the terminal. The computer
35 may for instance be a desktop, laptop or tablet computer. Non-limiting examples of a wired connection are for instance a USB connection and a serial connection. Non-limiting examples of a wireless connection are a WLAN connection, a Bluetooth connection, a Near Field Communica-

tion (NFC) connection and an infrared (e.g. IrDA) connection. The computer may for instance be connected to a network (e.g. the Internet) to which also a source for the information of the database (e.g. a master database or network having access to such a master database) is connected. Alternatively, the information may for instance be made available to the computer by means of data carriers that can be read by the computer, such as for instance memory sticks (e.g. USB sticks), magnetic discs or optical data carriers like CDs, DVDs or Blu-ray discs. The information may for instance be stored into a removable (see memory 26 of Fig.2) or non-removable memory (see memory 27 of Fig. 2) of the terminal.

Fig. 6a illustrates an example of a system 6a according to the tenth embodiment of the present invention. In system 6a, a radiomap database 8 with respective coverage area identification information and respective coverage area position information for a plurality of coverage areas is connected to a server 7, which can be accessed via internet 9 (or another network) by a personal computer (PC) 11a. Personal computer 11a may for instance be a computer of the user of terminal 10a. To store at least some information of database 8 into a memory of terminal 10a, a connection between terminal 10a and PC 11a is established, which may for instance be a wired connection (e.g. a USB connection) or a wireless connection (e.g. a Bluetooth, WLAN, NFC or IrDA connection, to name but a few examples). PC 11a then may for instance run software (e.g. a software like the NOKIA suite) that allows to retrieve information from database 8 and to provide this information to terminal 10a. Possibly, this software further allows to define what type/extent of information shall be retrieved from database 8, as will be discussed below. The retrieved information is then provided to terminal 10a for storage as radiomap database in a memory thereof for later offline positioning. It is also possible that only a part of the information retrieved from database 8 by PC 11a is provided to terminal 10a, and that the rest of this information is stored on PC 11a.

Fig. 6c illustrates a further example of a how to retrieve a database for local storage in the terminal, which has already briefly been discussed in the context of the ninth embodiment above. Therein, system 6c shown in Fig. 6c basically resembles system 6a of Fig. 6a, with the only differences that instead of PC 11a, a WLAN access point 12 is connected to the Internet 9 (or another network), and that terminal 10c is connected to the WLAN access point 12 via a WLAN connection. In the system 6c of Fig. 6c, terminal 10c may thus retrieve information from database 8 via WLAN access point 12, Internet 9 and server 7. For instance, terminal 10c may operate software (for instance an application retrieved from an application store) allowing to retrieve information from database 8, and possibly also to specify which information shall be retrieved from database 8. Similarly, terminal 10c may retrieve information from database 8 via a service offered by server 7. For instance,

server 7 may offer an internet application that can be accessed by terminal 10c (e.g. via a browser installed in terminal 10c) to retrieve information from database 8.

If WLAN access point 12 is a public access point, retrieving of the information from the database 8 may for instance be free of charge for a user of terminal 10c. The retrieved information may then be stored as radiomap database in a memory of terminal 10c for later offline positioning. Similarly, terminal 10c could use a data connection provided by a cellular mobile communications system to connect to server 7 (for instance directly, if server 7 is part of the infrastructure of the cellular mobile communications system, or via a gateway of the cellular mobile communications system connected to Internet 9, if server 7 is not part of the cellular mobile communications system) to be able to retrieve information from database 8.

According to an eleventh embodiment of the invention, the first embodiment of the invention has the further feature that the memory is a removable memory. The database is thus stored in a removable memory of the terminal. The removable memory (see memory 26 of Fig. 2) may for instance be embodied as memory card (e.g. SIM card or SD card) or as memory stick (e.g. a USB-Stick), to name but a few examples. Alternatively, the memory of the terminal may be a non-removable memory (see memory 27 of Fig. 2). In this case, the database may for instance have been stored into the memory of the terminal before the terminal is sold to end users, for instance by a manufacturer (for instance during production of the terminal) or by a retailer.

The removable memory may for instance be sold with the database already stored on it (for instance together with the terminal or separate therefrom). For instance, different removable memories with respectively different databases stored thereon may be purchased by a user. The different databases may for instance differ by the coverage areas covered. For instance, a first database may pertain to coverage areas of a first geographic region (e.g. a state, country, continent, etc.), whereas a second database may pertain to coverage areas of a second geographic region, which does not overlap (or only to a small extent) with the first geographic region. As a further example, a first database may pertain to coverage areas of a first communication system (e.g. a cellular mobile communication system), and a second database may pertain to coverage areas of a second communication system (a non-cellular system based on non-cellular wireless access points). The removable memory may be read-only. Alternatively, the removable memory may grant read and write access, and thus allow updating (for instance to add, alter or remove respective coverage area position information and/or respective coverage area position information of one or more coverage areas).

In the eleventh embodiment, the (offline positioning) method (e.g. the steps of flowchart 400 of Fig. 4) may for instance be controlled by a computer program, and a representation of the computer program may be stored in the removable memory in a way that the computer program can be installed on the terminal (for instance into program memory 22 of Fig. 2) from the memory or executed by the terminal from the memory. Said removable memory may then for instance have both the database and the computer program stored thereon, allowing a user that purchases the removable memory and inserts it into the terminal to perform offline positioning without requiring a data connection (neither for obtaining the database nor for obtaining the computer program, and of course also not for exchanging positioning-related information with a server during actual positioning).

Fig. 6b illustrates an example of a system 6b according to the eleventh embodiment of the invention. System 6b basically resembles the system 6a of Fig. 6a. The main difference is that PC 11b of system 6b is not connected via a wired or wireless connection to terminal 10b. Instead, PC 11b comprises a slot or other connector for removably connecting a memory (e.g. SD) card 13 thereto. Information from database 8 can then be retrieved via PC 11b (for instance once again via a computer program run by PC 11b) and stored on the removable memory card. This removable memory card 13 may then be removed from PC 11b and inserted into terminal 10b, which comprises a slot or other connector for removably connecting memory card 13. Therein, PC 11b does not necessarily have to be a PC of the user of the terminal, it can equally well be understood as a computer (e.g. an industrial computer system) for writing information from database 8 to a plurality of removable memory cards (perhaps also several at the same time) to be sold to users.

According to an twelfth embodiment of the present invention, the first embodiment of the invention has the further features that the database stored in the memory of the terminal only comprises a part (but for instance not all) of the information stored in a database of a service provider. The service provider may for instance generate and regularly update his database based on fingerprints received from a plurality of collector terminals as described with reference to Fig. 1a.

In the twelfth embodiment of the invention, the information of the database of the service provider may for instance pertain to at least two different types of coverage areas, and the database stored in the memory of the terminal may for instance not pertain to all of the at least two types of coverage areas. Additionally or alternatively, the information of the database of the service provider may for instance pertain to at least two different geographic regions, and the database stored in the memory of the terminal may for instance not pertain to all of the at least two geographic regions.

Said database of the service provider thus may be a (master) database that comprises more information than the database stored locally in the memory of the terminal.

In the following, further embodiments of the invention inter alia directed to retrieving the database information to be locally stored on the terminal are discussed.

A method according to a thirteenth embodiment of the invention comprises (see the flowchart 800 of Fig. 8):

- retrieving database information from a database or an entity connected to the database according to a specification defining which database information shall be retrieved, wherein the database comprises, for a plurality of coverage areas, respective coverage area identification information and respective coverage area position information, and wherein the specification defines for which coverage areas respective information shall be contained in the database information (see step 801); and
- storing or providing the retrieved database information (see step 802).

This method may for instance be performed by an apparatus (e.g. a processor), which is referred to as an apparatus according to the thirteenth embodiment of the invention below. Examples of such an apparatus are the PC 11a of Fig. 6a or a part thereof, the PC 11b of Fig. 6b or a part thereof, or the terminal 10c of Fig. 6c. Similarly, server 7 in Fig. 6a-6c (or a part thereof) can be understood as such an apparatus, which retrieves database information from a database in response to a request from a PC (see Figs. 6a, 6b) or terminal (see Fig. 6c). The retrieved database information may for instance be stored in a memory removably connected to the apparatus according to the thirteenth embodiment of the invention and connectable to a terminal (see Fig. 6b), or provided to the terminal for storage in a memory of the terminal (see Fig. 6a). Alternatively, the retrieved database information may for instance be stored in a memory of a terminal (see Fig. 6c), for instance if the apparatus according to the thirteenth embodiment of the invention is a terminal or part thereof and is connected to a server that has access to the database (e.g. via WLAN and Internet). For the details on the various connections via which the database information can be retrieved, it is referred to the description of Fig. 6a-6c above. Said database information may for instance not be retrieved via a data connection provided by a cellular mobile communication system and/or by a data connection provided by a non-cellular wireless access point. Said database information may for instance be retrieved from the database before coverage area position information is determined by a terminal for which a position estimate is to be determined based on this coverage area position information and the retrieved database information.

Fig. 7 shows an example of an apparatus 70 according to the thirteenth embodiment of the invention. The apparatus 70 comprises a processor 71, program memory 72, main memory 73, a communication interface 74, and optional user interface 75 and an optional removable memory 76. For the description of the characteristics of these components, reference is made to their counterparts in Fig. 2 described above. User interface 75 may for instance only be present if apparatus 70 is embodied as a terminal, e.g. the terminal 10c of Fig. 6c, or as a PC, e.g. PC 11a/11b of Figs. 6a/6b. Removable memory 76 may for instance only be present if apparatus 70 is embodied as PC 11b of Fig. 6b, or as terminal 10c of Fig. 6c. Program memory 72 may for instance be embodied as the tangible storage medium 30 of Fig. 3, and may comprise computer program code for implementing the method of flowcharts 800/900 of Figs. 8/9. If apparatus 70 is embodied as server, e.g. server 7 of Figs. 6a-6c, the communication interface 74 may for instance further be configured to interface with database 8 and Internet 9. Similarly, if apparatus 70 is embodied as PC, e.g. PC 11a/11b of Figs. 6a/6b, communication interface 74 may for instance further be configured to interface with Internet 9. If apparatus 70 is embodied as PC 11a of Fig. 6a, communication interface 74 may be further configured to interface with terminal 10a via a wired (e.g. USB) or wireless (e.g. WLAN, Bluetooth, IrDA, NFC, etc.) connection.

Further features of the thirteenth embodiment of the invention are as follows.

The retrieved database information may for instance constitute the database locally stored in the terminal in the first to twelfth embodiments of the invention described above. The database from which this database information is retrieved may for instance be a (master) database of a service provider that is generated and/or updated based on fingerprints received from a plurality of collector terminals, as described with reference to Fig. 1b above.

Said specification may for instance define a subset of the information contained in the database, this subset then being retrieved and either stored (e.g. in a memory of the terminal) or provided (e.g. to the terminal for storage in its memory), as for instance described with reference to Figs. 6a-6c above.

The method of the thirteenth embodiment may for instance further comprise determining or obtaining the specification for the database information to be retrieved. For instance, the specification may be obtained by requesting it from a user, for instance by presenting a specification mask or form (or dialog) to a user that may for instance be completed by the user, for instance by checking boxes or making selections. Alternatively, the specification may be automatically generated, for instance based on default values or known or requested information on the terminal in which the retrieved database information is to be used. For instance, a terminal that is only capable of oper-

ating in specific communication systems may be assumed to only require database information comprising information on coverage areas of these specific communication systems, but not of other communication system, also such further information would be available in the database of the service provider.

5

Fig. 9 shows a flowchart 900 of exemplary method steps for determining the specification of the database information to be retrieved. In a first step 901, the geographic region(s) to which the database information to be retrieved shall pertain are requested, and in a step 902, the type(s) of coverage areas to which the database information to be retrieved shall pertain, are requested. Based on the results of these requests, then the specification may be generated and used to retrieve the database information from the database.

10

A computer program according to the thirteenth aspect of the invention comprises program code for performing at least the operations of the method according to the first embodiment of the invention presented above when the computer program is executed on a processor. The computer program may for instance be storable and/or encodable in a computer-readable medium. The features of such a computer program and such a computer-readable medium have already been described above in the context of the first embodiment of the invention.

15

20

An apparatus according to the thirteenth embodiment of the invention is configured to perform or comprises respective means for realizing at least the operations (or steps) of the method according to the thirteenth embodiment of the invention presented above. The means of this apparatus can be implemented in hardware and/or software. They may comprise for instance a processor (see for instance processor 71 of Fig. 7) for executing program code for realizing the required functions, a memory (see for instance program memory 72 of Fig. 7) storing the program code, or both. Alternatively, they could comprise for instance a circuitry that is designed to realize the required functions, for instance implemented in a chipset or a chip, like an integrated circuit. Further alternatively, the means could be functional modules of a computer program code.

25

30

Another apparatus according to the thirteenth embodiment of the invention comprises at least one processor (see for instance processor 71 of Fig. 7) and at least one memory (see for instance program memory 72 of Fig. 7) including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus at least to perform the operations of the method according to the thirteenth embodiment of the invention presented above. The computer program code included in the memory may for instance at least partially represent software and/or firmware for the processor.

35

According to the thirteenth embodiment of the invention, furthermore a removable memory is disclosed, having stored thereon said retrieved database information.

Advantages that may arise from this thirteenth embodiment of the invention have already been described above in the "SUMMARY" section.

According to a fourteenth embodiment of the invention, the thirteenth embodiment of the invention further has the feature that the retrieved database information comprises less information than the database. Said database may for instance be available for online positioning, whereas the retrieved database information may be locally stored in a terminal to allow offline positioning. Said locally stored database information may then for instance be coarser (e.g. less accurate) and/or may cover less geographic regions and/or less types of coverage areas (e.g. less communication systems). Nevertheless, the benefit of being able to perform offline positioning may by far outweigh these disadvantages, in particular if online positioning, despite the better database, is not available and/or costly and/or frequently fails.

According to a fifteenth embodiment of the invention, the thirteenth embodiment of the invention further has the feature that the coverage areas of the plurality of coverage areas pertain to at least two different types of coverage areas, and wherein the retrieved database information does not comprises information on all of the at least two types of coverage areas.

According to a sixteenth embodiment of the invention, the thirteenth embodiment of the invention further has the feature that the coverage areas of the plurality of coverage areas pertain to at least two different geographic regions, and wherein the retrieved database information does not comprises information on all of the at least two geographic regions.

An example of a realization of the invention may for instance take the following shape:

1. Radiomap data which models the individual cells (or coverage areas) are stored on the memory card of the terminal. The radiomap data are either preloaded from factory, or the end user downloads the data using a tool on PC (for instance, for the Nokia S40, using the NOKIA Suite) connected to the terminal.
2. Upon a position request from an application (e.g. Maps), the terminal uses its modem to get information/measurements about current cell / neighbor cells and/or use the WLAN receiver to get information/measurements about WLANs.
3. The terminal then uses the cell information to find the proper models of the cells / neighbor cells from the radiomap data on the memory card.

4. When the models have been read from local data on the terminal, the models are given to a positioning algorithm which estimates the position. This position is provided to the requesting application (e.g. Maps).

5 As used in this application, the term 'circuitry' refers to all of the following:

(a) hardware-only circuit implementations (such as implementations in only analog and/or digital circuitry) and

(b) combinations of circuits and software (and/or firmware), such as (as applicable):

(i) to a combination of processor(s) or

10 (ii) to portions of processor(s)/software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as a mobile phone or a positioning device, to perform various functions) and

(c) to circuits, such as a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation, even if the software or firmware is not physically present.

15

This definition of 'circuitry' applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term "circuitry" would also cover an implementation of merely a processor (or multiple processors) or portion of a processor and its (or their) accompanying software and/or firmware. The term "circuitry" would also cover, for example
20 and if applicable to the particular claim element, a baseband integrated circuit or applications processor integrated circuit for a mobile phone or a positioning device.

With respect to the embodiments of the invention described above, it is understood that a disclosure of any action or step of a method according to this embodiment shall be understood as a
25 disclosure of a corresponding (functional) configuration of an apparatus (for instance a configuration of the computer program code and/or the processor and/or some other means of the apparatus) according to this embodiment, of a corresponding computer program code defined to cause such an action or step when executed and/or of a corresponding (functional) configuration of a system (or parts thereof) according to this embodiment.

30

The embodiments of the invention presented above and their single features shall also be understood to be disclosed in all possible combinations with each other. It should also be understood that the sequence of method steps in the flowcharts presented above is not mandatory, also alternative sequences may be possible.

35

The invention has been described above by means of embodiments, which shall be understood to be non-limiting examples. In particular, it should be noted that there are alternative ways and

variations which are obvious to a skilled person in the art and can be implemented without deviating from the scope and spirit of the appended claims.

CLAIMS

1. A method performed by an apparatus, said method comprising:

- determining respective coverage area identification information of one or more coverage areas associated with a terminal,
- 5 - obtaining, from a database locally stored in a memory of said terminal and at least based on said determined coverage area identification information, respective coverage area position information of one or more coverage areas of said one or more coverage areas associated with said terminal, and
- determining a position estimate for said terminal at least based on said obtained coverage area position information.

2. The method according to claim 1, wherein said database comprises respective coverage area position information of at least one coverage area that is provided by a beacon of a cellular mobile communication system.

3. The method according to any of the claims 1-2, wherein said database comprises respective coverage area position information of at least one coverage area that is provided by a non-cellular wireless access point.

4. The method according to any of the claims 1-3, wherein said terminal supports at least two positioning modes, wherein a first positioning mode of said at least two positioning modes comprises said obtaining of said respective coverage area position information of said one or more coverage areas of said one or more coverage areas associated with said terminal from said database at least based on said determined coverage area identification information, and said determining of said position estimate for said terminal at least based on said obtained coverage area position information, and wherein a second positioning mode of said at least two positioning modes comprises providing said determined coverage area identification information to a server and receiving information obtained or determined at least based on said determined coverage area identification information from said server.

5. The method according to claim 4, wherein said second positioning mode comprises either

- providing said determined coverage area identification information to said server to enable said server to determine, at least based on said determined coverage area identification information or a part thereof, a position estimate for said terminal, and receiving said position estimate from said server, or

- providing said determined coverage area identification information to said server to enable said server to obtain, from a database and at least based on said determined coverage area identification information, respective coverage area position information of one or more coverage areas of said one or more coverage areas associated with said terminal, receiving
5 said obtained coverage area position information, and determining, at least based on said obtained coverage area position information, a position estimate for said terminal.

6. The method according to any of the claims 4-5, wherein in said second positioning mode, said determined coverage area identification information is provided to said server and said in-
10 formation derived from said determined coverage area identification information is received from said server via a data connection, and wherein said first positioning mode is automatically selected by said terminal if said data connection is not available or not available with a pre-defined quality or deactivated by a user.

15 7. The method according to any of the claims 4-5, wherein said terminal further supports a third positioning mode that is based on GNSS signals received at the terminal via a GNSS receiver, wherein said second positioning mode is automatically selected by said terminal if said third positioning mode is not available or not available with a pre-defined quality or deactivated by a user, wherein in said second positioning mode, said determined coverage area identification
20 information is provided to said server and said information derived from said determined coverage area identification information is received from said server via a data connection, and wherein said first positioning mode is automatically selected by said terminal if both (i) said third positioning mode is not available or not available with a pre-defined quality or deactivated by a user and (ii) said data connection is not available or not available with a
25 pre-defined quality or deactivated by a user.

8. The method according to any of the claims 4-5, wherein a selection of which of the at least two positioning modes shall be used by said terminal is made by a user of said terminal.

30 9. The method according to any of the claims 1-8, wherein said database has not been retrieved for storage in said memory via a data connection provided to said terminal by a cellular mobile communication system.

10. The method according to any of the claims 1-9, wherein at least some information of said
35 database has been loaded into said memory during production of said terminal.

11. The method according to any of the claims 1-10, wherein at least some information of said database has been loaded into said memory by a user of said terminal.

5 12. The method according to any of the claims 1-11, wherein at least some information of said database has been retrieved for storage in said memory before said respective coverage area identification information of said one or more coverage areas associated with said terminal is determined.

10 13. The method according to claim 12, wherein said information of said database is retrieved via a data connection provided to said terminal by a cellular mobile communication system or via a data connection provided to said terminal by a non-cellular wireless access point.

15 14. The method according to any of the claims 1-13, wherein at least some information of said database has been retrieved for storage in said memory at least via a wired or wireless data connection between a personal computer and said terminal.

15. The method according to any of the claims 1-14, wherein said memory is a removable memory.

20 16. The method according to claim 15, wherein said method is controlled by a computer program, and wherein a representation of said computer program is stored in said removable memory in a way that said computer program can be installed on said terminal from said memory or executed by said terminal from said memory.

25 17. The method according to any of the claims 1-14, wherein said memory is a non-removable memory.

30 18. The method according to any of the claims 1-17, wherein said database stored in said memory of said terminal only comprises a part of the information stored in a database of a service provider.

19. The method according to claim 18, wherein said information of said database of said service provider pertains to at least two different types of coverage areas, and wherein said database

stored in said memory of said terminal does not pertain to all of said at least two types of coverage areas.

20. The method according to any of the claims 18-19, wherein said information of said database of said service provider pertains to at least two different geographic regions, and wherein said database stored in said memory of said terminal does not pertain to all of said at least two geographic regions.

21. The method according to any of the claims 1-20, wherein said apparatus is said terminal or a component thereof.

22. A method performed by an apparatus, said method comprising:

- retrieving database information from a database or an entity connected to said database according to a specification defining which database information shall be retrieved, wherein said database comprises, for a plurality of coverage areas, respective coverage area identification information and respective coverage area position information, and wherein said specification defines for which coverage areas respective information shall be contained in said database information; and
- storing or providing said retrieved database information.

23. The method according to claim 22, wherein said database information is not retrieved via a data connection provided by a cellular mobile communication system.

24. The method according to any of the claims 22-23, wherein said retrieved database information comprises less information than said database.

25. The method according to any of the claims 22-24, wherein said coverage areas of said plurality of coverage areas pertain to at least two different types of coverage areas, and wherein said retrieved database information does not comprises information on all of said at least two types of coverage areas.

26. The method according to any of the claims 22-25, wherein said coverage areas of said plurality of coverage areas pertain to at least two different geographic regions, and wherein said retrieved database information does not comprises information on all of said at least two geographic regions.

27. A removable memory having stored thereon said retrieved database information according to any of the claims 22-26.
- 5 28. A computer program comprising:
- program code for performing the method according to any of the claims 1-26 when said computer program is executed on a processor.
- 10 29. A computer-readable medium having a computer program according to claim 28 stored thereon.
30. An apparatus configured to perform the method according to any of the claims 1-21 or comprising respective means for performing the method steps of any of the claims 1-21.
- 15 31. An apparatus, comprising at least one processor; and at least one memory including computer program code, said at least one memory and said computer program code configured to, with said at least one processor, cause said apparatus at least to perform the method of any of the claims 1-21.
- 20 32. The apparatus according to any of the claims 30-31, wherein said apparatus is said terminal or a component thereof.
33. The apparatus according to any of the claims 30-32, further comprising a user interface.
- 25 34. An apparatus configured to perform the method according to any of the claims 22-26 or comprising respective means for performing the method steps of any of the claims 22-26.
- 30 35. An apparatus, comprising at least one processor; and at least one memory including computer program code, said at least one memory and said computer program code configured to, with said at least one processor, cause said apparatus at least to perform the method of any of the claims 22-26.
36. The apparatus according to any of the claims 34-35, wherein said apparatus is one of a terminal on which said retrieved database information is to be stored, a computer connected to a

terminal to which said retrieved database information is to be provided and a server connected to said database.

1/6

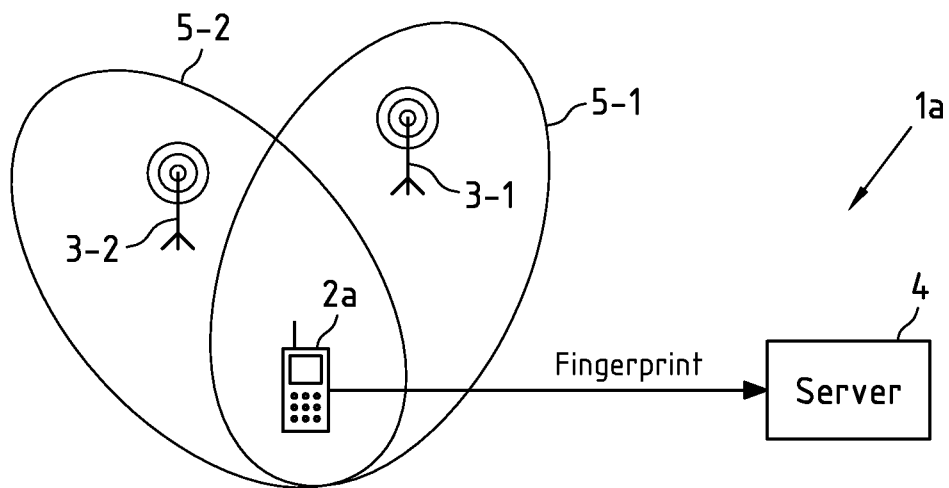


Fig.1a

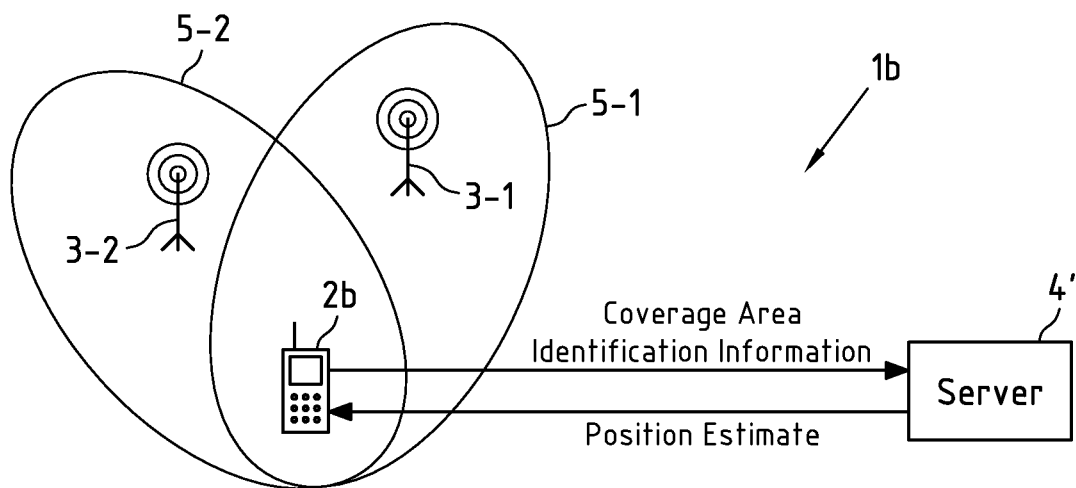


Fig.1b

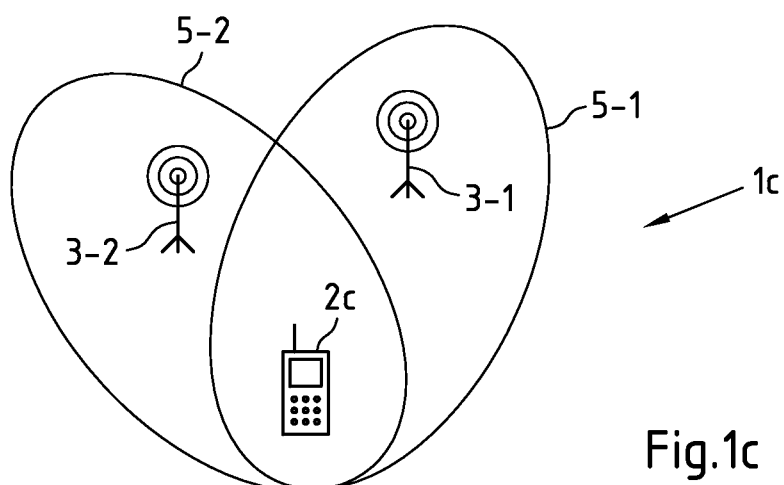


Fig.1c

2/6

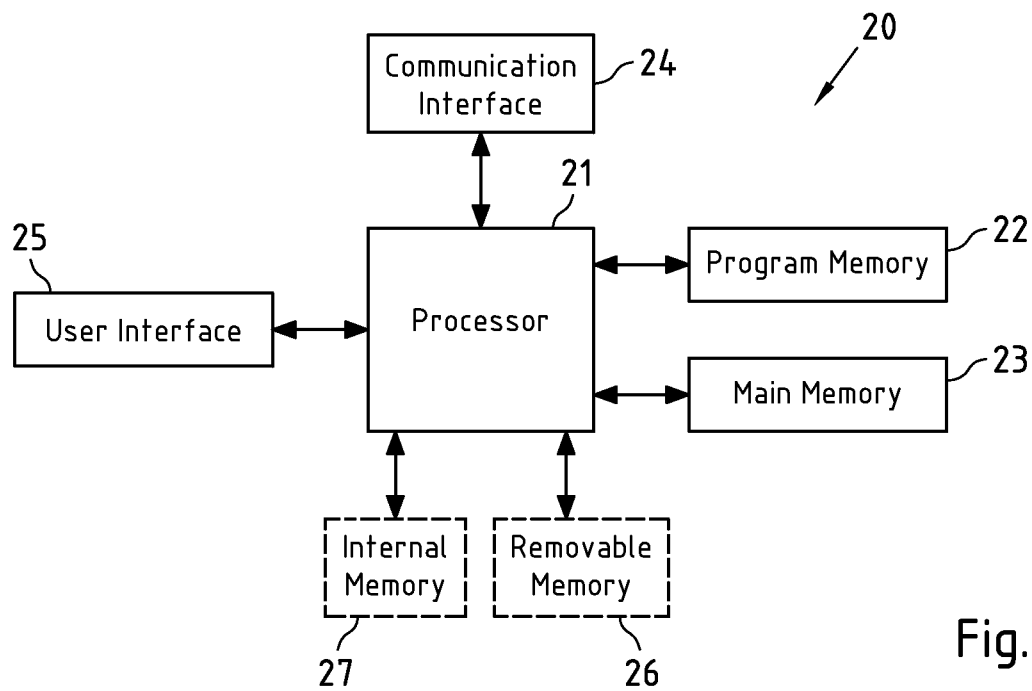


Fig.2

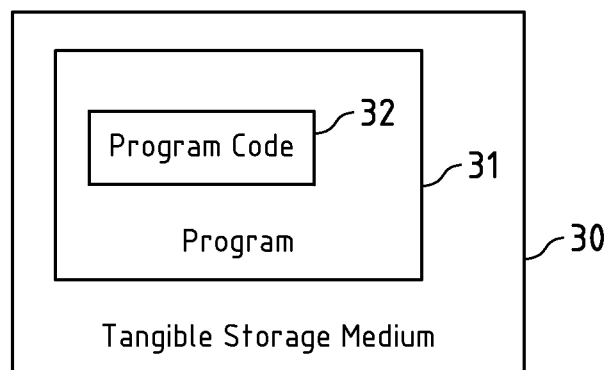


Fig.3

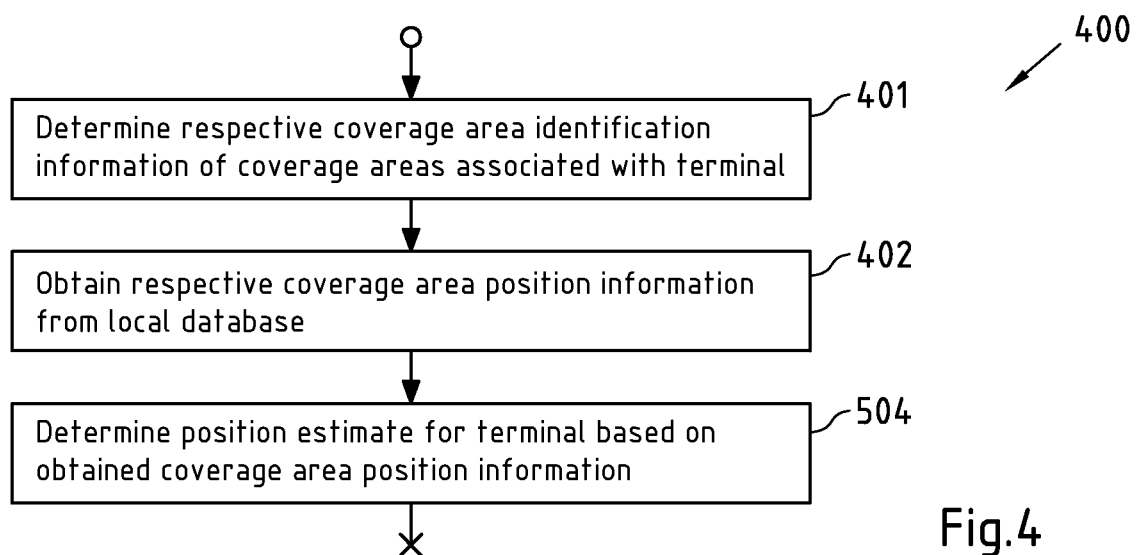


Fig.4

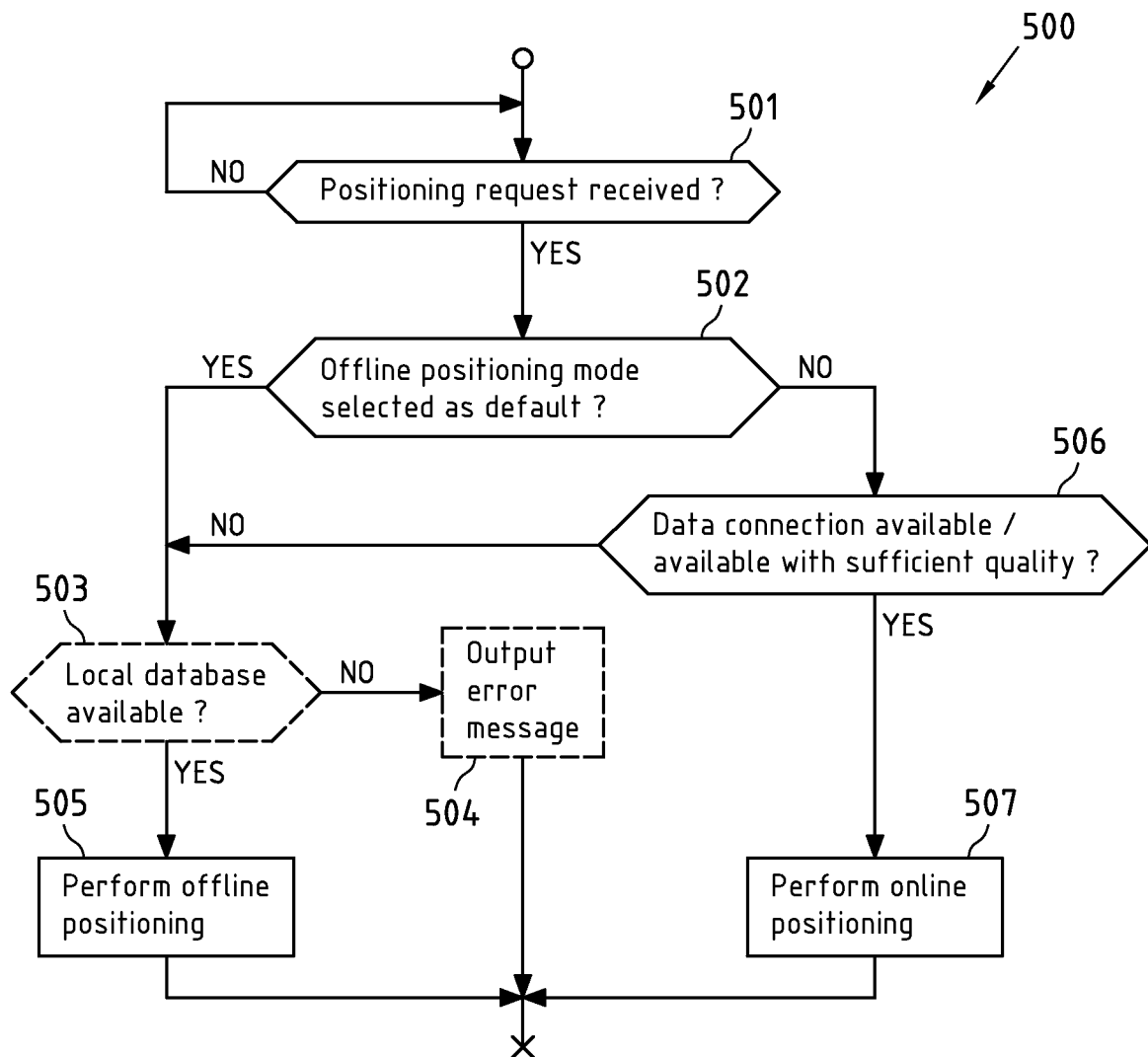


Fig.5a

4/6

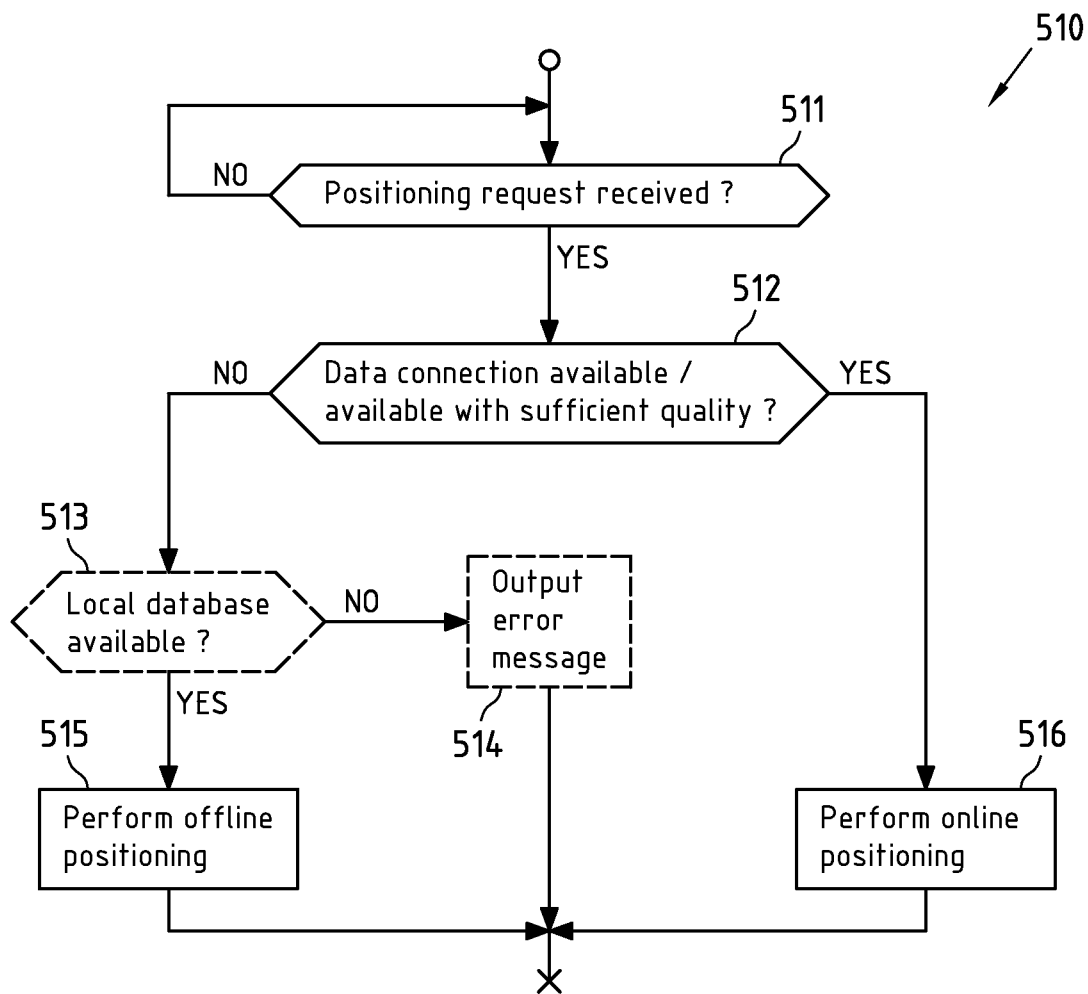
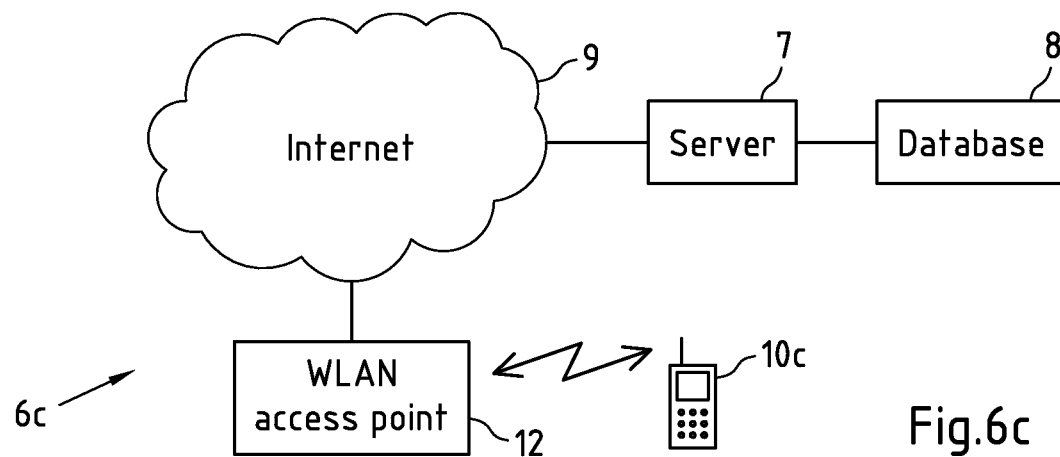
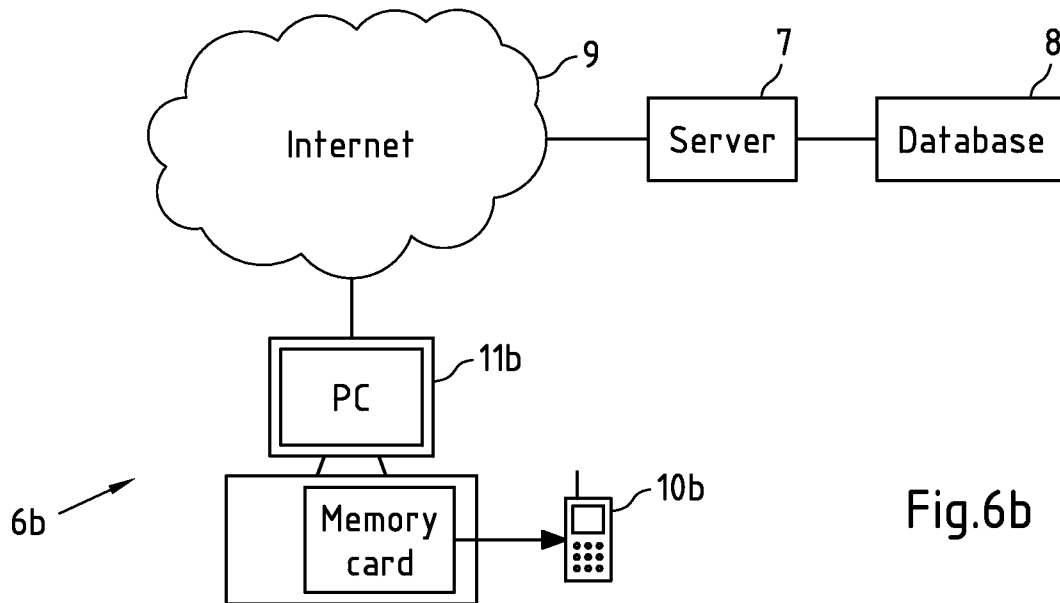
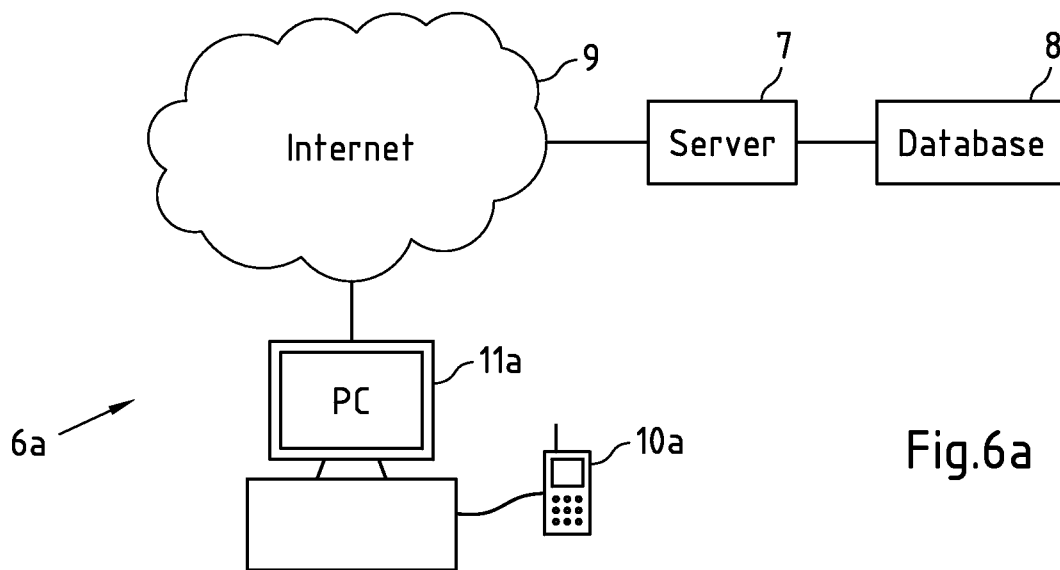


Fig.5b

5/6



6/6

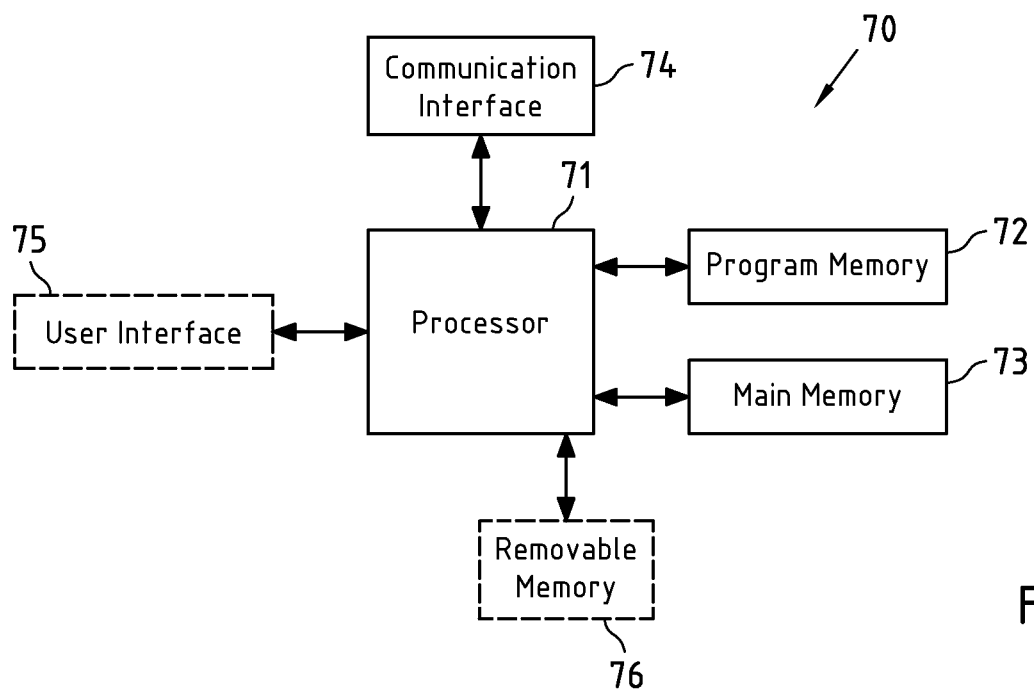


Fig.7

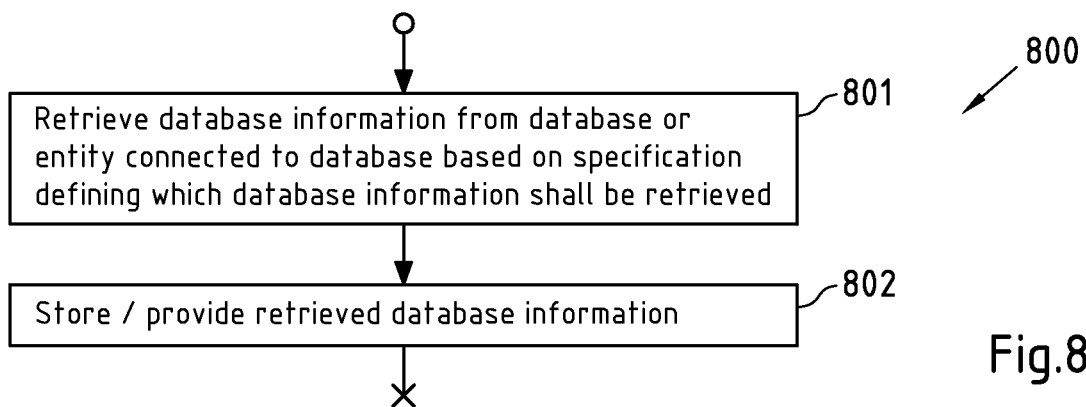


Fig.8

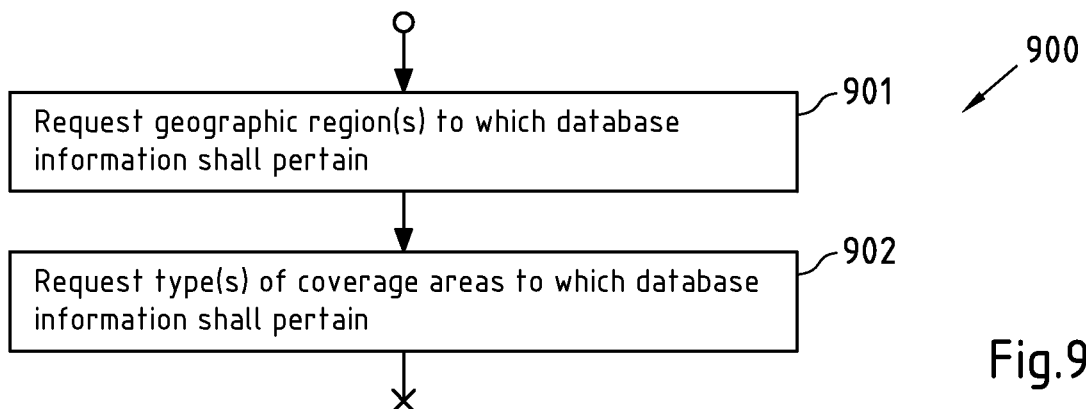


Fig.9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB20 11/055577

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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: G01 S, G06F, H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

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

EPO-Internal, WPI, INSPEC, XPESP, XPESP2, XPIEE, XPI3E

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 201 0 10 1551 A 1 (NOKIA CORP et al.) 10 September 201 0 (10.09.201 0) p. 1, lines 8-16; p. 31, lines 1-15; p. 31, line 22-p. 32, line 11; p. 32, line 24-p. 33, line 5; p. 33, line 30-p. 34, line 9; Figs. 4-5	1-22, 27-35
X	WO 201 1135406 A 1 (NOKIA CORP et al.) 03 November 201 1 (03.11.201 1) p. 1, second par.-p. 3, last par.; p. 23, last par.-p. 24, third par.; p. 27, third-fifth par.; p. 37, last par.-p. 38, first par.; p. 38, third par.; p. 41, third par.-p. 42, second par.; Figs. 1-2	1, 22-31, 34-36
X	US 2007258421 A 1 (ALIZADEH-SHABDIZ, F et al.) 08 November 2007 (08.11.2007) par. [0014], [0024], [0044]; Fig. 1	1, 22, 27-31, 34-35



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

07 September 201 2 (07.09.201 2)

Date of mailing of the international search report

20 September 201 2 (20.09.20 12)

Name and mailing address of the ISA/FI

National Board of Patents and Registration of Finland
P.O. Box 1160, FI-00101 HELSINKI, Finland

Facsimile No. +358 9 6939 5328

Authorized officer

Ville Mottonen

Telephone No. +358 9 6939 500

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB201 1/055577

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group 1. Claims 1-21, 28-29 (partly) and 30-33 relate to the subject matter (terminal positioning) where the position of a terminal is determined by determining identification information of coverage areas associated with the terminal and by using coverage area position information obtained from terminal's database based on the identification information.

Group 2. Claims 22-27, 28-29 (partly) and 34-36 relate to the subject matter (information retrieval) where coverage area identification information and respective coverage area position information for specified coverage areas is retrieved from a database (other than terminal's database) and then stored or provided.

The claims of group 1 and group 2 do not solve the same problem, and they do not have any common special technical features over the prior art.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB20 11/055577

CLASSIFICATION OF SUBJECT MATTER

Int.Cl.

H04W 64/00 (2009.01)

G01S 5/02 (2010.01)

G01S 1/08 (2006.01)

G01S 5/12 (2006.01)

G06F 17/30 (2006.01)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB20 11/055577

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
WO 201 0 10 1551 A 1	10/09/201 0	EP 2404439 A 1 US 201 13 19097 A 1	11/01/201 2 29/1 2/201 1
.....			
WO 201 1135406 A 1	03/1 1/201 1	None	
.....			
US 2007258421 A 1	08/1 1/2007	US 201 2 196621 A 1 US 201 1164522 A 1 US 20091 54371 A 1 KR 20090008465 A WO 20071 33967 A2 JP 2009536808 A EP 2022278 A2 CA 2651 853 A 1	02/08/201 2 07/07/201 1 18/06/2009 21/01/2009 22/1 1/2007 15/1 0/2009 11/02/2009 22/1 1/2007
.....			