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(54) **METHOD FOR ENERGY EFFICIENT BODY SENSOR NETWORK DISCOVERY**

VERFAHREN UND VORRICHTUNG ZUR STROMSPARENDEN ERKENNUNG VON KÖRPERSENSORNETZWERKEN

PROCÉDÉ ASSOCIÉ À LA DÉCOUVERTE D'UN RÉSEAU DE CAPTEURS CORPORELS ÉCONOME EN ÉNERGIE

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Description

[0001] The present innovation finds application in patient monitoring systems, particularly with regard to physiological monitoring systems. However, it will be appreciated that the described techniques may also find application in other monitoring systems, other healthcare information collection scenarios, other status monitoring techniques, and the like.

[0002] Recent advances in semiconductor and circuit miniaturization, biosensor development, and wireless communication have made small integrated sensors with on-board processing and wireless data transfer a reality. These sensors use short range wireless communication protocols and can be combined into wearable wireless sensor networks to acquire data concerning the physiological parameters (heart rate, oxygen saturation, blood pressure, temperature, electro-cardiogram (ECG), etc.) as well as the physical activities of a person. The applications for these sensor networks include home monitoring of the elderly, monitoring of patients with chronic disease, wellness, rehabilitation and patient monitoring in hospitals. For example, a patient may have several wireless bio-sensor nodes attached to the body, and sensor data is wirelessly transmitted to a wireless gateway and further sent over a wired network to a server for processing, visualization and storage. The server may be located in a hospital in case of patient monitoring.

[0003] Since the body sensors are battery powered, low-power consumption for all system components, including wireless data transmission, is a crucial performance parameter. Therefore, low-power short-range radio technologies are useful for wireless connectivity in the described systems and methods. One wireless technology that has gained the traction in the healthcare industry for this application due to its low power consumption, low complexity, and low cost, is the wireless personal area network (WPAN) technology defined in the IEEE 802.15.4 standard. An IEEE 802.15.4 WPAN comprises one WPAN coordinator and one or more end devices. A number of physical channels have been defined, i.e. 10 in the 2.4GHz ISM band. A WPAN usually operates in one frequency chosen by the PAN coordinator in a way to minimize interference from other IEEE 802.14.5 WPANs or non-802.15.4 traffic.

[0004] Two types of network nodes have been defined in the standard: full function devices (FFD) and reduced function devices (RFD). RFDs implement a subset of 802.15.4 primitives and cannot function as WPAN coordinators. RFD radios are turned off as much as possible to minimize power consumption. FFDs have a full implementation of the primitives defined in the standard and are able to function as PAN coordinators. Although IEEE 802.15.4 defines an optional synchronized channel access mechanism using beacons that allows for bandwidth reservations as well as for the WPAN coordinator to enter sleep mode, the vast majority of WPAN implementations do not use it. To reduce power consumption the radios are turned off as much as possible. Generally, the PAN coordinator has to be on at all times to receive transmissions from the end devices.

[0005] Current state of the art mechanisms put the burden of rediscovering a fixed aggregator (FA) on the mobile wireless personal area network (WPAN) devices, thus increasing their power consumption and reducing their battery life. In the simplest case, the sensors or WPAN end devices individually scan for the fixed aggregator patient area network (PAN) and report findings to a mobile aggregator (MA) to allow the MA to abandon its PAN. The MA itself cannot scan on channels other than the one the MA is operating on, since the MA has to be able to receive asynchronous transmissions from the end devices. In a more efficient mechanism, the MA instructs the end devices, one at a time, to perform a scan and report the results to the MA. Even in the latter approach power is consumed by the end devices for scanning and by both the end devices and the MA for signaling. More specifically, if each of the nodes or sensors sends out a beacon request or listens for transmissions from a bedside monitor or other fixed aggregator unit, the nodes or individual monitors will have shortened battery life.

[0006] In US 2008/0228045 A1 there is presented a wireless medical monitoring system and medical monitoring devices adapted to communicate using a plurality of wireless protocols and networks. For each transmission, a wireless protocol or network is selected based on the properties of the available protocols and networks and the nature of the data that is to be transmitted. Thus, the medical system and devices can move seamlessly from one context and location to another.

[0007] In WO 2005/062232 A2 a wireless medical apparatus having a transceiver unit, an indicating device and an input device and having a function for automatic integration of the medical apparatus into the nearest patient network is presented. Allocation of the medical apparatus can be effected by a method in which the apparatus is integrated into the nearest patient network after enabling the apparatus.

[0008] The present application provides new and improved systems and methods for permitting one or more mobile devices in a mobile WPAN to discover their fixed aggregator while minimizing the power consumption of the battery-powered mobile WPAN devices, which overcome the above-referenced problems and others.

[0009] The invention is set out in the appended set of claims. The embodiments and/or examples of the following description which are not covered by the scope of the appended claims are considered as not being part of the present invention."

[0010] In accordance with one aspect, a method of transferring a patient monitoring sensor group, said sensor group including one or more patient-mounted sensors and a mobile aggregator sensor for establishing a mobile aggregator wireless personal area network, between fixed and mobile modes of communication with a wired healthcare network, wherein a fixed aggregator module

for establishing a fixed aggregator wireless personal area network (FA-PAN) is connected to said wired healthcare network, comprises detecting at the fixed aggregator module that the sensor group is within range of the fixed aggregator module. The method further comprises the fixed aggregator module informing the mobile aggregator sensor that it and the one or more patient-mounted sensors are within communication range of the fixed aggregator module, and, when the fixed aggregator module is within communication range of the sensor group, communicating status information from the sensor group to a wired network via the fixed aggregator personal area network. The method further comprises, when the mobile aggregator sensor is out of communication range of the fixed aggregator module, establishing a mobile aggregator personal area network (MA-PAN) at the mobile aggregator sensor, receiving the status information from the one or more patient sensors at the mobile aggregator sensor via the mobile aggregator personal area network and transmitting the status information from the mobile aggregator sensor to the wired network and bypassing the fixed aggregator module.

[0011] In accordance with another aspect, a system for facilitating transferring a patient monitoring sensor group, said sensor group including one or more patient-mounted sensors and a mobile aggregator sensor for establishing a mobile aggregator wireless personal area network, between fixed and mobile modes of communication with a wired healthcare network, wherein a fixed aggregator module for establishing a fixed aggregator wireless personal area network (FA-PAN) is connected to said wired healthcare network, comprises the fixed aggregator module configured to detect the sensor group, when the sensor group is within communication range of the fixed aggregator module. The fixed aggregator module is configured to notify the mobile aggregator sensor that the sensor group is within communication range of the fixed aggregator module. The one or more patient-mounted sensors are configured to communicate status information to a wired network via the fixed aggregator personal area network when the sensor group is notified that it is within communication range of the fixed aggregator module and to the wired network via the mobile aggregator wireless personal area network when the sensor group is not within communication range of the fixed aggregator module.

[0012] One advantage is that battery power is conserved.

[0013] Another advantage resides in providing continuous patient monitoring as a patient moves about a monitoring area.

[0014] Still further advantages of the subject innovation will be appreciated by those of ordinary skill in the art upon reading and understanding the following detailed description.

[0015] The drawings are only for purposes of illustrating various aspects and are not to be construed as limiting.

FIGURE 1 illustrates a system that facilitates mobile connectivity using two connectivity modes for a plurality of on-body wireless sensors positioned on a patient.

FIGURE 2 illustrates a system that facilitates conserving battery power in on-body devices or sensors.

FIGURE 3 illustrates a system in a mobile mode of operation, where the MA sensor has started its own PAN (MA-PAN) and the sensors have connected to the MA PAN and the MA further transmits the patient information to the wired network.

FIGURE 4 illustrates a system in which the FA has fixed sensors connected to its PAN, wherein the sensors are not part of the mobile sensor group.

FIGURE 5 illustrates a system in a mobile mode of operation, where the MA sensor has started its own PAN (MA-PAN) and the sensors have connected to the MA PAN and the MA further transmits the patient information to the wired network. The FA continues to have fixed sensors connected to its PAN.

FIGURE 6 illustrates a system showing the FA and MA in greater detail, and coupled to the wired network, e.g., via a wired or wireless connection.

FIGURE 7 illustrates a method of transferring a patient monitoring sensor group between fixed and mobile modes of communication with a wired healthcare network.

[0016] To overcome the aforementioned problems, the described systems and methods facilitate conserving battery life by handing off the mobile patient sensors between the mobile and fixed networks, and placing the burden of determining whether the patient-carried personal area network (PAN) is in the vicinity of the fixed aggregator on the bedside monitor, which uses wall power and therefore has no battery life issues.

[0017] FIGURE 1 illustrates a system **10** that facilitates mobile connectivity using two connectivity modes for a plurality of on-body wireless sensors **12** positioned on a patient **14.** In the first mode, shown on the right and henceforth called fixed mode (FM), all on-body sensors connect to a fixed aggregator (FA) **16,** which receives the sensor data and transmits it over the wired network **18** (e.g., a hospital or healthcare environment network). The FA is mains powered and acts as the PAN coordinator for the FA-PAN **20.** In addition to serving as the point of attachment to the wired network for the mobile sensors, the FA can process the data. In the second operating mode, shown on the left in Figure 1 and henceforth called mobile mode (MM), the monitored person has left the service area of the fixed aggregator. Consequently, an on-body mobile aggregator (MA) **22** creates a second PAN, MA-PAN **24,** to which the sensors connect. The mobile aggregator receives the sensor data and forwards it through a second, local area wireless link such as IEEE 802.11 (Wireless LAN) via an access point **26** to the wired network. The mobile aggregator can be a stand-alone device. In one embodiment, the MA **22** is

one of the body sensors and contains additional functionality for carrying out the reception and forwarding of sensor data. When the monitored patient re-enters the service area of the fixed aggregator, the on-body sensors **12** switch back to the first operating mode, i.e. they reconnect to the fixed FA-PAN **20.** The mobile aggregator then abandons its MA-PAN **24.** During mobile mode, the mobile aggregator's power consumption may increase in order to receive the sensor data on the short range radio at all times, and transmit it through the local area network radio.

[0018] In one embodiment, the FA **16** is part of a bedside monitor (not shown) that detects communications between the mobile aggregator and the nodes or sensors and determines that the patient carried PAN is within range based on signal strength. In another embodiment, the fixed and mobile units are both connected to the WLAN and can use the WLAN network to monitor proximity. In another embodiment, the mobile aggregator receives PAN beacon requests from the fixed unit to establish a communication link which establishes proximity. In another embodiment, the bedside monitor can include a second short range radio unit which either scans for signals from the individual on body sensor nodes or sends beacon signals to the mobile aggregator to establish proximity.

[0019] In another embodiment, radio signal strength is relied upon to determine proximity of the wireless sensors to the fixed aggregator. However, a map and an asset tracking system or GPS systems can be utilized to determine proximity at the server level.

[0020] FIGURE 2 illustrates a system **50** that facilitates conserving battery power in on-body devices or sensors. The fixed aggregator **16** discovers that the mobile PAN has returned to the FA's vicinity and that connectivity between the FA and the mobile group of sensors **52** is once again possible using short range radio. This approach improves battery life of the mobile sensors **S1, S2, S3**, and therefore increases convenience for the user (e.g., layman, medical provider, etc.). In one embodiment, the FA only connects to sensors that are part of a mobile sensor group connected to the FA-PAN **20.** Thus, Figure 2 shows an example configuration for fixed mode operation where the FA **16** is the PAN coordinator for the FA-PAN. Three reduced function device (RFD) sensors **S1, S2,** and **S3,** as well as a fourth sensor (the MA) **22,** which is a full-function device and WLAN-capable, are connected to the FA-PAN. The MA's WLAN radio (not shown) is not used for communication and turned off to save power in this embodiment. All data coming from the sensors is routed through the FA to the wired network **18** and on to a server **54.** As the mobile sensor group **52** moves away from the FA **16,** communication with the FA is no longer possible, and the communication scheme transitions from that shown in Figure 2 to that shown in Figure 3.

[0021] FIGURE 3 illustrates a system **60** in a mobile mode of operation, where the MA sensor **22** has started its own PAN (MA-PAN) **24** and the sensors **S1, S2** and **S3** have connected to the MA-PAN and the MA further transmits the patient information to the wired network. The MA has established a connection to the WLAN infrastructure and uses this link to forward the sensor data to the wired network **18.** The FA **16** does not have any more devices attached to it after the mobile sensor group **52** has left, which frees up its short range radio. In this embodiment, the FA uses its short range radio to scan for the MA-PAN **24** for transmissions from the MA **22** in all channels (passive scan) or by sending beacon requests (active scan) in all channels. The MA may also store its current channel in the server **54** via the wired network, from which the FA can retrieve its current channel for a more targeted scanning. The MA can be notified that the mobile sensor group is once again in the vicinity of the FA in several ways. In one embodiment, the FA communicates with the MA over short range radio link. In another embodiment, the FA communicates with the MA through the wired network over a WLAN link. In another embodiment, the MA detects beacon requests from the FA.

[0022] FIGURE 4 illustrates a system **70** in which the FA **16** has fixed sensors **S4, S5** connected to its PAN **20,** wherein the sensors **S4, S5** are not part of the mobile sensor group **52.** As the mobile sensor group leaves the coverage area of the FA and starts its own PAN, **S4** and **S5** remain connected to the FA. In this case the FA cannot easily change its channel to scan for the MA **22** because it has to maintain connectivity to the fixed sensors **S4** and **S5.** In this embodiment, the FA uses a second onboard short range radio (not shown) to scan for the MA-PAN for transmissions from the MA. The scanning can be either passive or active as described previously. The MA can be notified that short range radio connectivity can be re-established with the FA through the mechanisms described with regard to Figure 3.

[0023] In another embodiment, the FA instructs one of the fixed sensors connected to it, e.g. **S4** or **S5,** to scan for the MA-PAN. The scanning can be either passive or active as described previously with regard to Figure 3. The fixed sensor reports the results back to the FA. The MA can be notified that short range radio connectivity can be re-established with the FA through the mechanisms described with regard to Figure 3.

[0024] FIGURE 5 illustrates a system in a mobile mode of operation, where the MA sensor has started its own PAN (MA-PAN) and the sensors have connected to the MA PAN and the MA further transmits the patient information to the wired network. The FA continues to have fixed sensors connected to its PAN. The MA may store information about its WLAN connectivity (WLAN channel, etc.) on a server **54** in the network **18,** where the FA can retrieve it for a more targeted scanning. To infer from successful receptions of WLAN transmissions from the MA that the MA is in range of the short range radio, the FA may compare the received signal strength (RSS) of the WLAN transmission to a pre-determined threshold.

If the RSS exceeds the pre-determined threshold, short range radio communication may be determined to be possible. The MA can be notified that short range radio connectivity can be re-established with the FA through the mechanisms described with regard to Figure 3.

[0025] FIGURE 6 illustrates a system **90** showing the FA **16** and MA **22** in greater detail, and coupled to the wired network **18,** e.g., via a wired or wireless connection. It will be appreciated that each of devices (e.g., the fixed aggregator, the mobile aggregator, the server etc.), and the wired network described in various embodiments and figures herein may include a memory or computer-readable medium that stores, and one or more processors that executes, computer-executable instructions for performing the various functions, actions, steps, methods, etc., described herein. For instance, the FA **16** includes a processor **92** and memory **94,** and the MA **22** includes a processor **100** and a memory **102.** The memory may be a computer-readable medium on which a control program is stored, such as a disk, hard drive, or the like. Common forms of computer-readable media include, for example, floppy disks, flexible disks, hard disks, magnetic tape, or any other magnetic storage medium, CD-ROM, DVD, or any other optical medium, RAM, ROM, PROM, EPROM, FLASH-EPROM, variants thereof, other memory chip or cartridge, or any other tangible medium from which the processor can read and execute. In this context, the systems described herein may be implemented on or as one or more general purpose computers, special purpose computer(s), a programmed microprocessor or microcontroller and peripheral integrated circuit elements, an ASIC or other integrated circuit, a digital signal processor, a hardwired electronic or logic circuit such as a discrete element circuit, a programmable logic device such as a PLD, PLA, FPGA, Graphical card CPU (GPU), or PAL, or the like.

[0026] A server **54** is coupled to the wired network includes one or more maps **110** of a healthcare facility or environment (e.g., a hospital, nursing home, a patient's home in the case of home-monitoring, etc.). Additionally, each of the FA, the MA, and a server **54** coupled to the wired network includes a GPS module **99, 108, 112** respectively with which the location of the MA relative to the FA can be tracked. In another embodiment, the server includes an asset tracking system **114** that is used in conjunction with the map(s) **110** to track the location of the MA relative to the FA.

[0027] The system **90** facilitates transferring a patient monitoring sensor group (Figures 2-5) between fixed and mobile modes of communication with the wired network **18.** In one embodiment, the fixed aggregator module detects when the sensor group and/or the MA **22** is within a predefined distance from the fixed aggregator module (e.g., 10 meters or so). When the MA is determined to be within range of the FA, The FA notifies the MA that the sensor group and the one or more patient-mounted sensors that are communicating through the MA switch over to communicate patient status information to the wired network **18** via the FA.

[0028] Several manners of detecting the MA are described herein. In one embodiment, the FA includes a short range radio **96** that scans a plurality of short range radio channels to detect transmissions from a short range radio **104** in the MA, in order to detect the sensor group. Additionally or alternatively, the FA includes a WLAN radio **98** that scans a plurality of WLAN radio channels to detect transmissions from a WLAN radio **106** in the MA, which the MA uses to transmit patient information received from the sensors to the wired network.

[0029] In another embodiment, the FA's processor **92** establishes a communication link with the wired network, and the MA's processor **100** also establishes a communication link with the wired network **18.** The server **54** monitors the location of the mobile aggregator sensor relative to the fixed aggregator module using the map **112** and at least one of the GPS modules or the asset tracking system.

[0030] In another embodiment, the at least one of the short range radio **96** and the WLAN radio **98** transmits a beacon signal from the FA, and the MA includes at least one of a short range radio **104** and a WLAN radio **106** that transmits a signal indicating that the mobile aggregator sensor is within the predefined distance of the fixed aggregator module in response to the beacon signal.

[0031] The MA establishes a mobile aggregator personal area network (MA-PAN) when outside of the predefined distance from the fixed aggregator, receives patient parameter data from the one or more patient sensors via the MA-PAN, and transmits the patient parameter data to the wired network over a wireless local area network (WLAN) communication link. The patient parameter data may include without limitation information associated with a patient parameter including information associated with blood pressure, heart rate, respiratory rate, temperature, blood oxygen level, etc.

[0032] FIGURE 7 illustrates a method of transferring a patient monitoring sensor group between fixed and mobile modes of communication with a wired healthcare network. At **120,** a location of a patient-mounted, mobile sensor group is detected or monitored. The mobile sensor group comprises a plurality of reduced-function devices (RFDs) and at least one full-function device (FFD) that serves as a mobile aggregator (MA) sensor that aggregates information from all sensors in the group and transmits the information to a wired network. At **122,** a determination is made regarding whether the MA is within range of the FA for communication. If not, then at **124,** the sensed patient data is transmitted from the sensors through the MA to a wired network. If the MA is within range of the FA, then at **126** the MA is informed that it is within range of FA. At **128,** the sensor group begins transmitting sensed information to the FA (e.g., using a short-range radio communication link or the like), which is mains-powered (e.g., plugged into a wall or the like). In this manner valuable battery power is conserved at the MA.

[0033] The MA and mobile sensor group location monitoring is performed periodically or continuously, so that if the MA moves out of range of the FA, then the sensor group reverts back to transmitting through the MA for communication of patient parameter data (e.g., blood pressure, heart rate, temperature, respiratory rate, blood-oxygen level, etc.) to the wired network (e.g., via a WLAN communication link or the like). Determining the location of the MA relative to the FA can be performed in various ways (e.g., GPS, asset tracking, beacon signal and response, etc.) as described with regard to the preceding figures.

[0034] The invention has been described with reference to several embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description.

Claims

1. A method of transferring a patient monitoring sensor group (52), said sensor group (52) including one or more patient-mounted sensors (12, S1, S2, S3) and a mobile aggregator sensor (22) for establishing a mobile aggregator wireless personal area network (MA-PAN, 24), between fixed and mobile modes of communication with a wired healthcare network (18), wherein a fixed aggregator module (16) for establishing a fixed aggregator wireless personal area network (FA-PAN, 20) is connected to said wired healthcare network (18), said method comprising:

   detecting at the fixed aggregator module (16) that the sensor group (52) is within communication range of the fixed aggregator module (16);
   the fixed aggregator module (16) informing the mobile aggregator sensor (22) that the sensor group (52) is within communication range of the fixed aggregator module (16);
   when the fixed aggregator module (16) is within communication range of the sensor group (52), communicating status information from the sensor group (52) to the wired healthcare network (18) via the fixed aggregator module (16) through the fixed aggregator wireless personal area network (FA-PAN, 20); and
   when the mobile aggregator sensor (22) is out of communication range of the fixed aggregator module (16), establishing a mobile aggregator personal area network (MA-PAN, 24) at the mobile aggregator sensor (22), receiving the status information from the one or more patient-mounted sensors (12, S1, S2, S3) at the mobile aggregator sensor (22) via the mobile aggregator personal area network (MA-PAN, 24) and transmitting the status information from the mobile aggregator sensor (22) to the wired healthcare network (18) and bypassing the fixed aggregator module (16).

2. The method according to claim 1, wherein the mobile aggregator sensor (22) transmits the status information to the wired healthcare network over a wireless local area network communication link.

3. The method according to any one of claims 1-2, wherein detecting at the fixed aggregator module (16) that the sensor group (52) is within communication range of the fixed aggregator module (16) includes:
   monitoring, at the fixed aggregator module (16), a plurality of wireless local access network radio channels in order to detect wireless local access network transmissions from the mobile aggregator sensor (22).

4. The method according to any one of claims 1-2, wherein detecting at the fixed aggregator module (16) that the sensor group (52) is within communication range of the fixed aggregator module (16) includes:

   establishing a communication link between the wired healthcare network (18) and each of the mobile aggregator sensor (22) and the fixed aggregator module (16); and
   monitoring, at the wired healthcare network (18), the location of the mobile aggregator sensor (22) relative to the fixed aggregator module (16) using at least one of:

      a global positioning system (99, 108, 110) and a map (112) of the of the healthcare facility; and
      a map (112) of the healthcare facility and an asset tracking system (114).

5. The method according to any one of claims 1-2, wherein detecting at the fixed aggregator module (16) that the sensor group (52) is within communication range of the fixed aggregator module (16) includes:

   transmitting a beacon signal from the fixed aggregator module (16);
   receiving, via the wired healthcare network and in response to the beacon signal, location information from the mobile aggregator sensor (22) indicating that the mobile aggregator sensor (22) is within communication range of the fixed aggregator module (16).

6. The method according to any one of claims 1-2, wherein detecting at the fixed aggregator module (16) that the sensor group (52) is within communication range of the fixed aggregator module (16) in-

cludes:
monitoring, at the fixed aggregator module (16), a plurality of short range radio channels in order to detect short range radio transmissions from the mobile aggregator sensor (22).

7. The method according any one of the preceding claims, wherein the status information includes information associated with a patient parameter including at least one of:

blood pressure;
heart rate;
respiratory rate;
temperature; and
blood oxygen level.

8. A computer-readable medium carrying software for controlling a processor to configure and perform the method of claim 1.

9. A system for facilitating transferring a patient monitoring sensor group (52), said sensor group (52) including one or more patient-mounted sensors (12, S1, S2, S3) and a mobile aggregator sensor (22) for establishing a mobile aggregator wireless personal area network (MA-PAN, 24), between fixed and mobile modes of communication with a wired healthcare network (18), wherein a fixed aggregator module (16) for establishing a fixed aggregator wireless personal area network (FA-PAN, 20) is connected to said wired healthcare network (18), said system comprising:

the fixed aggregator module (16) configured to detect the sensor group (52), when the sensor group (52) is within communication range of the fixed aggregator module (16);
wherein the fixed aggregator module (16) is configured to notify the mobile aggregator sensor (22) that the sensor group (52) is within communication range of the fixed aggregator module (16); and
wherein the one or more patient-mounted sensors (12, S1, S2, S3) are configured to communicate status information to the wired healthcare network (18) via the fixed aggregator module (16) through the fixed aggregator wireless personal area network (FA-PAN, 20) when the sensor group is notified that it is within communication range of the fixed aggregator module (16) and to the wired healthcare network via the mobile aggregator wireless personal area network (MA-PAN, when the sensor group is not within communication range of the fixed aggregator module (16).

10. The system according to claim 9, wherein the mobile aggregator sensor (22) is configured to:

establish a mobile aggregator personal area network (MA-PAN, 24) when the mobile aggregator sensor (22) is out of communication range of the fixed aggregator module (16);
receive the status information from the one or more patient-mounted sensors (12, S1, S2, S3) via the mobile aggregator personal area network (MA-PAN, 24);
transmit the status information to the wired healthcare network (18) over a wireless local area network communication link.

11. The system according to either of claims 9 or 10, wherein the fixed aggregator module (16) includes a wireless local area network radio (98) configured to scan a plurality of wireless local area network radio channels to detect transmissions from a wireless local area network radio (106) in the mobile aggregator sensor (22), in order to detect that the sensor group (52) is within communication range of the fixed aggregator module (16).

12. The system according to either of claims 9 or 10, wherein the fixed aggregator module (16) includes a processor (92) configured to establish a communication link with the wired healthcare network (18) and the mobile aggregator sensor (22) includes a processor (100) configured to establish a communication link with the wired healthcare network (18), and wherein a server (54) coupled to the wired healthcare network (18) is configured to monitor the location of the mobile aggregator sensor (22) relative to the fixed aggregator module (16) using at least one of:

a global positioning system (99, 108, 110) and a map (112) of the of the healthcare facility; and
a map (112) of the healthcare facility and an asset tracking system (114).

13. The system according to either of claims 9 or 10, wherein the fixed aggregator module (16) includes at least one of a short range radio (96) and a wireless local area network radio (98) configured to transmit a beacon signal from the fixed aggregator module (16), and wherein the mobile aggregator sensor (22) includes at least one of a short range radio (104) and a wireless local area network radio (106) configured to transmit indicating that the mobile aggregator sensor (22) is within communication range of the fixed aggregator module (16) in response to the beacon signal.

14. The system according to either of claims 9 or 10, wherein the fixed aggregator module (16) includes a short range radio (96) configured to scan a plurality

of short range radio channels to detect transmissions from a short range radio (104) in the mobile aggregator sensor (22), in order to detect the sensor group (52).

15. The system according to any one of claims 9-14, wherein the fixed aggregator module (16) resides on a patient bedside monitor.

Patentansprüche

1. Verfahren zum Transferieren einer Patientenüberwachungssensorgruppe (52), wobei die genannte Sensorgruppe (52) einen oder mehrere am Patienten angebrachte Sensoren (12, S1, S2, S3) und einen mobilen Aggregatorsensor (22) zum Aufbauen eines drahtlosen Personal Area Network (MA-PAN, 24) des mobilen Aggregators umfasst, zwischen ortsfesten und mobilen Kommunikationsmodi mit einem drahtgebundenen Gesundheitsnetzwerk (18), wobei ein ortsfestes Aggregatormodul (16) zum Aufbauen eines drahtlosen Personal Area Network (FA-PAN, 20) des ortsfesten Aggregators mit dem genannten drahtgebundenen Gesundheitsnetzwerk (18) verbunden ist, wobei das genannte Verfahren Folgendes umfasst:

Detektieren, an dem ortsfesten Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet;
Informieren des mobilen Aggregatorsensors (22) durch das ortsfeste Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet;
wenn sich das ortsfeste Aggregatormodul (16) innerhalb der Kommunikationsreichweite der Sensorgruppe (52) befindet, Mitteilen von Statusinformationen aus der Sensorgruppe (52) an das drahtgebundene Gesundheitsnetzwerk (18) über das ortsfeste Aggregatormodul (16) durch das drahtlose Personal Area Network (FA-PAN, 20) des ortsfesten Aggregators; und
wenn sich der mobile Aggregatorsensor (22) außerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, Aufbauen eines Personal Area Network (MA-PAN, 24) des mobilen Aggregators am mobilen Aggregatorsensor (22), Empfangen der Statusinformationen aus dem einen oder mehreren am Patienten angebrachten Sensoren (12, S1, S2, S3) am mobilen Aggregatorsensor (22) über das Personal Area Network (MA-PAN, 24) des mobilen Aggregators und Senden der Statusinformationen aus dem mobilen Aggregatorsensor (22) an das drahtgebundene Gesundheitsnetzwerk (18) und Umgehen des ortsfesten Aggregatormoduls (16).

2. Verfahren nach Anspruch 1, wobei der mobile Agregatorsensor (22) die Statusinformationen über eine WLAN-Kommunikationsverbindung (Wireless Local Area Network) an das drahtgebundene Gesundheitsnetzwerk sendet.

3. Verfahren nach einem der Ansprüche 1 bis 2, wobei das Detektieren an dem ortsfesten Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, Folgendes umfasst:
Überwachen, am ortsfesten Aggregatormodul (16), einer Vielzahl von WLAN-Funkkanälen, um WLAN-Übertragungen von dem mobilen Aggregatorsensor (22) zu detektieren.

4. Verfahren nach einem der Ansprüche 1 bis 2, wobei das Detektieren an dem ortsfesten Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, Folgendes umfasst:

Aufbauen einer Kommunikationsverbindung zwischen dem drahtgebundenen Gesundheitsnetzwerk (18) und jedem von dem mobilen Aggregatorsensor (22) und dem ortsfesten Aggregatormodul (16); und
Überwachen, am drahtgebundenen Gesundheitsnetzwerk (18), des Orts des mobilen Aggregatorsensors (22) in Bezug auf das ortsfeste Aggregatormodul (16) unter Verwendung von mindestens einem von:

einem globalen Positionsbestimmungssystem (99, 108, 110) und einer Karte (112) der Gesundheitseinrichtung; und
einer Karte (112) der Gesundheitseinrichtung und eines Asset-Verfolgungssystems (114).

5. Verfahren nach einem der Ansprüche 1 bis 2, wobei das Detektieren an dem ortsfesten Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, Folgendes umfasst:

Senden eines Beacon-Signals von dem ortsfesten Aggregatormodul (16) aus;
Empfangen, über das drahtgebundene Gesundheitsnetzwerk und als Reaktion Antwort auf das Beacon-Signal, von Ortsinformationen von dem mobilen Aggregatorsensor (22), die angeben, dass sich der mobile Aggregatorsensor (22) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet.

6. Verfahren nach einem der Ansprüche 1 bis 2, wobei das Detektieren an dem ortsfesten Aggregatormodul (16), dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, Folgendes umfasst:
Überwachen, am ortsfesten Aggregatormodul (16), einer Vielzahl von Kurzstrecken-Funkkanälen, um Kurzstrecken-Funkübertragungen von dem mobilen Aggregatorsensor (22) zu detektieren.

7. Verfahren nach einem der vorstehenden Ansprüche, wobei die Statusinformationen Informationen umfassen, die einem Patientenparameter zugehörig sind, welcher mindestens eines von Folgendem umfasst:

Blutdruck;
Herzfrequenz;
Atemfrequenz;
Temperatur; und
Blutsauerstoffgehalt.

8. Computerlesbares Medium mit Software zum Steuern eines Prozessors, um das Verfahren aus Anspruch 1 zu konfigurieren und durchzuführen.

9. System zum Ermöglichen des Transferierens einer Patientenüberwachungssensorgruppe (52), wobei die genannte Sensorgruppe (52) einen oder mehrere am Patienten angebrachte Sensoren (12, S1, S2, S3) und einen mobilen Aggregatorsensor (22) zum Aufbauen eines drahtlosen Personal Area Network (MA-PAN, 24) des mobilen Aggregators umfasst, zwischen ortsfesten und mobilen Kommunikationsmodi mit einem drahtgebundenen Gesundheitsnetzwerk (18), wobei ein ortsfestes Aggregatormodul (16) zum Aufbauen eines drahtlosen Personal Area Network (FA-PAN, 20) des ortsfesten Aggregators mit dem genannten drahtgebundenen Gesundheitsnetzwerk (18) verbunden ist, wobei das genannte System Folgendes umfasst:

das ortsfeste Aggregatormodul (16), das konfiguriert ist, um die Sensorgruppe (52) zu detektieren, wenn sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet;
wobei das ortsfeste Aggregatormodul (16) konfiguriert ist, um den mobilen Aggregatorsensor (22) zu benachrichtigen, dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet; und
wobei der eine oder mehrere am Patienten angebrachte Sensoren (12, S1, S2, S3) konfiguriert sind, um dem drahtgebundenen Gesundheitsnetzwerk (18) über das ortsfeste Aggregatormodul (16) durch das drahtlose Personal Area Network (FA-PAN, 20) des ortsfesten Aggregators Statusinformationen mitzuteilen, wenn die Sensorgruppe benachrichtigt wird, dass sie sich innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet, und um dem drahtgebundenen Gesundheitsnetzwerk über das drahtlose Personal Area Network (MA-PAN, 24) des mobilen Aggregators Statusinformationen mitzuteilen, wenn sich die Sensorgruppe nicht innerhalb der Kommunikationsreichweite des ortfesten Aggregatormoduls (16) befindet.

10. System nach Anspruch 9, wobei der mobile Aggregatorsensor (22) konfiguriert ist zum:

Aufbauen eines Personal Area Network (MA-PAN, 24) des mobilen Aggregators, wenn sich der mobile Aggregatorsensor (22) außerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet;
Empfangen der Statusinformationen von dem einen oder mehreren am Patienten angebrachten Sensoren (12, S1, S2, S3) über das Personal Area Network (MA-PAN, 24) des mobilen Aggregators;
Senden der Statusinformationen an das drahtgebundene Gesundheitsnetzwerk (18) über eine WLAN-Kommunikationsverbindung.

11. System nach einem der Ansprüche 9 oder 10, wobei das ortsfeste Aggregatormodul (16) einen WLAN-Funk (98) umfasst, der konfiguriert ist, um eine Vielzahl von WLAN-Funkkanälen zu scannen und Übertragungen von einem WLAN-Funk (106) in dem mobilen Aggregatorsensor (22) zu detektieren, um zu detektieren, dass sich die Sensorgruppe (52) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet.

12. System nach einem der Ansprüche 9 oder 10, wobei das ortsfeste Aggregatormodul (16) einen Prozessor (92) umfasst, der konfiguriert ist, um eine Kommunikationsverbindung mit dem drahtgebundenen Gesundheitsnetzwerk (18) aufzubauen, und wobei der mobile Aggregatorsensor (22) einen Prozessor (100) umfasst, der konfiguriert ist, um eine Kommunikationsverbindung mit dem drahtgebundenen Gesundheitsnetzwerk (18) aufzubauen, und wobei ein mit dem drahtgebundenen Gesundheitsnetzwerk (18) gekoppelter Server (54) konfiguriert ist, um den Ort des mobilen Aggregatorsensors (22) in Bezug auf das ortsfeste Aggregatormodul (16) unter Verwendung von mindestens einem von Folgendem zu überwachen:

einem globalen Positionsbestimmungssystem (99, 108, 110) und einer Karte (112) der Ge-

sundheitseinrichtung; und
einer Karte (112) der Gesundheitseinrichtung und eines Asset-Verfolgungssystems (114).

13. System nach einem der Ansprüche 9 oder 10, wobei das ortsfeste Aggregatormodul (16) mindestens eines von einem Kurzstreckenfunk (96) und einem WLAN-Funk (98) umfasst, der konfiguriert ist, um ein Beacon-Signal von dem ortsfesten Aggregatormodul (16) aus zu senden, und wobei der mobile Aggregatorsensor (22) mindestens eines von einem Kurzstreckenfunk (104) und einem WLAN-Funk (106) umfasst, der konfiguriert ist, um als Reaktion auf das Beacon-Signal die Angabe zu senden, dass sich der mobile Aggregatorsensor (22) innerhalb der Kommunikationsreichweite des ortsfesten Aggregatormoduls (16) befindet.

14. System nach einem der Ansprüche 9 oder 10, wobei das ortsfeste Aggregatormodul (16) einen Kurzstreckenfunk (96) umfasst, der konfiguriert ist, um eine Vielzahl von Kurzstrecken-Funkkanälen zu scannen und Übertragungen von einem Kurzstreckenfunk (104) in dem mobilen Aggregatorsensor (22) zu detektieren, um die Sensorgruppe (52) zu detektieren.

15. System nach einem der Ansprüche 9 bis 14, wobei sich das ortsfeste Aggregatormodul (16) auf einem bettseitigen Patientenmonitor befindet.

Revendications

1. Procédé de transfert d'un groupe de capteurs (52) de surveillance d'un patient, ledit groupe de capteurs (52) incluant un ou plusieurs capteurs placés sur le patient (12, S1, S2, S3) et un capteur d'agrégateur mobile (22) pour établir un réseau personnel d'agrégateur sans fil mobile (MA-PAN, 24), entre des modes de communication fixes et mobiles avec un réseau de soins filaire (18), dans lequel un module d'agrégateur fixe (16) pour établir un réseau personnel sans fil d'agrégateur fixe (FA-PAN, 20) est relié audit réseau de soins filaire (18), ledit procédé comprenant :

la détection au niveau du module d'agrégateur fixe (16) du fait que le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) ;
le module d'agrégateur fixe (16) informant le capteur d'agrégateur mobile (22) que le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) ;
lorsque le module d'agrégateur fixe (16) est dans la portée de communication du groupe de capteurs (52), la communication des informations d'état du groupe de capteurs (52) au réseau de soin filaire (18) via le module d'agrégateur fixe (16) dans le réseau personnel d'agrégateur sans fil fixe (FA-PAN, 20) ; et
lorsque le capteur d'agrégateur mobile (22) est hors de la portée de communication du module d'agrégateur fixe (16), l'établissement d'un réseau personnel d'agrégateur mobile (MA-PAN, 24) au niveau du capteur d'agrégateur mobile (22) recevant les informations d'état des uns ou plusieurs capteurs (12, S1, S2, S3) placés sur le patient, au niveau du capteur d'agrégateur mobile (22) via le réseau personnel d'agrégateur mobile (MA-PAN, 24) et la transmission des informations d'état depuis le capteur d'agrégateur mobile (22) au réseau de soins filaire (18) et le contournement du module d'agrégateur fixe (16).

2. Procédé selon la revendication 1, dans lequel le capteur d'agrégateur mobile (22) transmet les informations d'état au réseau de soin filaire par un lien de communication du réseau local sans fil.

3. Procédé selon l'une quelconque des revendications 1 à 2, dans lequel la détection au niveau du module d'agrégateur fixe (16) selon laquelle le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) inclut :
la surveillance, au niveau du module d'agrégateur fixe (16), d'une pluralité de canaux radio du réseau d'accès local sans fil afin de détecter des transmissions de réseau d'accès local sans fil à partir du capteur d'agrégateur mobile (22).

4. Procédé selon l'une quelconque des revendications 1 à 2, dans lequel la détection au niveau du module d'agrégateur fixe (16) selon laquelle le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) inclut :

l'établissement d'un lien de communication entre le réseau de soins filaire (18) et chacun parmi le capteur d'agrégateur mobile (22) et le module d'agrégateur fixe (16) ; et
la surveillance, au niveau du réseau de soins filaire (18), de l'emplacement du capteur d'agrégateur mobile (22) par rapport au module d'agrégateur fixe (16) en utilisant au moins l'un parmi :

un système de positionnement mondial (99, 108, 110) et une carte (112) de l'installation de soins ; et
une carte (112) de l'installation de soins et un système de repérage des biens (114).

5. Procédé selon l'une quelconque des revendications 1 à 2, dans lequel la détection au niveau du module d'agrégateur fixe (16) selon laquelle le groupe de

capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) inclut :

la transmission d'un signal de balise à partir du module d'agrégateur fixe (16) ;
la réception, via le réseau de soins filaire et en réponse au signal de balise, les informations d'emplacement du capteur d'agrégateur mobile (22) indiquant que le capteur d'agrégateur mobile (22) est dans la portée de communication du module d'agrégateur fixe (16).

6. Procédé selon l'une quelconque des revendications 1 à 2, dans lequel la détection au niveau du module d'agrégateur fixe (16) selon laquelle le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) inclut :
la surveillance, au niveau du module d'agrégateur fixe (16), d'une pluralité de canaux radio à courte portée afin de détecter des transmissions radio à courte portée à partir du capteur d'agrégateur mobile (22).

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel les informations d'état incluent des informations associées à un paramètre du patient incluant au moins l'un parmi :

la pression artérielle ;
la fréquence cardiaque ;
la fréquence respiratoire ;
la température ; et
le niveau d'oxygène sanguin.

8. Logiciel portant un support pouvant être lu par ordinateur pour commander un processeur pour configurer et mettre en oeuvre le procédé selon la revendication 1.

9. Système pour faciliter le transfert d'un groupe de capteurs (52) de surveillance d'un patient, ledit groupe de capteurs (52) incluant un ou plusieurs capteurs placés sur le patient (12, S1, S2, S3) et un capteur d'agrégateur mobile (22) pour établir un réseau personnel d'agrégateur sans fil mobile (MA-PAN, 24), entre des modes de communication fixes et mobiles avec un réseau de soins filaire (18), dans lequel un module d'agrégateur fixe (16) pour établir un réseau personnel sans fil d'agrégateur fixe (FA-PAN, 20) est relié audit réseau de soins filaire (18), ledit système comprenant :

le module d'agrégateur fixe (16) configuré pour détecter le groupe de capteurs (52) lorsque le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) ;
dans lequel le module d'agrégateur fixe (16) est configuré pour notifier au capteur d'agrégateur mobile (22) que le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16) ; et
dans lequel les un ou plusieurs capteurs (12, S1, S2, S3) placés sur le patient sont configurés pour communiquer des informations d'état au réseau de soins filaire (18) via le module d'agrégateur fixe (16) dans le réseau personnel d'agrégateur sans fil fixe (FA-PAN, 20) lorsqu'il est notifié au groupe de capteurs qu'il est dans la portée de communication du module d'agrégateur fixe (16) et au réseau de soins filaire via le réseau personnel d'agrégateur mobile sans fil (MA-PAN, 24) lorsque le groupe de capteurs n'est pas dans la portée de communication du module d'agrégateur fixe (16).

10. Système selon la revendication 9, dans lequel le capteur d'agrégateur mobile (22) est configuré pour :

établir un réseau personnel d'agrégateur mobile (MA-PAN, 24) lorsque le capteur d'agrégateur mobile (22) est hors de la portée de communication du module d'agrégateur fixe (16) ;
recevoir les informations d'état parmi les un ou plusieurs capteurs (12, S1, S2, S3) placés sur le patient via le réseau personnel d'agrégateur mobile (MA-PAN, 24) ;
transmettre les informations d'état au réseau de soins filaire (18) par un lien de communication du réseau local sans fil.

11. Système selon l'une ou l'autre des revendications 9 ou 10, dans lequel le module d'agrégateur fixe (16) inclut une radio de réseau local sans fil (98) configurée pour balayer une pluralité de canaux de radio de réseau local sans fil pour détecter des transmissions d'une radio de réseau local sans fil (106) dans le capteur d'agrégateur mobile (22), afin de détecter que le groupe de capteurs (52) est dans la portée de communication du module d'agrégateur fixe (16).

12. Système selon l'une ou l'autre des revendications 9 ou 10, dans lequel le module d'agrégateur fixe (16) inclut un processeur (92) configuré pour établir un lien de communication avec le réseau de soins filaire (18) et le capteur d'agrégateur mobile (22) inclut un processeur (100) configuré pour établir un lien de communication avec le réseau de soins filaire (18), et dans lequel un serveur (54) couplé au réseau de soins filaire (18) est configuré pour surveiller l'emplacement du capteur d'agrégateur mobile (22) par rapport au module d'agrégateur fixe (16) en utilisant au moins l'un parmi :

un système de positionnement mondial (99, 108, 110) et une carte (112) de l'installation de

soins ; et
une carte (112) de l'installation de soins et un système de repérage des biens (114).

13. Système selon l'une ou l'autre des revendications 9 ou 10, dans lequel le module d'agrégateur fixe (16) inclut au moins l'un parmi une radio à courte portée (96) et une radio de réseau local sans fil (98) configurée pour transmettre un signal de balise à partir du module d'agrégateur fixe (16), et dans lequel le capteur d'agrégateur mobile (22) inclut au moins l'un parmi une radio à courte portée (104) et une radio de réseau local sans fil (106) configurée pour transmettre une indication selon laquelle le capteur d'agrégateur mobile (22) est dans la portée de communication du module d'agrégateur fixe (16) en réponse au signal de balise.

14. Système selon l'une ou l'autre des revendications 9 ou 10, dans lequel le module d'agrégateur fixe (16) inclut une radio à courte portée (96) configurée pour balayer une pluralité de canaux de radio à courte portée pour détecter des transmissions à partir d'une radio à courte portée (104) dans le capteur d'agrégateur mobile (22) afin de détecter le groupe de capteurs (52).

15. Système selon l'une quelconque des revendications 9 à 14, dans lequel le module d'agrégateur fixe (16) se trouve sur un moniteur au chevet d'un patient.

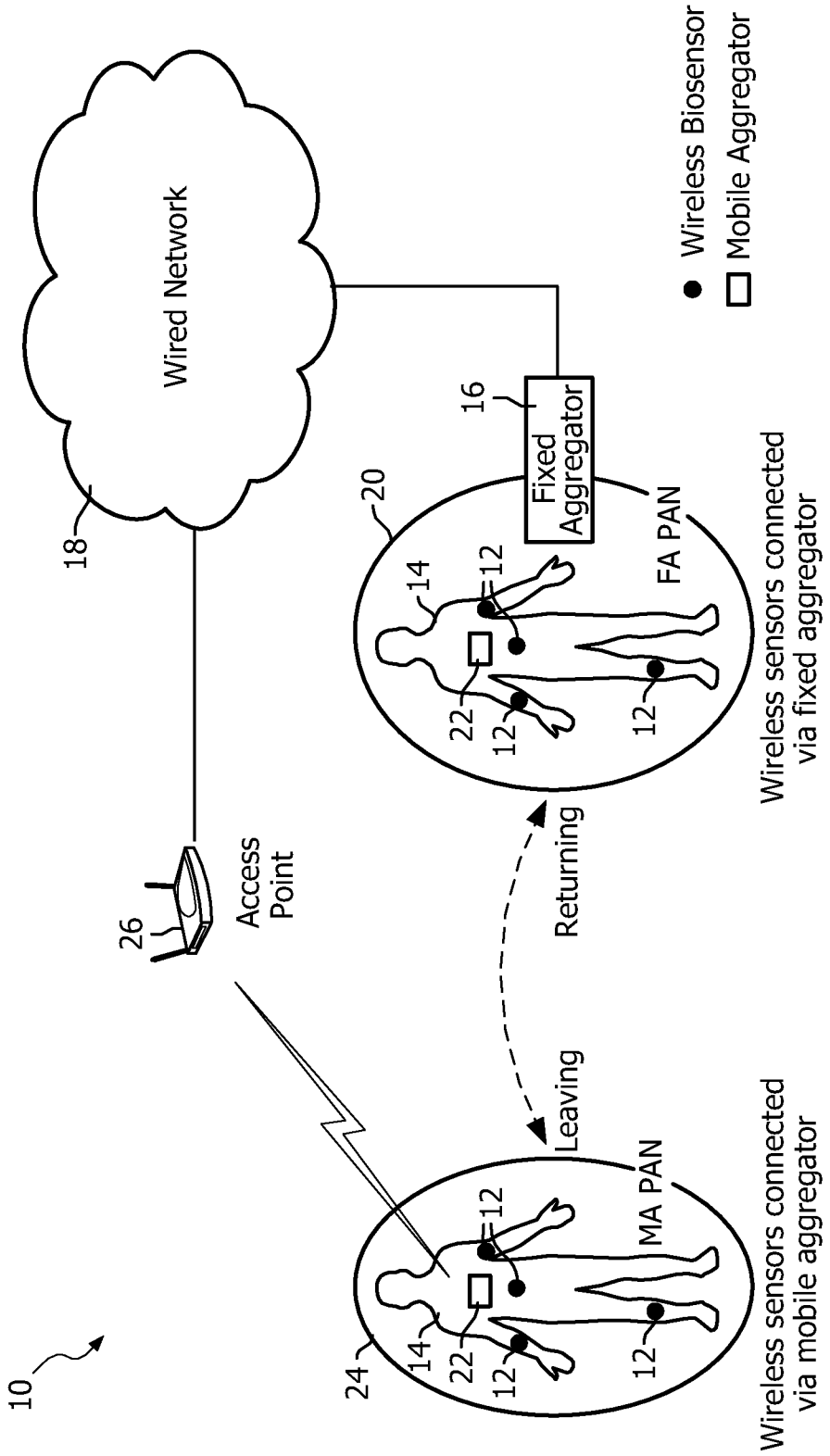
Wireless Biosensor
Mobile Aggregator
Wired Network
18
16
Fixed Aggregator
20
14
12
22
12
12
FA PAN
Wireless sensors connected via fixed aggregator
Returning
Leaving
Access Point
26
10
24
14
22
12
12
12
MA PAN
Wireless sensors connected via mobile aggregator

FIG. 1

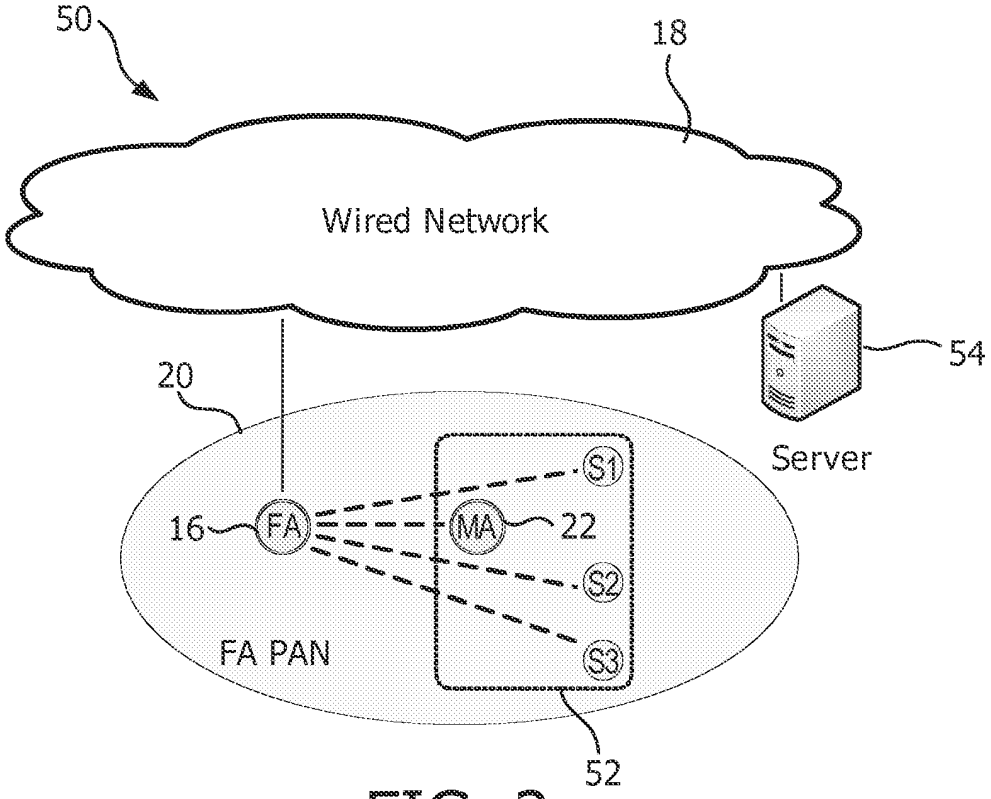
50
18
Wired Network
54
Server
20
16
FA
MA
22
S1
S2
S3
FA PAN
52

FIG. 2

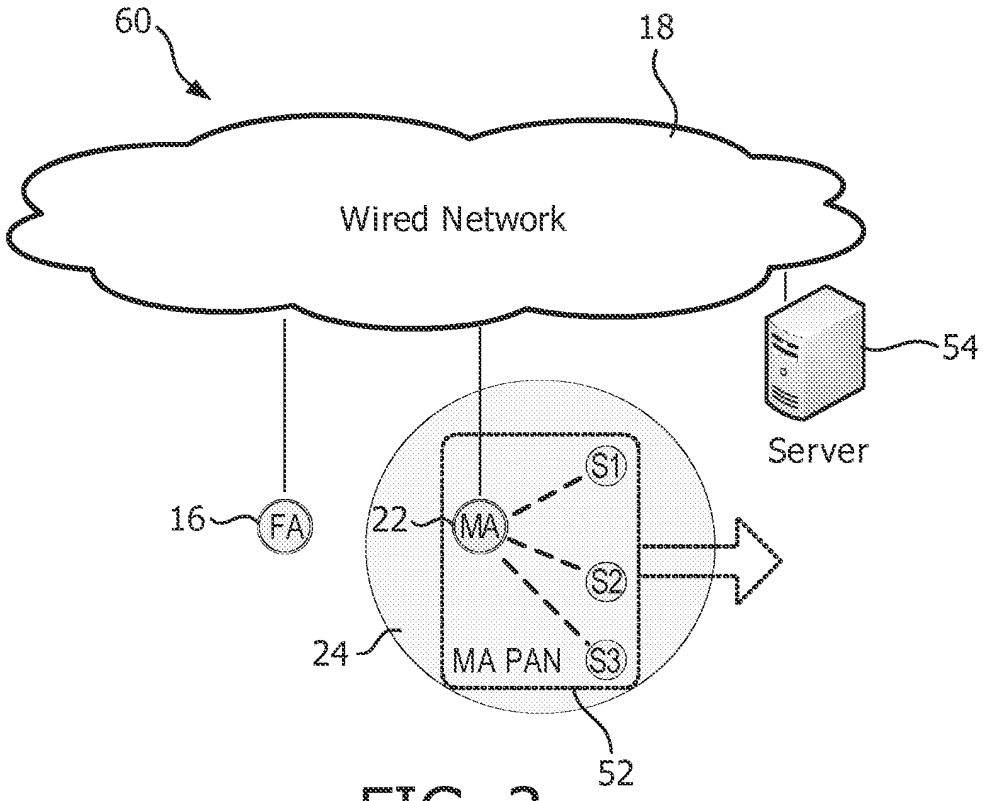
60
18
Wired Network
54
Server
16
FA
22
MA
S1
S2
S3
24
MA PAN
52

FIG. 3

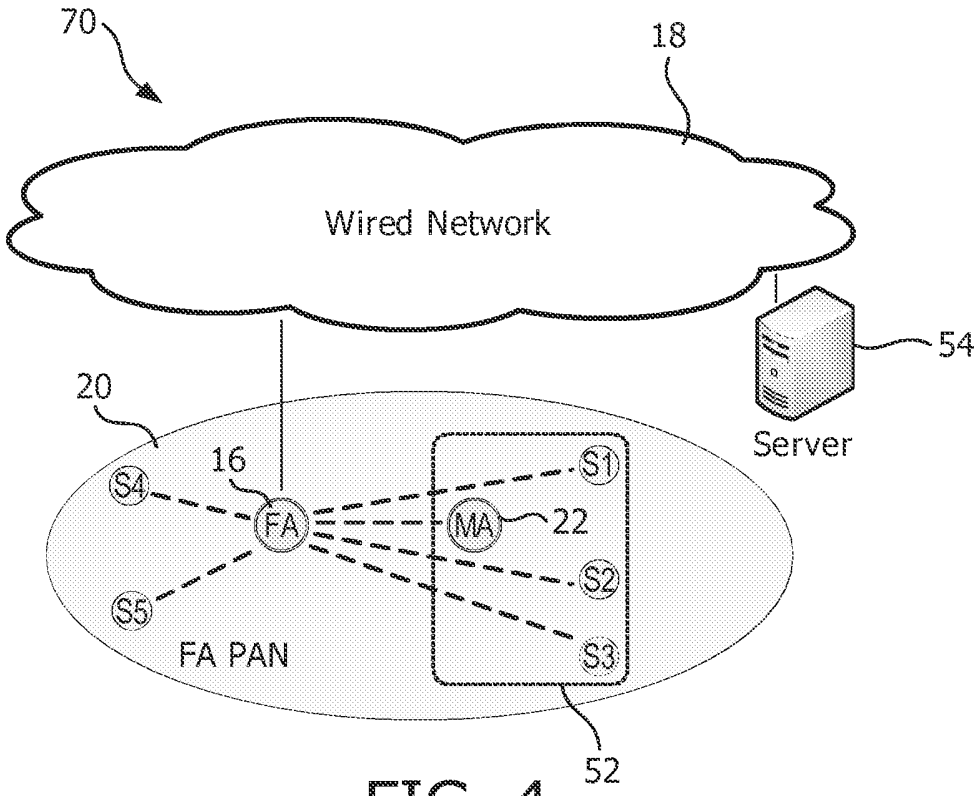
70
18
Wired Network
54
Server
20
16
S4
FA
S1
MA
22
S2
S5
FA PAN
S3
52

FIG. 4

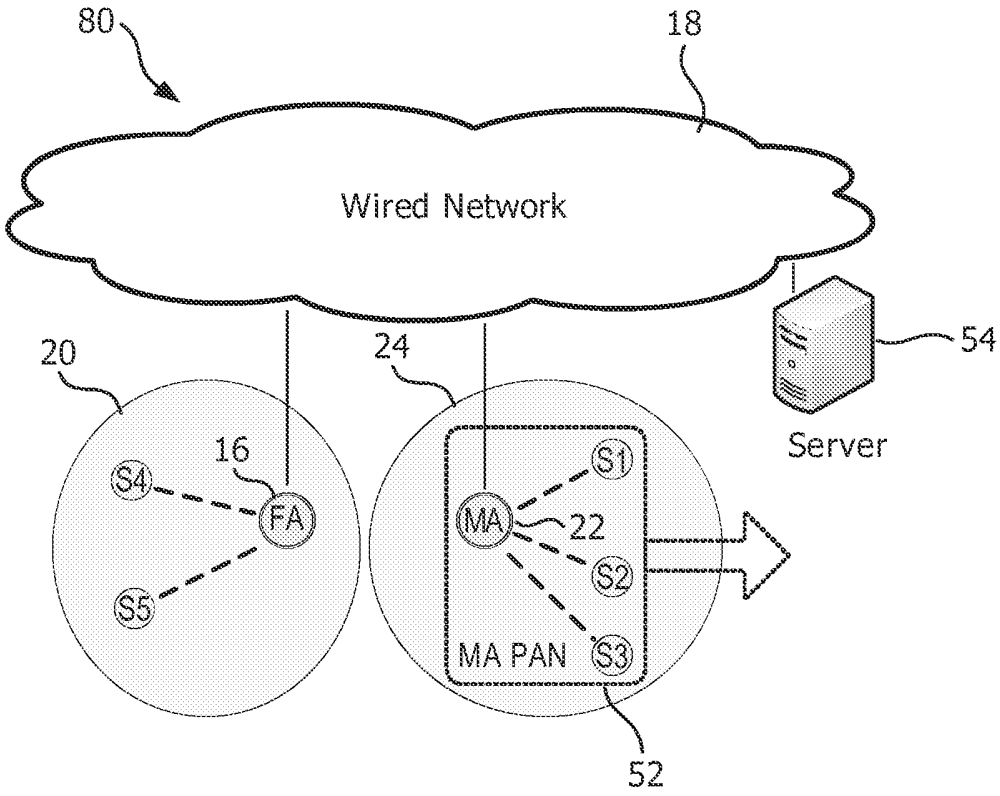
80
18
Wired Network
54
Server
20
24
16
S4
FA
S1
MA
22
S2
S5
MA PAN
S3
52

FIG. 5

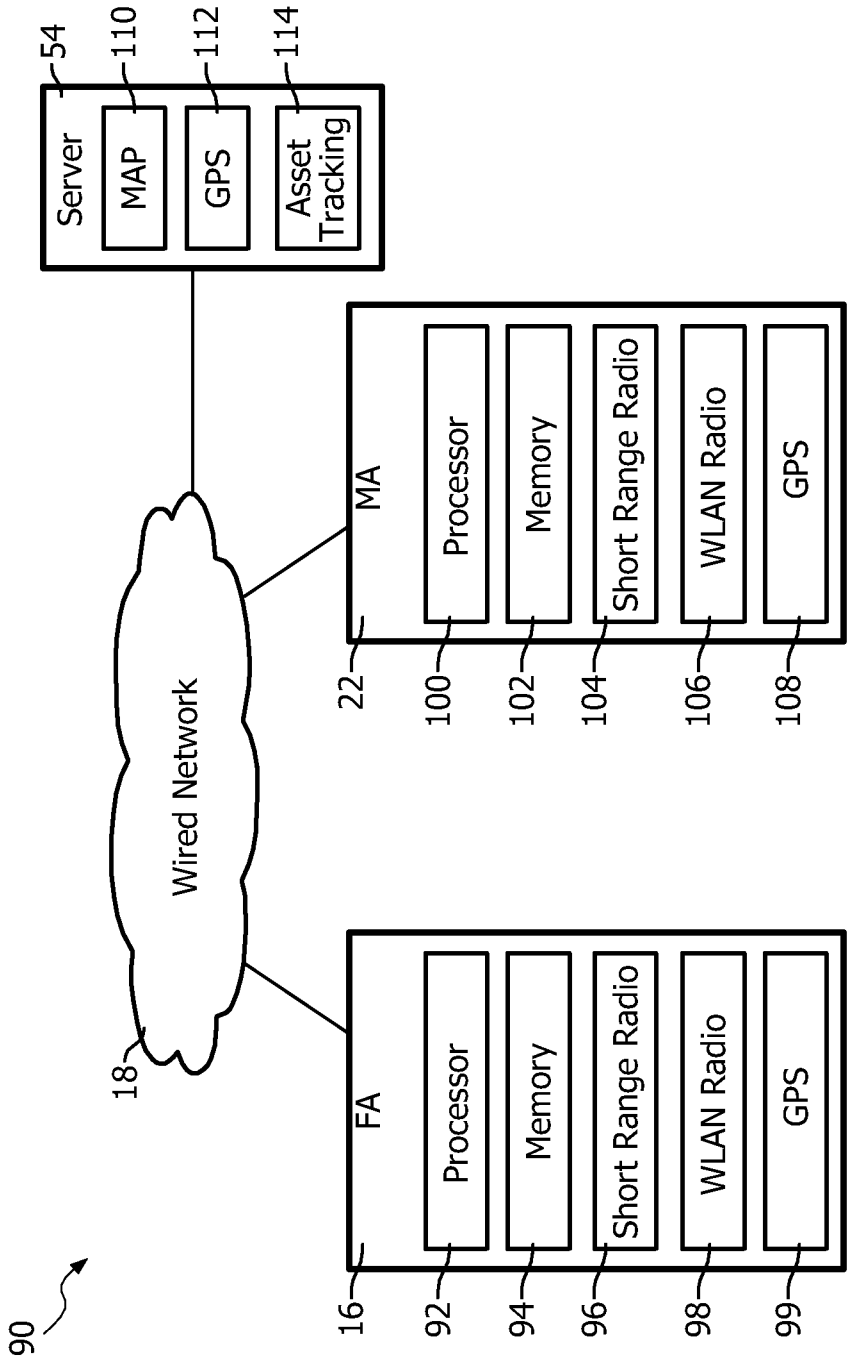
90
54
Server
110
MAP
112
GPS
114
Asset Tracking
18
Wired Network
16
FA
92
Processor
94
Memory
96
Short Range Radio
98
WLAN Radio
99
GPS
22
MA
100
Processor
102
Memory
104
Short Range Radio
106
WLAN Radio
108
GPS

FIG. 6

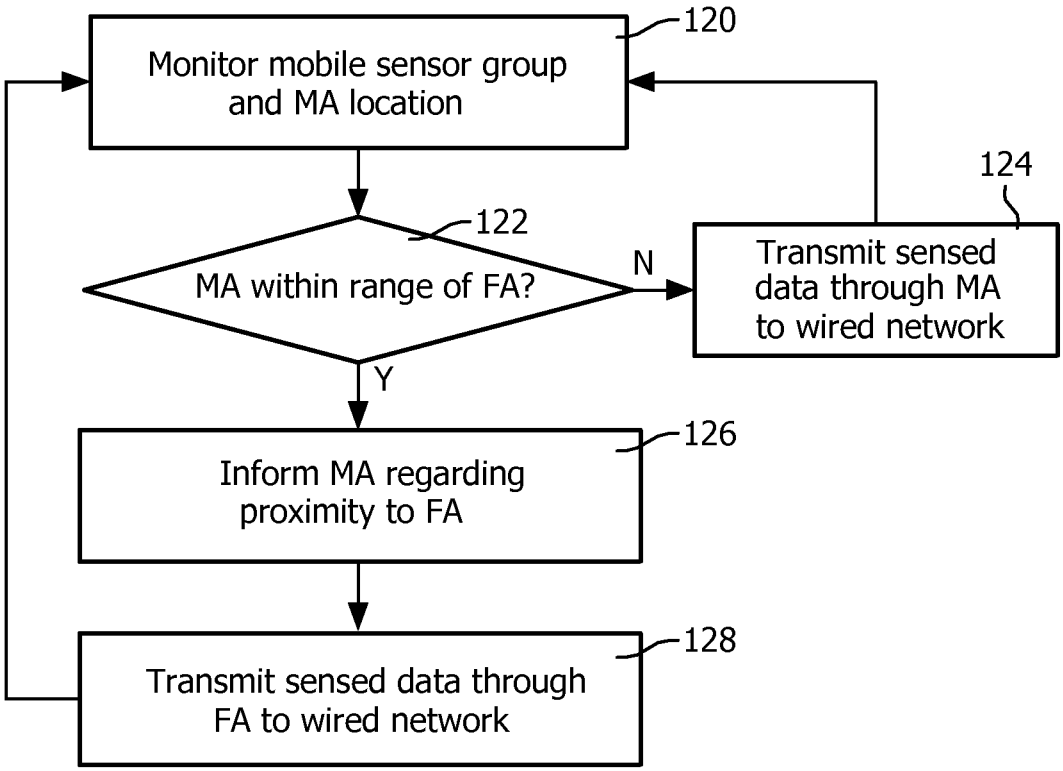
Monitor mobile sensor group and MA location
120
MA within range of FA?
122
N
Y
Transmit sensed data through MA to wired network
124
Inform MA regarding proximity to FA
126
Transmit sensed data through FA to wired network
128

FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- WO 2005062232 A2 **[0007]**

专利名称(译)	节能体传感器网络发现方法		
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摘要(译)

当在医疗保健环境中监视患者时，电池供电的移动聚合器（MA）传感器（22）的位置，其安装在具有一个或多个其他患者安装的传感器（12，S1，S2，S3）的患者身上，受到监控。 MA（22）维护用于传感器（12，S1，S2，S3）的个人区域网络（PAN）（24）并且将来自患者安装的传感器（12，S1，S2，S3）的信号无线传输到有线网络（18）。当MA（22）进入电源供电的固定聚合器（FA）（16）的范围内时，MA（22）被告知FA（16）的可用性，将患者数据通信任务传送给FA（16）），并关闭其PAN以节省电池电量。如果患者移出FA（16）的范围，则MA（22）再生PAN（24）并恢复无线患者数据传输。

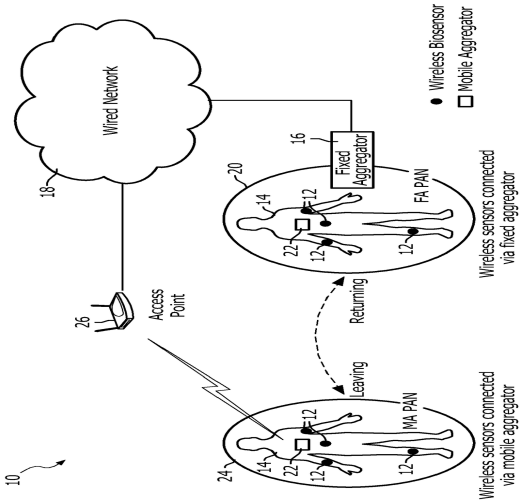

FIG. 1