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Lu et al.

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(54) **TERMINAL DEVICE EMULATOR**

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(22) Filed: **May 24, 2002**

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(51) **Int. Cl.**[7] **H04M 3/42**

(52) **U.S. Cl.** **455/419**; 455/3.01; 455/3.06; 455/558

(58) **Field of Search** 455/3.01, 3.03, 455/3.04, 3.06, 403, 414, 419, 424, 425, 428, 557, 558, 561, 62

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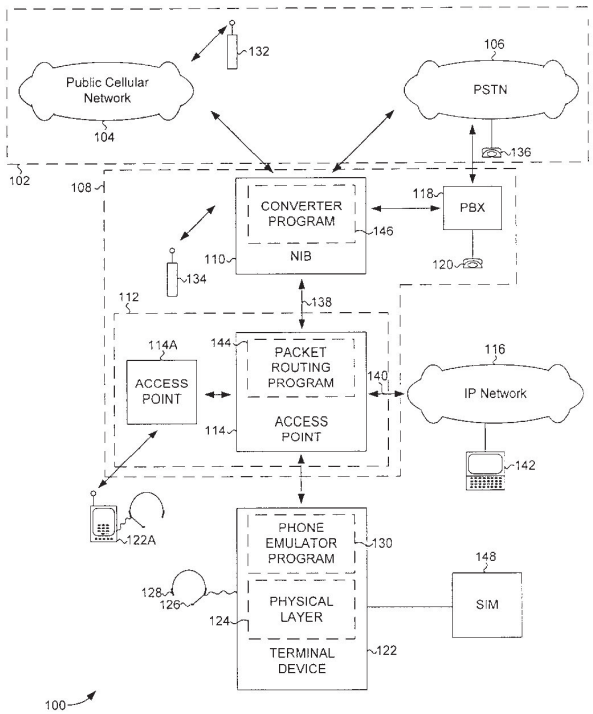
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(57) **ABSTRACT**

A communication network **(100)** is provided having a WLAN **(112)** and an WLAN enabled information processing device **(122)**, such as a portable computer or PDA, capable of emulating a cellular telephone. Generally, the device **(122)** includes a program **(130)** to emulate a cellular telephone and to identify voice packets to an access point **(114)** of the WLAN **(112)**. The access point **(114)** is configured to route voice packets to a public or private cellular network **(104, 110)** over a first path **(138)**, and to route other packets to an IP Network **(116)**, over a second path **(140)**. Thus, enabling a user of the device **(122)** to simultaneously engage in voice communication with a cellular network **(104, 110)** and data communication with the IP network **(116)**.

31 Claims, 7 Drawing Sheets



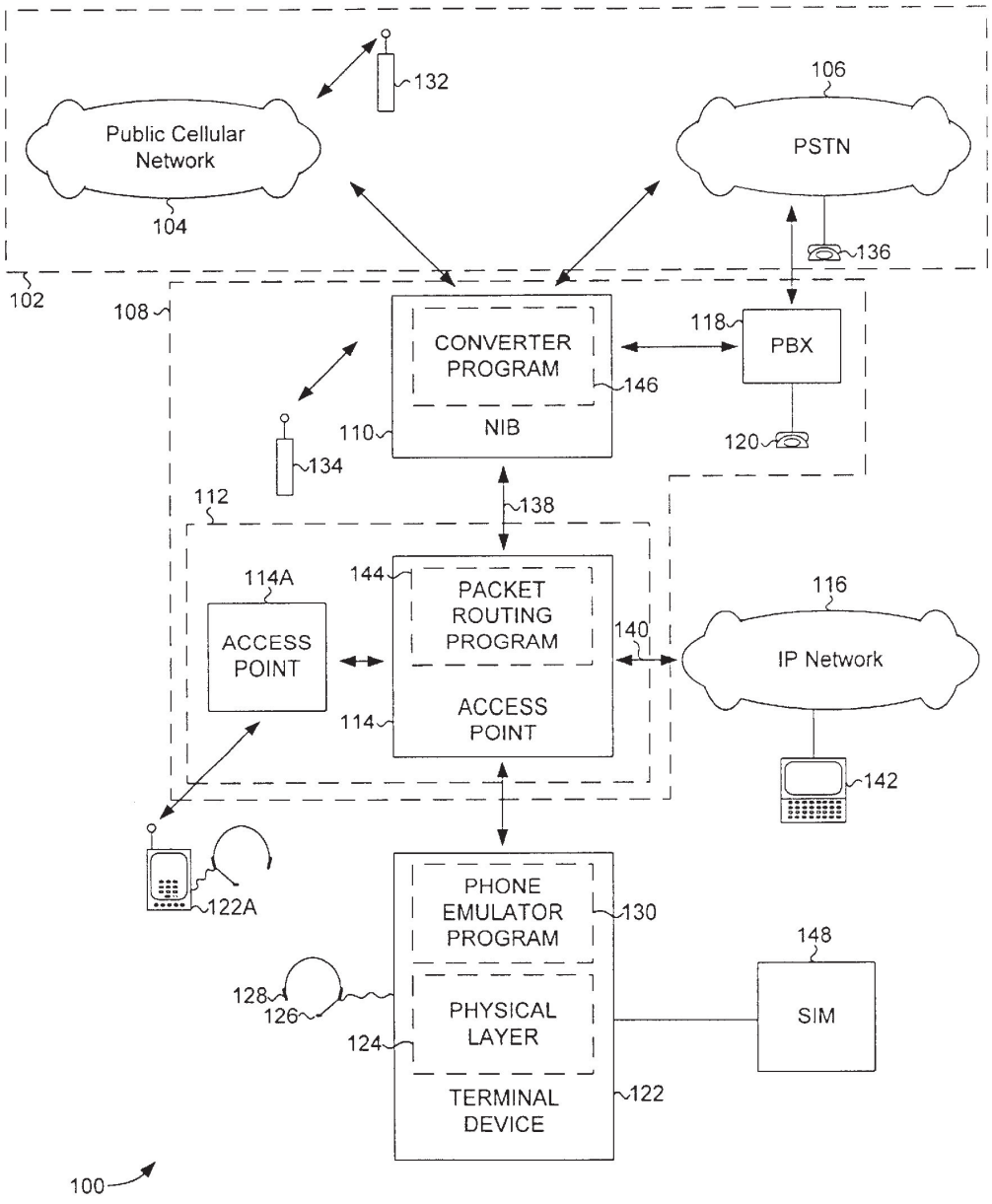

Public Cellular Network
104
132
106
PSTN
136
102
108
CONVERTER PROGRAM
146
NIB
110
118
PBX
120
134
112
138
114A
ACCESS POINT
144
PACKET ROUTING PROGRAM
140
ACCESS POINT
114
116
IP Network
142
122A
PHONE EMULATOR PROGRAM
130
148
128
126
PHYSICAL LAYER
124
SIM
TERMINAL DEVICE
122
100

FIG. 1

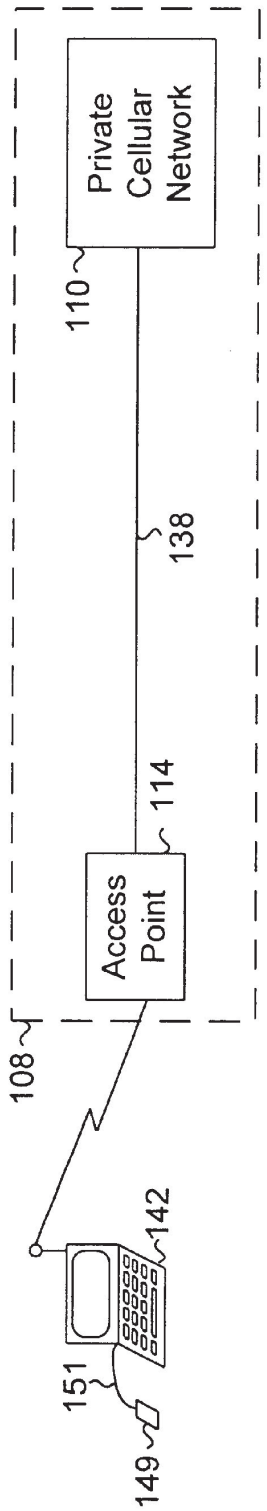

Private Cellular Network
110
138
114
Access Point
108
142
151
149

FIG. 2

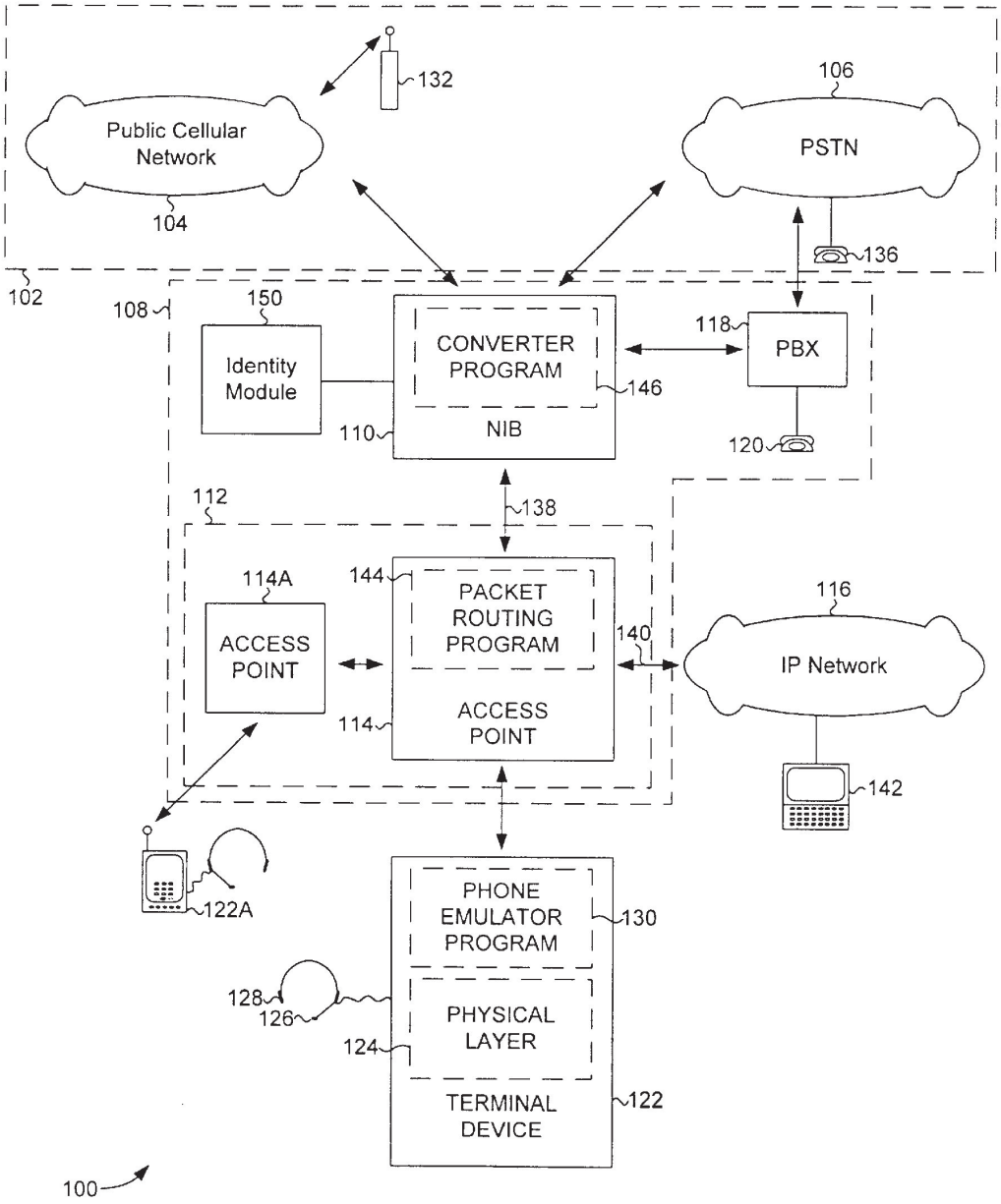

Public Cellular Network
104
132
106
PSTN
136
102
108
150
Identity Module
CONVERTER PROGRAM
146
NIB
110
118
PBX
120
112
138
114A
ACCESS POINT
144
PACKET ROUTING PROGRAM
140
ACCESS POINT
114
116
IP Network
142
122A
PHONE EMULATOR PROGRAM
130
128
126
PHYSICAL LAYER
124
TERMINAL DEVICE
122
100

FIG. 3

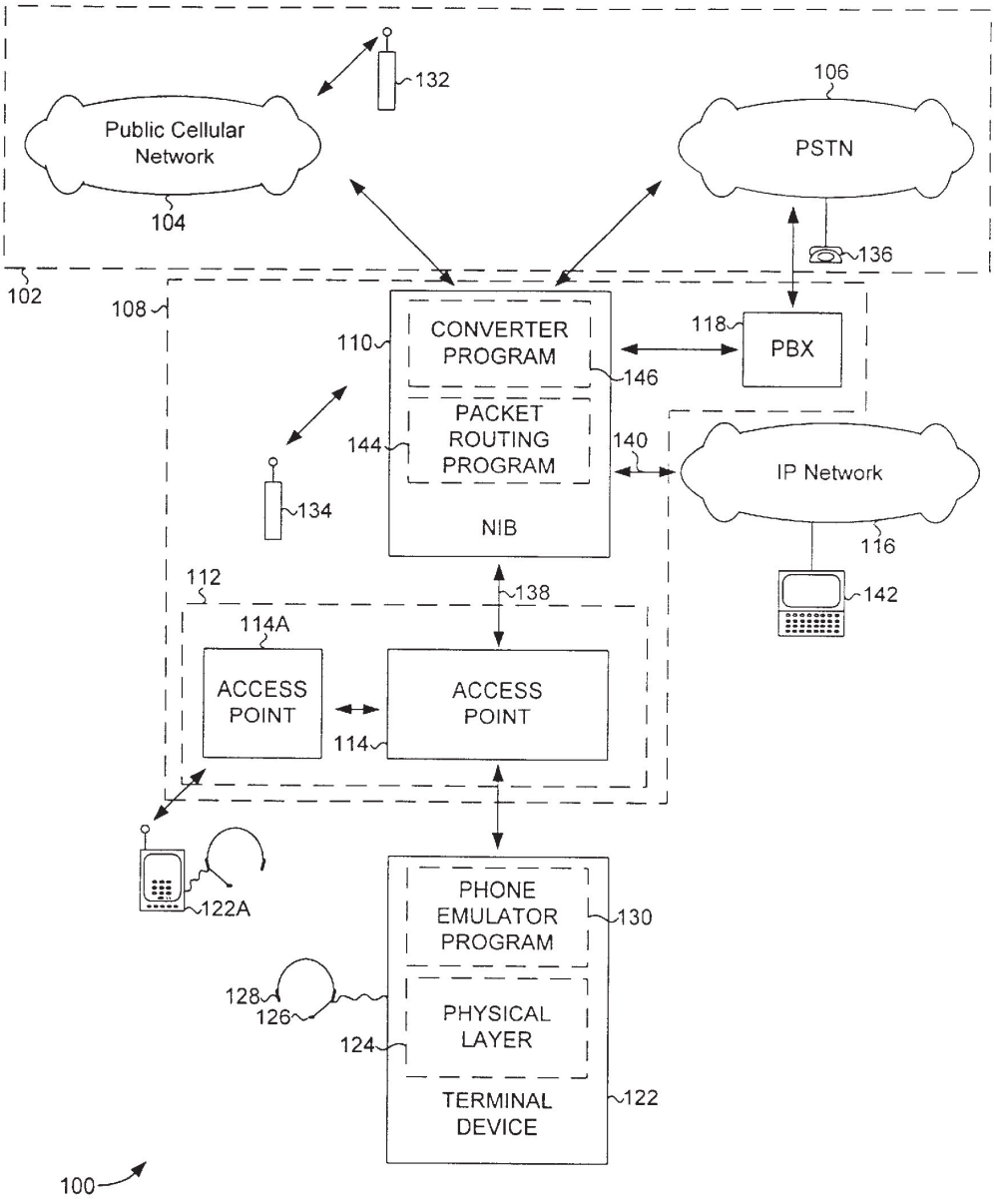

Public Cellular Network
104
132
106
PSTN
136
102
108
110
CONVERTER PROGRAM
146
118
PBX
144
PACKET ROUTING PROGRAM
140
IP Network
134
NIB
116
112
138
142
114A
ACCESS POINT
ACCESS POINT
114
122A
PHONE EMULATOR PROGRAM
130
128
126
PHYSICAL LAYER
124
TERMINAL DEVICE
122
100

FIG. 4

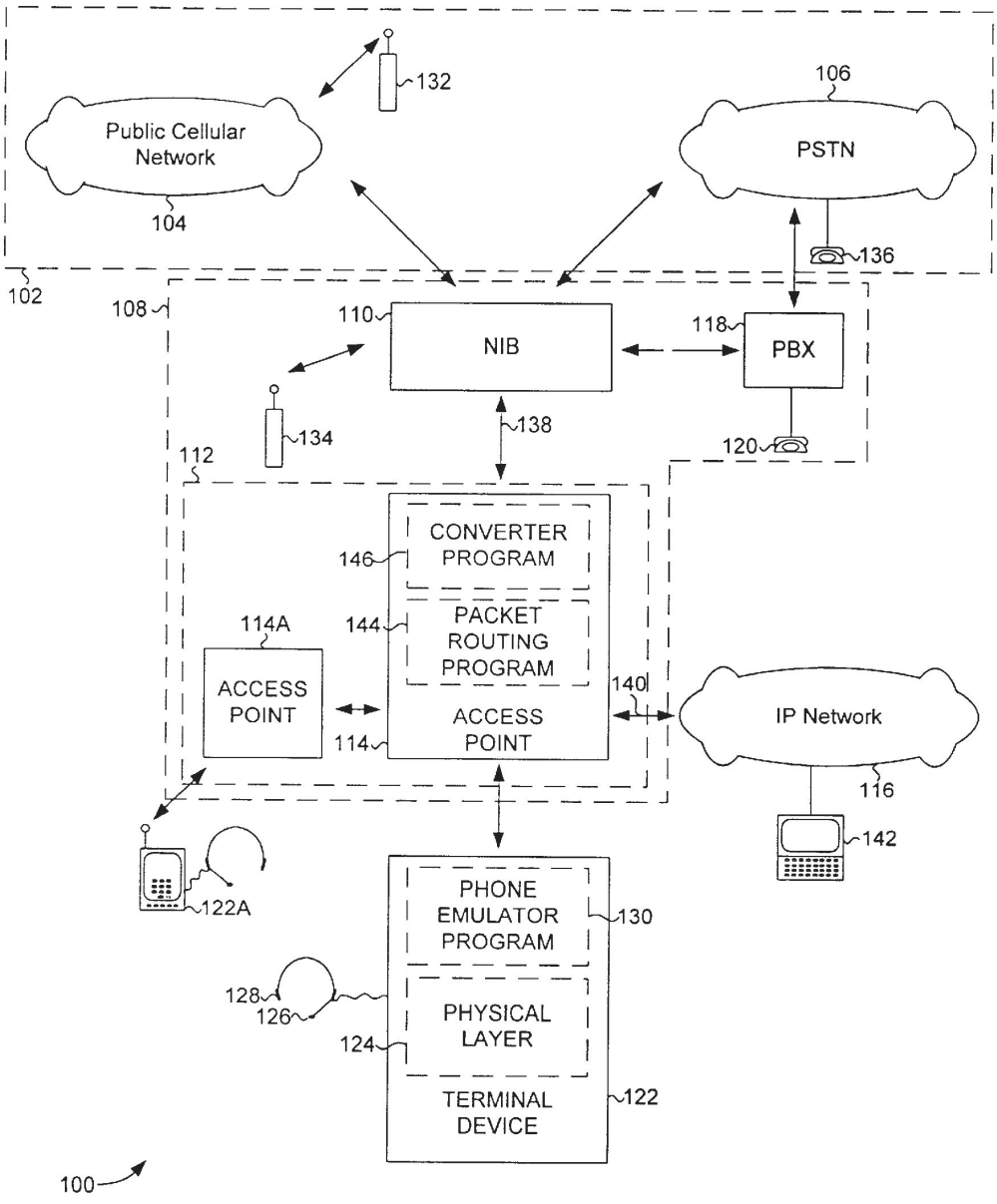

Public Cellular Network
104
132
106
PSTN
136
102
108
110
NIB
118
PBX
134
138
120
112
CONVERTER PROGRAM
146
114A
144
PACKET ROUTING PROGRAM
ACCESS POINT
140
IP Network
ACCESS POINT
114
116
142
122A
PHONE EMULATOR PROGRAM
130
128
126
PHYSICAL LAYER
124
TERMINAL DEVICE
122
100

FIG. 5

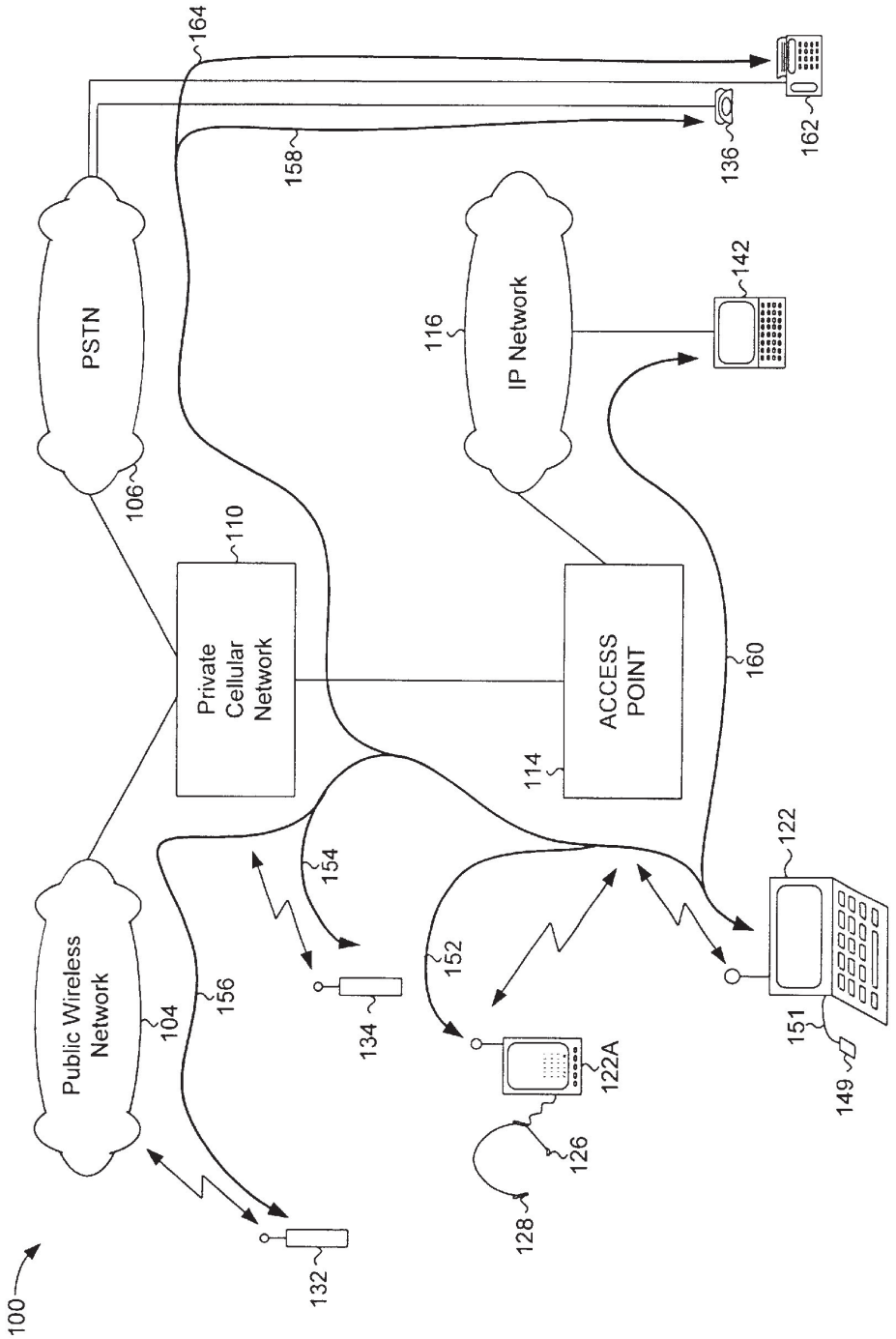

100
Public Wireless Network
104
PSTN
106
Private Cellular Network
110
IP Network
116
ACCESS POINT
114
132
134
136
142
149
151
154
156
158
160
162
164
122
122A
126
128
152

FIG. 6

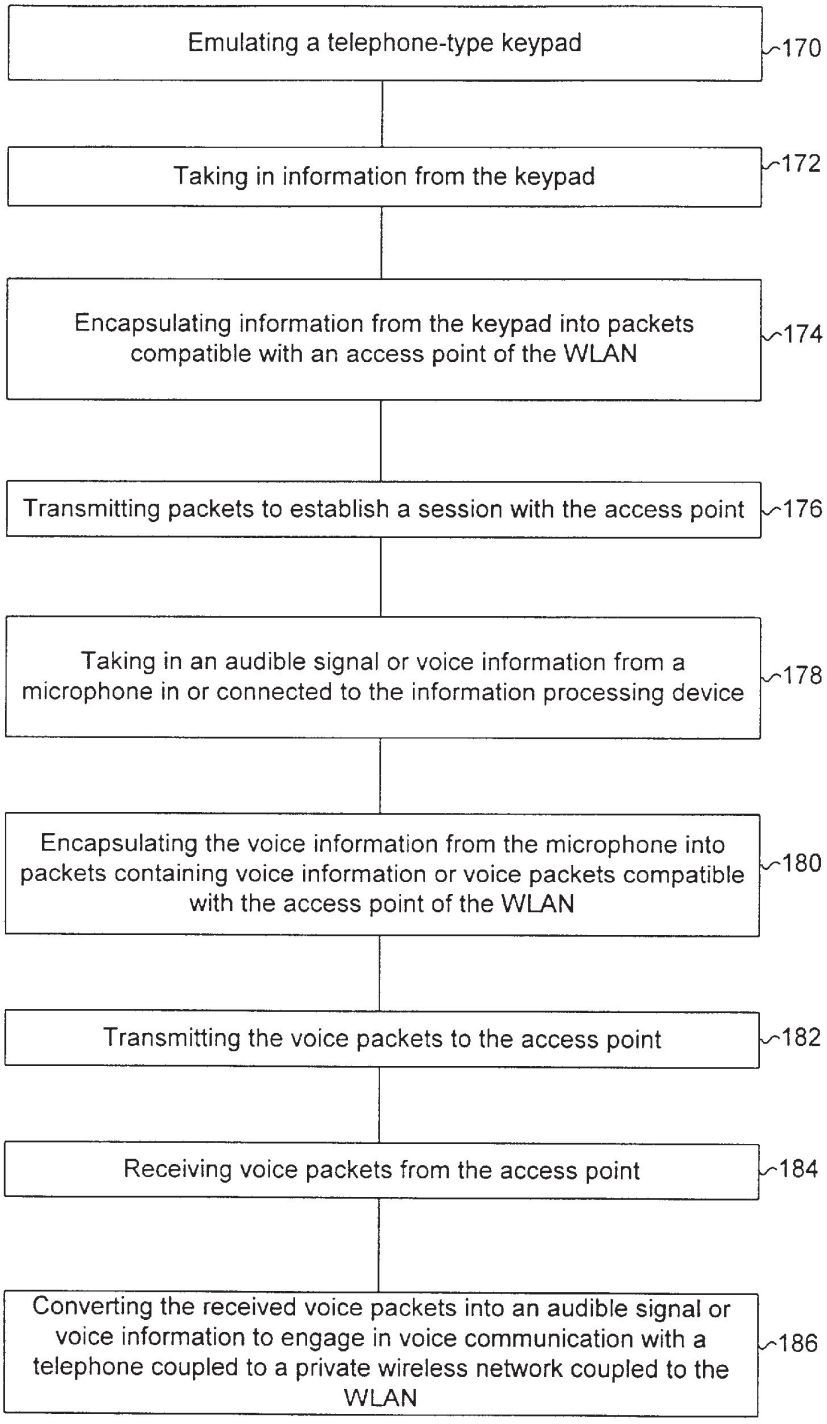

Emulating a telephone-type keypad
170
Taking in information from the keypad
172
Encapsulating information from the keypad into packets compatible with an access point of the WLAN
174
Transmitting packets to establish a session with the access point
176
Taking in an audible signal or voice information from a microphone in or connected to the information processing device
178
Encapsulating the voice information from the microphone into packets containing voice information or voice packets compatible with the access point of the WLAN
180
Transmitting the voice packets to the access point
182
Receiving voice packets from the access point
184
Converting the received voice packets into an audible signal or voice information to engage in voice communication with a telephone coupled to a private wireless network coupled to the WLAN
186

FIG. 7

TERMINAL DEVICE EMULATOR

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority from commonly assigned, co-pending U.S. Provisional Patent Application Serial No. 60/365,422, entitled Terminal Device Emulator, and filed Mar. 18, 2002, which is incorporated herein by reference.

FIELD

The present invention relates generally to communication networks, and more particularly to a communication network, computer program and method for enabling a wireless enabled information processing device, such as a portable computer or personal digital assistant, to emulate a cellular communications terminal, such as a GSM (Global System for Mobile communications) or 3G (third generation) cellular telephone.

BACKGROUND

The use of wireless communication networks and devices, including cellular telephones and portable computers or network access appliances, has increased exponentially in recent years. Many individuals now carry a cellular telephone, and a portable computer or a similar information processing device, such as a laptop computer, notebook computer or personal digital assistant (PDA), adapted to access a wireless local area network (WLAN) or the Internet via a radio link. Maintaining and carrying two devices that perform essentially the same function, i.e., provide wireless access to a communication network, presents a number of difficulties or disadvantages. First is the expense associated with purchasing the two separate devices, and the expense associated with subscribing to separate services for both devices. There is also the weight or bulk of the devices themselves. Although cellular telephones and portable computers or PDAs are decreasing in size, they are still somewhat bulky.

One possible solution to the above problem is a combination portable computer/telephone having dual radio functionality, including a first radio, such as a radio compatible with one or more high performance wireless communication standards, including, for example, Institute of Electrical and Electronics Engineers 802. 11, high performance local area network (HiperLAN) or Bluetooth, for accessing a computer network, and a second GSM or 3G radio transceiver for accessing a cellular network. However, this approach is not wholly satisfactory for a number of reasons. First the integration of two radios into a single combination device adds to the complexity of the device and therefore would probably not result in substantial savings in cost or weight. In fact, the integration of two radios in a single device, would necessarily require additional components, thereby adding to the cost and complexity of the devices. Moreover, because the two radios operate in vastly different frequency ranges, it is not necessarily the case that a single service provider would be able to provide service in both bands, and therefore there may not be any savings in operating or service costs.

There is yet another problem with conventional cellular telephones and with the above combination device. Wide spread use of cellular telephones, particularly in urban areas and along major travel corridors has led to an overload condition with congestion in the available licensed frequency bands oftentimes resulting in delays, denial of services, and degraded service.

Another approach to solving the above problems is the use of voice over an Internet Protocol network (VoIP) with a WLAN. In this approach voice information is 'packetized' and transmitted from a portable computer or wireless device to an access point connected to a wired local area network or the Internet. This approach is also not wholly satisfactory for a number of reasons. First, the portable computer lacks the ability to provide many of the services commonly expected with cellular telephones, including supplementary and value-added services such as call waiting, call-forwarding, call-conferencing and short message service. Second, while this approach might work well for a small, privately owned WLAN, traffic over public IP networks, such as the Internet, which would necessarily interconnect the access points, would likely cause problems with loss of packets, prioritization of packets, delay of packets and errors in packets. This in turn would result in an unacceptably degraded service.

Accordingly, there is a need for an apparatus and method capable of providing both wireless voice and data communication. It is desirable that the apparatus be less expensive, less complex, and weigh less or have less bulk than a separate cellular telephone and portable computer or other information processing device combined. It is also desirable that the apparatus be compatible with standardized private WLANs, and public cellular networks and Internet infrastructures. It is further desirable that the apparatus provide voice communication having a quality of service the same as or superior to that provided by single purpose GSM network or 3G network cellular telephones.

The system and method of the present invention provides these and other advantages over the prior art.

SUMMARY

It is an object of the present invention to provide a communication system or network and method for enabling information processing devices, such as portable computers or personal digital assistants (PDAs), to communicate with telephones of private and public networks via an access point of a wireless local area network (WLAN).

It is a further object of the present invention to provide a client computer program or software capable of being downloaded into an information processing device having access to a WLAN to enable the information processing device to communicate with telephones of private and public networks via the access point of the WLAN.

In one aspect, the invention is directed to an information processing device capable of emulating a cellular communications terminal, such as a cellular telephone. Generally, the information processing device includes: (i) a transceiver capable of communicating with an access point of a WLAN; (ii) a computer readable memory; (iii) a processor capable of executing instructions of a computer program stored in the computer readable memory; and (iv) a computer program stored in the computer readable memory, the computer program having program code for enabling the information processing device to emulate a cellular communications terminal. Generally, the communications terminal emulated is a voice terminal, and the computer program further includes program code for marking or identifying packets containing voice information or voice packets to the access point. Preferably, the computer program further includes program code to enable the information processing device to emulate any one of a number of different telephones includ-

ing: CDMA telephones; Global System for Mobile communications (GSM) cellular telephones; and third generation (3G) cellular telephones. More preferably, the computer program further includes program code to enable the information processing device to emulate a particular model of cellular telephone manufactured by a particular manufacturer.

In one embodiment, the information processing device further includes a subscriber identity module (SIM) card and an adapter that enables it to communicate with and function in a public or private cellular network. Alternatively, the information processing device further includes at least one virtual identity module with subscriber identification and security information stored in the computer readable memory to enable it to communicate with and function in a public or private cellular network.

In another embodiment, the computer program includes program code to enable the information processing device to control supplementary services and/or value added services provided by the public network or private network. Supplementary services controlled by the computer program can include: Voice Group Call Service; Voice Broadcast Service; Service definition Line Identification Supplementary Services; Call Forwarding Supplementary Services; Call Waiting and Call Hold Supplementary Services; Multiparty call conferencing; Closed User Group Supplementary Services; Advice of Charge Supplementary Services; Call Barring Supplementary Services; Unstructured Supplementary Service Data; Explicit Call Transfer; Completion of Calls to Busy Subscriber; Short Message Service; and Follow Me. Value-added services controlled by the computer program can include e-mail, calender, and wireless inventory.

In another aspect, the invention is directed to a communication network capable of operating with the information processing device configured and enabled as described above. Generally, the communication network further includes a public network having a public wireless network, and a private network having a switch through which the private network is coupled to the public network, and a WLAN with at least one access point.

Preferably, the WLAN is further coupled to an internet protocol (IP) network, and the access point further includes a computer readable memory; a processor capable of executing instructions of a computer program stored in the computer readable memory; and a packet routing program stored in the computer readable memory. The packet routing program includes program code to enable the access point to route voice packets to the switch over a first communication path, and packets not identified as voice packets to the IP network over a second communications path. Thus, enabling a user of the information processing device to simultaneously engage in voice communication with a terminal coupled to the public network, and data communication with a terminal coupled to the IP network. More preferably, the switch further includes a computer readable memory; a processor capable of executing instructions of a computer program stored in the computer readable memory; and a converter program stored in the computer readable memory to enable the switch to convert voice packets received from the information processing device to signals compatible with those used in the public network. In one version of this embodiment, the switch is a part of a private cellular network. Optionally, the public network further includes a public switched telephone network (PSTN), the private network further includes a private branch exchange (PBX), and the terminal emulator program, packet routing program and converter program are adapted to enable the information processing device to communicate with telephones coupled to the private cellular network, the PBX, the PSTN, and the public cellular network.

In yet another aspect, the invention is directed to a computer program product for use in conjunction with a WLAN enabled information processing device. Generally, the computer program is a terminal emulator program for enabling the information processing device to emulate a cellular communication terminal, and includes program code for: (i) emulating a telephone-type keypad; (ii) taking in information from the keypad; (iii) encapsulating information from the keypad into packets compatible with the access point of the WLAN; (iv) transmitting packets to establish a session with the access point; (v) taking in an audible signal or voice information from a microphone in or connected to the information processing device; (vi) encapsulating the voice information from the microphone into packets containing voice information or voice packets compatible with the access point of the WLAN; (vii) transmitting the voice packets to the access point; (viii) converting the voice packets received in the access point in to packets or signals compatible with the public or private wireless networks; (ix) receiving voice packets from the access point; and (x) converting the received voice packets into an audible signal or voice information to engage in voice communication with a telephone coupled to the private or public network.

In one embodiment, the program code for emulating a telephone-type keypad includes program code for emulating one or more different models of GSM, 3G, or CDMA cellular telephones produced by one or more different manufacturers. In one version of this embodiment, the type, manufacturer and model of the cellular telephone emulated is based on information stored in the VIM or SIM associated with the information processing device.

In still another aspect, the invention is directed to a computer program product for use in conjunction with a WLAN enabled information processing device. Generally, the computer program product includes a computer readable storage medium and a computer program mechanism embedded therein. The computer program mechanism has a program module that directs the information processing device, to function in a specified manner, to emulate a cellular communications terminal. The program module includes program code for: (i) emulating a telephone-type keypad; (ii) taking in information from the keypad; (iii) encapsulating information from the keypad into packets compatible with the access point of the WLAN; (iv) transmitting packets to establish a session with the access point; (v) taking in an audible signal or voice information from a microphone in or connected to the information processing device; (vi) encapsulating the voice information from the microphone into packets containing voice information or voice packets compatible with the access point of the WLAN; (vii) transmitting the voice packets to the access point; (viii) converting the voice packets received in the access point in to packets or signals compatible with the public network or private network; (ix) receiving voice packets from the access point; and (ix) converting the received voice packets into an audible signal or voice information to engage in voice communication with a telephone coupled to the private or public network.

In still another aspect, the invention is directed to a method of adapting a WLAN enabled device to emulate a cellular communications terminal. In the method, a telephone-type keypad is emulated on the information processing device and information taken in from the keypad.

Information from the keypad is then encapsulated into packets compatible with the access point of the WLAN, and packets transmitted to establish a session with the access point or WLAN. An audible signal or voice information is taken in from a microphone integrated with or connected to the information processing device, and the voice information from the microphone encapsulated into packets or voice packets compatible with the access point of the WLAN. The voice packets are then transmitted to the access point. Voice packets from the access point are received and converted into an audible signal or voice information, thereby enabling the user to engage in voice communication with a telephone coupled to a private wireless network coupled to the WLAN.

Advantages of the apparatus and method of the present invention include any or all of the following:

(i) the ability to provide both wireless voice and data communication to a portable computer or PDA simultaneously;

(ii) less expensive, less complex, and lower weight or bulk than separate cellular telephone and portable computer combined;

(iii) compatible with standardized public network and Internet network infrastructures;

(iv) voice communication having a quality of service the same as or superior to that provided by single purpose GSM or 3G cellular telephones; and

(v) ability to provide high-speed high-bandwidth broadband connection to an existing public wireless network using WLAN technology.

BRIEF DESCRIPTION OF THE FIGURES

These and various other features and advantages of the present invention will be apparent upon reading of the following detailed description in conjunction with the accompanying drawings, where:

FIG. **1** is a simplified block diagram of a communication network according to an embodiment of the present invention;

FIG. **2** is a block diagram of a portion of the communication system of FIG. **1** illustrating an access point and an information processing device a card holder/reader coupled thereto;

FIG. **3** is a simplified block diagram of a communication network according to another embodiment of the present invention having an identity module coupled to a private cellular network;

FIG. **4** is a simplified block diagram of a communication network according to another embodiment of the present invention having a routing program and a converter program combined in a private cellular network;

FIG. **5** is a simplified block diagram of a communication network according to yet another embodiment of the present invention having a routing program and a converter program combined in an access point;

FIG. **6** is a block diagram of a communication network various call paths between an information processing device and telephones coupled to private and public networks according to an embodiment of the present invention; and

FIG. **7** is a flowchart showing an embodiment of a process for enabling information processing devices to communicate with private and public networks via a WLAN according to an embodiment of the present invention.

DETAILED DESCRIPTION

The present invention is directed to a communication network and method for enabling information processing devices to communicate with telephones of private and public networks via an access point of a wireless local area network (WLAN).

A communication network according to the present invention will now be described with reference to FIG. **1**. For purposes of clarity, many of the details of communication networks, and in particular of the interconnections between public and private wireless networks and wired networks, that are widely known and are not relevant to the present invention have been omitted.

FIG. **1** is a simplified block diagram of a communication network according to an embodiment of the present invention. Referring to FIG. **1**, the communication network **100** includes a public network **102** having a public wireless or cellular network **104** and a public switched telephone network (PSTN **106**), and a private network **108**. The private network **108** generally includes a private wireless or cellular network **110**, coupled to the public network **102**, and a WLAN **112**. In one embodiment, the private cellular network **110** includes at least one WAVEXchange™ (WXC) or a Network-In-A-Box™ (NIB) commercially available from interWAVE Communications Inc., of Menlo Park, Calif. A WXC generally includes a mobile services switching centers (MSC), a built-in Visitor Location Registry (VLR)/Home Location Registry (HLR). A NIB can have a MSC, a Base Station Controller (BSC) and a Base Transceiver Station (BTS) in a single enclosure. The WLAN **112** generally includes one or more access points **114**, **114**A, coupled to one another, to an Internet protocol (IP) network **116**, such as the Internet, and, in accordance with the present invention, to the private cellular network **110**. Optionally, the private network **108** further includes a private branch exchange (PBX **118**) coupled to the WLAN **110** and/or to the PSTN **106**, and having a number of PBX telephones **120** connected thereto.

A number of WLAN enabled information processing devices **122**, **122**A, couple via a radio frequency (RF) link to the access points **114**, **114**A. The information processing device **122** can be any commercially available portable computer or personal digital assistant (PDA) capable of accessing a WLAN **112** compatible with a number of different communication standards including: IEEE 802. 11 or 802. 11, and European Telecommunications Standards Institute (ETSI) Broadband Radio Access Networks (BRAN) standards, such as High Performance Local Area Network (HiperLAN/1) and HiperLAN/2. Generally, the information processing device **122** includes a physical layer **124** having: (i) a transceiver (not shown) capable of communicating with the access points **114**, **114**A, of the WLAN **112**; (ii) a computer readable memory (not shown); and (iii) a processor (not shown) capable of executing instructions of computer programs stored in the computer readable memory.

In accordance with the present invention, the information processing device **122** further includes a microphone **126** for receiving an audible signal or voice, a speaker or headphones **128** for transmitting or outputting an audible signal or voice, and a computer program or terminal emulator program **130** that enables the information processing device to emulate a communication terminal. The emulator program **130** enables the information processing device **122** to communicate via an access point **114** of the WLAN **112** with telephones or communication terminals coupled to the public cellular network **104**, such as a mobile station (MS) **132**, with terminals coupled to the private cellular network **110**, such as MS **134**, with terminals coupled to the PSTN **106**, such as telephone **136**, and/or with terminals coupled to the PBX **118**, such as PBX telephone **120**.

The emulator program **130** includes program code for marking or identifying voice packets to the access point **114**. By voice packets it is meant any packets containing voice information or information for supporting voice communication with the public network **102**, including the public cellular network **104** and the PSTN **106**, and/or the private network **108**, including the private cellular network **110** and the PBX **118**. The access point **114** is configured to route voice packets to the private cellular network **110** over a first communication path **138**, and to route packets not identified as voice packets, to the IP network **116** over a second communications path **140**. Thus, the communication system **100** of the present invention enables a user of the information processing device **122** to simultaneously engage in voice communication with a communication terminal or telephone **120**, **132**, **134**, **136**, over or though the first communication path **138**, and to engage in data communication with a computer terminal **142** or server coupled to the IP network **116** over the second communications path **140**.

Generally, the terminal emulator program **130** further includes program code for: (i) emulating a telephone-type keypad; (ii) taking in information from the keypad; (iii) encapsulating information from the keypad into packets compatible with the access point **114** of the WLAN **112**; (iv) transmitting packets to establish a session with the access point; (v) taking in an audible signal or voice information from the microphone **126** in or connected to the information processing device **122**; (vi) encapsulating the voice information from the microphone into packets containing voice information or voice packets compatible with the access point **114** of the WLAN **112**; (vii) transmitting the voice packets to the access point **114**; (viii) receiving voice packets from the access point **114**; and (ix) converting the received voice packets into an audible signal or voice information to engage in voice communication with a telephone **120**, **132**, **134**, **136**, coupled to the public or private network **102**, **108**.

Preferably, the emulator program **130** further includes program code to enable the information processing device **122** to emulate a particular type of communication device or terminal, such as a cellular telephone, a GSM cellular telephone, a 3G cellular telephone, CDMA telephone or a PSTN telephone. More preferably, the emulator program **130** also includes program code to enable the information processing device **122** to graphically and logically emulate one or more different models of telephones produced by one or more different manufacturers. This is especially desirable where the user of the information processing device **122** is accustomed to a particular model of telephone, or wishes to access and control supplementary and/or value added services provided by service provider, as explained below.

In one embodiment, the access point **114** further includes: (i) a computer readable memory (not shown); (ii) a processor (not shown) capable of executing instructions of a computer program stored in the computer readable memory; and (iii) a packet routing program **144** stored in the computer readable memory. The routing program **144** includes program code for enabling the access point to route voice packets to the private cellular network **110** over the first communication path **138**, and packets not identified as voice packets to the IP network **116**, over the second communications path **140**.

Generally, the private cellular network **110** also includes a computer readable memory (not shown); a processor (not shown) capable of executing instructions of a computer program stored in the computer readable memory; and a converter program **146** stored in the computer readable memory. The converter program **146** includes program code for converting packets from the access point **114** to clear channel signals compatible with those used in the public cellular network **104**, the PSTN **106** and/or the PBX **118**.

In another embodiment, the information processing device **122** further includes or is coupled to a subscriber identity module (SIM **148**) having an algorithm and a key to support authentication and encryption necessary to enable or facilitate communication with the public network **102**, the private cellular network **110** and/or the PBX **118**. In one version of this embodiment, the information processing device **122** includes or is coupled a card holder/reader with one or more GSM-type SIM cards or 3G-type universal SIM (SIM) cards (not shown) held in the card holder/reader. Each SIM or SIM card has stored therein subscriber identification and security information for one or more user profiles. There are two different ways of coupling the card holder/reader to the information processing device **122**, including: (i) use of a universal serial bus (USB) adapter or card holder/reader **149** that enables the information processing device to communicate with a GSM-type SIM card or a 3G-type USIM card via a USB bus **151**, as shown in FIG. **2**; or (ii) use of a PCMCIA adapter (not shown) that enables the information processing device to communicate directly with a GSM-type SIM card.

Alternatively, the SIM **148** encompasses subscriber identification and security information stored in the memory system of the information processing device **122**A. This latter version has the advantage of enabling the SIM to be downloaded from the WLAN **112** along with computer software or the emulator program **130** that enable the information processing device **122**A to emulate or function as a communication terminal or telephone.

In yet another embodiment, shown in FIG. **3**, the private network **108** further includes an identity module **150** coupled to the private cellular network **110**, and having at least one identifier or virtual identifier stored therein that can be permanently or temporarily associated with one or more information processing devices **122**, to enable the information processing device to communicate with the public network **102** and/or the private cellular network **108** via the WLAN **112**. Identity modules and virtual identifiers and described in greater detail in commonly assigned, co-pending U.S. patent application Ser. No. 10/002,551, filed Nov. 1, 2001, which is incorporated herein by reference. Generally, the virtual identifiers include algorithms and a key to support authentication and encryption necessary to facilitate communication with the public network **102** or private cellular network **108**. In one version of this embodiment, the identity module **150** includes subscriber identification and security information stored in a memory system (not shown) coupled to the private cellular network **108**. Alternatively, the identity module includes a card holder/reader (not shown), as described above, and the virtual identifiers include one or more GSM-type SIM cards or 3G-type USIM cards held in the card holder/reader, as described above.

The virtual identifiers can be associated with the information processing devices **122** on a one-to-one basis; on a one-to-many basis; or on a many-to-many basis in which the virtual identifiers are maintained as a pool of virtual identifiers that are associated temporarily with a information processing device on an as needed basis. Alternatively, the virtual identifiers can be associated with the information processing, devices **122** on a many-to-one basis to provide a single information processing device with multiple different user profiles that can be selected by a user for record or

billing purposes. For example, a user placing a call from a information processing device **122** over the public cellular network **104** could enter a first code selecting a first user profile when the call is for business purposes, and a second when the call is for private purposes. In addition, the communication system **100** or the user can select a GSM-type SIM when the communication is over a GSM cellular network, and a 3G-type USIM when it is connected or routed over a 3G cellular network.

Preferably, the SIM **148** or identity module **150**, and computer software or emulator programs **130** in the information processing device **122** that allow it to emulate a communication terminal, also includes program code to enable the information processing device to interface with and control or access supplementary and/or value-added services provided by the private cellular network **108** and/or public network **102** service provider. Supplementary services can include, for example, Voice Group Call Service; Voice Broadcast Service; Service definition Line Identification Supplementary Services; Call Forwarding Supplementary Services; Call Waiting and Call Hold Supplementary Services; multiparty Supplementary Services including call conferencing; Closed User Group Supplementary Services, Advice of Charge Supplementary Services; Call Barring Supplementary Services; Unstructured Supplementary Service Data; Explicit Call Transfer; Completion of Calls to Busy Subscriber; Short Message Service; and Follow Me. Value added services include, for example, e-mail, calender, wireless inventory, etcetera.

In another embodiment of a communication network **100** according to the present invention, shown in FIG. **4**, all packets from the information processing device **122** are routed through the access point **114** and to the private cellular network **110**. In this embodiment, the WLAN **112** couples to the IP network **116** or Internet through the private cellular network **110**, and the packet routing program **144** is combined with the converter program **146** in the private cellular network.

In another embodiment of a communication network **100** according to of the present invention, shown in FIG. **5**, the converter program **146** is combined with the packet routing program **144** in the access point **114**.

FIG. **6** is a block diagram of a communication network various call paths between an information processing device **122** and telephones **120**, **132**, **134**, **136**, coupled to the public and private networks **102**, **108**, according to an embodiment of the present invention. Referring to FIG. **6**, it is seen that voice communication can be routed between two information processing devices **122**, **122**A, along call path **152**, and between the information processing device **122** and a telephone **134** coupled to the private cellular network **110** along call path **154**. Voice communication can also be routed between the information processing device **122** and a telephone **132** coupled to the public cellular network **104** along call path **156**, and between the information processing device and a telephone **136** coupled to the PSTN **106** along call path **158**. Simultaneously, the information processing device **122** can be communicating with the computer terminal **142** via the IP Network **116** along call path **160**, and with a fax machine **162** coupled to the PSTN **106** along call path **164**.

A method or process for enabling information processing devices **122** to communicate with private and public networks **108**, **102** via a WLAN **112** will now be described with reference to FIG. **7**. FIG. **7** is a flowchart showing an embodiment of a process for enabling information processing devices to communicate with private and public networks via a WLAN according to an embodiment of the present invention. Generally, in the method a telephone-type keypad is emulated on the information processing device (step **170**) and information taken in from the keypad (step **172**). Information from the keypad is then encapsulated into packets compatible with the access point of the WLAN (step **177**), and packets transmitted to establish a session with the access point or WLAN (step **176**). An audible signal or voice information is taken in from a microphone integrated with or connected to the information processing device (step **178**), and the voice information from the microphone encapsulated into packets or voice packets compatible with the access point of the WLAN (step **180**). The voice packets are then transmitted to the access point (step **182**). Voice packets from the access point are received (step **184**) and converted into an audible signal or voice information (step **186**), thereby enabling the user to engage in voice communication with a telephone coupled to a private wireless network coupled to the WLAN.

In the preferred embodiment, the emulator program **130** is downloaded from the private or public network **108**, **102**, the first time the information processing device **122** accesses them.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best use the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

We claim:

1. An information processing device having:

a transceiver capable of communicating with an access point of a wireless local area network (WLAN);

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a computer program stored in the computer readable memory for enabling the information processing device to emulate a voice communications terminal, the computer program including program code for enabling the information processing device to take in an audible signal, encapsulate the audible signal into voice packets, and identify voice packets to the access point.

2. An information processing device according to claim **1**, wherein the transceiver is compatible with a WLAN communication standard selected from a group consisting of:

HIgh Performance Local Area Network (HiperLAN/1);

HIgh Performance Local Area Network (HiperLAN/2); and

Institute of Electrical and Electronics Engineers 802. 11 (IEEE 802.11).

3. An information processing device according to claim **1**, wherein the computer program further includes program code to enable the information processing device to emulate a cellular telephone selected from the group consisting of:

CDMA telephones;

Global System for Mobile communications (GSM) cellular telephones; and

third generation (3G) cellular telephones.

4. An information processing device according to claim **3**, wherein the computer program further includes program code to enable the information processing device to emulate a predetermined model of cellular telephone manufactured by a predetermined manufacturer.

5. An information processing device according to claim **1**, wherein the computer program further includes program code to enable the information processing device to emulate a cellular telephone and further comprising a subscriber identity module (SIM) card and an adapter that enables the information processing device to communicate with the public cellular network.

6. An information processing device according to claim **1**, wherein the computer program further includes program code to enable the information processing device to emulate a cellular telephone, and further comprising at least one virtual identity module including subscriber identification and security information stored in the computer readable memory to enable the information processing device to communicate with the public cellular network.

7. An information processing device according to claim **1**, wherein the computer program includes program code to enable the information processing device to control supplementary services provided by the public network or private network.

8. An information processing device according to claim **1**, wherein the computer program includes program code to enable the information processing device to control value-added services provided by the public network or private network.

9. An information processing device according to claim **8**, wherein the value-added services controlled by the computer program include e-mail, calender, and wireless inventory.

10. A communication network comprising:

a public network including a public cellular network;

a private network including:

a switch through which the private network is coupled to the public network;

a wireless local area network (WLAN) having at least one access point; and

an information processing device having:

a transceiver capable of communicating with the access point of the WLAN;

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a terminal emulator program stored in the computer readable memory to enable the information processing device to communicate with the public network, the terminal emulator program including program code to enable the information processing device to:

emulate a voice communications terminal capable of communicating with the public networks;

take in an audible signal from a microphone coupled to the information processing device;

encapsulate the audible signal into voice packets;

identify the voice packets to the access point;

transmit the voice packets to the access point;

receive voice packets from the access point; and

convert the received voice packets into an audible signal.

11. A communication network according to claim **10**, wherein the terminal emulator program includes program code for:

emulating a telephone-type keypad;

taking in information from the keypad;

encapsulating information from the keypad into packets compatible with the access point of the WLAN; and

transmitting packets to establish a session with the access point.

12. A communication network according to claim **10**, wherein the WLAN is further coupled to an internet protocol (IP) network, and wherein the access point further comprises:

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a packet routing program stored in the computer readable memory including program code to enable the access point to route voice packets to the switch over a first communication path, and packets not identified as voice packets to the IP network over a second communications path,

whereby a user of the information processing device can substantially simultaneously engage in voice communication with a terminal coupled to the public network, and data communication with a terminal coupled to the IP network.

13. A communication network according to claim **12**, wherein the switch further comprises:

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a converter program stored in the computer readable memory including program code to enable the switch to convert voice packets received from the information processing device to signals compatible with those used in the public network.

14. A communication network according to claim **13**, wherein the private network further comprises a private cellular network, and wherein the switch is a part of the private cellular network.

15. A communication network according to claim **14**, wherein the private network further comprises a private branch exchange (PBX).

16. A communication network according to claim **15**, wherein the public network further comprises a public switched telephone network (PSTN).

17. A communication network according to claim **16**, wherein the terminal emulator program, packet routing program and converter program enable the information processing device to communicate with at least one telephone selected from the group of:

telephones coupled to the private cellular network;

telephones coupled to the PBX;

telephones coupled the PSTN; and

telephones coupled to the public cellular network.

18. A communication network according to claim **10**, wherein the terminal emulator program further includes program code to enable the information processing device to emulate a cellular telephone selected from the group consisting of:

CDMA telephones;

Global System for Mobile communications (GSM) cellular telephones; and

third generation (3G) cellular telephones.

19. A communication network according to claim **18**, wherein the terminal emulator program further includes program code to enable the information processing device to emulate a predetermined model of cellular telephone manufactured by a predetermined manufacturer.

20. A communication network according to claim **10**, wherein the terminal emulator program further includes program code to enable the information processing device to emulate a cellular telephone, and wherein the information processing device further comprises a subscriber identity module (SIM) card and an adapter that enables the information processing device to communicate with a cellular telephone network.

21. A communication network according to claim **10**, wherein the terminal emulator program further includes program code to enable the information processing device to emulate a cellular telephone, and wherein the information processing device further comprises at least one virtual identity module including subscriber identification and security information stored in the computer readable memory to enable the information processing device to communicate with a cellular telephone network.

22. A communication network according to claim **10**, wherein the terminal emulator program includes program code to enable the information processing device to control supplementary services provided by the public network or private network.

23. A communication network according to claim **10**, wherein the terminal emulator program includes program code to enable the information processing device to control value-added services provided by the public network or private network.

24. A communication network according to claim **23**, wherein the value-added services controlled by the computer program include e-mail, calender, and wireless inventory.

25. A communication network according to claim **10**, wherein the information processing device is a portable computer or personal digital assistant (PDA).

26. A computer program product for use in conjunction with a wireless local area network (WLAN) enabled information processing device, such as a portable computer or personal digital assistant, the computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, the computer program mechanism, comprising:

a program module that directs the information processing device, to function in a specified manner, to emulate a communications terminal, the program module including program code for:

emulating a telephone-type keypad;

taking in information from the keypad;

encapsulating information from the keypad into packets compatible with an access point of the WLAN;

transmitting packets to establish a session with the access point;

taking in an audible signal from a microphone coupled to the information processing device;

encapsulating the voice information from the microphone into voice packets;

identifying the voice packets to the access point;

transmitting the voice packets to the access point;

receiving voice packets from the access point; and

converting the received voice packets into an audible signal to engage in voice communication with a telephone coupled to a cellular network coupled to the WLAN.

27. A computer program product according to claim **26**, wherein the program module further includes program code to enable the information processing device to emulate a cellular telephone selected from the group consisting of:

CDMA telephones;

Global System for Mobile communications (GSM) cellular telephones; and

third generation (3G) cellular telephones.

28. A communication network according to claim **27**, wherein the program module further includes program code to enable the information processing device to emulate a predetermined model of cellular telephone manufactured by a predetermined manufacturer.

29. A method of adapting a wireless local area network (WLAN) enabled information processing device to emulate a cellular communications terminal, the method comprising steps of:

emulating a telephone-type keypad on the information processing device;

taking in information from the keypad;

encapsulating information from the keypad into packets compatible with an access point of the WLAN;

transmitting packets to establish a session with the access point;

taking in an audible signal from a microphone coupled to the information processing device;

encapsulating the voice information from the microphone into voice packets compatible with the access point of the WLAN;

identifying the voice packets to the access point

transmitting the packets and voice packets to the access point;

receiving voice packets from the access point; and

converting the received voice packets into an audible signal to engage in voice communication with a telephone coupled to a cellular network coupled to the WLAN.

30. An information processing device having:

a transceiver capable of communicating with an access point of a wireless local area network (WLAN);

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a computer program stored in the computer readable memory for enabling the information processing device to emulate a communications terminal, the computer program including program code for enabling the information processing device to emulate the communications terminal and to control supplementary services provided by the public network or private network, wherein the supplementary services controlled by the computer program include:

Voice Group Call Service;

Voice Broadcast Service;

Service definition Line Identification Supplementary Services;

Call Forwarding Supplementary Services;

Call Waiting and Call Hold Supplementary Services;

Multiparty call conferencing;

Closed User Group Supplementary Services;

Advice of Charge Supplementary Services;

Call Barring Supplementary Services;

Unstructured Supplementary Service Data;

Explicit Call Transfer;
Completion of Calls to Busy Subscriber;
Short Message Service; and
Follow Me.

31. A communication network comprising:

a public network including a public cellular network;

a private network including:

a switch through which the private network is coupled to the public network;

a wireless local area network (WLAN) having at least one access point; and

an information processing device having:

a transceiver capable of communicating with the access point of the WLAN;

a computer readable memory;

a processor capable of executing instructions of a computer program stored in the computer readable memory; and

a terminal emulator program stored in the computer readable memory to enable the information processing device to communicate with the public network, the terminal emulator program including program code to enable the information processing device to emulate a communications terminal capable of communicating with the public network and to enable the information processing device to control supplementary services provided by the public network or private network, wherein the supplementary services controlled by the computer program include:

Voice Group Call Service;
Voice Broadcast Service;
Service definition Line Identification Supplementary Services;
Call Forwarding Supplementary Services;
Call Waiting and Call Hold Supplementary Services;
Multiparty call conferencing;
Closed User Group Supplementary Services;
Advice of Charge Supplementary Services;
Call Barring Supplementary Services;
Unstructured Supplementary Service-Data;
Explicit Call Transfer;
Completion of Calls to Busy Subscriber;
Short Message Service; and
Follow Me.

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