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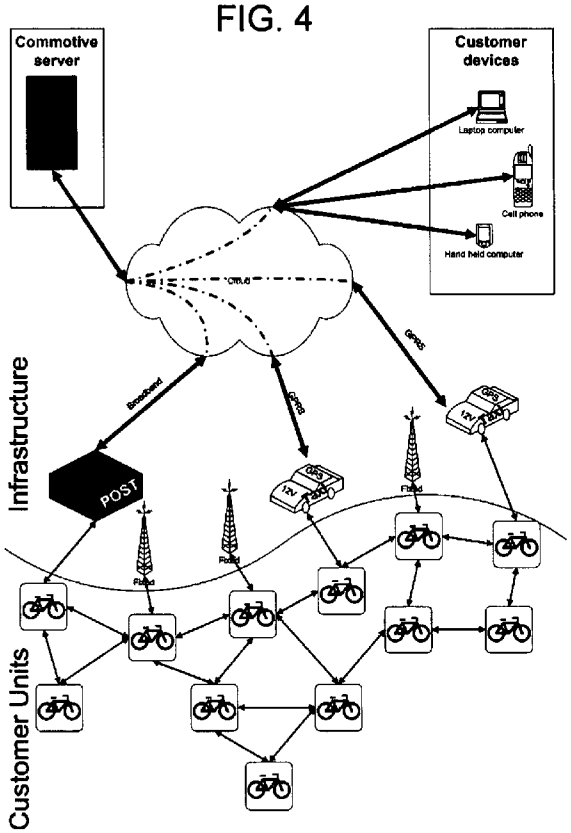
(54) Title: A TRACKING SYSTEM AND A METHOD OF TRACKING AN ITEM

FIG. 4



(57) Abstract: The invention relates to a tracking system comprising a plurality of portable marking units, at least one position data element, at least one data transfer element and at least one central processing server. The marking units comprise each an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data. The marking units comprise a standard mode in which mode they are arranged to automatically communicate with each other when within a predetermined distance d1 from each other. The position data element comprises a transmitter for wireless transmitting a position data to any of the marking units which are within a predetermined distance d2 from the position data element. The data transfer element comprises a receiver for wireless receiving data transmitted from any of the marking units which are within a predetermined distance d3 from the data transfer element, and a transmitter for transmitting the data to the central processing server. The central processing server comprises a processing unit for processing the received data to extract data related to at least one historical position of a selected marking unit. The position data element and the data transfer element may be integrated with each other.

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A TRACKING SYSTEM AND A METHOD OF TRACKING AN ITEM

TECHNICAL FIELD

The invention relates to a tracking system which can be used for tracking a plurality of objects. The tracking system may for example be useful for tracking one or more items for example for tracking lost or stolen items as well as for tracking living objects such as pets or children.

BACKGROUND ART

Several types of systems for tracking desired items are known in the art. An example of such a tracking system is described in US 7081818. This tracking system uses RFID (radio frequency identification) tag technology to facilitate the identification and tracking of items in an environment through a technique known as shadowing. As an object or target moves within a pre-described detection zone with communication antenna and RFID sensors, the object or target blocks the line of sight between respective antenna and sensors, preventing electromagnetic coupling between the sensor and the antenna and thus casting an electromagnetic shadow along the line of sight. These types of systems are useful as anti-theft systems in warehouses or similar shopping areas where the detection zone is limited and well defined. A similar system particular useful for tracking persons within a known location or assets in a warehouse is described in US 7005968. This tracking system is associated with radio frequency identification and radio frequency data communication (RFID/RFDC) devices and RF tags at known locations. The RFID/RFDC devices interrogate the RF tags and receive response signals from RF tags within range. This information may then be sent to a host computer which can, among other things, locate and track the assets. The RFID/RFDC devices are placed at known locations. The RFID/RFDC devices interrogate the RF tags and receive response signals, which are sent to a host computer which may then determine, locate, and track the assets.

US 2004/0084525 describes a tracking system and method for providing a more deterministic method of tracking objects. The system uses a plurality of smart monitors in combination with a plurality of passive tags that can be inductively coupled to the monitors to pass identification signals between the two. The monitors are also linked to a communication network, in particular a wireless peer-to-peer communication network, providing direct peer-to-peer communication across the network and access to one or more central databases that contain information related to the identification tags. Therefore, network coverages and capabilities are leveraged to provide for larger coverage areas to track and search for objects, to make searching quicker by communicating directly with other monitors, and to allow users of the system to initiate and control searches.

Tags are associated with objects, and the objects can be associated with an owner or with one or more monitors. In addition, rules to control the tracking and locating objects are provided for each object and are stored in a database for reference by one or more monitors. As objects that contain identification tags pass by monitors, the monitors receive signals from the identification tags and log the receipt of these signals and any information provided by the signal. Tracking of an object is accomplished by contacting one or more monitors and checking for receipt of a signal from a particular identification tag by the contacted monitors.

Alternatively, signal receipt and the information provided by the signal can be forwarded to and stored in the central databases accessible through the network. Any monitor having access to the network can then access a central database and look for any information about an identification tag and the object to which that tag is attached. In addition to general information about tags, objects, and owners, the database may contain a series of policies associated with each tag. These policies include protocols to be followed to search for particular tags including parameters for determining when an object is lost, a list of monitors to contact when searching for an object, and reporting requirements for lost objects.

DISCLOSURE OF INVENTION

The object of the present invention is to provide a new and effective tracking system, which simultaneously is relatively inexpensive.

The object of the invention is achieved by the invention as defined in the claims and as described in the following.

The tracking system of the invention comprises a plurality of portable marking units, at least one position data element, at least one data transfer element and at least one central processing server.

A core element of the invention is that the marking units can communicate with each other which thereby intensify the tracking of the individual marking units and thereby the items onto which they are fixed. A particular beneficial function of the tracking system of the invention is thus that in practice the more items that are marked with a marking unit the better and faster the tracking system works. Furthermore the tracking system may provide historical information about movement of an item (a historical log) with a marking unit (also called a target item). As it will be explained further below, the system may not necessarily provide the exact present position, but due to a historical log of the target item, the target item may be located to be within a limited area.

The market units may for cost reasons preferably be free of any active position data elements comprising a position data reader as defined below. Furthermore for cost reasons it is desired that the market units has a maximum transmitting and receiving range which does not exceed a selected range, such as up to about 5 Km, for example a maximum transmitting and receiving range of 2 Km, 1 Km or even 500 m or less.

The term "item" is used herein to denote anything onto which a marking unit can be fixed or into which a marking unit can be incorporated for example any dead items but also living objects, such as children, pets and other.

The marking units may be any kind of units, usually electronic units which are capable of communicating with each other. In order to facilitate the communication it is generally desired that the marking units have some kind of energy supply. The energy supply unit may be an integrated part of the respective marking units e.g. in the form of a battery or it may be an energy supply unit in the form of an energy supply connection to an external energy source e.g. to withdraw energy from the item onto which it is fixed.

In one embodiment at least one of said marking units comprises at least one of a battery, a dynamo, a sun cell and a fuel cell. Any kind of battery which can supply the sufficient amount of energy supply for performing the desired functions of the marking units may be used. Such batteries are generally known in the art and will not be described in further detail herein.

In one embodiment it is desired that the battery is kept relatively small. Simultaneously it is desired that the battery have a long lifetime. The selection of the battery in this embodiment will therefore often be a compromise between size and capacity. Preferably the battery should have a capacity of at least about 100 mAh (milli Ampere hours), such as at least about 1000 mAh. If for example we consider providing a marking unit to send and receive 500 bytes per minutes, we estimate that it uses about 40 mA for sending and about 40 mA for receiving. Based on this we can calculate that the marking unit will have a lifetime of about 2.1 years. For some uses this will be sufficient, for other uses a larger battery, a regenerable battery or a changeable battery will be necessary.

The marking units comprise a standard mode in which mode they are arranged to automatically communicate with each other when within a predetermined distance d1 from each other and they comprise each an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data.

Standard mode means "mode of operation". The marking units may additionally comprise one or more other modes of operations which may be

activated e.g. by data received by the respective marking units, by a time setting (pre-programmed), or by other means. For example the marking units may individually of each other comprise a saving mode with low activity, a sleeping mode with substantially no activity and an alerted mode with increased activity.

The memory element of the respective marking units may be any kind of element capable of storing electronic data. As examples can be mentioned a memory element comprising at least one of an integrated circuit, an SOI (silicon on insulator) layer, a magnetic storing element, digital storing element and an electronic printed circuit board.

In one embodiment the memory element is readable and writable.

The capacity of the memory element may in principle be as large as desired, but due to cost and size optimization it is generally desired that the storing capacity of the memory element is not too large compared to the desired function of the marking units.

In one embodiment it is desired that the memory element has a capacity of at least about 10 bytes, such as at least about 128 Kbytes, such as at least up to about 1 Mbyte (mega byte). In a desired embodiment the memory element has a capacity of from about 8 Kbytes to about 256 Kbytes, such as from about 32 Kbytes to about 64 Kbytes, such as at least up to about 10 Gbytes.

It should be observed that the various marking units of the system may be identical or may differ from each other. The various marking units of the tracking system may thus have different or equal memory capacity.

The identification code may be any kind of code which can be stored in the respective marking units e.g. in their memory element. The identification code may preferably comprise a combination of numbers and/or characters. In one embodiment the identification code is a unique combination of numbers and/or characters. The identification code may be an integrated

part of the respective marking units or it may be a code which is programmed into the marking unit e.g. by the user.

The identification code may preferably comprise a unique code for the specific unit. Additionally or alternatively the identification code may comprise a group code, such as a group code indicating the type/group of unit or a type/group element to which the unit is fixed or is adapted to be fixed.

In one embodiment the identification code is an RFID code having a unique number, or combination of numbers and characters, that identify a specific item. The RFID code may be stored in the marking units. EPCglobal is an organisation involved with the issue and coordination of RFID codes referred to as Electronic Product Code (EPC). The EPC may be stored on a radio frequency identification (RFID) tag.

The marking unit receiver may be any kind of receiver capable of receiving the transmitted signals.

In one embodiment the marking unit receiver is arranged to receive electromagnetic waves and being connected to or comprises an antenna for receiving electromagnetic waves, said marking unit receiver preferably being adjusted to receive electromagnetic waves of a predetermined wavelength, said predetermined wavelength preferably being in the non visible range, more preferably in the range having a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves. The antenna may e.g. be PCB antenna.

The marking unit receiver of the respective marking units may be arranged to be activated for receiving electromagnetic waves continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data. As explained above the marking units may comprises two or more modes of operation.

In one embodiment the marking units is activated to shift mode of operation by a received signal, which shift of mode includes a shift of receiving activating pattern.

The predetermined wavelength preferably is a wavelength below 300 THz, such as preferably below 30 THz, such as preferably below 30 THz, such as preferably at least 30 Hz, such as preferably within the range of an ISM band.

In principle the predetermined wavelength may be any wavelength; however the use of some wavelengths requires specific approval in a country by country basis.

The ISM bands are defined by the ITU-R in 5.138, 5.150, and 5.280 of the Radio Regulations. Because communication devices using the ISM bands must tolerate any interference from ISM equipment, these bands are typically given over to uses intended for unlicensed operation, since unlicensed operation typically needs to be tolerant of interference from other devices anyway. In the United States of America ISM uses of the ISM bands are governed by Part 18 of the FCC rules, while Part 15 Subpart B contains the rules for unlicensed communication devices, even those that use the ISM frequencies. Thus, designers of equipment for use in the United States in the ISM bands should be familiar with the relevant portions of both Part 18 and Part 15 Subpart B of the FCC Rules

As example of other useful wavelengths are Wireless LAN usages such as Bluetooth: 2450 MHz band; HIPERLAN: 5800 MHz band; IEEE 802.11: 2450 MHz and 5800 MHz bands.

Based on international frequency regulation it is believed that the frequency from 1 to 900 MHz, such as 433 MHz may be a good choice which can be accepted in most countries for use in the tracking system of the invention

The marking unit transmitter may be any kind of receiver capable of receiving the transmitted signals.

In one embodiment the marking unit transmitter is arranged to receive electromagnetic waves and being connected to or comprises an antenna for transmitting electromagnetic waves, said marking unit transmitter preferably being adjusted to transmit electromagnetic waves of at least one predetermined wavelength, said predetermined wavelength(s) preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves. The antenna may e.g. be PCB antenna.

The predetermined wavelength transmitted preferably is as described above.

In this connection it should be observed that higher frequency requires higher power than lower frequencies. For example a 433 MHz transmission requires less than 1 milliwatt for a 100 meter communication whereas a 915 MHz transmission requires about 100 milliwatt.

The choices of frequency also influence the communication range. In one embodiment the marking unit transmitter and the marking unit receiver transmit and receive signals at two or more wavelengths.

The transmitter is preferably an electronic device which with the aid of an antenna propagates an electromagnetic signal such as radio waves.

The transmitter may preferably comprise an oscillator, a modulator, and amplifiers for the desired frequencies.

In one embodiment the marking unit transmitter transmits a marking unit signal comprising the identification code. The marking unit transmitter may preferably transmit said marking unit signal continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data.

The predetermined scheme (e.g. pre programmed) may be dependent on the time (day/night and etc.), on number of received signals, on a selected

setting and/or other regulation factors. For example the transmission rate may increase with decreasing number of received signals and vice versa.

In one embodiment the marking units is activated to shift mode of operation by a received signal, which shift of mode includes a shift of transmission pattern.

The marking unit transmitter and the marking unit receiver may for example be combined in a transceiver.

In one embodiment the transceiver is a 802.15.4 transceiver operating according to IEEE standard 802.15.4, the transceiver preferably being connected to an antenna or being integrated with an antenna. The antenna may e.g. be PCB antenna.

The marking unit may in one embodiment comprise at least one crystal, such as a crystal connected to or being an integrated into the receiver, the transmitter and/or the transceiver.

In one embodiment the marking units are chips, preferably in the form of active RFID (Radio Frequency Identification Devices) tags.

Such RFID are known in the art and may be mass produced. The RFID produced today do not comprise a marking unit receiver, however all the active RFID which are known today may be used in the present invention provided that they are modified to comprise such marking unit receiver and optionally other elements as defined herein.

The tracking system may comprise as many marking units as desired. As indicated above the number of items carrying a marking unit increases the functionality of the tracking system of the invention. In other words - the more the better. The system should thus preferably comprise at least 10 marking units, such as at least about 100 marking units, such as at least about 1000 marking units, such as at least about 1 million units. In practice the tracking system may comprise many millions of marking units.

The marking units should preferably be arranged to communicate with each other using their respective transmitters, receivers and/or the transceiver e.g. using electromagnetic waves e.g. the wavelength as described above.

In one embodiment the marking units are arranged to communicate with each other using Bluetooth technology.

Bluetooth is an industrial specification for wireless personal area networks (PANs). Bluetooth provides a way to connect and exchange information between devices such as mobile phones, laptops, PCs, printers, digital cameras, and video game consoles over a secure, globally unlicensed short-range radio frequency. The Bluetooth specifications are developed and licensed by the Bluetooth Special Interest Group (SIG).

The marking units may e.g. be arranged to automatically communicate with each other when they are within a predetermined distance d1 from each other, wherein the distance d1 preferably is up to about 5000 m, such as up to about 500 m, such as at least about 1 m.

The distance d1 may vary from marking unit to marking unit. The transmitting marking unit is the one which sets the distance limitation.

In one embodiment the marking units in their standard mode are arranged to automatically communicate with each other when within a predetermined distance d1 from each other, wherein the distance d1 is larger for communication between two or more of the marking units than for communication between to or more other of the marking units.

Generally it is believed that the optimal distance d1 is within about 5 to about 100 m, however depending on the system, the use of the system and the number of marking units which in average will be within a specific area, e.g. per square Km.

If the tracking system e.g. is to be used in an amusement park to track individual children (each child carries one marking unit) the transmission distance d1 may preferably be about 1- about 10 meters.

If the tracking system e.g. is to be used to track items such a bicycles, cars and/other belongings e.g. to prevent theft, the transmission distance d1 may preferably be about 10 meters or more.

In one embodiment the receiving marking units are capable of determining the distance and/or the direction to the transmitting marking unit. This function may e.g. be provided by the marking unit comprising two marking unit receivers placed with a distance or the item is marked with two marking units placed with a distance. The optimal distance may be dependent on the transmitting wavelength(s).

In one embodiment the marking units may in their standard mode be arranged to automatically communicate with each other when they are within a predetermined distance d1 from each other, wherein the distance d1 is individually adjustable. The distance d1 may be adjustable e.g. by changing the transmitting wavelength, the power supplied and/or other adjusting factors.

The tracking system comprises in one embodiment two or more different groups of marking units, where the groups differs in at least one feature, e.g. in their operation modes, in their memory capacity, in their battery capacity, in their transmission length, in the design and/or other features.

In one embodiment at least one of the marking units comprises a level sensor, arranged to determine if the marking unit is in motion. Such level sensors are well known and the skilled person will be able to select a usable level sensor.

For optimizing the systems capability to determine the historical positions or even actual position for a specific marking units it is desired that at least one of the marking units comprises a timekeeping element, such as a timepiece

or a clock, e.g. an oscillator based timekeeping element. The transmitted data may accordingly also comprise data related to time.

The timepiece may for example be a mechanical or electronic device measuring consecutive intervals of time. The clock may for example be a computer which keep time with a quartz crystal, but are periodically (usually weekly) synchronized over the internet to atomic clocks (UTC), using a system called Network Time Protocol. In one embodiment the clock is a radio clock which keep time with a quartz crystal, but are periodically (often daily) synchronized to atomic clocks (UTC) with time signals from government radio stations like WWV, WWVB, CHU, DCF77 and the GPS system.

The tracking system of the invention may additionally comprise a plurality of track units, each track unit comprises an energy supply unit, and a transmitter for wireless transmitting data, each track unit does not comprise an active memory.

The term "track unit" is used to denote a unit which is as the marking unit described herein with the difference that it does not comprise an active memory. Accordingly the track unit will typically be a one-way communication unit and only transmit data, such as its identification code and optionally position data and/or time data.

Accordingly the track units preferably comprises each an identification code, said identification code preferably comprises at least one of a unique code for the specific unit and a group code indicating the type/group of unit or a type/group element to which the unit is fixed.

The tracking system comprises a position data element and a data transfer element as mentioned above. The position data element comprises a transmitter for wireless transmitting a position data to any of said marking units which are within a predetermined distance d2 from said position data element, and the data transfer element comprises a receiver for wireless receiving data transmitted from any of said marking units which are within a

predetermined distance d3 from said data transfer element, and a transmitter for transmitting said data to said central processing server.

The position data may be any data providing information relating to position e.g. a geographical position e.g. in the form of coordinates in a geographic coordinate system.

The position data element and data transfer element may be integrated to a position data and transfer element. The tracking system of the invention may comprise a combined position data and transfer element in combination with an individual position data element and/or an individual data transfer element.

In one embodiment the position data element is a stationary element and comprising position data including its stationary position optionally in the form of a code and/or data stored in a memory. The position data element may e.g. be positioned at a gas station or at similar position where passing of target items may be expected.

In one embodiment the position data element is a non-stationary (movably) element and comprising position data reader.

In one embodiment the position data element is movable and comprises a distance counter, determining the distance travelled within a selected period.

In one embodiment the position data element comprises a position data reader capable of determining the position of said position data element, said position data reader preferably being selected from the group consisting of satellite position systems (GPS (Global Position System), Galileo, GLONASS, triangulation systems using wireless network and gyroscopes.

Gyroscopes are e.g. described in the gyrocompass navigation system disclosed in US 4693114 and/or in US 6185502.

In one embodiment the position data element comprises a GSM (Global System for Mobile communications) unit.

In one embodiment the position data element comprises a timekeeping element, e.g. as described above.

In one embodiment the position data element transmits the position data using a position data element transmitter comprising or being connected to an antenna for transmitting electromagnetic waves, said position data element preferably being adjusted to transmit electromagnetic waves of at least one predetermined wavelength, said predetermined wavelength(s) preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

The predetermined wavelength transmitted preferably is as described above.

The transmitter may also be as above.

In one embodiment the position data element transmits said position data signal continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data e.g. as described above for the marking unit transmitter.

The predetermined distance d2 may e.g. be as described for the distance d1 above. The distances d2 and d1 may be equal or different from each other.

In one embodiment the position data element comprises a memory.

In one embodiment the position data element comprises an identification code, said identification code preferably comprises at least one of a unique code for the specific unit and a group code indicating the type/group of unit or a type/group element to which the unit is fixed.

In one embodiment the position data element is as a marking unit as described above with the difference that it additionally comprises position data e.g. by being in a fixed position and/or by comprising a position data reader.

In one embodiment the data transfer element receiver comprises an antenna for receiving electromagnetic waves, said transfer element receiver preferably being adjusted to receive electromagnetic waves of a predetermined wavelength, said predetermined wavelength preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

The predetermined wavelength transmitted preferably is as described above.

The data transfer element receiver is arranged to receive the signal transmitted from the marking units which are within a predetermined distance d3 from said data transfer element. The distance d3 may be equal or different from any one of d2 and d1. In one embodiment the predetermined distance d3 is between about 50 and about 200 % of the predetermined distance d1. In one embodiment the predetermined distance d3 is essentially equal to the predetermined distance d1.

In one embodiment the data transfer element transmitter is a wireless transmitter, said wireless transmitter preferably being transmitting by telecommunication, preferably selected from the group consisting of radio signals such as blue tooth; microwave signals; infrared light; visible light; ultraviolet light; laser light; and acoustic waves.

In one embodiment the data transfer element transmitter is a wired transmitter. The selection between a wired transmitter and a wireless transmitter depends among others on the position of the data transfer element. Often it is desired to use a wired transmitting system for fast and reliable transmission of larger amount of data.

In one embodiment the data transfer element comprises all the function of a marking unit, an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data.

The central processing server comprises a processing unit for processing the received data to extract data related to historical positions of a selected marking unit.

The central processing server may further be programmed to present the historical position data of a target item in any way e.g. on a map or by a list of latest registered positions.

In one embodiment the central processing server is a server. The server preferably is connected to the Internet, such that data related to historical positions of a selected marking unit can be obtained via the internet optionally protected by a pass word.

In one embodiment the central processing server comprising a billing unit for directly billing the users over the internet. For example a user may buy or renew subscription to one or more marking units over the internet, he may make a call for historical positions of one or more of his marking units, and/or report an item with a marking units stolen and he may for example pay for this service over the internet.

The user of the system may thus follow and/or track the positions of his own marked items via the internet. In practice the user may buy one or more marking units in a store and via the internet he can activate the marking units and e.g. simultaneously select password, identify the items marked with the marking units, register the marked items and/or other. He may also via the internet call a search for a lost target item.

The number of position data elements may be as high as desired but generally the number of position data elements is less than the number of

marking units, such as up to about 1 %, such as up to about 0.1 % of the number of marking units.

In one embodiment the tracking system comprises a plurality of position data elements, such as at least 5, such as at least about 100, such as up to about 50000 or more.

The number of data transfer elements may be as high as desired but generally the number of position data elements is less than the number of marking units, such as up to about 1 %, such as up to about 0.1 % of the number of marking units.

In one embodiment the tracking system comprises a plurality of data transfer elements, such as at least 5, such as at least about 100, such as up to about 50000 or more.

In one embodiment the tracking system comprises at least one stationary data transfer element and/or at least one stationary position data elements.

In one embodiment the tracking system comprises at least one movably data transfer element and/or at least one movably position data elements.

The term 'movable' means that the movable unit can be moved by itself or by other means without this movement destroying the movable element. The movable element need not be moved.

In one embodiment the tracking system comprises at least about 100 portable marking units, a plurality of position data elements, a plurality of data transfer elements and at least one central processing server.

In one embodiment the tracking system comprises a plurality of stationary data and transfer elements, a plurality of movably data transfer elements and at least one central processing server.

The marking units may have any design and shape. Preferably the marking units are relative small and easy to handle. In one embodiment the marking units are arranged to be fixed to a desired item, e.g. by adhesive, by a clips arrangement, by a needle or by other fixing arrangement. In one embodiment the marking units are arranged to be fixed to a desired item by being integrated with said item e.g. during production of the item. The item may e.g. be a biker seat and the marking unit is integrated into the biker seat.

In one embodiment at least one of said position data elements and/or at least one of said data transfer elements are fixed to or are arranged to be fixed to a movable item, such as a vehicle e.g. a car.

In one embodiment wherein said marking units communicate with each other when they are in their standard mode and are within a predetermined distance d1 from each other, the communication comprises transmitting from a transmitting marking unit to a receiving marking unit the identification code of the transmitting marking unit and a predetermined amount of data stored in the memory of said transmitting marking unit, at least a part of said transmitted data being stored in the memory of said receiving marking unit.

The transmitted data may in principle include all kind of electronic data, including but not limited to position data, time data, direction data, owner data, item type data, velocity data, and other data.

In one embodiment the communication between two marking units comprises a two way communication where both marking units are transmitting and receiving data from each other. If for example two marking units are placed on respective bicycles, and the bicycles are passing each other, the two marking units communicates by transmitting data to each other including at least their identification code.

In one embodiment the transmitted predetermined amount of data stored in the memory of said transmitting marking unit, comprises the data most recently received from other elements of the tracking system, wherein the

other elements of the tracking system comprise other marking units, the position data element(s) and the data transfer element(s).

In one embodiment the transmitted predetermined amount of data stored in the memory of said transmitting marking unit, comprises primarily data which has been marked a first priority and secondarily the data most recently received from other elements of the tracking system, wherein the other elements of the tracking system comprise other marking units, the position data element(s) and the data transfer element(s).

In one embodiment the position data element further can transmit a call for a selected marking unit via its identification code, data relating to said selected marking unit thereby becomes first priority data. Such first priority data may receive a higher range and may be transmitted with a higher priority than other stored data in the memory unit. The stored data may preferably be administrated by a first in- first out rule, whereas priority date may remain stored for longer time in the memory of the marking unit than non-priority data.

In one embodiment the transmitted predetermined amount of data stored in the memory of said transmitting marking unit, comprises the data received from at least 1, such as at least 2, such as from 2 to about 100 received transmissions obtained from other elements of the tracking system which have been within the predetermined distance d1 of the transmitting marking units.

In one embodiment data received from at least 1 element of the tracking system comprises identification code of said other element(s) of the tracking system, data relating to the time at which the data was sent from said other element(s) of the tracking system, and optionally position data.

In one embodiment data received from at least 1 element of the tracking system comprises substantially all the data transmitted from said other element(s) of the tracking system.

In one embodiment the transmitted predetermined amount of data stored in the memory of said transmitting marking unit comprises a selected amount of bits which in principle may be as large as desired e.g. from 1 bit to about 200 kbits, such as from 2 bits to about 100 bits.

As described above the transmission of data and/or activation for receiving data by the marking units, other units (e.g. track units), the elements and/or the central processing server may be continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data.

In one embodiment at least one of the marking units, preferably all of the marking units are arranged to transmit data at least partly in dependence of received data. In the same or in another embodiment at least one of the marking units, preferably all of the marking units are arranged to be activated for receiving data at least partly in dependence of received data.

In one embodiment at least one of the marking units, preferably all of the marking units are arranged to have an alert mode with a higher frequency than in its/their standard mode. A marking unit may e.g. be activated to its alert mode if a search has been called for the marking units, e.g. if the item on which it is placed is stolen, lost or wanted for other reasons.

In one embodiment the marking units are arranged to have a power saving mode. In the power saving mode the marking units may e.g. transmit data with about 1 to about 1000 transmissions per hour and are activated to receive data continuously or in intervals with up to about 100 seconds, and with intervals of about 2 minutes to about 1 hour.

In one embodiment of the power saving mode, the marking unit is activated to receive and/or transmit data with a lower frequency than in a standard mode.

In one embodiment at least one, such as at least two of the marking units, preferably all of the marking units are arranged to have a power saving

mode, in which power saving mode they preferably are arranged to receive and/or transmits data with a predetermined pattern. The power saving mode may preferably be activated and deactivated according to a pre programmed schedule, by received data and/or by a level sensor in the respective marking units.

In one embodiment at least one, such as at least two of the marking units, preferably all of the marking units are arranged to have a power saving mode, which power saving mode is activated and deactivated according to a pre programmed schedule, e.g. in relating to a 24 hour circle, in dependence on battery power left and/or in relating to a termination date.

In one embodiment the marking unit(s) are arranged to have a first power saving mode S1 where they transmit data with a higher frequency than the frequency at which they are activated for receiving data. Preferably each marking unit in the first saving mode S1 transmits data with a frequency of for example from about 1 transmission per 1 second to about 1000 seconds, such as about 1 transmission per 1 second to about 100 seconds, and it is activated for receiving data for up to for example about 100 seconds at intervals of about 0.2 to about 5 hours, such as at intervals of about 0.5 to about 3 hours.

A marking unit may for example be activated to go into first saving mode S1 when the number of received transmissions from other marking units exceed a pre-selected level (e.g. more than 10 received transmission per minutes), when it receives a specific S1 saving mode signal, when it have communicated with a transfer element and/or by a clock at a pre-selected time. The marking unit may for example be deactivated from first saving mode e.g. to return to standard mode when the number of received transmissions from other marking units go below a pre-selected level (e.g. less than 10 received transmission per hour), when it receives a specific standard mode signal, after having been in the first saving mode S1 or a pre-selected time and/or by a clock at a pre-selected time.

In one embodiment the marking unit is arranged to go into first saving mode S1 when it have received a pre-selected number of transmission from another specific data transmitting unit of the system and/or one or more other specific marking units. The marking unit in question will in this situation be placed together with another specific data transmitting unit of the system and/or the one or more other specific marking units.

In one embodiment the marking units are arranged to have a second saving mode S2 in which they transmit data with a lower frequency than in its standard mode and preferably is activated to receive data in shorter time than in its standard mode.

The marking units may be activated to go into second saving mode S2 the same way as described for the activation to go into first saving mode S1 and it may accordingly also be deactivated the same way as the deactivation from first saving mode S1.

In one embodiment the one or more marking units are activated to go into second saving mode S2 by data received from a transfer element. After having delivered all or a substantially amount of collected data to a transfer element, the marking unit may accordingly go into second saving mode S2. It is thus expected that the marking unit in question mainly will be close to other marking units which are also close to a transfer element and thus can communicate with this transfer element.

In one embodiment each of the marking units is activated to go into its second saving mode by data received from a stationary element.

In one embodiment each of the marking units is activated to go into its second saving mode by receiving a selected saving mode signal.

In one embodiment at least a group of the marking units are arranged to have a third saving mode S3 in which they transmit data with a lower frequency than in their standard mode and preferably being activated to receive data in shorter time than in their standard mode, the group of the

marking units being activated to be in the third saving mode S3 by being physically placed in a group for a selected time.

The marking units may be activated to go into third saving mode S3 the same way as described for the activation to go into first saving mode S1 and it may accordingly also be deactivated the same way as the deactivation from first saving mode S1.

In one embodiment a marking unit in the group of marking units being activated to be in the third saving mode S3 by repeatingly receiving data from at least one other of the marking units, e.g. by receiving a pre-selected number of transmissions from another specific marking unit within a pre-selected time.

In one embodiment where a group of marking units are activated to be in third saving mode S3 the marking units of the group will on shift e.g. in accordance with their activation numbers) enter to a higher activity state for a short period e.g. for 10 to 1000 seconds. The short period with higher activity may e.g. have a length which depends on the number of marking units in the group. The higher activity state may comprise a higher transmission activity and/or a higher activity for receiving transmissions.

In one embodiment the receiver of at least on of the marking units and/or at least one on the position data elements is direction sensitive, said direction sensitive unit being arranged to be placed in/on a vehicle, such as a truck. In this embodiment the tracking system of the invention may further comprises a plurality of track units and/or a plurality of marking units arranged to be placed somewhere on a bicycle and/or a bicyclist, e.g. to be incorporated into a bicycle helmet. The vehicle may accordingly be capable of determinate the position of such bicycle/bicyclist in the traffic and accordingly the risk of accidents, e.g. by right-turning trucks, may be reduced substantially.

In one embodiment the tracking system further comprises a bearing unit comprising a direction sensitive receiver. The bearing unit may preferably comprise a computer unit and a memory for storing identification data.

The bearing unit can be used to locate stolen or loss items comprising a marking unit. Identification codes of marking units which have been called for can be loaded into the memory of the bearing unit so that the bearing unit only reacts to these marking units.

In one embodiment wherein at least one of said position data elements and at least one of said data transfer elements are combined in a position data and transfer element, said combined position data and transfer element is arranged to update and/or correct data in said central processing server on request from the user of said position data and transfer element. The technology which is known in connection with TOMTOM systems can be used accordingly.

In one embodiment the tracking system of the invention can be used in watch of one or more items and/or living objects on a selected field. The system for this used comprises a field set of portable marking units for marking the selected field, a plurality of additional marking units and/or a plurality of track units, least one position data element, at least one data transfer element and at least one central processing server. The respective units and elements may be as described above.

The invention also relates to a method of tracking an item comprising

- providing a plurality of portable marking units, at least one position data element, at least one data transfer element and at least one central processing server;
- marking the target item with at least one of said marking units;
- marking at least one other movably item with at least one of said marking units;
- allowing at least one of said target items and other movably item(s) to move relative to each other to come within a predetermined distance d1 from each other;

- allowing at least one of said target items and other movably item(s) to be or to move within a predetermined distance d2 from said position data element;
- allowing at least one of said target items and other movably item(s) to be or to move within a predetermined distance d3 from said data transfer element; and
- extracting information relating to the position of said target item from said central processing server;

wherein

said marking units comprise each an energy supply unit, at least one memory element, an identification code, and a receiver for wireless receiving data, a transmitter for wireless transmitting data, said marking units comprise a standard mode, in which mode they are arranged to automatically communicate with each other when within said predetermined distance d1 from each other, said position data element comprises a transmitter for wireless transmitting a position data to any of said marking units which are within said predetermined distance d2 from said position data element, said data transfer element comprises a receiver for wireless receiving data transmitted from any of said marking units which are within said predetermined distance d3 from said data transfer element, and a transmitter for transmitting said data to said central processing server, said central processing server comprises a processing unit for processing the received data to extract data related to at least one historical position of a selected marking unit.

The method of the invention preferably comprises providing a tracking system as described above comprising said plurality of portable marking units, said at least one position data element, said at least one data transfer element and said at least one central processing server.

In one embodiment of the method at least one of the marking units, preferably all of the marking units are arranged to have a power saving mode where they are arranged to receive and/or transmits data in a predetermined

pattern, the power saving mode being activated and deactivated according to a pre programmed schedule, by received data and/or by a level sensor in the respective marking unit, and the method comprises

- fixing a stationary element arranged to transmit a selected saving mode signal, said stationary element being fixed at a "home base" at which communication position it is desired that the respective marking unit should go into power saving mode.

In one embodiment of the method at least one of the receivers of at least on of the marking units and/or at least one on the position data elements is direction sensitive, and the method comprises

- fixing said direction sensitive unit in or on a vehicle and
- fixing at least one cyclist marking unit on a bicycle or on another position on a bicyclist (e.g. on a helmet), said cyclist marking unite comprises an identification code comprising type/group data indicating that it is fixed to a bicyclist.

In one embodiment of the method, the system further comprises at least one cyclist track unit comprising a transmitter for wireless transmitting data, wherein at least one of the receivers of at least on of the marking units and/or at least one on the position data elements is direction sensitive, the method comprises

- fixing said direction sensitive unit in or on a vehicle and
- fixing at least one cyclist track unit on a bicycle or on another position on a bicyclist (e.g. on a helmet), said cyclist track unite comprises an identification code comprising type/group data indicating that it is fixed to a bicyclist.

In one embodiment of the method for watching one or more items on a selected field, the method comprises

- providing a tracking system as claimed in claim 80 arranging the field set of portable marking units to cover the selected field (preferably so that all point in the selected field it within a distance d1' from at least one of the marking units of the field set of marking units where d1' is the transmission distance for the one or more additional marking units and/or track units) so that a

communication line between all of the marking units of the field set of marking unit is provided;

- arranging the position data element, to provide the marking units of the field set of marking units with position data,
- arranging the data transfer element and the central processing server so that data from the marking units of the field set of marking units can be transferred to the central processing server; and
- providing the items to be watched with at least one of an additional marking unit and a track unit.

It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other stated features, integers, steps, components or groups thereof.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be explained more fully below in connection with a preferred embodiment and with reference to the drawings in which:

FIG. 1 shows a schematic view of a first tracking system according to the invention.

FIG. 2 shows a schematic example of a dynamic tracking of a target item.

FIGs. 3a and 3b show a schematic view of elements/units of a third tracking system according to the invention.

FIG. 4 shows a schematic view of a fourth tracking system according to the invention.

FIG. 5 illustrates an example of a communication between a marking unit and another element/unit of the system.

FIG. 6 illustrates an example of a communication between two marking units.

FIG. 7 illustrates an example of a communication between elements/marking units of the invention where at least one marking unit go into power saving mode.

FIG. 8 illustrates an example of a power saving mode.

FIG. 9 illustrates another example of a communication between elements/marking units of the invention where at least one marking unit go into power saving mode.

FIG. 10 illustrates a further example of a communication between elements/marking units of the invention where at least one marking unit go into power saving mode.

The tracking system illustrated in FIG. 1 comprises a plurality of marking units B5, B6, including tag marking units B5 adapted to be placed on desired items and tag-chip marking units adapted to be integrated in desired items e.g. during one of its production stages.

The marking units B5, B6 may be as described above and comprise at least an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data.

The tracking system further comprises at least one movably position data element placed in or on a movable vehicle B4, which may e.g. be a taxi, a police car, an ambulance, a post car or other. The position data element may be as described above.

The tracking system further comprises at least one movably combined position data element and data transfer element placed in or on a movable

vehicle B3, which may e.g. be a taxi, a police car, an ambulance, a post car or other. The position data element and data transfer element may be as described above.

The tracking system further comprises at least one stationary combined position data element and data transfer element placed on a stationary site B2 e.g. a gas station, a burger bar, a bridge, a streetlamp or other. The position data element and data transfer element may be as described above. Finally, the tracking system comprises a central processing server B1. The central processing server B1 may be as described above. The data transfer elements placed on the movable vehicle/ stationary site transfer data to the central processing server B1 as illustrated by the arrows A1, where the data is processed and from where data related to historical positions of a selected marking unit can be extracted and presented to the user e.g. as described above

FIG. 2 shows a schematic example of a dynamic tracking of a target item using a tracking system as shown in FIG. 1. As illustrated all the marking units B5, B6 can communicate with each other when they are within a selected distance illustrated with the circular areas D1. Furthermore the marking units B5, B6 can communicate with the other elements B2, B3, B4 of the tracking system and the data transfer element placed on the units B2 and B3 can transfer data to the central processing server B1 e.g. wireless illustrated by the circle D2 or via wire(s).

FIGs. 3a and 3b show a schematic view of elements/units of a third tracking system according to the invention. These shown elements/units may e.g. all be a part of the same tracking system and comprises in this example the following units/elements all comprising individual identification codes:

A plurality of track units B5 each comprising an antenna, a crystal, a battery and a transceiver or a transmitter indicated as a 802.15.4 unit. The transmitter/transceiver is arranged to at least transmit its identification code.

A plurality of track units $B5_{fixed}$ adapted to be temporally or permanently placed at a fixed (preferably known) position and each comprising an antenna, a crystal, a battery and a transceiver or a transmitter indicated as a 802.15.4 unit. The transmitter/transceiver is arranged to at least transmit its identification code and it fixed position.

A plurality of track units $B5_{level}$ each comprising an antenna, a crystal, a battery, a level indicator and a transceiver or a transmitter indicated as a 802.15.4 unit. The transmitter/transceiver is arranged to at least transmit its identification code and data from the level indicator, preferably data showing if the track units $B5_{level}$ is moving or is still.

A plurality of marking units $B5_{power}$ comprising an antenna, a crystal, a battery (12 Volt regulator), a memory and a transceiver indicated as a 802.15.4 unit. The transceiver is arranged to at least transmit its identification code and data from its memory preferably including data obtained from at least one other unit/element from the system which it has communicated with at an earlier point of time.

A plurality of marking units $B5_{can}$ each comprising an antenna, a crystal, a battery (12 Volt regulator), a memory, a transceiver indicated as a 802.15.4 unit and a mileages counter. The transceiver is arranged to at least transmit its identification code and data from its memory preferably including data obtained from at least one other unit/element from the system which it has communicated with at an earlier point of time. The marking units $B5_{can}$ can be used for placing in or on a vehicle e.g. a rental car for counting the units of distance travelled by the vehicle.

A plurality of marking units $B5_{can\text{-}truck}$ each comprising an antenna, a crystal, a battery (12 Volt regulator), a memory, a transceiver indicated as a 802.15.4 unit and a mileages counter. The transceiver is arranged to at least transmit its identification code and data from its memory preferably including data obtained from at least one other unit/element from the system which it has communicated with at an earlier point of time. The marking units $B5_{can}$ can be used for placing in or on a vehicle e.g. a truck for counting. The units of

distance travelled can be automatically be reported e.g. to a selected central. The marking units $B5_{can\text{-}truck}$ further comprises or being linked to a light/sound unit in or on the vehicle. The transceiver comprises a direction sensitive receiver capable of determine if a marking unit or a track unit is close to the right side of the truck. If this is the case the light/sound unit will make a signal to the driver, thereby warning the driver that an item e.g. a bicyclist is on the right side of the truck and right-turning accidents may be avoided. The direction sensitive receiver may e. g. be activated for receiving data (electromagnetic waves) continuously, or it may in a preferred embodiment be activated to be activated for receiving data upon an initial right-turning of the steering wheel and/or when the driver make signal for driving right.

A plurality of movably position data elements B4 each comprising at least one antenna (in the example it comprises two antennas one for the transceiver and one for the GPS), a crystal, a battery (12 Volt regulator), a memory, a transceiver indicated as a 802.15.4 unit and a GPS. The respective position data elements B4 may e.g. be placed in a taxi, a police car, an ambulance, a post car or other. The position data element may be as described above, and may preferably be arranged to transmit data comprising its position continuously or at predetermined intervals, thereby providing passing elements/units of the system with position data.

A plurality of movably position data and transfer elements B3 which is similar to the position data elements B4, but additionally comprises a GSM unit with an antenna, by use of which transfer can be transmitted to the central processing server B1.

A plurality of stationary transfer elements and/or position data and transfer elements B2 each comprising an antenna, a crystal, a battery, and a receiver or a transceiver indicated as a 802.15.4 unit. The stationary transfer elements and/or position data and transfer elements B2 further comprises a LAN unit for transmitting data via the Internet to the central processing server B1. The transceiver/receiver is arranged to receive data from other units/elements of the system and optionally transmitting data including

position data. The LAN unit is adapted to transmit at least a part of the received data to the central processing server B1.

A plurality of movably transfer elements and/or position data and transfer elements B2(POS) which each comprising an antenna, a crystal, a battery, and a receiver or a transceiver indicated as a 802.15.4 unit. The movably transfer elements and/or position data and transfer elements B2 further comprises a GPS unit with antenna and a LAN unit for transmitting data via the Internet to the central processing server B1. The transceiver/receiver is arranged to receive data from other units/elements of the system and optionally transmitting data including position data. The LAN unit is adapted to transmit at least a part of the received data to the central processing server B1.

Finally the system comprises the central processing server B1. The central processing server B1 comprises at least one element/unit for receiving data, e.g. an SMS unit for receiving data via SMS', a E-mail unit for receiving data via E-mails, a WEB unit and/or a LAN unit for receiving data via the Internet. The central processing server B1 may further comprise a billing unit as described above.

FIG. 4 shows a schematic view of a fourth tracking system according to the invention comprising a central processing server (Commotive server), an infrastructure and customer units. The infrastructure comprises movably position data and transfer elements e.g. mounted in taxis, stationary position data and transfer elements e.g. mounted on post boxes and stationary position data elements e.g. mounted on mast senders. The customer units comprise a plurality of marking units e.g. placed on bicycles. In the shown examples the system additionally comprises a plurality of track units e.g. placed on customer devices such as laptop computers, cell phones and/or hand held computers.

FIG. 5 illustrates an example of a communication between a marking unit fixed on a bicycle and a fixed unit/element 52. The bicycle path 51 is placed with a shortest distance of about 10 meters from the fixed unit/element 52. If

the transmission distance of the marking unit is 100 meters and we consider the bicycle to have a velocity of 20 km/h, we can calculate that the fixed unit/element 52 will be within the transmission distance of the bicycle for about 40 seconds. If the marking unit on the bicycle makes one transmission every 8th second, the fixed unit/element 52 should at least receive 5 transmissions from the marking units. If the fixed unit/element 52 transmits with same frequency and transmission length the marking unit will accordingly also receive at least 5 transmissions from the fixed unit/element 52.

FIG. 6 illustrates an example of a communication between two marking units each fixed on a bicycle. The bicycles are driving in opposite directions (as indicated with the arrows) on bicycle patches 61, 62 placed on either side on a road. If the transmission distance of the marking units are 100 meters and we consider the bicycles to have a velocity of 20 km/h, we can calculate that the two marking units fixed on the respective bicycles will be within the transmission distance of each other for about 18 seconds.

FIG. 7 illustrates an example of a communication between elements/marking units of the invention where at least one marking unit go into power saving mode. Only a few elements/units of the system are shown, namely a movably position data and transfer element 71 mounted in a taxi, a stationary position data element 72, a transfer element 73 e.g. mounted on a building and two marking units mounted on respective a first and a second bicycles 74, 75. As indicated on the figure the marking unit on the first bicycle 74 make transmissions with a relatively high frequency e.g. every 8th second, and it may also be activated for receiving data e.g. constantly or for a period of e.g. at least 8 seconds every 25 seconds. The marking unit on the second bicycle has gone into power saving mode and is activated for receiving data for a period of at least 8 seconds every second hours. The marking unit on the second bicycle may for example continue making transmission with a relatively high frequency e.g. every 8th second or it may make fever or even none transmissions in its power saving mode.

FIG. 8 illustrates an example of a power saving mode for a marking unit. The marking unit is activated for receiving data for a period of 8 seconds every second hours (TX period), it is making a transmission every 8th second (RX period).

FIG. 9 illustrates another example of a communication between elements/marking units of the invention where at least one marking unit go into power saving mode. Only a few elements/units of the system are shown, namely a stationary position data element 91 e.g. mounted on a post-box or a building and three marking units mounted on respective a first bicycles 92, 93. As indicated on the figure at least the marking unit on a first bicycle 92 make transmissions with a relatively high frequency e.g. every 8th second. The marking units on all three bicycles have gone into a power saving mode and they are activated for receiving data for a period of at least 8 seconds every second hours only. Thereby - as long as the bicycles are not moved - the marking units on the respective bicycles will every second hour receive at least one signal from the transmitting marking unit(s) on at least the first bicycle 92 and at least one signal from the stationary position data element 91. The marking units on the bicycles may e.g. comprise a level indicator which can sense if the respective bicycle is moved in which situation it may return to standard mode.

FIG. 10 illustrates a further example of a communication between marking units of the invention where at least one marking unit go into power saving mode. In this embodiment a group of bicycles (here four) comprising each a marking unit have been isolated from other elements/units of the systems. All of the marking units have gone into a power saving mode and they are activated for receiving data for a period of at least 8 seconds every second hours only. The marking units may for example continue making transmission with a relatively high frequency e.g. every 8th second or it may make fever or even none transmissions in its power saving mode. Once the marking units receives transmissions from other elements/units of the systems the may change into another mode e.g. standard mode.

The figures are schematic and simplified for clarity, and they just show details which are essential to the understanding of the invention, while other details are left out. Throughout, the same reference numerals are used for identical or corresponding parts.

Some preferred embodiments have been shown in the foregoing, but it should be stressed that the invention is not limited to these, but may be embodied in other ways within the subject-matter defined in the following claims.

CLAIMS

1. A tracking system comprising a plurality of portable marking units, at least one position data element, at least one data transfer element and at least one central processing server,
said marking units comprise each an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data, said marking units comprise a standard mode in which mode they are arranged to automatically communicate with each other when within a predetermined distance d1 from each other,
said position data element comprises a transmitter for wireless transmitting a position data to any of said marking units which are within a predetermined distance d2 from said position data element,
said data transfer element comprises a receiver for wireless receiving data transmitted from any of said marking units which are within a predetermined distance d3 from said data transfer element, and a transmitter for transmitting said data to said central processing server,
said central processing server comprises a processing unit for processing the received data to extract data related to at least one historical position of a selected marking unit.

2. A tracking system as claimed in claim 1 wherein said energy supply unit of at least one of said marking units comprises at least one of a battery, a dynamo, a sun cell and a fuel cell.

3. A tracking system as claimed in any one of claims 1 and 2 wherein said memory element comprises at least one of an integrated circuit, an SOI (silicon on insulator) layer and an electronic printed circuit board.

4. A tracking system as claimed in any one of the preceding claims wherein the memory element has a capacity of at least about 10 bytes, such as at least about 128 Kbytes, such as at least up to about 1 Mbyte, such as at least up to about 10 Gbytes.

5. A tracking system as claimed in any one of the preceding claims wherein the identification code is stored in the memory element or in a separate element, said identification code preferably comprises a combination of numbers and/or characters.

6. A tracking system as claimed in any one of the preceding claims wherein the identification code comprises a unique code for the specific unit.

7. A tracking system as claimed in any one of the preceding claims wherein the identification code comprises a group code indicating the type/group of unit or a type/group element to which the unit is fixed.

8. A tracking system as claimed in any one of the preceding claims wherein the marking unit receiver is arranged to receive electromagnetic waves and being connected to or comprises an antenna for receiving said electromagnetic waves, said marking unit receiver preferably being adjusted to receive electromagnetic waves of a predetermined wavelength, said predetermined wavelength preferably being in the non visible range, more preferably in the range having a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

9. A tracking system as claimed in any one of the preceding claims wherein the marking unit receiver is arranged to be activated for receiving electromagnetic waves continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data.

10. A tracking system as claimed in any one of the preceding claims wherein the marking unit transmitter is arranged to transmit electromagnetic waves and being connected to or comprises an antenna for transmitting electromagnetic waves, said marking unit transmitter preferably being adjusted to transmit electromagnetic waves of at least one predetermined wavelength, said predetermined wavelength(s) preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

11. A tracking system as claimed in any one of the preceding claims wherein the marking unit transmitter transmits a marking unit signal comprising the identification code, said marking unit transmitter preferably transmitting said marking unit signal continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data.

12. A tracking system as claimed in any one of the preceding claims wherein the marking unit transmitter and the marking unit receiver are combined in a transceiver.

13. A tracking system as claimed in claim 12 wherein the transceiver is a 802.15.4 transceiver operating according to IEEE standard 802.15.4, the transceiver preferably being connected to an antenna or being integrated with an antenna.

14. A tracking system as claimed in any one of the preceding claims wherein the marking unit comprises at least one crystal, said crystal being connected or being an integrated part of the receiver, the transmitter and/or the transceiver.

15. A tracking system as claimed in any one of the preceding claims wherein the marking unit comprises a PCB antenna.

16. A tracking system as claimed in any one of the preceding claims wherein the marking units are chips, preferably in the form of active RFID (Radio Frequency Identification Devices) tags.

17. A tracking system as claimed in any one of the preceding claims wherein the system comprises at least 10 marking units, such as at least about 100 marking units, such as at least about 1000 marking units, such as at least about 1 million units.

18. A tracking system as claimed in any one of the preceding claims wherein the marking units are arranged to communicate with each other using their respective transmitters, receivers and/or transceivers.

19. A tracking system as claimed in any one of the preceding claims wherein the marking units are arranged to communicate with each other using Bluetooth technology.

20. A tracking system as claimed in any one of the preceding claims wherein the marking units are arranged to communicate with each other using electromagnetic waves.

21. A tracking system as claimed in any one of the preceding claims wherein the marking units in their standard mode are arranged to automatically communicate with each other when within a predetermined distance d1 from each other, wherein the distance d1 preferably is up to about 5000 m, such as up to about 500 m, such as at least about 1 m.

22. A tracking system as claimed in any one of the preceding claims wherein the marking units in their standard mode are arranged to automatically communicate with each other when within a predetermined distance d1 from each other, wherein the distance d1 preferably being individually adjustable.

23. A tracking system as claimed in any one of the preceding claims wherein the marking units in their standard mode are arranged to automatically communicate with each other when within a predetermined distance d1 from each other, wherein the distance d1 is larger for communication between two or more of the marking units than for communication between two or more other of the marking units.

24. A tracking system as claimed in any one of the preceding claims wherein at least one of the marking units comprises a level sensor, arranged to determine if the marking unit is in motion.

25. A tracking system as claimed in any one of the preceding claims wherein at least one of the marking units comprises a timekeeping element, such as a timepiece or a clock, e.g. an oscillator based timekeeping element

26. A tracking system as claimed in any one of the preceding claims further comprising a plurality of track units, each track unit comprises an energy supply unit, and a transmitter for wireless transmitting data, each track unit does not comprise an active memory.

27. A tracking system as claimed in 26 wherein at least one of the track units comprises an identification code, said identification code preferably comprises at least one of a unique code for the specific unit and a group code indicating the type/group of unit or a type/group element to which the unit is fixed.

28. A tracking system as claimed in any one of the preceding claims wherein said position data element comprises a memory.

29. A tracking system as claimed in any one of the preceding claims wherein said position data element comprises an identification code, said identification code preferably comprises at least one of a unique code for the specific unit and a group code indicating the type/group of unit or a type/group element to which the unit is fixed.

30. A tracking system as claimed in any one of the preceding claims wherein said position data element is a stationary element and comprising position data including its stationary position optionally in the form of a code and/or data stored in a memory.

31. A tracking system as claimed in any one of the preceding claims wherein said position data element is a non-stationary (movably) element and comprising position data reader

32. A tracking system as claimed in any one of the preceding claims wherein said position data element comprises a position data reader capable

of determining the position of said position data element, said position data reader preferably being selected from the group consisting of satellite position systems (GPS (Global Position System), Galileo, GLONASS, triangulation systems using wireless network and gyroscopes.

33. A tracking system as claimed in any one of the preceding claims wherein said position data element comprises a GSM (Global System for Mobile communications) unit.

34. A tracking system as claimed in any one of the preceding claims wherein said position data element comprises a timekeeping element, such as a timepiece or a clock, e.g. an oscillator based timekeeping element.

35. A tracking system as claimed in any one of the preceding claims wherein said position data element transmits said position data using a position data element transmitter comprising or being connected to an antenna for transmitting electromagnetic waves, said position data element preferably being adjusted to transmit electromagnetic waves of at least one predetermined wavelength, said predetermined wavelength(s) preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

36. A tracking system as claimed in any one of the preceding claims wherein the position data element transmits said position data signal continuously, at predetermined intervals, according to a predetermined scheme and/or in dependence of received data.

37. A tracking system as claimed in any one of the preceding claims wherein the position data element is arranged to transmit to a predetermined distance d2, wherein the distance d2 preferably is up to about 5000 m, such as up to about 500 m, such as at least about 1 m.

38. A tracking system as claimed in any one of the preceding claims wherein the position data element is movable and comprises a distance counter, determining the distance travelled within a selected period.

39. A tracking system as claimed in any one of the preceding claims wherein said data transfer element receiver comprises or being connected to an antenna for receiving electromagnetic waves, said data transfer element receiver preferably being adjusted to receive electromagnetic waves of a predetermined wavelength, said predetermined wavelength preferably being in the non visible range, more preferably in the range hawing a lower frequency than the visibly light, more preferably in the range of IR waves and radio waves.

40. A tracking system as claimed in any one of the preceding claims wherein said data transfer element receiver is arranged to receive the signal transmitted from said marking units which are within a predetermined distance d3 from said data transfer element, wherein the predetermined distance d3 is between about 50 and about 200 % of the predetermined distance d1, preferably the predetermined distance d3 is essentially equal to the predetermined distance d1.

41. A tracking system as claimed in any one of the preceding claims wherein said data transfer element transmitter is a wireless transmitter, said wireless transmitter preferably being transmitting by telecommunication, preferably selected from the group consisting of radio signals such as blue tooth; microwave signals; infrared light; visible light; ultraviolet light; laser light; and acoustic waves.

42. A tracking system as claimed in any one of the preceding claims wherein said data transfer element transmitter is a wired transmitter.

43. A tracking system as claimed in any one of the preceding claims wherein said central processing server is a server, said server preferably being connected to the Internet, such that data related to historical positions

of a selected marking unit can be obtained via the internet optionally protected by a pass word.

44. A tracking system as claimed in any one of the preceding claims wherein said central processing server comprising a billing unit for directly billing the users over the internet.

45. A tracking system as claimed in any one of the preceding claims wherein the tracking system comprises a plurality of position data elements, such as at least 5, such as at least about 100, such as up to about 50000 or more.

46. A tracking system as claimed in any one of the preceding claims wherein the tracking system comprises a plurality data transfer elements, such as at least 5, such as at least about 100, such as up to about 50000 or more.

47. A tracking system as claimed in any one of the preceding claims 45 and 46 wherein the tracking system comprises at least one stationary data transfer element and/or at least one stationary position data elements.

48. A tracking system as claimed in any one of the preceding claims 45- 47 wherein the tracking system comprises at least one movably data transfer element and/or at least one movably position data elements.

49. A tracking system as claimed in any one of the preceding claims wherein at least one of said position data elements and at least one of said data transfer elements are combined in a position data and transfer element.

50. A tracking system as claimed in any one of the preceding claims wherein said tracking system comprises at least 100 portable marking units, a plurality of position data elements, a plurality of data transfer elements and at least one central processing server.

51. A tracking system as claimed in claim 50 comprising a plurality of stationary data and transfer elements, a plurality of movably data transfer elements and at least one central processing server.

52. A tracking system as claimed in any one of the preceding claims wherein each of said marking units are fixed or are arranged to be fixed to a desired item.

53. A tracking system as claimed in any one of the preceding claims wherein at least one of said position data elements and/or at least one of said data transfer elements are fixed to or are arranged to be fixed to a movable item, such as a vehicle e.g. a car.

54. A tracking system as claimed in any one of the preceding claims wherein said marking units communicate with each other when within a predetermined distance d1 from each other, the communication comprises transmitting from a transmitting marking unit to a receiving marking unit the identification code of the transmitting marking unit and a predetermined amount of data stored in the memory of said transmitting marking unit, at least a part of said transmitted data being stored in the memory of said receiving marking unit.

55. A tracking system as claimed in claim 54 wherein the communication between two marking units comprises a two way communication where both marking units are transmitting and receiving data from each other.

56. A tracking system as claimed in any one of the preceding claims 54-55 wherein said transmitted predetermined amount of data stored in the memory of said transmitting marking unit, comprises the data most recently received from other elements of the tracking system, wherein the other elements of the tracking system comprise other marking units, the position data element(s) and the data transfer element(s).

57. A tracking system as claimed in any one of the preceding claims 54-56 wherein said transmitted predetermined amount of data stored in the

memory of said transmitting marking unit, comprises primarily data which has been marked a first priority and secondarily the data most recently received from other elements of the tracking system, wherein the other elements of the tracking system comprise other marking units, the position data element(s) and the data transfer element(s).

58. A tracking system as claimed in claim 57 wherein said position data element further can transmit a call for a selected marking unit via its identification code, data relating to said selected marking unit thereby becomes first priority data.

59. A tracking system as claimed in any one of the preceding claims 54-58 wherein said transmitted predetermined amount of data stored in the memory of said transmitting marking unit, comprises the data received from at least 1, such as at least 2, such as from 2 to about 100 received transmissions obtained from other elements of the tracking system which have been within the predetermined distance d1 of the transmitting marking units.

60. A tracking system as claimed in claim 59 wherein data received from at least 1 element of the tracking system comprises identification code of said other element(s) of the tracking system, data relating to the time at which the data was sent from said other element(s) of the tracking system, and optionally position data.

61. A tracking system as claimed in claim 57 wherein data received from at least 1 element of the tracking system comprises substantially all the data transmitted from said other element(s) of the tracking system.

62. A tracking system as claimed in any one of the preceding claims 54-61 wherein said transmitted predetermined amount of data stored in the memory of said transmitting marking unit comprises a selected amount of bits, such as from 1 bytes to about 200 kbytes, such as from 2 to about 100 bytes.

63 A tracking system as claimed in any one of the preceding claims wherein at least one of the marking units, preferably all of the marking units are arranged to transmit data at least partly in dependence of received data.

64. A tracking system as claimed in any one of the preceding claims wherein at least one of the marking units, preferably all of the marking units are arranged to be activated for receiving data at least partly in dependence of received data.

65. A tracking system as claimed in any one of the preceding claims wherein at least one of the marking units, preferably all of the marking units are arranged to have an alert mode with a higher frequency than in its/their standard mode.

66. A tracking system as claimed in any one of the preceding claims wherein the marking units are arranged to have a power saving mode, wherein they transmit data with about 1 to about 1000 transmissions per hour and are activated to receive data continuously or in intervals with up to about 100 seconds, and with intervals of about 2 minutes to about 1 hour.

67. A tracking system as claimed in any one of the preceding claims wherein at least two of the marking units, preferably all of the marking units are arranged to have a power saving mode where they are arranged to receive and or transmits data with a lower frequency than in its standard mode.

68. A tracking system as claimed in claim 67 wherein at least two of the marking units, preferably all of the marking units are arranged to have a power saving mode where they are arranged to receive and/or transmits data with a predetermined pattern, the power saving mode being activated and deactivated according to a pre programmed schedule, by received data and/or by a level sensor in the respective marking units.

69. A tracking system as claimed in claim any one of claims 67 and 68 wherein the marking unit(s) in a first saving mode S1 transmit data with a

higher frequency than the frequency they are activated for receiving data, preferably each marking unit in a first saving mode S1 transmit data with a frequency of from about 1 transmission per 1 second to about 100 seconds and it is activated for receiving data for up to about 100 seconds at intervals of about 0.2 to about 5 hours, such as at intervals of about 0.5 to about 3 hours.

70. A tracking system as claimed in any one of claims 67 - 69 wherein each of the marking units in a second saving mode S2 transmit data with a lower frequency than in its standard mode and preferably is activated to receive data in shorter time than in its standard mode.

71. A tracking system as claimed in claim 70 wherein each of the marking units is activated to go into its second saving mode S2 by data received from a transfer element.

72. A tracking system as claimed in claim 70 wherein each of the marking units is activated to go into its second saving mode by data received from a stationary element.

73. A tracking system as claimed in claim 70 wherein each of the marking units is activated to go into its second saving mode by receiving a selected saving mode signal.

74. A tracking system as claimed in any one of claims 67 - 73 wherein a group of the marking units in a third saving mode S3 transmit data with a lower frequency than in their standard mode and preferably being activated to receive data in shorter time than in their standard mode, the group of the marking units being activated to be in the third saving mode S3 by being physically placed in a group for a selected time.

75. A tracking system as claimed in claim 74 wherein a marking unit in the group of marking units being activated to be in the third saving mode S3 by repeatingly receiving data from another one of the marking units.

76. A tracking system as claimed in any one of the preceding claims wherein the receiver of at least on of the marking units and/or at least one on the position data elements is direction sensitive, said direction sensitive unit being arranged to be placed in/on a vehicle.

77. A tracking system as claimed in claim 76 further comprising a plurality of track units, said track units preferably being arranged to be incorporated into a bicycle helmet.

78. A tracking system as claimed in any one of the preceding claims further comprising a bearing unit comprising a direction sensitive receiver, said bearing unit preferably comprising a computer unit and a memory for storing identification data.

79. A tracking system as claimed in any one of the preceding claims wherein at least one of said position data elements and at least one of said data transfer elements are combined in a position data and transfer element, said combined position data and transfer element is arranged to update and/or correct data in said central processing server on request from the user of said position data and transfer element.

80. A tracking system preferably as claimed in any one of the preceding claims for use in watch of one or more items and/or living objects on a selected field comprising a field set of portable marking units for marking the selected field, a plurality of additional marking units and/or a plurality of track units, least one position data element, at least one data transfer element and at least one central processing server,
said marking units comprise each an energy supply unit, at least one memory element, an identification code, a receiver for wireless receiving data, and a transmitter for wireless transmitting data, said marking units comprise a standard mode in which mode they are arranged to automatically communicate with each other when within a predetermined distance d1 from each other,

said track unit if included comprises each an energy supply unit, and a transmitter for wireless transmitting data, each track unit does not comprise an active memory,

said position data element comprises a transmitter for wireless transmitting a position data to any of said marking units which are within a predetermined distance d2 from said position data element,

said data transfer element comprises a receiver for wireless receiving data transmitted from any of said marking units which are within a predetermined distance d3 from said data transfer element, and a transmitter for transmitting said data to said central processing server,

said central processing server comprises a processing unit for processing the received data to extract data related to at least one historical position of a selected marking unit.

81. A method of tracking an item comprising

- providing a plurality of portable marking units, at least one position data element, at least one data transfer element and at least one central processing server;
- marking the target item with at least one of said marking units;
- marking at least one other movably item with at least one of said marking units;
- allowing at least one of said target items and other movably item(s) to move relative to each other to come within a predetermined distance d1 from each other;
- allowing at least one of said target items and other movably item(s) to be or to move within a predetermined distance d2 from said position data element;
- allowing at least one of said target items and other movably item(s) to be or to move within a predetermined distance d3 from said data transfer element; and
- extracting information relating to the position of said target item from said central processing server;

wherein

said marking units comprise each an energy supply unit, at least one memory element, an identification code, and a receiver for wireless receiving data, a transmitter for wireless transmitting data, said marking units comprise a standard mode in which mode they are arranged to automatically communicate with each other when within said predetermined distance d1 from each other, said position data element comprises at transmitter for wireless transmitting a position data to any of said marking units which are within said predetermined distance d2 from said position data element, said data transfer element comprises a receiver for wireless receiving data transmitted from any of said marking units which are within said predetermined distance d3 from said data transfer element, and a transmitter for transmitting said data to said central processing server, said central processing server comprises a processing unit for processing the received data to extract data related to at least one historical position of a selected marking unit.

82. A method according to claim 81 comprising
-providing a tracking system as claimed in any one of the claims 1-45 comprising said plurality of portable marking units, said at least one position data element, said at least one data transfer element and said at least one central processing server.

83. A method according to any one of claims 81 and 82 wherein at least one of the marking units, preferably all of the marking units are arranged to have a power saving mode where they are arranged to receive and/or transmits data with a predetermined pattern, the power saving mode being activated and deactivated according to a pre programmed schedule, by received data and/or by a level sensor in the respective marking unit, the method comprising
- fixing a stationary element arranged to transmit a selected saving mode signal, said stationary element being fixed at a "home base" at which communication position it is desired that the respective marking unit should go into power saving mode.

84. A method according to any one of claims 81 and 82 wherein at least one of the receiver of at least on of the marking units and/or at least one on the position data elements is direction sensitive, the method comprising
- fixing said direction sensitive unit in/on a vehicle and
- fixing at least one cyclist marking unit on a bicycle or on another position on a bicyclist (e.g. on a helmet), said cyclist marking unite comprises an identification code comprising type/group data indicating that it is fixed to a bicyclist.

85. A method according to any one of claims 81 and 82 further comprising at least one cyclist track unit comprising a transmitter for wireless transmitting data, wherein at least one of the receiver of at least on of the marking units and/or at least one on the position data elements is direction sensitive, the method comprising
- fixing said direction sensitive unit in/on a vehicle and
- fixing at least one cyclist track unit on a bicycle or on another position on a bicyclist (e.g. on a helmet), said cyclist track unite comprises an identification code comprising type/group data indicating that it is fixed to a bicyclist.

86. A method according to any one of claims 81 and 82 of one or more items on a selected field, the method comprising
- providing a tracking system as claimed in claim 80 arranging the field set of portable marking units to cover the selected field so that a communication line between all of the marking units of the field set of marking unit is provided;
- arranging the position data element, to provide the marking units of the field set of marking units with position data,
- arranging the data transfer element and the central processing server so that data from the marking units of the field set of marking units can be transferred to the central processing server; and
- providing the items to be watched with at least one of an additional marking unit and a track unit.

FIG. 1

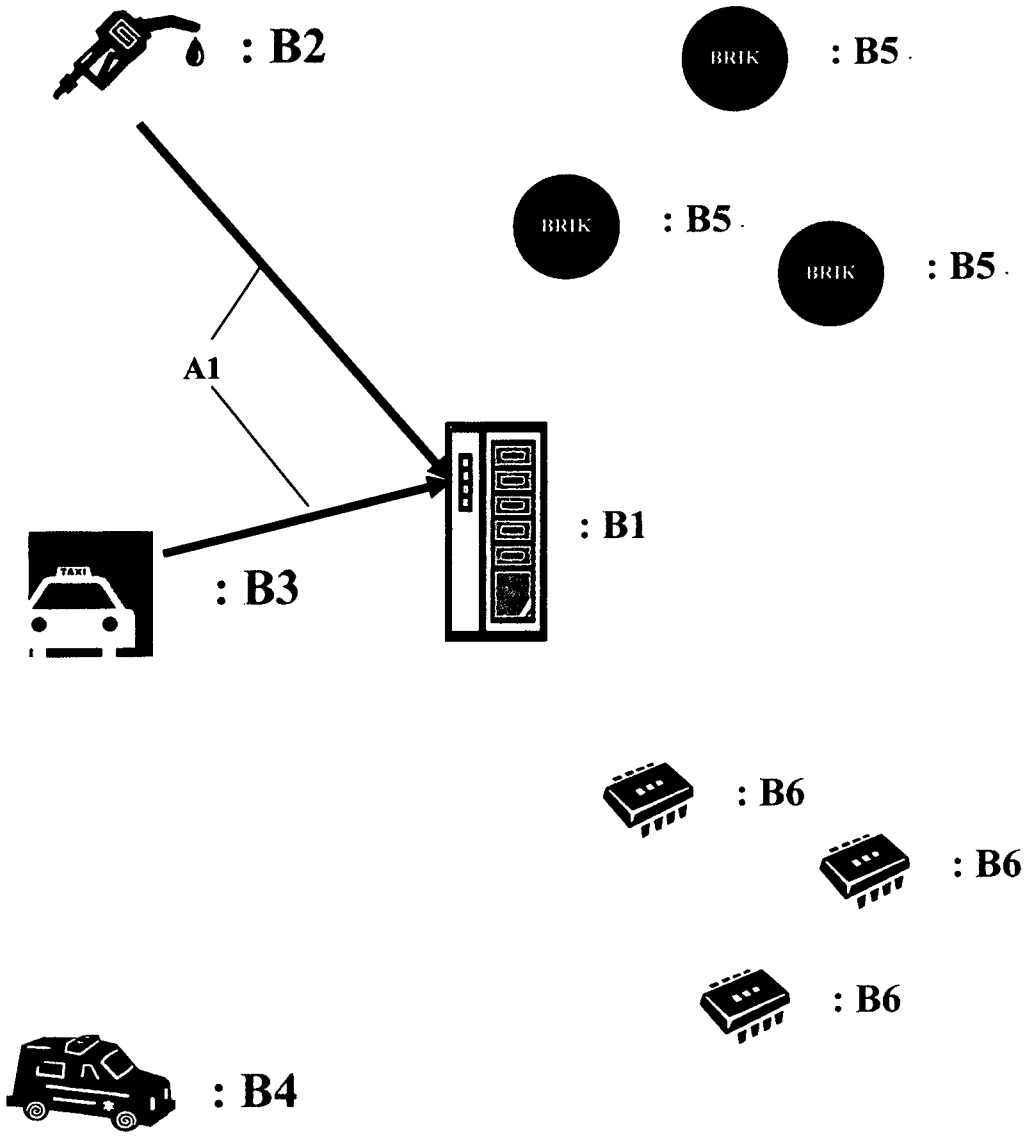


FIG. 2

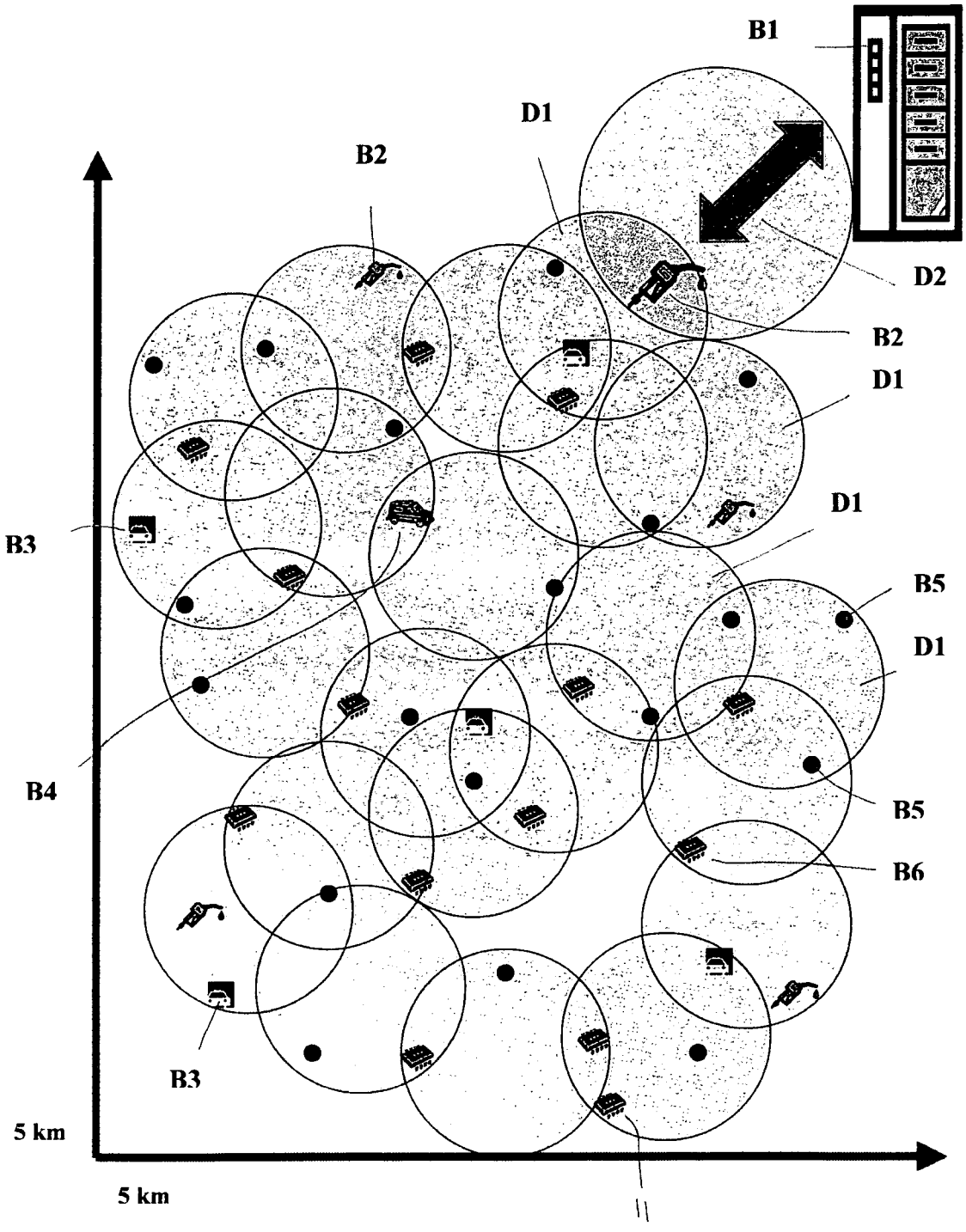
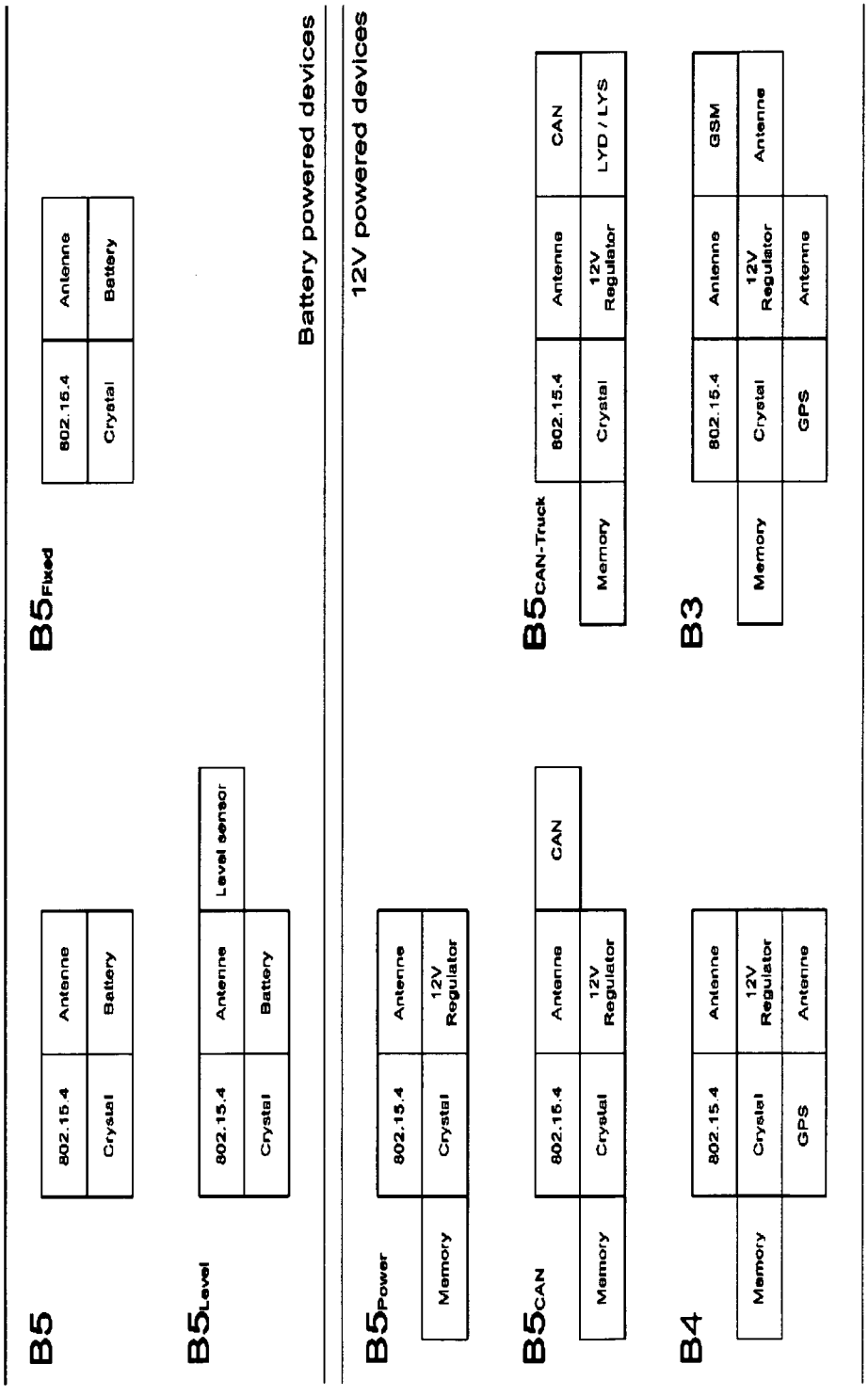


FIG. 3a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802.15.4
Antenne
Crystal
Battery
B5Fixed
802.15.4
Antenne
Crystal
Battery
B5Level
802.15.4
Antenne
Level sensor
Crystal
Battery
Battery powered devices
12V powered devices
B5Power
802.15.4
Antenne
Memory
Crystal
12V Regulator
B5CAN
802.15.4
Antenne
CAN
Memory
Crystal
12V Regulator
B5CAN-Truck
802.15.4
Antenne
CAN
Memory
Crystal
12V Regulator
LYD / LYS
B4
802.15.4
Antenne
Memory
Crystal
12V Regulator
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GSM
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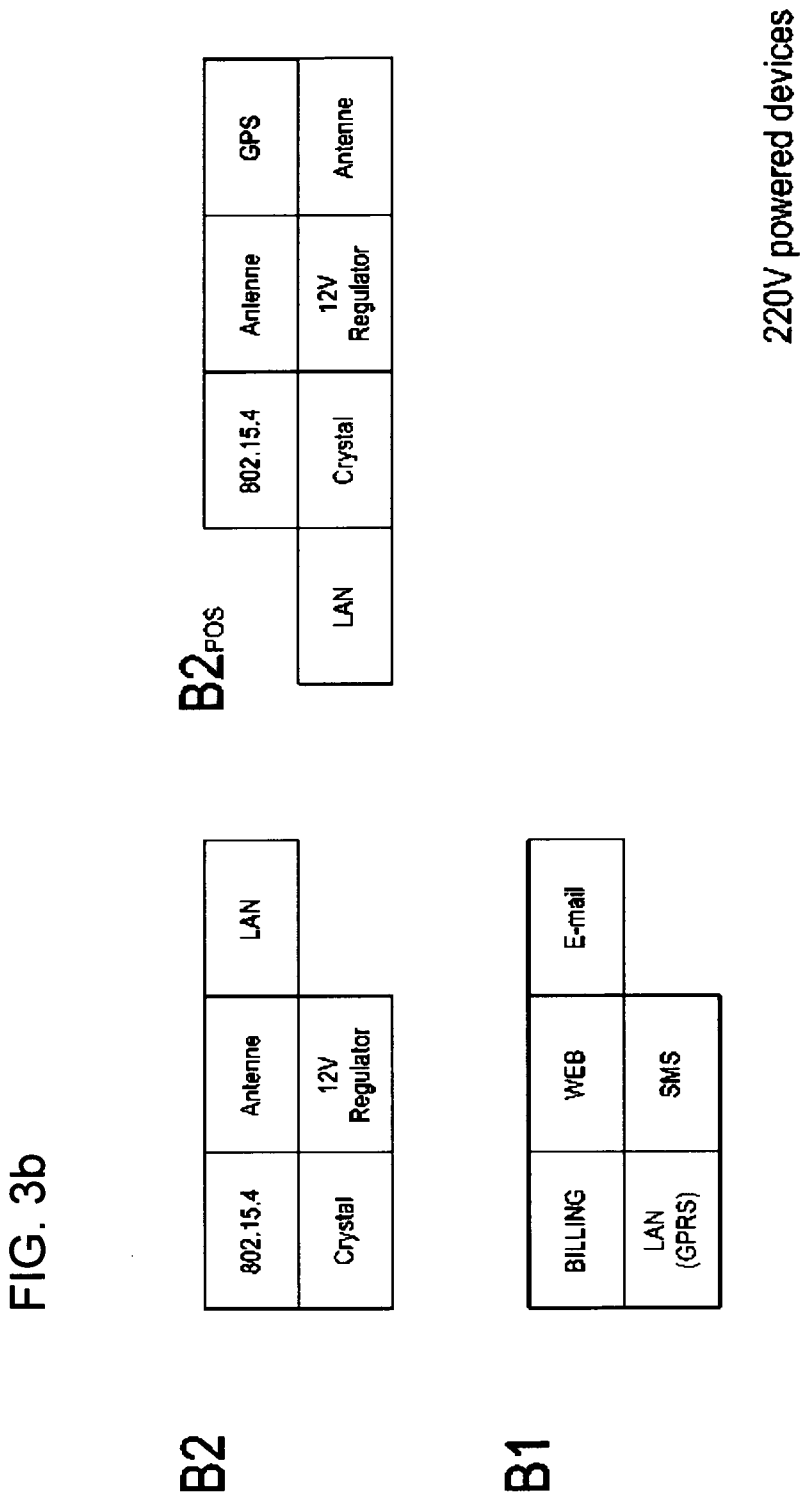
GPS
Antenne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Crystal
Antenne
12V Regulator
LAN
B2POS
802.15.4
Crystal
Antenne
12V Regulator
LAN
GPS
Antenne
B1
BILLING
LAN (GPRS)
WEB
SMS
E-mail
220V powered devices

FIG. 3b

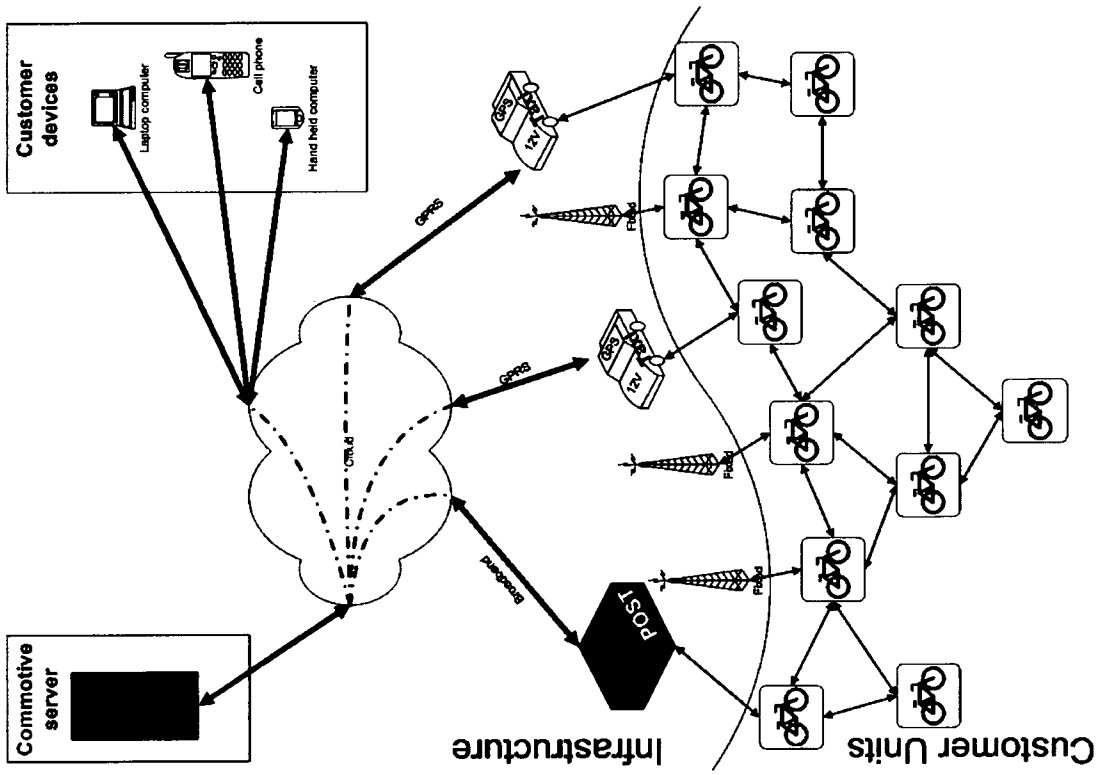

Customer devices
Laptop computer
Cell phone
Hand held computer
GPRS
GPRS
Bluetooth
Commotive server
POST
Infrastructure
Customer Units

FIG. 4

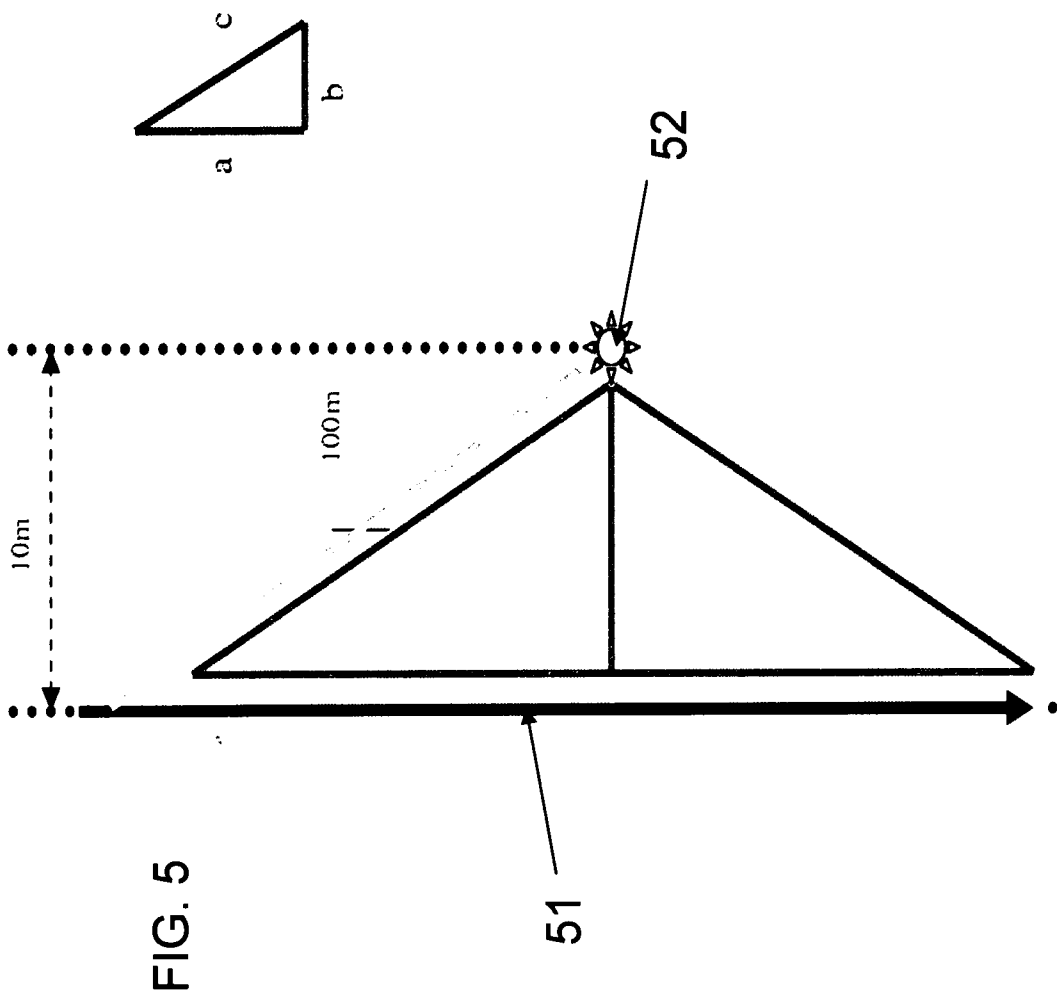
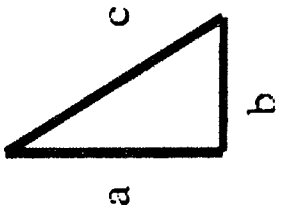


FIG. 5



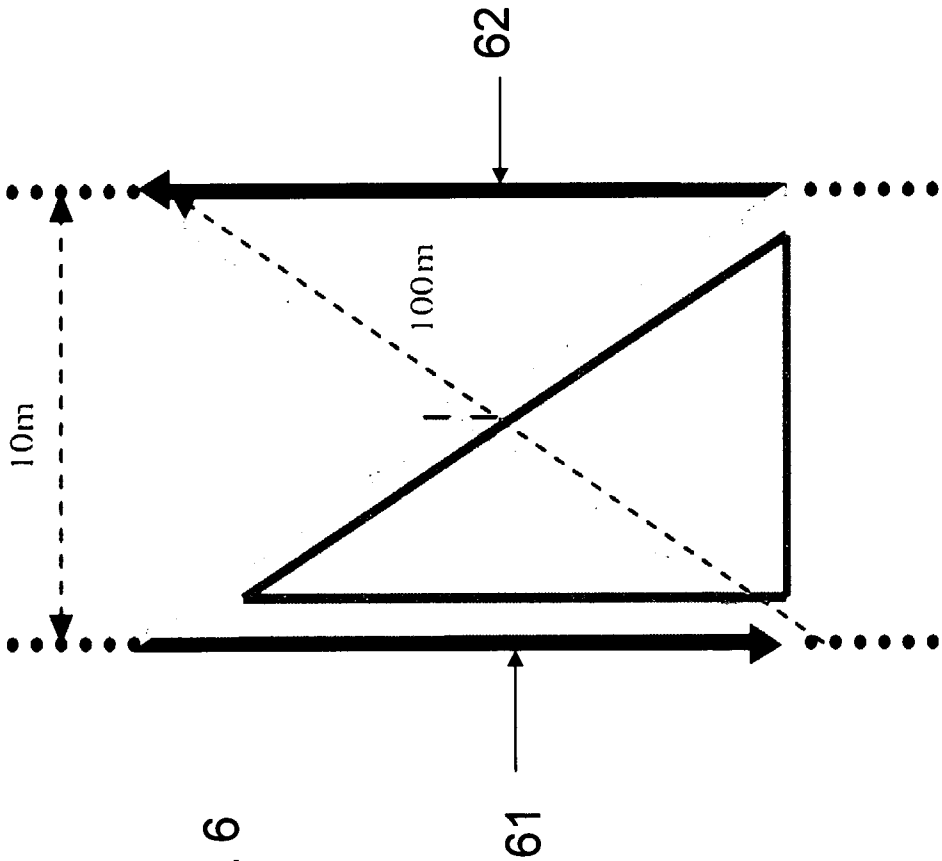


FIG. 6

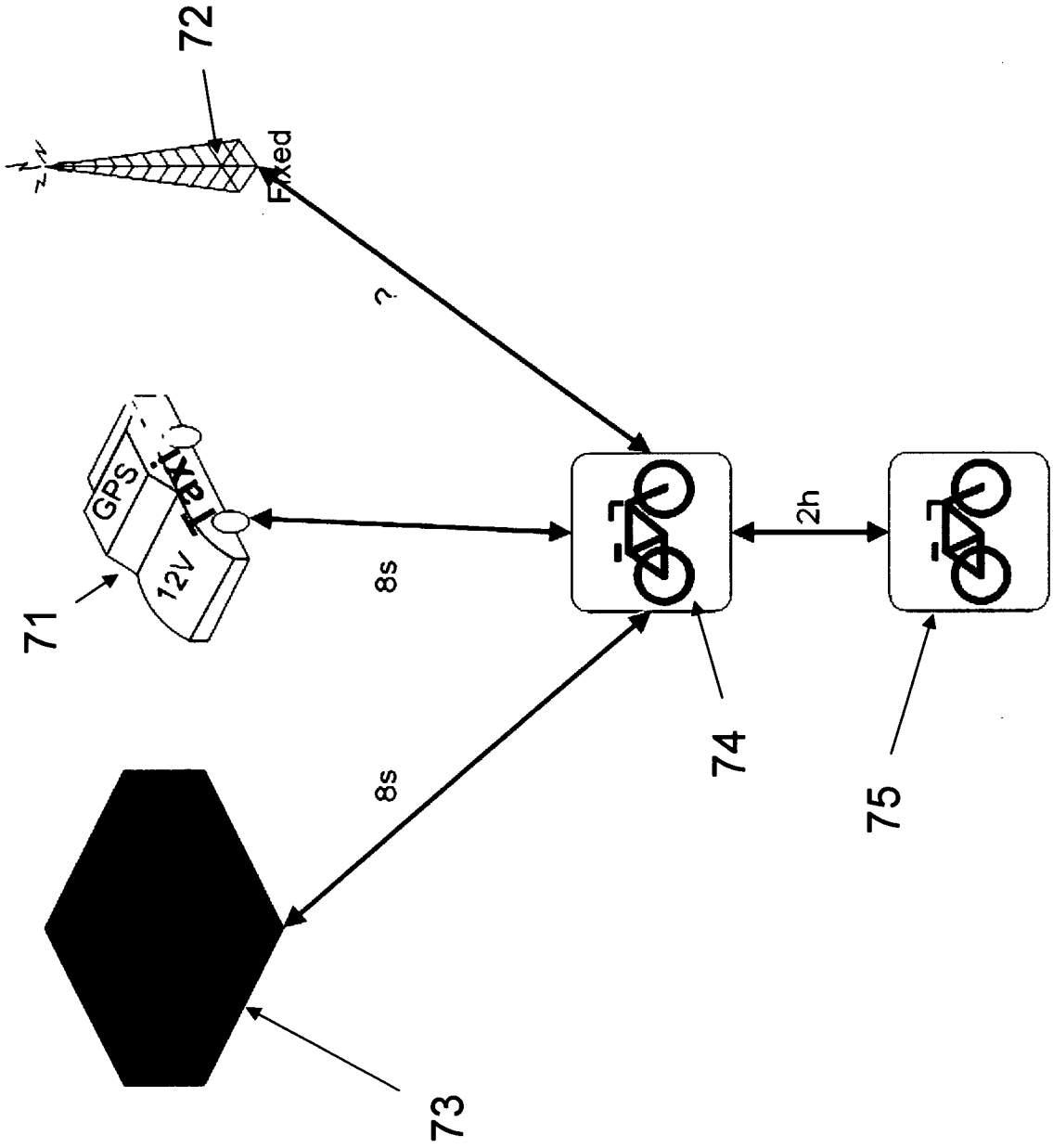


FIG. 7

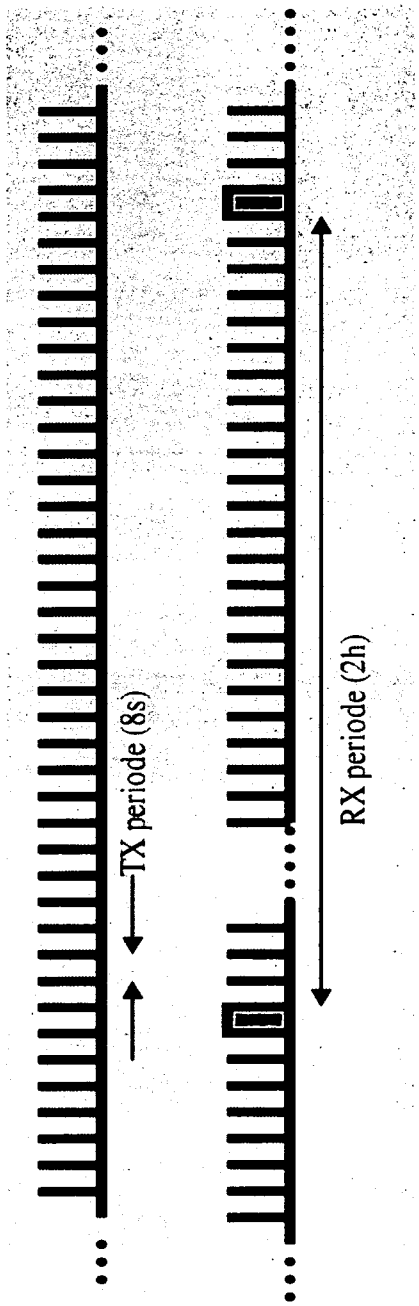


FIG. 8

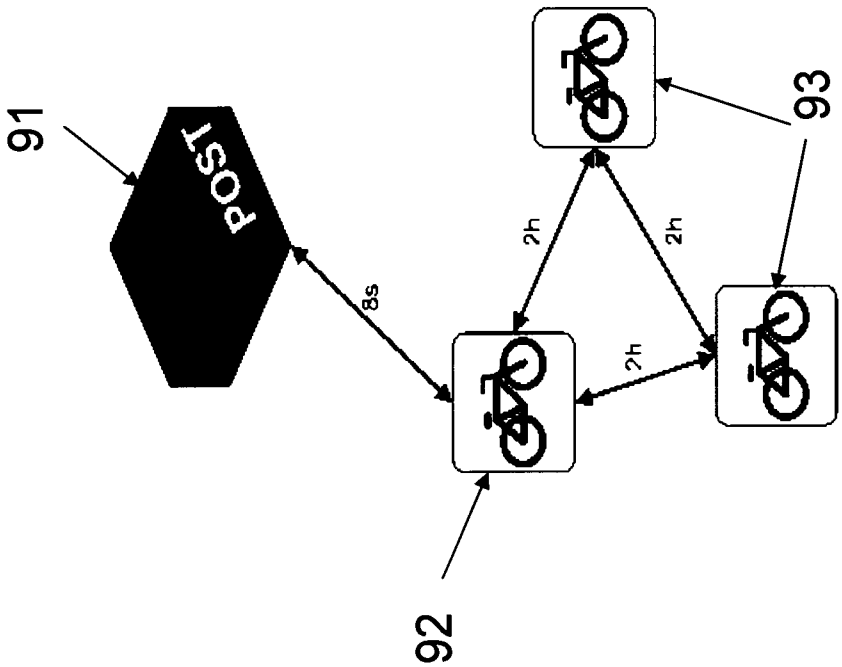


FIG. 9

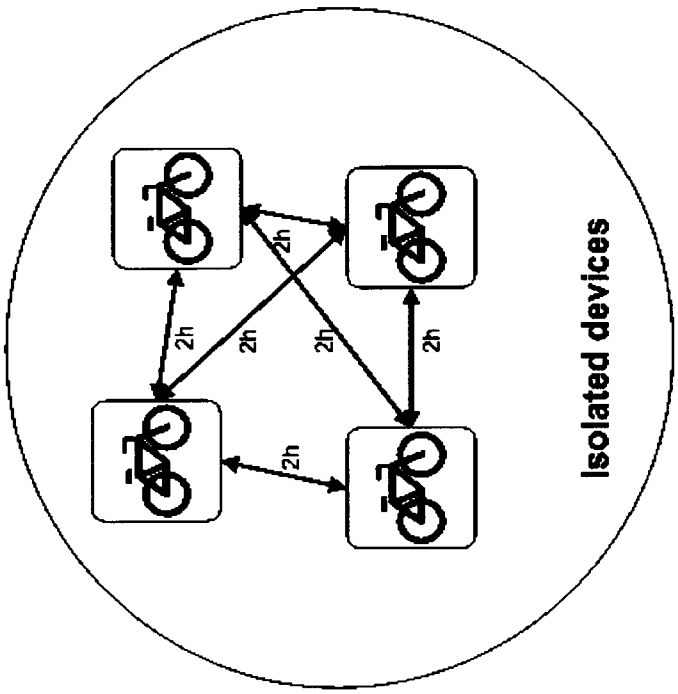


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2008/000267

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01S5/00 G01S5/02 G01S1/68

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)
G01S

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/060098 A1 (MCCOY JAMES W [US]) 15 March 2007 (2007-03-15) paragraphs [0031] - [0045], [0063]; figure 1	1-86
X	US 6 631 271 B1 (LOGAN JAMES D [US]) 7 October 2003 (2003-10-07) the whole document	1-86
X	US 2006/009240 A1 (KATZ DANIEL A [IL]) 12 January 2006 (2006-01-12) the whole document	1-86
X	WO 2007/007259 A (AMBROSETTI ANTONIO [IT]) 18 January 2007 (2007-01-18) the whole document	1-86

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"E" earlier document 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	Date of mailing of the international search report
25 November 2008	03/12/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lupo, Emanuela

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2008/000267

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	STEFAN BRUNING ET AL: "Cooperative Positioning with MagicMap" POSITIONING, NAVIGATION AND COMMUNICATION, 2007. WPNC '07. 4TH WO RKSHOP ON, IEEE, PI, 1 March 2007 (2007-03-01), pages 17-22, XP031080610 ISBN: 978-1-4244-0870-2 the whole document	1-86

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DK2008/000267

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007060098 A1	15-03-2007	NONE	
US 6631271 B1	07-10-2003	NONE	
US 2006009240 A1	12-01-2006	NONE	
WO 2007007259 A	18-01-2007	EP 1907877 A2	09-04-2008