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(54) **WIRELESS MEDICAL MONITORING DEVICE**

DRAHTLOSE MEDIZINISCHE ÜBERWACHUNGSVORRICHTUNG

DISPOSITIF DE SURVEILLANCE MEDICALE SANS FIL

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Description

[0001] The following relates to monitoring a person's physiological state. It finds particular application to wireless body networks and, more particularly, to conveying at least a subset of physiological data signals via previously allocated spectra to a monitoring system. Some aspects are also applicable for general wellness monitoring.

[0002] Patients have traditionally been monitored using sensing units connected by wires to a base unit. These wires inhibited patient mobility and were labor intensive to install. To facilitate installation and eliminate wire clutter, wireless sensing units have been developed. Wireless units also enable the patient to move around the room and possibly the ward or the hospital. Outpatients were similarly limited to a convalescent room or possibly their home. Many outpatients, while needing monitoring are well enough to move about the community, but to do so they had to move about unmonitored. Although higher powered wireless monitors are theoretically possible, there are radio frequency communication spectrum problems. Particularly, there is a shortage of frequency bands, and existing bands are crowded.

[0003] Spectrum access, use, efficiency, and reliability are critical public policy issues. In response to the increasing demand for spectrum use within a domain of a finite number of frequency bands, the United States Federal Communications Commission (FCC) is looking at proposed rule changes that will allow third parties to use a portion of a previously allocated spectrum when that portion is not being utilized by the controlling party. Currently, they have divided the communications frequency spectrum into many bands that have been allocated, leased or sold to specific users/industries (e.g., radio, television, wire, satellite and cable). The quantity and quality of unused previously allocated spectrum available to third parties and the duration that such spectrum will be available (e.g., remain unused) will vary from allocated party to allocated party.

[0004] WO 03/101289 A1 discloses a deployable telemetry system for communicating medical information, which includes portable modules that receive medical information associated with one or more patients. The portable modules have devices including a medical device that collects the medical information comprising medical data, an audio-video device that collects the medical information comprising multi media data, and a communication device that communicates the medical information to a station in real time. A paramedic station may be used to collect and communicate medical information about the patient. The paramedic station is operated by a user. A communication manager determines the capacity of communication links and makes a link selection in response to the determination. It also supports dynamic bandwidth allocation across multiple communication devices and supports various data rates based on the available communication links. A routing engine provides routing support for applications. It decides how data streams from applications are to be transmitted to communication devices. Thus, patient telemetry is sent over a dedicated communication device.

[0005] US 2004/0146149 A1 discloses a medical monitoring system having a sensor system including a sensor associated with a patient and a remote monitoring unit. The remote monitoring unit includes a microprocessor in communication with the sensor system, and a portable-monitoring unit transceiver system in communication with the microprocessor. The portable-monitoring unit transceiver system has a land-line telephone transceiver and/or a cellular telephone receiver, and a third-network transceiver such as a paging-network transceiver. A full data set is transmitted over the land-line telephone transceiver or the cellular telephone transceiver when communication links over these transceivers are available, and a reduced data set is transmitted over the third-network transceiver when communication links over the land-line telephone transceiver and the cellular telephone transceiver are not available.

[0006] The following relates to a patient monitoring system as defined in claim 1. Advantageous embodiments are defined in the dependent claims.

[0007] One advantage includes wirelessly communicating signals from a wireless Body Area Network (BAN) over previously allocated but unused spectrum for monitoring by a clinician.

[0008] Another advantage resides in enabling extended patient monitoring outside the hospital with minimal modification to their lifestyle.

[0009] Another advantage is wireless monitoring that can be deployed anywhere in the world with minimal configuration.

[0010] Another advantage resides in reducing the numerous wires between a patient, monitoring systems, and associated displays.

[0011] Another advantage resides in an alternative for managing disease and outpatient care.

[0012] Still further advantages will become apparent to those of ordinary skill in the art upon reading and understanding the detailed description of the preferred embodiments.

FIGURE 1 illustrates a cognitive (spectrum agile) device for receiving and selectively conveying signals from one or more monitoring devices residing within a wireless body network.

FIGURE 2 illustrates an embodiment of the cognitive monitor having a cognitive monitor reasoner component that determines the signals to transmit.

FIGURE 3 illustrates an exemplary embodiment of the cognitive monitor reasoner component.

FIGURE 4 illustrates an embodiment of the cognitive radio having a cognitive radio reasoner component.

FIGURE 5 illustrates an exemplary embodiment of the cognitive radio reasoner component.

[0013] FIGURE 1 illustrates a cognitive (spectrum agile) device 2 for receiving and selectively conveying signals from one or more monitoring devices residing within a wireless body network. The cognitive device 2 includes a cognitive radio 4 that detects frequency spectrum 6 within a transmission range of a transmitter 8 of the cognitive device 2. The cognitive radio 4 determines various characteristics (e.g., noise, total bandwidth, unused bandwidth, application, frequency range...) of the detected spectrum and recommends a transmission spectrum (and protocol, power, coding scheme...) for the transmitter 8 based at least in part on the characteristics. The characteristics define a bandwidth opportunity to transmit signals.

[0014] The selected transmission spectrum can be associated with various networks such as wireless a cellular network, a Wide Area Network (WAN), a Local Area Networks (LAN), a Metropolitan Area Network (MAN), a Campus Area Network (CAN), a Home Area Network (HAN), a Personal Area Networks (PAN), and the like. The cognitive radio 4 continuously (e.g., at some predefined rate) monitors spectrum and dynamically changes parameters (e.g., the transmission spectrum, protocol, coding scheme...) based on interaction with the environment in which it operates. This interaction can involve active negotiation or communications with other spectrum users and/or passive sensing and decision making within the radio 4. The cognitive radio 4 provides the transmission spectrum recommendation and the spectrum characteristics to a cognitive monitor 10.

[0015] The cognitive monitor 10 is an intelligent system that decides what monitored information will be communicated by the transmitter 8. The decision making involves understanding monitoring parameters, a patient's condition, and the environment. The cognitive monitor 10 receives information (e.g., sensed signals, personal information...) from one or more sensors 12 or emitters 14 residing on an individual's body through a Body Area Network (BAN) 16. The sensors 12 collect information such as an Electrocardiogram (ECG), an Electroencephalogram (EEG), an Electromyogram (EMG), a non-invasive blood pressure (NiBP), pulse, respirations, blood oxygen (Sp02), core body temperature, etc. The emitters 14 transmit an individual's identification, current medications, scheduled procedures, etc. In some aspects, devices (not shown) that sense environmental information communicate such information to the BAN.

[0016] After collecting this information, the cognitive monitor 10 analyzes the signals. Such analysis includes fusion techniques such as verifying blood pressure using ECG signals to identify erroneous signals (artifacts), which are ignored or discarded. In addition, the analysis includes parsing the received information into one or more groups of related information such as grouping ECG signals, etc. Grouped signals are compared for consistency with each other, and signals deemed inconsistent with the group are discarded or ignored. The cognitive monitor 10 sorts these signals according to quality; artifact- free signals are deemed higher quality signals and signals with artifacts are deemed lower quality signals. In one example, the cognitive monitor 10 selects signals to transmit based on the sorted (or ranked) signals and the recommended transmission spectrum provided by the cognitive radio 4. It is to be understood that the cognitive monitor 10 can receive and use additional information to facilitate selecting signals to transmit. The transmitter 8 sends the selected signals over the transmission spectrum. The cognitive device 2 monitors individuals in various states or conditions. For example, the cognitive device 2 monitors post- operative recovery patients, geriatric patients, mentally ill individuals, depressed individuals, infants susceptible to Sudden Infant Death Syndrome (SIDS), individuals prone to allergic reactions, etc. Non clinical applications include wellness monitoring using application specific modules depending on an individual's concerns.

[0017] The cognitive device 2 preferably employs a platform that is universal to different markets throughout the world. This enables the cognitive device 2 to operate as an "always on" monitoring device irrespective of the individual's location. Such pervasiveness allows alarm reporting to be tailored per-person and such alarms can be communicated throughout the world. The actual periodicity of operation (checking available spectrum, receiving signals from the BAN, transmitting signals...) and quantity of information transmitted is individual specific. Factors considered when determining a duty cycle and volume of information include, but are not limited to, cost, location, sensed physiological signals, the individual's condition, channel noise, quality and reliability, interference, average length of time the spectrum remains unused, and available bandwidth. Examples of suitable modes of operation include continuous, on-demand and emergency only.

[0018] By way of example, the following description focuses on a cognitive device that is configured to monitor a post-operative patient. When the patient is at home, the cognitive device 2 leverages a low-use home wireless network (e.g., the patient's personal wireless network or a network in a neighboring house). Since such network commonly is associated with a relatively large percentage of unused bandwidth, signals deemed at least remotely relevant to the patient's recovery are conveyed to a monitoring system accessible to the monitoring clinicians. Depending on the procedure (e.g., coronary bypass surgery, ACL...), the relevant signals are transmitted every couple minutes, hourly, daily, weekly, etc. When the patient is travelling in a vehicle, the transmission spectrum shifts to an available spectrum. In one instance, this new transmission spectrum is within a cellular network. Since such networks typically are high-use networks, the cognitive device 2 determines that only the most important of these signals should or can be transmitted. In addition, safety measures (e.g., internal memory, buffers...) are activated for emergency situations such as when there is no suitable unused bandwidth

available or when bandwidth being used by the cognitive device 2 is required by the owner of bandwidth. If while travelling in the vehicle a low-use or high-bandwidth spectrum becomes available, the cognitive device 2 increases the amount of signals and frequency with which they are sent. In another example, the patient needs to return to the hospital due to post-operative complications. When entering the hospital's coverage area, the cognitive device 2 transmits clinically relevant signals and patient information to expedite admitting and caring for the patient.

[0019] FIGURE 2 illustrates an embodiment of the cognitive monitor 10 having a cognitive monitor reasoner component 18 that determines which signals to transmit. As noted previously, the cognitive monitor 10 receives signals indicative of physiological state, an individual's identification, the environment, etc., and selects which signals to transmit based on a signal ranking and the transmission spectrum. Such selection is accomplished through the cognitive monitor reasoner component 18. For example, the physiological signals from the sensors 14 are analyzed by a ranking component 20. This analysis includes distinguishing clinically viable signals (artifact- free signals) from erroneous signals (artifacts), and sorting the signals based on quality. The ranking component 20 provides the ranked signals to the cognitive monitor reasoner component 18. Concurrently, the cognitive radio 4 determines various characteristics (e.g., noise, bandwidth, unused bandwidth, application, frequency range...) of detected frequency spectrums and provides the cognitive monitor reasoner component 18 with one or more recommendations of available spectrum for transmission by the transmitter 8. The cognitive radio 4 also provides the spectrum characteristics to the cognitive monitor reasoner component 18. It is to be appreciated that such information can be expressed in XML.

[0020] The cognitive monitor reasoner component 18 can receive and use additional information to facilitate determining which signals to transmit. For instance, in one embodiment the cognitive monitor reasoner component 18 receives environmental characteristics 22 describing the current usage environment. Such characteristics captures information about location, time, temperature, inputs from a variety of sensors, and information describing the circumstances (e.g., ambulance, home, office, emergency room...) and so forth. In another embodiment, the cognitive monitor reasoner component 18 checks monitoring capabilities of the monitoring devices within the BAN and at a destination. These capabilities describe monitoring devices such as Fetal Transducer Unit, and can be described using the Composite Capabilities/Preference Profile (CC/PP) recommendation from World Wide Web Consortium (W3C).

[0021] In yet another embodiment, the cognitive monitor reasoner component 18 receives application requirements 26 describing relationships amongst different monitoring data. For example, the application requirements 26 can describe rules that facilitate determining the data to communicate under particular circumstances. For instance, the rules may indicate all sensed or monitored data should be communicated if available unused bandwidth surpasses a defined threshold, or only the SpO2 and one ECG lead data should be sent if the available unused bandwidth is within a particular range. The rules can be tailored to an attending clinician such that when that clinician monitors the individual, signals deemed clinically relevant to that clinician will be readily available. Furthermore, these requirements capture clinical constraints based on interaction amongst organs and patient's conditions. For instance, it will capture the relationship between ECG and SpO2, ECG and blood pressure, and blood pressure and Sp02. These requirements can be expressed in a Web Ontology language (OWL) recommendation from W3C.

[0022] It is to be appreciated that any or all of this information described above can be stored within the cognitive monitor 2. For instance, the information can be stored within internal RAM or ROM. The information can also be retrieved by the cognitive monitor 2 or communicated to the cognitive monitor 2 when requested.

[0023] The cognitive monitor 2 uses the signal ranking provided by the ranking component 20, the bandwidth recommendation by the cognitive radio 4, the monitoring capabilities 24, the application requirements 26, the environmental characteristics 22, and, optionally, other inputs to determine which signals the transmitter 8 will transmit.

[0024] FIGURE 3 illustrates an exemplary embodiment of the cognitive monitor reasoner component 18. As depicted, the cognitive monitor reasoner component 18 includes an inference engine 28 and a set of rules 30. The inference engine 28 draws inferences from the information received by the cognitive monitor reasoner component 18 (ranked signals, available transmission spectrum, environmental, characteristics, monitoring capabilities, application requirements...) based on the rules 30. Such inferences determine which signals will be transmitted by the transmitter 8. It is to be appreciated that the inference engine 28 can be a JESS rules engine (a JAVA based rules engine), a neural network, a support vector machine (SVM), a Bayesian classifier, and the like. In addition, the rules 30 include representations of algorithms that a device will employ and can be modelled using Protégé.

[0025] FIGURE 4 illustrates an embodiment of the cognitive radio 4 having a cognitive radio reasoner component 34. As described above, the cognitive radio 4 recommends one or more transmission spectrum, transmission protocols, coding schemes, etc. for the transmitter 8 based on spectrum characteristics such as noise, total bandwidth, unused bandwidth, application, frequency range, etc. The cognitive radio reasoner component 34 uses various information to determine this transmission spectrum. For example, in one embodiment the cognitive radio reasoner component 34 uses an FCC policy description 36, which describes the constraints on trans-

mission parameters to limit the level of interference perceived by primary radio systems in the respective area close to the secondary radio system. Such policy typically is represented in the OWL language. In another embodiment, the cognitive radio reasoner component 34 take into consideration device capabilities 38 that describe the characteristics and limitations of the device such as its source of electrical power, CPU, memory, frequency range, channelization, modulation and coding scheme, and communication protocols, for example. Such capabilities can be described using the CC/PP recommendation from W3C.

[0026] In yet another embodiment, current transmission/ reception (Tx/Rx) conditions 40, which describe the feedback from Media Access Control (MAC) and physical layers about the condition of the transmission environment (noisy, low chatter, ...), are analyzed by the cognitive radio reasoner component 34. Measurement results can be provided through known measurement reports such as defined in the IEEE 802.11h and IEEE 802.11k standards using the OWL language. In still another embodiment, radio domain knowledge 42 is made accessible to the cognitive radio reasoner component 34. The radio domain knowledge 42 is a repository of knowledge about the domain of radio communication. Examples of such knowledge includes: algorithms for spectrum opportunity management typically require information about how transmission parameters such as transmission power, frequency, maximum distances between communicating radio devices, modulation technique and coding scheme, etc. are related to each other. The cognitive radio reasoner component 34 may have to know that if the device increases the transmission power, the detection range increases (the distance to the intended receiving device increases), and at the same time the level of interference that other radio devices would observe increases as well.

[0027] The cognitive radio reasoner component 34 uses the above information to recommend to the cognitive monitor 8 a transmission frequency spectrum for the transmitter 8. This recommendation describes parameters for transmission such as frequency, maximum allowed power, coding scheme, a protocol, etc. This information can be represented as an XML document/string, provided to the cognitive monitor 10, and used by the cognitive monitor reasoner 18 of the cognitive monitor 10 as described above.

[0028] FIGURE 5 illustrates an exemplary embodiment of the cognitive radio reasoner component 34. The cognitive radio reasoner component 34 includes an inference engine 44 and a set of rules 46. The inference engine 44 draws inferences from the information received by the cognitive radio reasoner component 34 (e.g., FCC policies, device capabilities ...) based on the rules 46. These inferences facilitate recommending transmission spectrum for use by the cognitive monitor 10. The inference engine 44 can be a JESS rules engine (a JAVA based rules engine), a neural network, a support vector machine (SVM), a Bayesian classifier, and the like. In addition, the rules 46 include representations of algorithms that a device will employ and can be modelled using Protégé.

Claims

1. A patient monitoring system, comprising:

a body network (16) including:

at least one sensor (12) that senses physiological information about a patient, and
a cognitive device (2) for communicating the physiological information to a remote location, the cognitive device including.
a cognitive radio (4) that continuously checks detected frequency spectra (6) for unused bandwidth and dynamically updates and recommends one or more bands on which to transmit clinically relevant information received from the body network (16) to the remote location;
a cognitive monitor (10) that receives the information from the body network (16), prioritizes the information based at least in part on a set of rules (30), and selects which information to transmit based on the prioritization and the recommended transmission bands;
a transmitter (8) that transmits the selected information as a function of priority over at least one of the recommended transmission bands, and
a buffer for buffering the physiological information and which is activated in case there is no suitable unused bandwidth available,
characterized in that the cognitive monitor (10) determines a level of noise in the received information and prioritizes the information from information with the least amount of noise to the information with the greatest amount of noise.

2. The patient monitoring system as set forth in claim 1, wherein the cognitive radio (4) selects the transmission bands from the spectrum based in part on at least one of noise and quantity of unused bandwidth available.

3. The patient monitoring system as set forth in claim 1, wherein the information received from the body network (16) includes at least one of an Electrocardiogram (ECG), an Electroencephalogram (EEG), an Electromyogram (EMG), a non-invasive blood pressure (NiBP), pulse, respirations, blood oxygen (SpO2), and core body temperature.

4. The patient monitoring system as set forth in claim 1, wherein the cognitive monitor (10) parses the received information into one or more groups of related information.

5. The patient monitoring system as set forth in claim 4, wherein the cognitive monitor (10) compares the related information within a group for consistency and discards inconsistent information.

6. The patient monitoring system as set forth in claim 1, wherein the cognitive monitor (10) determines a degree of artifact in the received information and prioritizes the information from information with the least artifact to the information with the greatest artifact.

7. The patient monitoring system as set forth in claim 1, wherein the set of rules (32) prioritize the received information based on at least one of: a person's known physiological condition; clinical events deemed relevant to a monitoring clinician; and a predetermined priority defined by an administering clinician.

8. The patient monitoring system as set forth in claim 1, wherein the cognitive monitor (10) periodically analyzes the information remaining to be transmitted and the current transmission band, and re-prioritizes the information for transmission.

9. The patient monitoring system as set forth in claim 1, the cognitive monitor (10) includes:

a reasoner component (34) that analyzes spectrum characteristics to which spectrum to recommend as transmission spectrum.

10. The patient monitoring system as set forth in claim 9, the characteristics include at least one of noise, total bandwidth, unused bandwidth, application, and frequency range.

11. The patient monitoring system as set forth in claim 9, the reasoner component (4) includes:

a set of rules (46) representing algorithms; and an inference engine (44) that draws inferences from at least one of a FCC policy (36), a device capability (38), a current transmission/reception condition (40), and radio domain knowledge (42) based on the rules (46).

12. The patient monitoring system as set forth in claim 1, the cognitive monitor (10) includes:

a ranking component (20) that ranks the information received from the body network (16) based on quality;
a reasoner component (18) that selects which signals to transmit based on the ranked information and the transmission spectrum.

13. The patient monitoring system as set forth in claim 12, the reasoner component (18) further bases its decision on at least one of a monitoring capability (24), an application requirement (26), and an environmental characteristic (22).

14. The patient monitoring system as set forth in claim 12, the reasoner component (18) includes:

a set of rules (32) representing algorithms; and an inference engine (28) that draws inferences from one or more of a monitoring capability (24), an application requirement (26), an environmental characteristic (22), and a recommended transmission spectrum based on the rules (32).

15. A method for conveying physiological information received from a body network (16), which senses the physiological information, to a remote location, comprising:

receiving one or more physiological information carrying signals from the body network (16);
grouping the signals based on type;
prioritizing the signals within each group, wherein a level of noise in the received information is determined and the information is prioritized from information with the least amount of noise to the information with the greatest amount of noise;
prioritizing the groups;
continuously locating frequency bands with at least a portion of bandwidth available for transmitting the signals, and selecting and dynamically updating a transmission band based on qualitative and quantitative transmission characteristics;
selecting one or more of the signals to transmit based on signal priority and the band characteristics;
transmitting the selected signals over the selected band to the remote location; and
buffering the physiological information in case there is no suitable unused bandwidth available.

16. A cognitive computer device (2) programmed to perform the method of claim 15.

Patentansprüche

1. Patientenüberwachungssystem, das Folgendes umfasst:

ein Body Area Network (16), das Folgendes umfasst:

mindestens einen Sensor (12), der physiologische Informationen über einen Patienten erfasst, und
eine kognitive Vorrichtung (2) zum Kommunizieren der physiologischen Informationen an einen entfernten Ort, wobei die kognitive Vorrichtung Folgendes umfasst:

eine kognitive Funkeinheit (4), die kontinuierlich die detektierten Frequenzspektren (6) auf unbenutzte Bandbreite kontrolliert, dynamische Aktualisierungen durchführt und ein oder mehrere Bänder empfiehlt, auf denen klinisch relevante Informationen, die vom Body Area Network (16) empfangen wurden, an den entfernten Ort überragen werden können;
einen kognitiven Monitor (10), der die Informationen von dem Body Area Network (16) empfangt, die Informationen zumindest teilweise basierend auf einem Satz von Regeln (30) priorisiert und basierend auf der Priorisierung und den empfohlenen Übertragungsbändern auswählt, welche Informationen zu übertragen sind;
einen Sender (8), der die ausgewählten Informationen als eine Funktion der Priorität über mindestens eines der empfohlenen Übertragungsbänder sendet, und
einen Pufferspeicher zum Zwischenspeichern der physiologischen Informationen und der aktiviert wird, falls keine geeignete unbenutzte Bandbreite zur Verfügung steht,

dadurch gekennzeichnet, dass
der kognitive Monitor (10) einen Rauschpegel in den empfangenen Informationen ermittelt und die Informationen von Informationen mit dem geringsten Rauschen bis zu den Informationen mit dem meisten Rauschen priorisiert.

2. Patientenüberwachungssystem nach Anspruch 1, wobei die kognitive Funkeinheit (4) die Übertragungsbänder teilweise basierend auf mindestens entweder dem Rauschen oder der Quantität der verfügbaren unbenutzten Bandbreite aus dem Spektrum auswählt.

3. Patientenüberwachungssystem nach Anspruch 1, wobei die von dem Body Area Network (16) empfangenen Informationen mindestens entweder ein Elektrokardiogramm (EKG), ein Elektroenzephalogramm (EEG), ein Elektromyogramm (EMG), einen nicht-invasiven Blutdruck (NiBP), den Puls, die Atmung, den Blutsauerstoff (SpO2) oder die Körperkerntemperatur umfassen.

4. Patientenüberwachungssystem nach Anspruch 1, wobei der kognitive Monitor (10) die empfangenen Informationen in eine oder mehrere Gruppe von zusammenhängenden Informationen aufgliedert.

5. Patientenüberwachungssystem nach Anspruch 4, wobei der kognitive Monitor (10) die zusammenhängenden Informationen innerhalb einer Gruppe auf Konsistenz vergleicht und inkonsistente Informationen aussondert.

6. Patientenüberwachungssystem nach Anspruch 1, wobei der kognitive Monitor (10) einen Artefaktgrad in den empfangenen Informationen ermittelt und die Informationen von Informationen mit dem geringsten Artefakt bis zu den Informationen mit dem größten Artefakt priorisiert.

7. Patientenüberwachungssystem nach Anspruch 1, wobei der Satz von Regeln (32) die empfangenen Informationen basierend auf mindestens einem der folgenden Elemente priorisiert: dem bekannten physiologischen Zustand einer Person; klinischen Ereignissen, die als relevant für einen überwachenden Arzt erachtet werden; und einer vorgegebene Priorität, die durch einen behandelnden Arzt definiert wurde.

8. Patientenüberwachungssystem nach Anspruch 1, wobei der kognitive Monitor (10) die noch zu übertragenden Informationen und das aktuelle Übertragungsband periodisch analysiert und die Informationen für die Übertragung neu priorisiert.

9. Patientenüberwachungssystem nach Anspruch 1, wobei der kognitive Monitor (10) Folgendes umfasst:

eine Reasoner-Komponente (34), die die Spektrumeigenschaften daraufhin analysiert, welches Spektrum als Übertragungsspekrum zu empfehlen ist.

10. Patientenüberwachungssystem nach Anspruch 9, wobei die Eigenschaften mindestens entweder das Rauschen, die Gesamtbandbreite, die unbenutzte Bandbreite, die Anwendung oder den Frequenzbereich umfassen.

11. Patientenüberwachungssystem nach Anspruch 9, wobei die Reasoner-Komponente (4) Folgendes umfasst:

einen Satz von Regeln (46), die Algorithmen darstellen; und
eine Inferenzmaschine (44), die basierend auf den Regeln (46) Inferenzen aus mindestens entweder eine FCC-Politik (36), einer Vorrichtungsfähigkeit (38), einer aktuellen Übertragungs-/Empfangsbedingung (40) oder einem Funkdomänewissen (42) zieht.

12. Patientenüberwachungssystem nach Anspruch 1, wobei der kognitive Monitor (10) Folgendes umfasst:

einen Rangordnungs-Komponente (20), die die von dem Body Area Network (16) empfangenen Informationen basierend auf der Qualität in eine Rangfolge bringt;
eine Reasoner-Komponente (18), die die zu übertragenden Signale basierend auf den in eine Rangfolge gebrachten Informationen und dem Übertragungsspektrum auswählt.

13. Patientenüberwachungssystem nach Anspruch 12, wobei die Reasoner-Komponente (18) weiterhin ihre Entscheidung auf mindestens entweder einer Überwachungsfähigkeit (24), einer Anwendungsanforderung (26) oder einer Umgebungseigenschaft (22) basiert.

14. Patientenüberwachungssystem nach Anspruch 12, wobei die Reasoner-Komponente (18) Folgendes umfasst:

einen Satz von Regeln (32), die Algorithmen darstellen; und
eine Inferenzmaschine (44), die basierend auf den Regeln (32) Inferenzen aus einem oder mehreren der folgenden Elemente zieht: einer Überwachungsfähigkeit (24), einer Anwendungsanforderung (26), einer Umgebungseigenschaft (22) oder einem empfohlenen Übertragungsspektrum.

15. Verfahren zum Übermitteln der von einem Body Area Network (16), das die physiologischen Informationen erfasst, empfangenen physiologischen Informationen an einen entfernten Ort, wobei das Verfahren Folgendes umfasst:

Empfangen von einem oder mehreren die physiologischen Informationen beinhaltenden Signalen von dem Body Area Network (16);
Gruppieren der Signale basierend auf dem Typ;
Priorisieren der Signale innerhalb jeder Gruppe, wobei ein Rauschpegel in den empfangenen Informationen ermittelt wird und die Informationen von Informationen mit dem geringsten Rauschen bis zu Informationen mit dem meisten Rauschen priorisiert werden;
Priorisieren der Gruppen;
kontinuierliches Lokalisieren von Frequenzbändern, bei denen mindestens ein Teil der Bandbreite zur Übertragung der Signale zur Verfügung steht, und Auswählen und dynamisches Aktualisieren eines Übertragungsbandes basierend auf qualitativen und quantitativen Übertragungseigenschaften;
Auswählen von einem oder mehreren zu übertragenden Signalen basierend auf Signalpriorität und Bandeigenschaften;
Übertragen der ausgewählten Signale über das ausgewählte Band an den entfernten Ort;
und
Zwischenspeichern der physiologischen Informationen, falls keine geeignete unbenutzte Bandbreite zur Verfügung steht.

16. Kognitive Computervorrichtung (2), die programmiert ist, um das Verfahren nach Anspruch 15 auszuführen.

Revendications

1. Système de surveillance d'un patient, comprenant :

un réseau corporel (16) comprenant :

au moins un capteur (12) qui capte des informations physiologiques relatives à un patient, et
un dispositif cognitif (2) pour communiquer les informations physiologiques à un site distant, le dispositif cognitif comprenant
une radio cognitive (4) qui vérifie en continu des spectres de fréquence détectés (6) pour une largeur de bande non utilisée et qui actualise et recommande de façon dynamique une ou plusieurs bande(s) sur lesquelles transmettre des informations cliniquement pertinentes reçues du réseau corporel (16) au site distant ;
un moniteur cognitif (10) qui reçoit les informations du réseau corporel (16), accorde la priorité aux informations basées au moins en partie sur un groupe de règles (30) et choisit quelles informations transmettre sur la base de la propriété accordée et les bandes de transmission recommandées ;
un transmetteur (8) qui transmet les informations choisies en fonction d'une propriété par rapport à au moins l'une des bandes de transmission recommandées, et
un tampon pour tamponner les informations physiologiques et qui est activé dans le cas où il n'y ait pas de largeur de bande non utilisée appropriée, **caractérisé en ce que**

le moniteur cognitif (10) détermine un niveau de bruit dans les informations reçues et accorde la priorité aux informations, parmi les informations, présentant la quantité de bruit la plus faible par rapport aux informations présentant la quantité de bruit la plus élevée.

2. Système de surveillance d'un patient selon la revendication 1, dans lequel la radio cognitive (4) choisit les bandes de transmission à partir du spectre basé en partie sur au moins un élément parmi le bruit et la quantité de largeur de bande non utilisée disponible.

3. Système de surveillance d'un patient selon la revendication 1, dans lequel les informations reçues du réseau corporel (16) comprennent au moins l'une parmi un électrocardiogramme (ECG), un électroencéphalogramme (EEG), un électromyogramme (EMG), une mesure de la pression artérielle non invasive (NiBP), une mesure du pouls, de la respiration, de l'oxygène sanguin (Sp02) et de la température corporelle interne.

4. Système de surveillance d'un patient selon la revendication 1, dans lequel le moniteur cognitif (10) analyse les informations reçues en un ou plusieurs groupes d'informations apparentées.

5. Système de surveillance d'un patient selon la revendication 4, dans lequel le moniteur cognitif (10) compare les informations apparentées dans un groupe pour déterminer leur conformité et élimine les informations non-conformes.

6. Système de surveillance d'un patient selon la revendication 1, dans lequel le moniteur cognitif (10) détermine un degré d'artefact dans les informations reçues et accorde la priorité aux informations, parmi les informations présentant l'artefact le plus réduit par rapport aux informations présentant l'artefact le plus important.

7. Système de surveillance d'un patient selon la revendication 1, dans lequel le groupe de règles (32) accorde la priorité aux informations reçues sur la base d'au moins un élément parmi : des conditions physiologiques connues d'une personne ; des évènements cliniques jugés pertinents pour un clinicien assurant la surveillance ; et une priorité prédéterminée définie par un clinicien administrateur.

8. Système de surveillance d'un patient selon la revendication 1, dans lequel le moniteur cognitif (10) analyse périodiquement les informations restant à transmettre et la bande de transmission actuelle et redéfinit la priorité de transmission des informations.

9. Système de surveillance d'un patient selon la revendication 1, le moniteur cognitif (10) comprenant :

un composant de raisonnement (34) qui analyse les caractéristiques spectrales selon lesquelles recommander un spectre en tant que spectre de transmission.

10. Système de surveillance d'un patient selon la revendication 9, les caractéristiques comprenant au moins l'une parmi le bruit, la largeur de bande totale, la largeur de bande non utilisée, l'application et la gamme de fréquences.

11. Système de surveillance d'un patient selon la revendication 9, le composant de raisonnement (4) comprenant :

un groupe de règles (46) représentant des algorithmes ; et
un moteur d'interférences (44) qui élimine les interférences parmi au moins une politique de FCC (36), une capacité d'un dispositif (38), une condition de transmission/réception de courant (40) et une connaissance de domaine radio (42) sur la base des règles (46).

12. Système de surveillance d'un patient selon la revendication 1, le moniteur cognitif (10) comprenant :

un composant de classement (20) qui classe les informations reçues du réseau corporel (16) sur la base de la qualité ;
un composant de raisonnement (18) qui choisit les signaux à transmettre sur la base des informations classées et du spectre de transmission.

13. Système de surveillance d'un patient selon la revendication 12, le composant de raisonnement (18) basant en outre sa décision sur au moins un élément parmi une capacité de surveillance (24), un besoin d'application (26) et une caractéristique environnementale (22).

14. Système de surveillance d'un patient selon la revendication 12, le composant de raisonnement (18) comprenant :

un groupe de règles (32) représentant des algorithmes ; et
un moteur d'interférences (28) qui élimine les interférences parmi l'un ou plusieurs des éléments parmi une capacité de surveillance (24), un besoin d'application (26), une caractéristique environnementale (22) et un spectre de transmission recommandé sur la base de règles (32).

15. Procédé d'acheminement d'informations physiologiques reçues d'un réseau corporel (16) qui détecte les informations physiologiques, à un site distant, comprenant :

la réception d'une ou plusieurs informations physiologiques portant des signaux du réseau corporel (16) ;
le groupement des signaux sur la base du type ;
l'établissement d'une priorité des signaux dans chaque groupe, dans lequel un niveau de bruit dans les informations reçues est déterminé et une priorité est accordée, aux informations parmi les informations présentant la quantité de bruit la plus faible par rapport aux informations présentant la quantité de bruit la plus grande ;
l'établissement d'une priorité des groupes ;
la localisation continue des bandes de fréquence présentant au moins une partie de largeur de bande disponible pour transmettre les signaux et la sélection et l'actualisation dynamique d'une bande de transmission basées sur des caractéristiques de transmission qualitatives et quantitatives ;
la sélection d'un ou plusieurs des signaux à transmettre sur la base d'une priorité de signal et des caractéristiques de bande ;
la transmission des signaux choisis sur la bande choisie au site distant ; et
le tamponnement des informations physiologiques dans le cas où aucune largeur de bande non utilisée n'est appropriée.

16. Dispositif cognitif informatique (2) programmé pour réaliser le procédé selon la revendication 15.

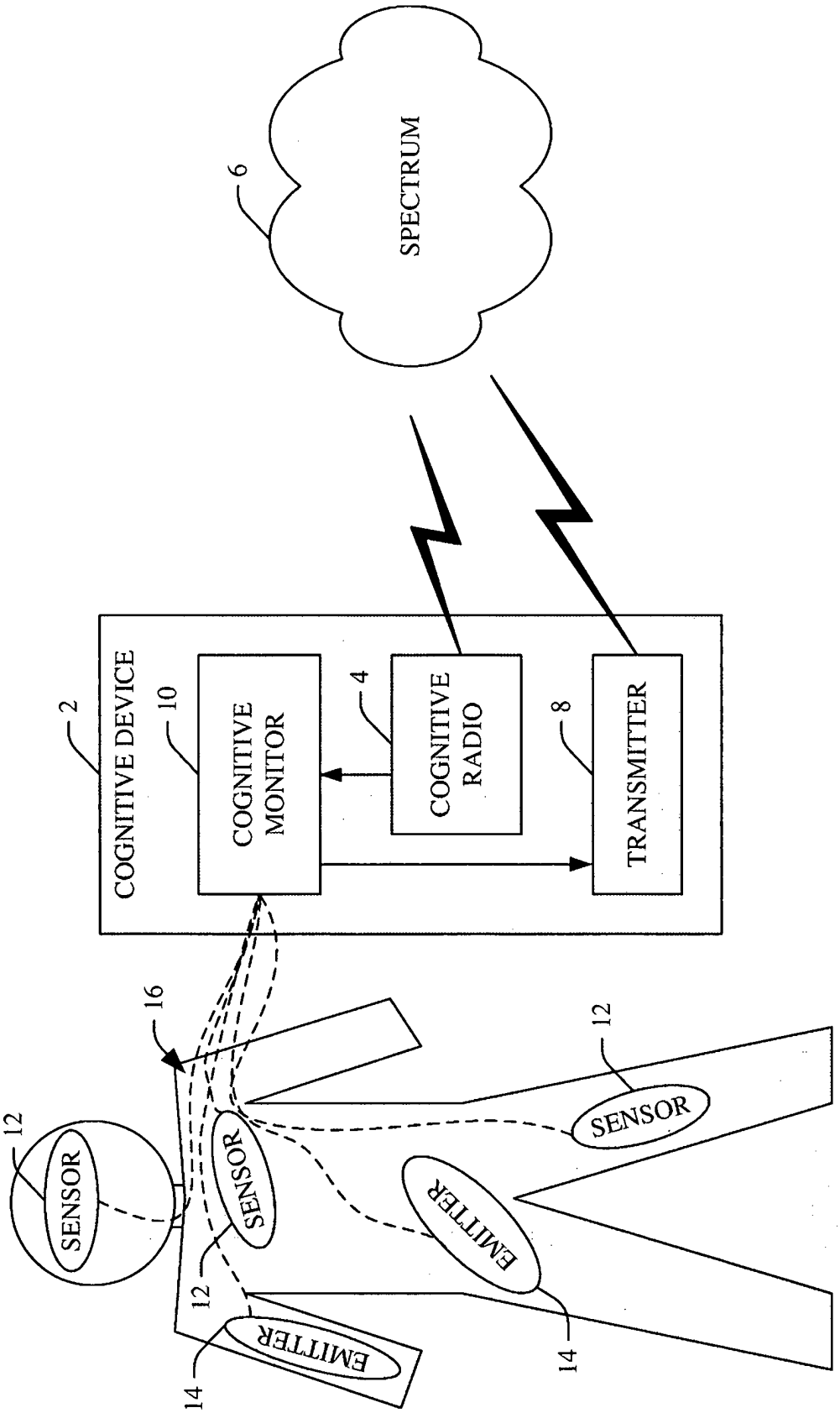
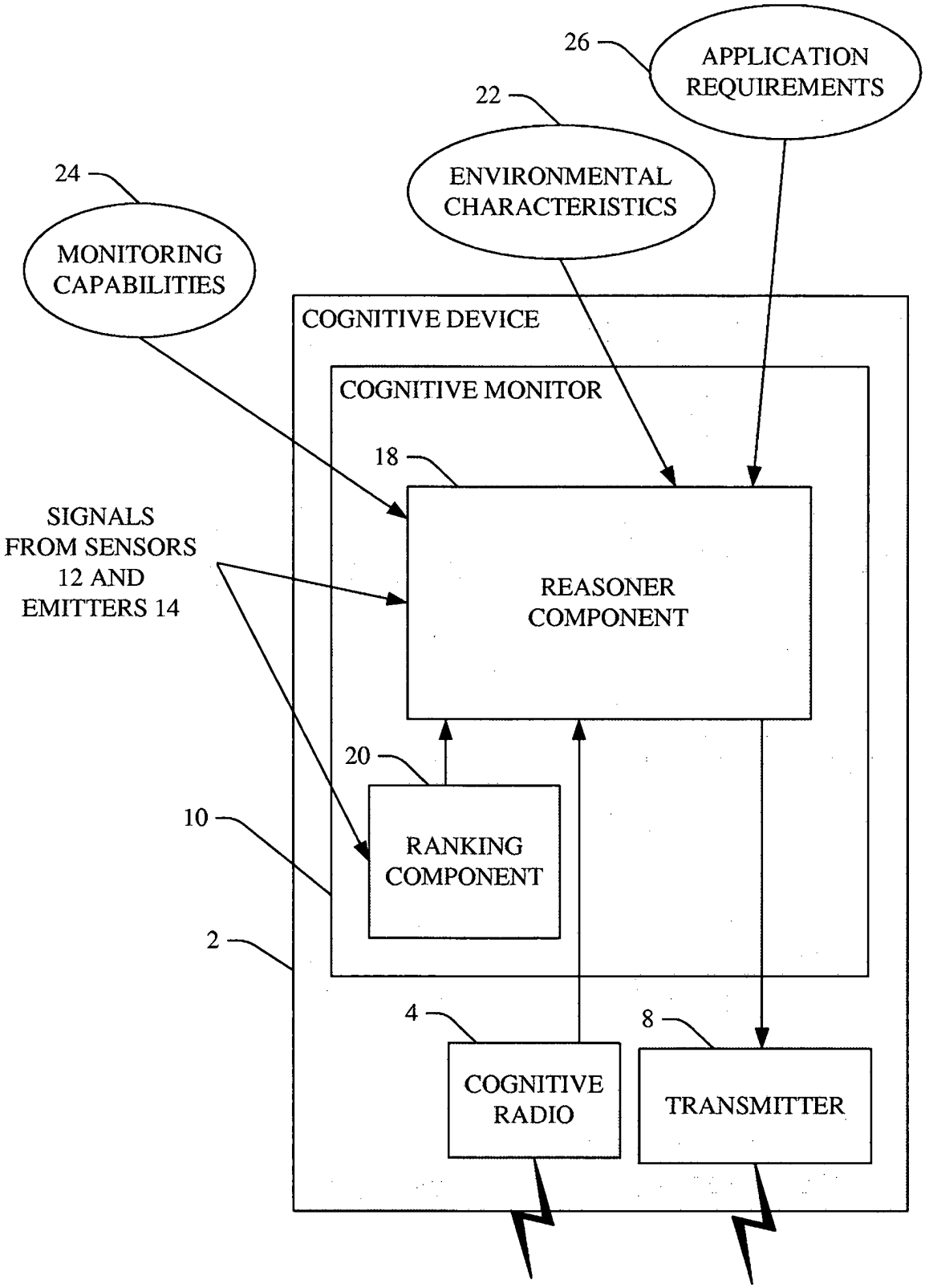

SPECTRUM
6
COGNITIVE DEVICE
2
COGNITIVE MONITOR
10
COGNITIVE RADIO
4
TRANSMITTER
8
16
SENSOR
12
SENSOR
12
SENSOR
12
EMITTER
14
EMITTER
14

FIGURE 1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ENVIRONMENTAL CHARACTERISTICS
24
MONITORING CAPABILITIES
COGNITIVE DEVICE
COGNITIVE MONITOR
18
SIGNALS FROM SENSORS 12 AND EMITTERS 14
REASONER COMPONENT
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10
RANKING COMPONENT
2
4
8
COGNITIVE RADIO
TRANSMITTER

FIGURE 2

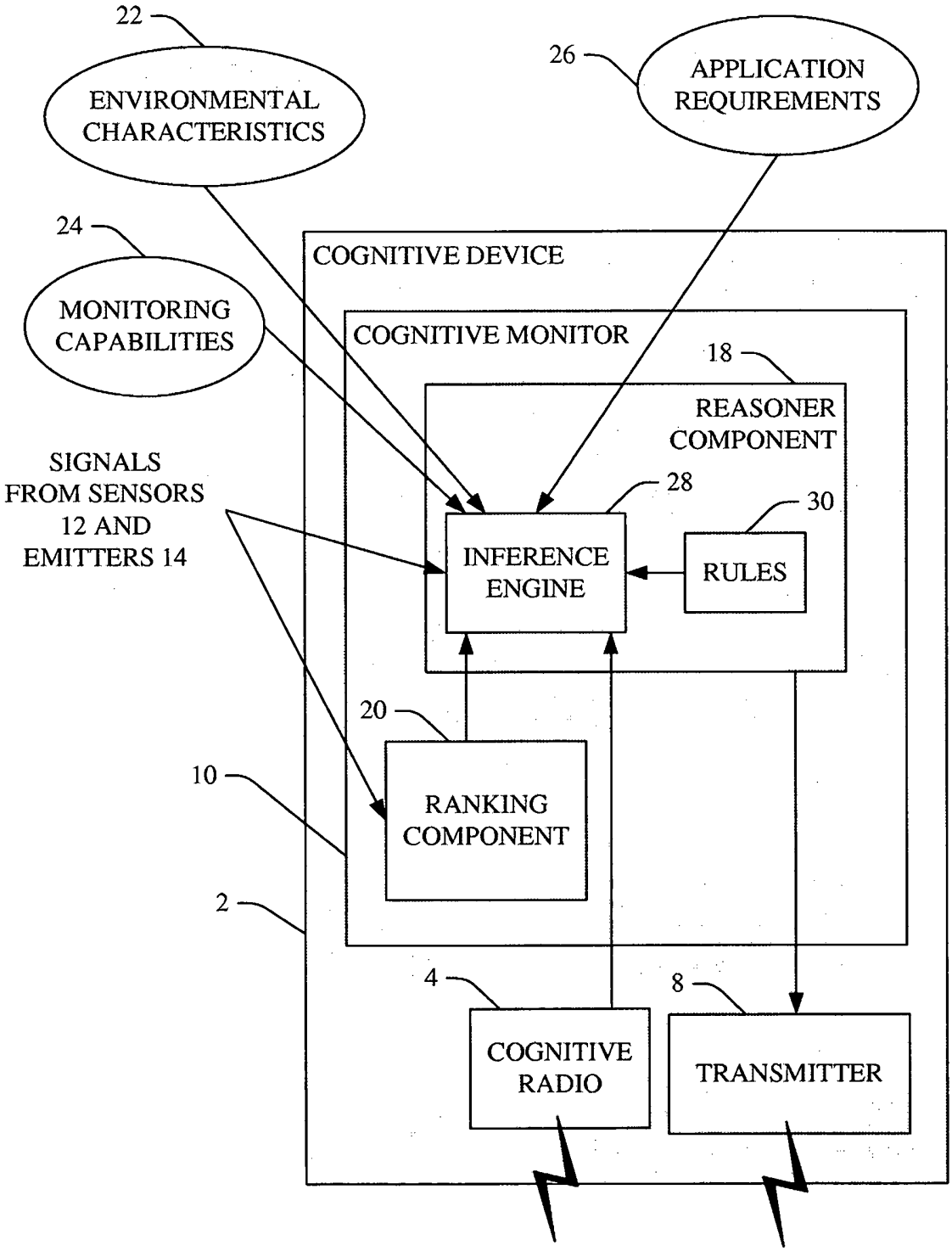
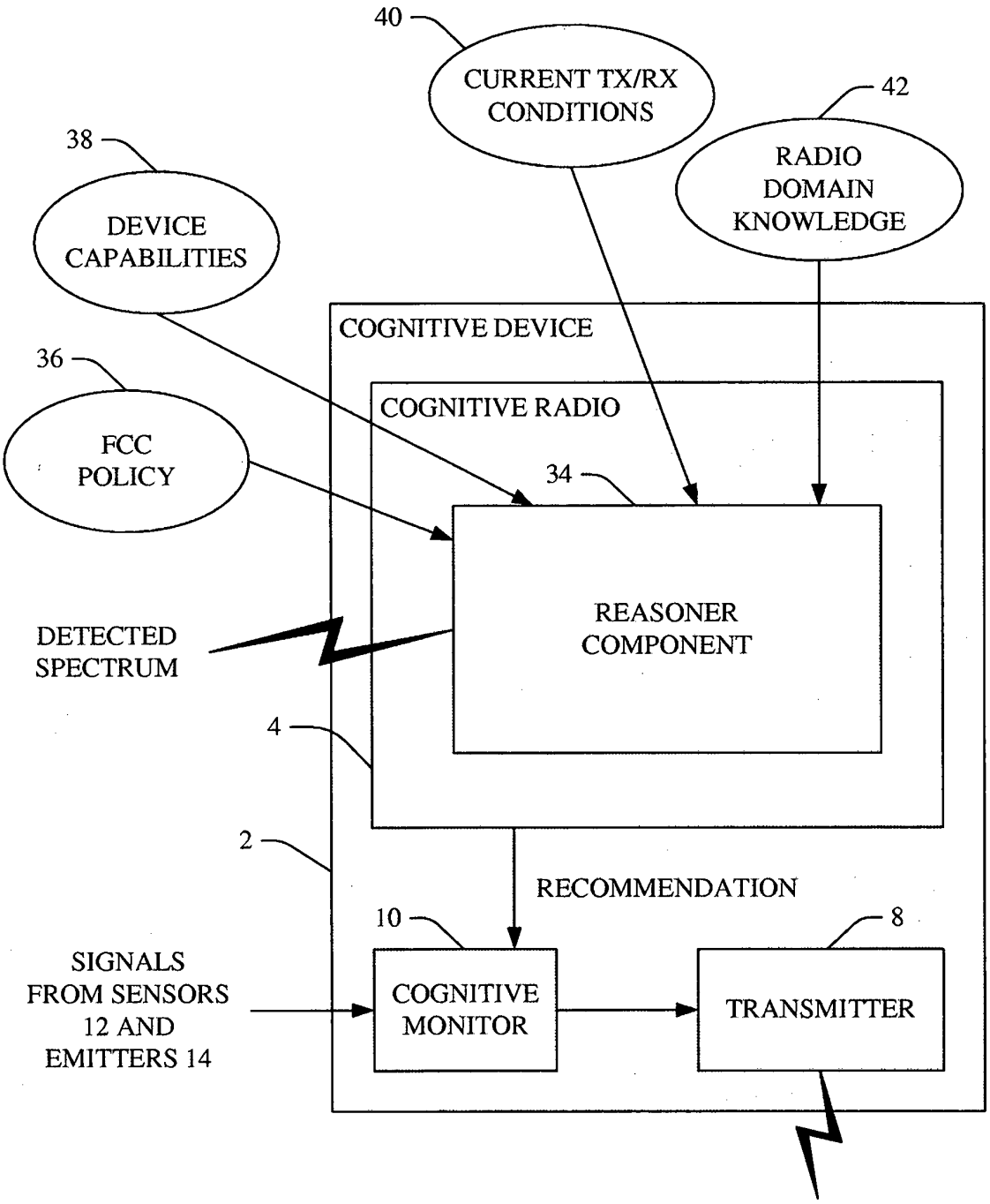

22
ENVIRONMENTAL CHARACTERISTICS
26
APPLICATION REQUIREMENTS
24
MONITORING CAPABILITIES
COGNITIVE DEVICE
COGNITIVE MONITOR
18
REASONER COMPONENT
SIGNALS FROM SENSORS 12 AND EMITTERS 14
28
30
INFERENCE ENGINE
RULES
20
10
RANKING COMPONENT
2
4
8
COGNITIVE RADIO
TRANSMITTER

FIGURE 3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RADIO DOMAIN KNOWLEDGE
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DEVICE CAPABILITIES
COGNITIVE DEVICE
36
FCC POLICY
COGNITIVE RADIO
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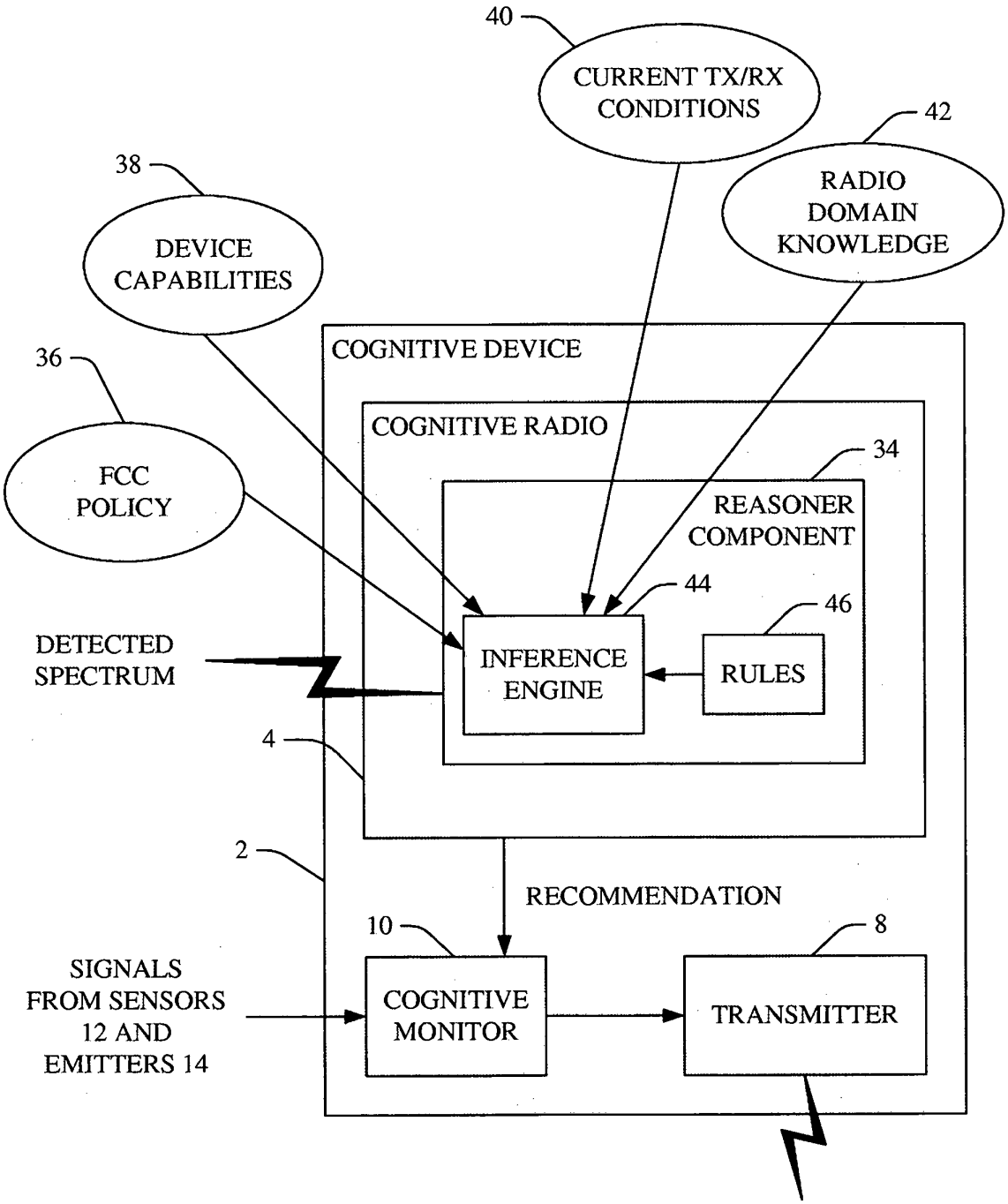
REASONER COMPONENT
DETECTED SPECTRUM
4
2
RECOMMENDATION
10
8
SIGNALS FROM SENSORS 12 AND EMITTERS 14
COGNITIVE MONITOR
TRANSMITTER

FIGURE 4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CURRENT TX/RX CONDITIONS
42
RADIO DOMAIN KNOWLEDGE
38
DEVICE CAPABILITIES
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FCC POLICY
COGNITIVE DEVICE
COGNITIVE RADIO
34
REASONER COMPONENT
44
46
INFERENCE ENGINE
RULES
DETECTED SPECTRUM
4
2
RECOMMENDATION
10
8
SIGNALS FROM SENSORS 12 AND EMITTERS 14
COGNITIVE MONITOR
TRANSMITTER

FIGURE 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 03101289 A1 **[0004]**
- US 20040146149 A1 **[0005]**

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申请(专利权)人(译)	皇家飞利浦电子N.V.		
当前申请(专利权)人(译)	皇家飞利浦N.V.		
[标]发明人	ALSAFADI YASSER ALI WALID S I		
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IPC分类号	A61B5/00		
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代理机构(译)	VERWEIJ，PETRONELLA DANIELLE		
优先权	60/678685 2005-05-06 US		
其他公开文献	EP1881784A1		
外部链接	Espacenet		

摘要(译)

本文描述了一种患者监测系统，其包括身体网络（16），其具有至少一个传感器（12），其感测关于患者的生理信息;以及认知装置（2），用于将生理信息传送到远程位置。认知设备包括认知无线电（4），认知监视器（10）和发射器（8）。认知无线电设备（4）检查检测到的未使用带宽的频谱（6），并推荐一个或多个频带，在该频带上将从身体网络（16）接收的临床相关信息发送到远程位置;认知监视器（10）从身体网络（16）接收信息，至少部分地基于一组规则（30）对信息进行优先级排序，并基于优先级和推荐的传输频带选择要传输的信息;发送器（8）在至少一个或推荐的传输频带上发送所选择的信息作为优先级的函数。

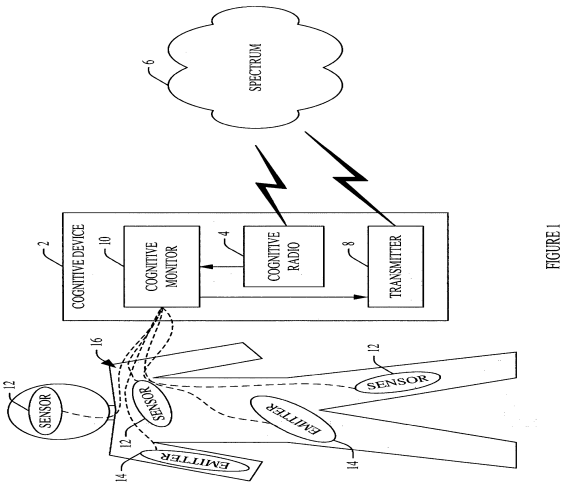

FIGURE 1