

We claim:

1. A wireless relay network for providing communications between a medical device and a remote device connected to the internet comprising:

at least one interface circuit coupled to a respective medical device and capable of transmitting medical device data over a wireless relay network;

at least first and second relay modules; each of said relay modules comprising:

a first receiver capable of wirelessly receiving medical device data over a wireless relay network;

a first transmitter capable of wirelessly transmitting medical device data to a second wireless relay module over the wireless relay network;

a second transmitter capable of wirelessly transmitting data over an internet-accessible wireless communications network; and

a controller coupled to the first and second transmitters.

2. The wireless relay network of claim 1, wherein said controller is capable of determining a status of said internet-accessible wireless communications network and of selecting one of said first or second transmitter for transmitting said medical device data based on said status.

3. The wireless relay network of claim 2, wherein said controller is configured to transmit said medical device data over said communications channel by said second transmitter if said status satisfies a particular criteria; and is configured to transmit said medical device data by said first transmitter in communication with said wireless relay network if said status fails to satisfy said particular criteria.

4. The wireless relay network of claim 1, further comprising a second receiver capable of receiving instructions and/or data from said internet-accessible wireless communications network, wherein said first transmitter is further capable of transmitting the instructions and/or data to said at least one medical device.

5. The wireless relay network of claim 4, wherein said at least one relay module further comprises:

a memory electrically connected to said controller, said memory capable of buffering said received instructions and/or data destined for respective ones of said medical devices, wherein said controller controls the order and/or priority for transmission of said instructions and/or data to said respective ones of said medical devices.

6. The wireless relay network of claim 4, wherein said at least one relay module further comprises:

a memory electrically connected to said controller, said memory capable of buffering said received instructions and/or data destined for respective ones of said medical devices, wherein said controller controls transmission of said instructions and/or data to all or a subset of said medical devices.

7. The wireless relay network of claim 1, wherein said wireless relay network is a ZIGBEE network.

8. The wireless relay network of claim 1, wherein said internet-accessible wireless communications network is a mobile communications network.

9. The wireless relay network of claim 8, wherein said mobile communications network is a CDMA or GSM-based network.

10. The wireless relay network of claim 1, wherein said interface device comprises:
a transmitter capable of wirelessly transmitting said medical device data over said wireless relay network.

11. The wireless relay network of claim 1, wherein said interface device further comprises:
a receiver capable of wirelessly receiving instructions over said wireless relay network for execution by said medical device.

12. A process for operating a wireless medical device relay network, comprising the steps of:

- a. receiving at a first relay module via a wireless relay network medical device data transmitted by at least one interface circuit coupled to a respective medical device;
- b. determining a first relay module status of access by said first relay module to an internet-accessible communications network;
- c. transmitting said medical device data by said first relay module over said internet-accessible communications channel when said status satisfies a particular criteria, and
- d. transmitting said medical device data by said first relay module to a second relay module over the wireless relay network when said status parameter does not satisfy said particular criteria.

13. The process of claim 12, further comprising the steps of:

- e. determining a second relay module status of access by said second relay module to the internet-accessible communications network;
- f. transmitting said medical device data by said second relay module over said internet-accessible communications channel when said second relay module status satisfies the particular criteria, and
- g. transmitting said medical device data by said second relay module to a third relay module over the wireless relay network when said second relay module status does not satisfies said particular criteria.

14. The process of claim 12 further comprising the steps of:

receiving medical device instructions and/or data over the internet-accessible wireless communications network intended for at least one of said medical devices; and

transmitting said received instructions and/or data via at least first relay module to said intended ones of said at least one medical device.

15. The process of claim 14 further comprising the steps of:
buffering by said first relay module said received instructions and/or data destined for respective ones of said medical devices; and
controlling the order and/or priority of transmitting said instructions and/or data to said respective ones of said medical devices.

16. The process of claim 14 further comprising the step of:
transmitting said received instructions and/or data destined for respective ones of said medical devices to all or a subset of all of said medical devices.

17. The process of claim 12 further comprising the step of:
providing an indication of potential communications over said wireless communications network during a power-up sequence of said first relay module.

18. The process of claim 12 further comprising the step of:
providing an indication of potential communications over said wireless relay network during a power-up sequence of said relay module.

19. The process of claim 12, wherein said wireless relay network is a ZIGBEE network.

20. The process of claim 12, wherein said wireless relay network is a relay enabled Bluetooth network.

21. The process of claim 12, wherein said wireless communications network is a communications channel of a mobile communications network.

22. The process of claim 21, wherein said mobile communications network is a CDMA or GSM-based network.

23. The process of claim 12, wherein the determining step further comprises the steps of:
measuring a state of said wireless communications network; and
determining said status of said wireless communications network as a function of said
measured state of said wireless communications network.

24. The process of claim 12, wherein said status is determined as a function of a value
stored by a storage element of said relay module.

CLAIMS

1. A system for providing communications between one or more medical devices and a remote device connected to the Internet comprising:

at least one interface circuit coupled to one or more of the one or more medical devices and capable of transmitting medical device data using a wireless data connection;

at least two relay modules, each of the at least two relay modules wirelessly coupled to form a mesh network of wireless relay modules, with each of the at least two relay modules comprising:

a first receiver capable of wirelessly receiving medical device data over the wireless data connection;

a first transmitter capable of wirelessly transmitting medical device data to another of the at least two relay modules over the mesh network of wireless-relay modules;

a second transmitter capable of wirelessly transmitting medical device data over an Internet-accessible wireless communications network; and

a processor coupled to the second transmitter to determine if the Internet-accessible wireless communications network is accessible by the second transmitter and coupled to the first transmitter to transmit the medical device data over the mesh network of wireless-relay modules to another of the at least two relay modules if the Internet-accessible wireless communications network is not accessible by the second transmitter;

wherein at least one of the at least two relay modules in the mesh network of wireless relay modules is capable of determining an access status of the mesh network of wireless relay modules and providing the access status to the processor for selecting the first or second transmitter for medical device data transmission based on at least two of:

(1) the access status of the mesh network of wireless relay modules;

(2) a device status of the one or more medical devices; and

(3) a connection status of each of the first and second transmitters in the wireless relay modules;

wherein the connection status of the first transmitter indicates whether the Internet-accessible wireless communications network is accessible to the wireless relay modules and the connection status of the second transmitter indicates whether the mesh network of wireless relay modules is accessible to the wireless relay modules; and

wherein each of the relay modules in the wireless mesh network is configured to determine its own current status and to communicate its own current status to each of the other relay modules in the wireless mesh network.

2. The system of claim 1, wherein said processor is configured to determine the connection status of the Internet-accessible wireless communications network and transmit medical device data over a communications channel by said second transmitter if said connection status satisfies a particular criteria; and

is configured to transmit said medical device data by said first transmitter in communication with said mesh network of wireless relay modules if said connection status fails to satisfy said particular criteria.

3. The system of claim 1, further comprising a second receiver capable of receiving instructions and/or medical device data from said Internet-accessible wireless communications network, wherein said first transmitter is further capable of transmitting the instructions and/or medical device data to said at least one medical device.

4. The system of claim 3, wherein said at least two relay modules each comprise:
a memory electrically connected to said processor, said memory capable of buffering said received instructions and/or medical device data destined for respective ones of said medical devices, wherein said processor controls an order and/or priority for transmission of said instructions and/or medical device data to said respective ones of said medical devices.

5. The system of claim 3, wherein said at least two relay modules each comprise:
a memory electrically connected to said processor, said memory capable of buffering said received instructions and/or medical device data destined for respective ones of said medical devices, wherein said processor controls transmission of said instructions and/or medical device data to all or a subset of said medical devices.

6. The system of claim 1, wherein said mesh network of wireless relay modules operates in accordance with a ZIGBEE network.

7. The system of claim 1, wherein said internet-accessible wireless communications network is a mobile communications network.

8. The system of claim 1, wherein said interface circuit comprises:
a transmitter capable of wirelessly transmitting said medical device data over the mesh network of wireless relay modules.

9. The system of claim 1, wherein said interface circuit further comprises:
a receiver capable of wirelessly receiving instructions over the mesh network of wireless relay modules for execution by at least one of the one or more medical devices.

10. The system of claim 1 wherein each of the at least two relay modules form a fully connected wireless mesh network of wireless relay modules.

11. The system of claim 1, wherein each of the at least two relay modules form a fully connected wireless mesh network of wireless relay modules; and
at least one relay module in the wireless mesh network of wireless relay modules is capable of determining the access status of the wireless mesh network of wireless relay modules and providing the access status to the processor for selecting the first or second transmitter for medical device data transmission based upon at least two of:
(1) the access status of the wireless mesh network;
(2) the device status of the one or more medical devices; and
(3) the connection status of each of the first and second transmitters in the wireless relay modules.

12. A process for communicating medical device data from one or more medical devices over a wireless network, the process comprising the steps of:
forming a wireless mesh network from a plurality of relay modules;
receiving at a first relay module via the wireless mesh network medical device data transmitted by at least one interface circuit coupled to a respective medical device;
determining a first relay module status of access by said first relay module to an Internet-accessible wireless communications network;

transmitting said medical device data by said first relay module over said Internet-accessible wireless communications network when said Internet-accessible wireless communications network is accessible; and

transmitting said medical device data by said first relay module to a second relay module over the wireless mesh network when said Internet-accessible wireless communications network is not accessible;

wherein at least one relay module in the wireless mesh network is capable of determining an access status of the mesh network of wireless relay modules and providing the access status to a processor of the first relay module for selecting a first and second transmitter for medical data transmission based upon at least two of:

- (1) the access status of the mesh network of wireless relay modules;
- (2) a device status of the one or more medical devices; and
- (3) a connection status of each of the first and second transmitters in the wireless relay modules;

wherein the connection status of the first transmitter indicates whether the Internet accessible wireless communications network is accessible to the first wireless relay module and the connection status of the second transmitter indicates whether the wireless mesh network is accessible to the first wireless relay module; and

wherein each of the relay modules in the wireless mesh network is configured to determine its own current status and to communicate its own current status to each of the other relay modules in the wireless mesh network.

13. The process of claim 12, further comprising:

determining a second relay module status of access by said second relay module to the Internet-accessible wireless communications network; and

transmitting said medical device data by said second relay module over said Internet-accessible wireless communications network when said second relay module is able to access the Internet-accessible wireless communications network, and transmitting said medical device data by said second relay module to a third relay module over the wireless mesh network when said second relay module is not able to access the Internet-accessible wireless communications network.

14. The process of claim 12 further comprising:

receiving medical device instructions and/or said medical device data over the Internet-accessible wireless communications network intended for at least one of said medical devices; and

transmitting said received instructions and/or said medical device data via at least a first relay module to said intended at least one of said medical devices.

15. The process of claim 14 further comprising:

buffering by said first relay module said received instructions and/or medical device data destined for respective ones of the medical devices; and

controlling an order and/or priority of transmitting said instructions and/or medical device data to said respective ones of the medical devices.

16. The process of claim 14 further comprising:

transmitting said received instructions and/or medical device data destined for respective ones of the medical devices to all or a subset of all of the medical devices.

17. The process of claim 12 further comprising:

providing an indication of potential communications over said internet-accessible wireless communications network during a power-up sequence of said first relay module.

18. The process of claim 12 further comprising:

providing an indication of potential communications over said wireless mesh network during a power-up sequence of said first relay module.

19. The process of claim 12, wherein said wireless mesh network operates in accordance with a ZIGBEE network protocol.

20. The process of claim 12, wherein said wireless mesh network is a relay enabled Bluetooth network.

21. The process of claim 12, wherein said Internet-accessible wireless communications network comprises a communications channel of a mobile communications network.

22. The process of claim 21, wherein said Internet-accessible wireless communications network operates in accordance with one of:

- a CDMA network protocol; or
- a GSM-based network protocol.

23. The process of claim 12, wherein determining the first relay module status of access further comprises:

- measuring a state of said wireless mesh network; and
- determining said status of access of said wireless mesh network as a function of said measured state of said wireless mesh network.

24. The process of claim 12, wherein said first relay module status of access is determined as a function of a value stored by a storage element of said first relay module.

25. A system comprising:

at least one medical device, each of said at least one medical device having at least one interface circuit coupled thereto, with each of said at least one interface circuits configured to receive medical device data from at least one of said at least one medical devices and configured to transmit medical device data provided thereto using a wireless data connection; and

at least two relay modules, each of the at least two relay modules wirelessly coupled to each of said at least one medical devices via respective interface circuitry such that each of said at least two relay modules and at least some of said at least one medical devices form a wireless mesh relay network over which each of said at least two relay modules are capable of wirelessly receiving medical device data transmitted by one or more of said interface circuitry and wherein at least one relay module is capable of determining an access status of the wireless mesh relay network and selecting a wireless communication path for medical device data transmission and wherein at least one of the at least two relay modules is capable of transmitting medical device data provided thereto over an Internet-accessible wireless communications network and wherein each of the at least two relay modules selects the wireless communication path based upon at least two of:

- (1) the access status of the wireless mesh relay network;
- (2) a device status for each of the at least one medical device; and

(3) a connection status of the at least one relay module to the Internet accessible wireless communications network;

wherein the connection status comprises: a first connection status which indicates whether the Internet accessible wireless communications network is accessible by the wireless relay modules; and a second connection status indicates whether the wireless mesh relay network is accessible by the wireless relay module; and

wherein each of the relay modules in the wireless mesh relay network is configured to determine its own current status and to communicate its own current status to each of the other relay modules in the wireless mesh relay network.

26. The system of claim 25 wherein each of the relay modules in the wireless mesh relay network is configured to determine its own current status and to communicate its own current status to each of the other relay modules in the wireless mesh relay network; and

each of the relay modules in the wireless mesh relay network is configured to receive said own current status of each of the other relay modules in the wireless mesh relay network.

27. The system of claim 25 wherein at least one of the relay modules comprises:

a first transceiver capable of wirelessly receiving medical device data transmitted by each of said at least one interface circuits and capable of wirelessly transmitting medical device data to another of the relay modules in the wireless mesh relay network;

a second transceiver capable of wirelessly transmitting medical device data over the Internet-accessible wireless communications network; and

a processor coupled to the first and second transceivers and configured to determine if the wireless mesh relay network is accessible by the first transceiver of the relay modules and to determine if the Internet-accessible wireless communications network is accessible by the second transceiver of the relay modules.

28. The system of claim 27 wherein, in response to the Internet-accessible wireless communications network not being accessible by the second transceiver, the first transceiver transmits the medical device data over the wireless mesh relay network to another of the at least two relay modules comprising the wireless mesh relay network.