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(54) **INTERNET-PROTOCOL BASED
TELEMETRY PATIENT MONITORING
SYSTEM**

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(57) **ABSTRACT**

A method and device for communicating physiological or control data between a portable device and an information system via telemetry. The system includes at least one portable device, and usually many, each having an I/O port for bidirectionally communicating physiological or control data in the form of IP data packets via telemetry. The portable device in operation includes a layered network interface that supports a standard internet-based networking protocol (IP) stack and PHY and MAC layers. The system also includes an information system connected to a wired network through a networking switch, and having a port for bidirectionally communicating data via telemetry with the portable device. The access point may include a program that converts the IP data packets between the RF PHY and MAC and network, such as Ethernet, PHY and MAC layers and further may include a server such as a BOOTP/DHCP server to support a dynamic assignment of an IP address to a number of portable devices.

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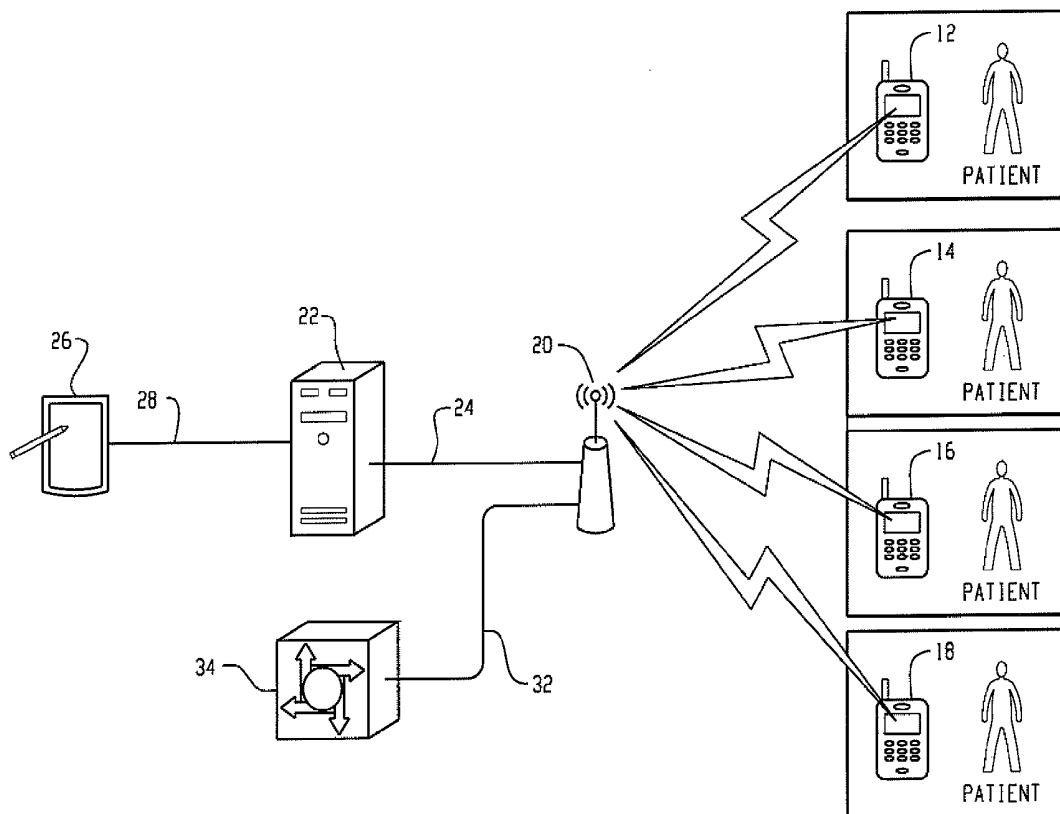
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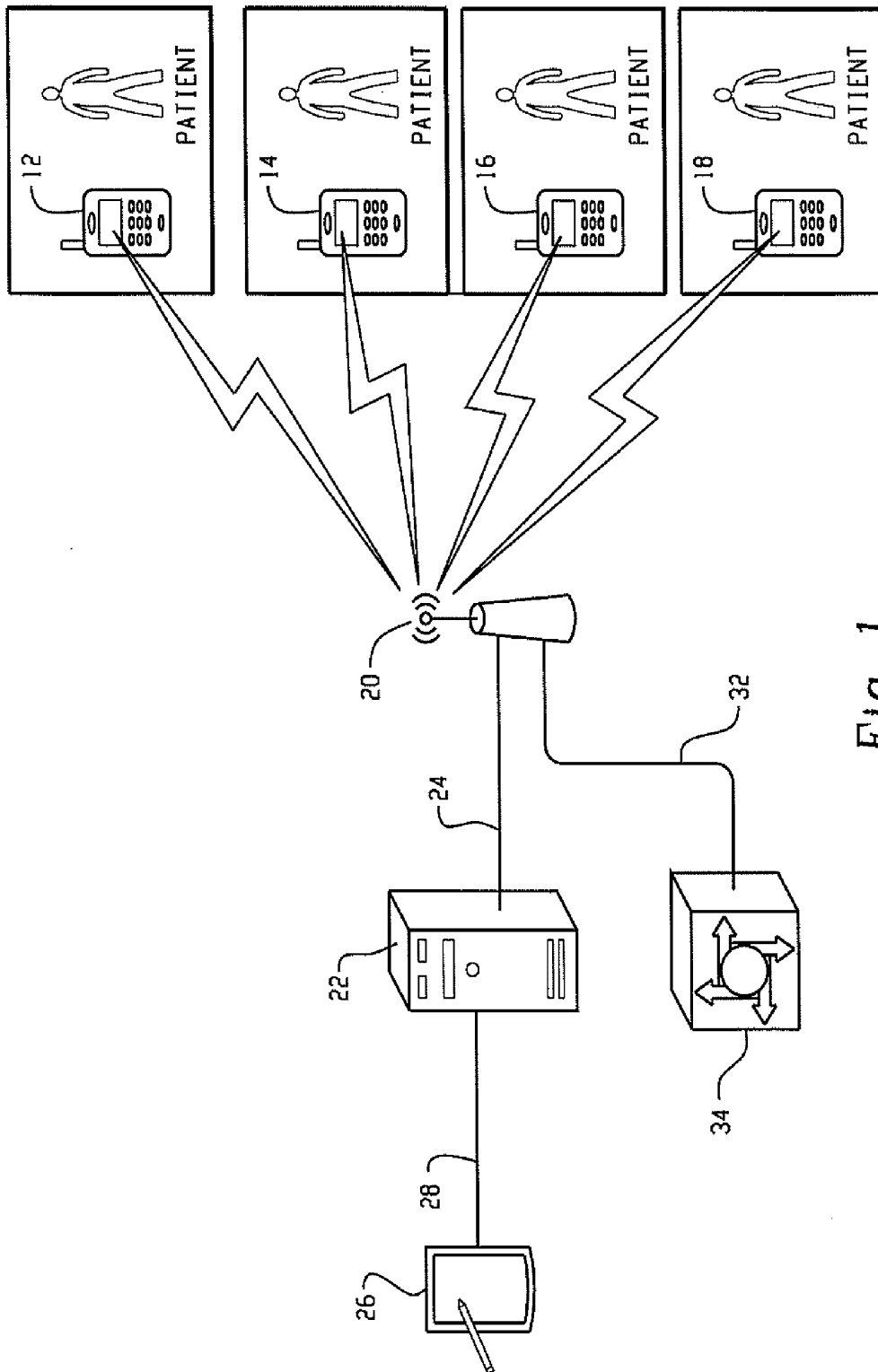


Fig. 1

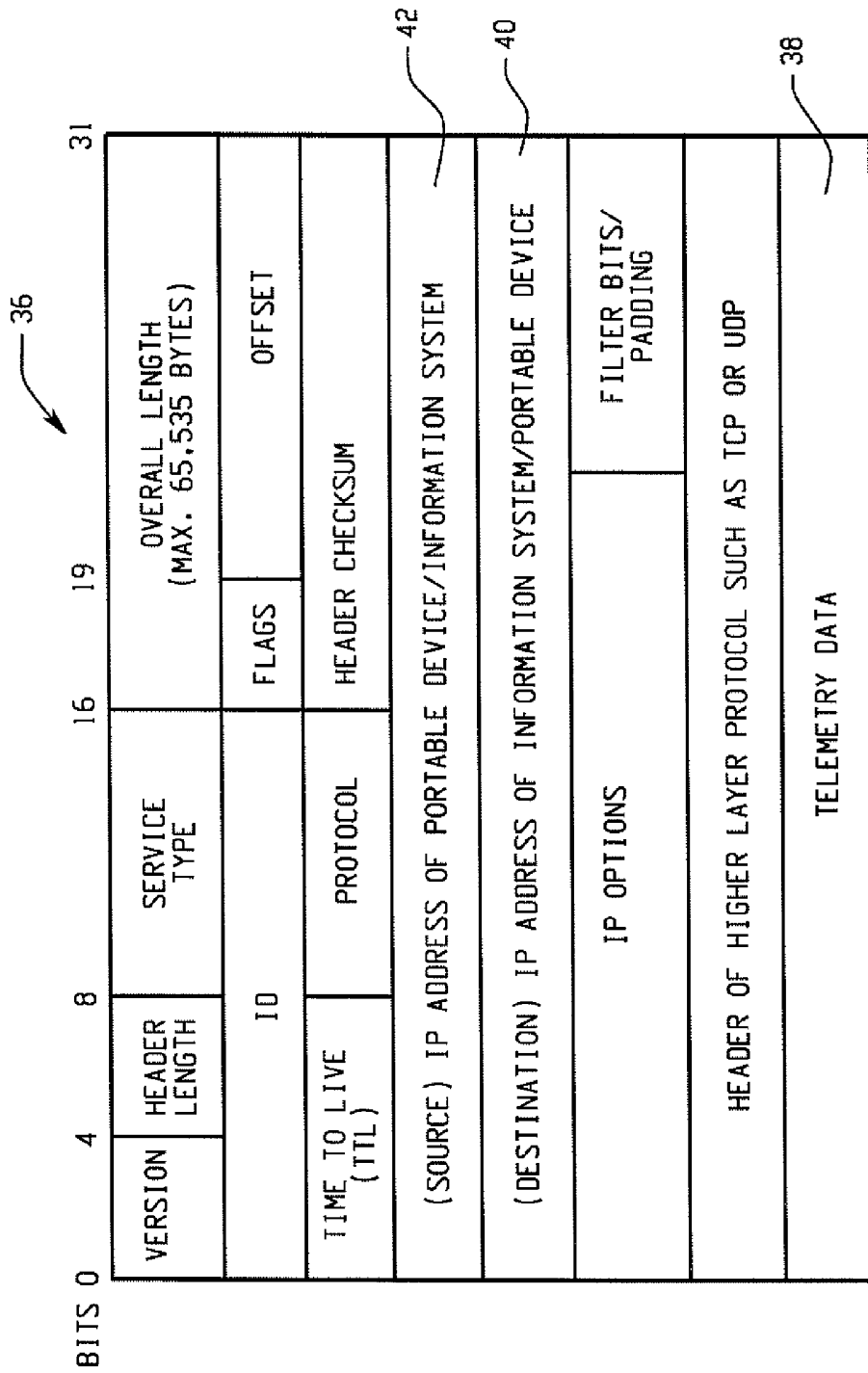


Fig. 2

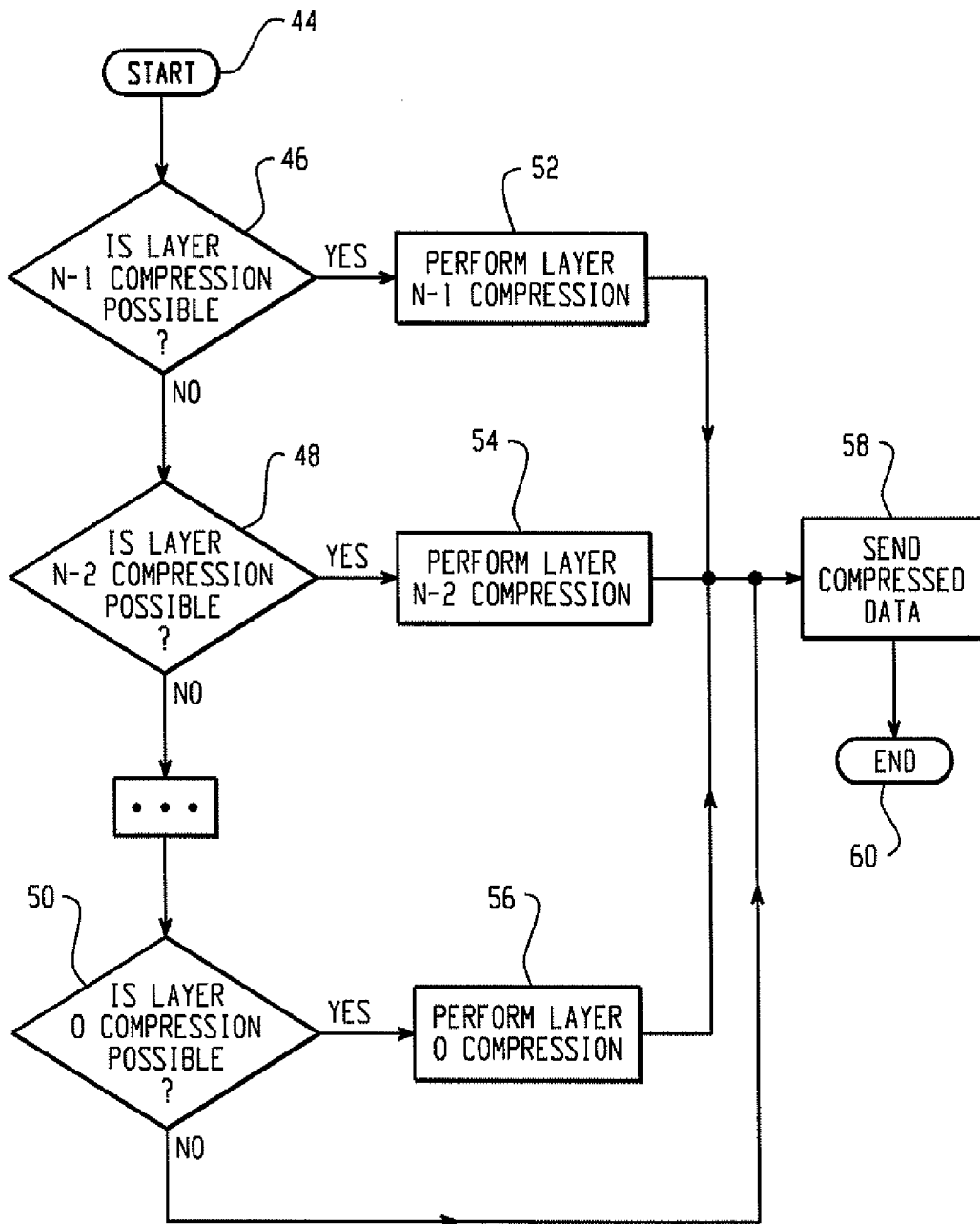


Fig. 3

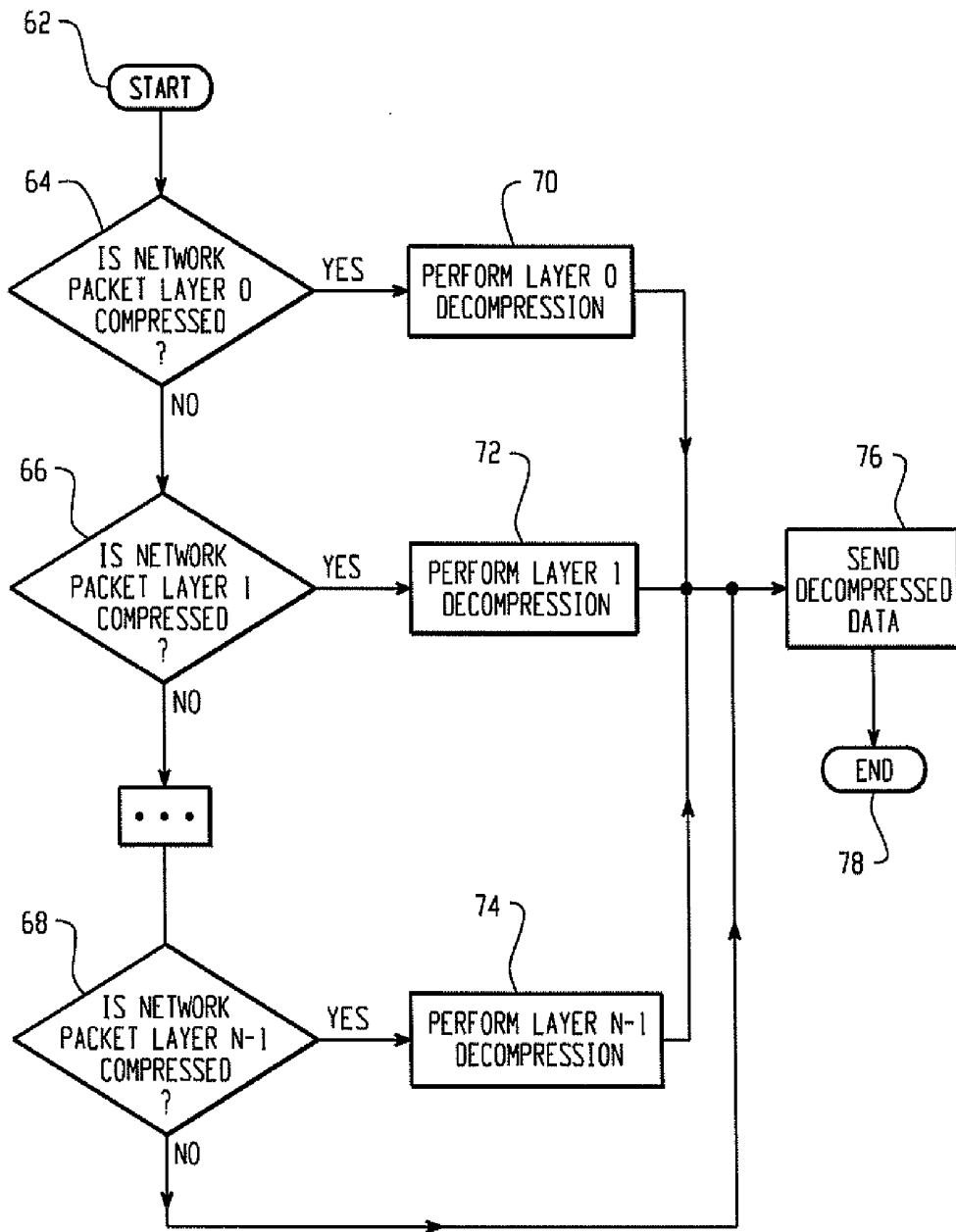


Fig. 4

INTERNET-PROTOCOL BASED TELEMETRY PATIENT MONITORING SYSTEM

[0001] The invention relates to patient telemetry methods and devices.

[0002] Telemetry is well-known in the field of patient monitoring in medical facilities. For example, US Patent Publication 2004/0109429, published Jun. 10, 2004, discloses a wireless LAN architecture for various services within a medical facility. The same uses multiple WLAN protocols for wireless access. Similarly, PCT WO 02/067122 discloses a wireless telemetry monitoring system that connects to a wireless network and then to the Internet.

[0003] In prior art systems of these types, battery power for portable devices is at a premium. The battery power must be employed for powering very specific circuitry, not larger scale “general” circuitry, as this latter dissipates too much power, limiting battery life. Matched crystals are generally used to generate the RF connection, and the battery power is limited to powering only these and any necessary accompanying electronics.

[0004] Such systems include NBFM RF systems with frequency-paired transmitters and receivers. These systems employ a proprietary networking protocol that is tightly coupled with the RF system to transmit physiological and status information into an information system from the transmitter to the receiver.

[0005] Embodiments of the current invention provide a more sophisticated software architecture design for the portable devices employed for telemetry, and thus can run the more sophisticated—and more general and useful—Internet Protocol (IP) on the same. This architecture design is made possible in part by improvements in power performance from the portable device electronics, and by better and more general networking architecture systems for portable devices.

[0006] Embodiments of the system include a bidirectional, cellular-based, RF system that may employ DECT technology to implement the RF PHY and MAC. The system may operate within the WMTS telemetry monitor RF spectrum. On top of the RF PHY and MAC layers, the system abstracts data transport by implementing a standard TCP/UDP/IP/Ethernet networking stack to enable bi-directional transport of physiological and control information throughout the heterogeneous network, which may include both wired and wireless portions. Every portable device may be statically assigned an Ethernet MAC address and dynamically assigned an IP address to enable data communication within the network.

[0007] The system may be employed, e.g., within the PMS/CMS Intellivue® product family available from Philips Medical Systems of Andover, Mass. USA and Best, the Netherlands.

[0008] The system includes a method and device for communicating physiological or control data between a portable device and an information system via telemetry. The system includes at least one portable device, the portable device having an I/O port for bidirectionally communicating physiological or control data in the form of IP data packets via telemetry. The portable device in operation includes a layered network interface that supports a standard

internet-based networking protocol stack and RF PHY and MAC layers. The system also includes an information system including at least one access point and an optional associated access pointer controller, connected to a wired network through a networking switch, and having an I/O port for bidirectionally communicating physiological or control data via telemetry with the portable device. The access point in operation includes a program that converts the IP data packets between the RF PHY and MAC and network, such as Ethernet, PHY and MAC layers and further includes a server such as a BOOTP/DHCP server to support a dynamic assignment of an IP address to the portable device.

[0009] Embodiments of the invention may employ adaptive compression based on the network headers as appropriate, e.g., UDP, IP, etc., for bandwidth optimization.

[0010] Advantages of embodiments of the invention are manifold. The use of standard networking protocols within telemetry monitoring reduces the cost of the network by allowing the use of standard networking infrastructure components. Management of the entire network is simplified, from portable device, to information system, by allowing the use of commonly available network management tools and services. The abstraction of the data communication protocol from the RF physical layer allows for the future swapping of the DECT-based RF PHY and MAC layers with other RF technologies, such as Zigbee, 802.15.1, 802.11a/b/g/e, NBFM, etc., without affecting the fundamental network architecture of the monitoring system. This approach decouples the portable device from a specific RF frequency and allows for the development of large-scale telemetry monitoring systems. The approach further allows other products, such as bedside monitors, defibrillators, etc., to easily be employed within the same RF and wired network as the portable telemetry devices.

[0011] FIG. 1 shows a standard patient telemetry system, which may be within a house or medical facility.

[0012] FIG. 2 shows a schematic of an IP data packet that may be employed within an embodiment of the present invention.

[0013] FIG. 3 shows a flowchart of an embodiment of the invention in which compression may be used for a layered network interface with N layers in the transmit path.

[0014] FIG. 4 shows a flowchart of an embodiment of the invention in which decompression may be used for a layered network interface with N layers in the receive path.

[0015] A standard patient telemetry system is shown in FIG. 1. A plurality of portable telemetry devices **12-18** is shown in wireless, e.g., mobile, cellular, Zigbee, 802.15.1, 802.11a/b/g/e, NBFM, etc., communication with an access point **20**. Portable telemetry devices **12-18** are typically battery-powered. Portable telemetry devices **12-18** transact IP data packets, bi-directionally, with an information system **22** via a connection **24** of the wired network. The data packets are typically real-time physiological and control information.

[0016] Portable telemetry devices **12-18** communicate with devices, e.g., tablet PC **26** on the wired network, e.g., via connection **28**, through an access point **20**. An optional access point controller **34** controls and directs the signals

through access point 20 via a connection 32. The access point controller 34 may provide a control function for the access points and a routing function for the network data packets from the portable devices. It may be an independent device or it may be merged with the information system 22. The access point 20 and its associated access point controller 34 convert the IP data packets between, e.g., a DECT RF PHY and MAC and an Ethernet PHY and MAC. The access point 20 and its associated access point controller 34 are connected to the wired network via a standard networking switch (not shown). The information system 22 may be PC-based, and is connected to the wired network via a switch (not shown).

[0017] To support data transfer from the portable devices to the information system, the portable telemetry devices 12-18 implement in software a layered network interface that supports both a standard internet-based networking protocol stack, with, e.g., a BOOTP client service, and the RF PHY and MAC layers. The RF PHY and MAC layers may be implemented using DECT technology and may operate within the WMTS telemetry monitor RF spectrum. In this way, the portable devices 12-18 may wirelessly communicate data to the access point 20. Of course, future variants are not tied to DECT technology to support this function. Any appropriate wireless protocol may be employed. Nor are future variants tied to the WMTS telemetry monitor RF spectrum.

[0018] As noted, on top of RF PHY and MAC layers, the system abstracts data transport by implementing a standard TCP/UDP/IP/Ethernet networking stack to enable bidirectional transport of physiological and control information throughout the network (wired and wireless).

[0019] For example, as shown in FIG. 2, an IP data packet 36 appropriate for communication of physiological and control information is shown. One of portable devices 12-18 may measure a physiological value, and the same may be disposed in the data payload 38. The portable device may then wirelessly communicate the IP data packet 36 to the access point 20 using, e.g., DECT RF PHY and MAC layers. In so doing, the portable device imprints its source IP address on the IP data packet 26 as source address 42. The access point 20 may receive the IP data packet 36 and may further convert the same to Ethernet PHY and MAC layers. Once within the Ethernet PHY and MAC layer, the IP data packet 36 may be directed to the IP address indicated by a destination address 40, such as the information system 22.

[0020] To accomplish the addressing, especially dynamic addressing, the information system 22 may run a BOOTP/DHCP server to support the dynamic assignment of IP addresses for the portable devices 12-18. For example, access point controller 34 may also serve as the BOOTP/DHCP server in the system. Of course, it will be clear to one of ordinary skill in the art that any number of portable devices 12-18 may be employed, depending on the number of enduring IP addresses available to the system. In more detail, the portable devices may be dynamically assigned an IP address to enable communication within the network, as well as an Ethernet MAC address.

[0021] It should be noted here that the functions of access point 20 and access point controller 34 are flexible. The scheme in FIG. 1 may be employed, or the functions of access point controller 34 may be entirely contained with the access point 20 and/or the information system 22.

[0022] Referring to FIG. 3, an embodiment of the invention is shown in which adaptive compression specific to the network headers of the telemetric data packets is employed for a layered network interface with N layers in the transmit path. The compression is thus based on what type of data packet is used, e.g., UDP, IP, etc. This adaptive compression may be employed for bandwidth optimization, and is based on the detectable, uppermost layer in the network traffic, on a per packet basis. Such compression may apply to both the portable device, i.e., data from the measurement subsystems, and the access point, i.e., data from the wired network.

[0023] After a start step 44, which may simply be the last step of the immediately preceding algorithm, a determination is made as to whether a layer N-1 (of the network packets available for RF transmission) is compressible (step 46). If it is, compression is performed (step 52), and the data is sent on (step 58) and the process terminates (step 60). If it is not, a determination is made as to whether a layer N-2 is compressible (step 48). If it is, compression is performed (step 54), and the data is sent on (step 58) and the process terminates (step 60). This continues for all the layers until a determination is made as to whether a layer 0 is compressible (step 50). If it is, compression is performed (step 56), and the data is sent on (step 58) and in any case the process terminates here (step 60).

[0024] FIG. 4 shows a flowchart of an embodiment of the invention in which decompression may be used for a layered network interface with N layers in the receive path. The decompression is based on the encoding in the compression. Such procedures may apply to both the portable device and to the access point receiving data over the RF link.

[0025] After a start step 62, which again may simply be the last step of the immediately preceding algorithm, a determination is made as to whether a layer 0 packet (of a network packet received over RF) is compressed (step 64). If it is, decompression is performed (step 70), and the data is sent on (step 76) and the process terminates (step 78). If it is not, a determination is made as to whether a layer 1 packet is compressed (step 66). If it is, decompression is performed (step 72), and the data is sent on (step 76) and the process terminates (step 78). This continues for all the layers until a determination is made as to whether a layer N-1 packet is compressed (step 68). If it is, decompression is performed (step 74), and the data is sent on (step 76) and in any case the process terminates here (step 78).

[0026] The invention has been described with respect to certain embodiments. However, the scope of the invention is to be defined only by the scope of the appended claims.

1. A system for communicating physiological or control data between a portable device and an information system via telemetry, comprising:

At least one portable device, the portable device having an I/O port for bidirectionally communicating physiological or control data in the form of IP data packets via telemetry, wherein the portable device in operation includes a layered network interface that supports a standard internet-based networking protocol stack and RF PHY and MAC layers;

An information system including at least one access point, connected to a wired network through a networking switch, and having an I/O port for bidirectionally

- communicating physiological or control data via telemetry with the portable device, wherein the access point and the portable device in operation includes a program that converts the IP data packets between the RF PHY and MAC and Ethernet PHY and MAC layers and further includes a server to support a dynamic or static assignment of a network identifier to the portable device.
2. The system of claim 1, wherein the RF PHY and MAC layers are DECT based.
 3. The system of claim 1, wherein the RF PHY and MAC layers are selected from the group consisting of Zigbee, 802.15.1, 802.11a/b/g/e, and NBFM.
 4. The system of claim 1, wherein the RF operates within the WMTS band.
 5. The system of claim 1, wherein the portable device is battery-powered or wall-powered.
 6. The system of claim 1, wherein the portable device or the information system, or both, further includes a program for adaptive compression based on a network header of the physiological or control data.
 7. The system of claim 1, wherein the converted PHY and MAC layers are Ethernet layers.
 8. The system of claim 1, wherein the server is a BOOTP server.
 9. The system of claim 1, wherein the network identifier is an IP address.
 10. The system of claim 1, further comprising an access pointer controller associated with the access point.
 11. A method for communicating physiological or control data between at least one portable device and an information system via telemetry, comprising the steps of:

Bidirectionally communicating physiological or control data in the form of IP data packets via telemetry between at least one portable device and an information system,

wherein the portable device in operation performs steps including transmitting data using a standard internet-based networking protocol stack and RF PHY and MAC layers; and

wherein the information system in operation performs steps including converting the IP data packets between the RF PHY and MAC and Ethernet PHY and MAC layers and employing a server to support a dynamic or static assignment of a network identifier to each portable device.

12. The method of claim 11, wherein the RF PHY and MAC layers are DECT based.
13. The method of claim 11, wherein the RF PHY and MAC layers are selected from the group consisting of Zigbee, 802.15.1, 802.11a/b/g/e, and NBFM.
14. The method of claim 11, wherein the RF operates within the WMTS band.
15. The method of claim 11, wherein the portable device is battery-powered or wall-powered.
16. The method of claim 11, further comprising adaptively compressing the data based on a network header of the physiological or control data.
17. The method of claim 11, wherein the converting the IP data packets between the RF PHY and MAC and Ethernet PHY and MAC layers includes converting the IP data packets to Ethernet PHY and MAC layers.
18. The method of claim 11, wherein the employing a server includes employing a BOOTP server.
19. The method of claim 10, wherein the employing a server to support a dynamic or static assignment of a network identifier to each portable device includes employing a server to support a dynamic or static assignment of an IP address to each portable device.

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专利名称(译)	基于Internet协议的遥测病人监护系统		
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摘要(译)

一种用于通过遥测在便携式设备和信息系统之间传送生理或控制数据的方法和系统。该系统包括至少一个便携式设备，通常很多，每个都具有I/O端口，用于通过遥测以IP数据分组的形式双向地传送生理或控制数据。操作中的便携式设备包括分层网络接口，其支持标准的基于因特网的网络协议(IP)栈以及PHY和MAC层。该系统还包括通过网络交换机连接到有线网络的信息系统，并且具有用于通过遥测与便携式设备双向通信数据的端口。接入点可以包括在RF PHY和MAC之间转换IP数据分组的程序和/或网络，例如以太网，PHY和MAC层，并且还可以包括诸如BOOTP/DHCP服务器的服务器以支持动态分配许多便携式设备的IP地址。

