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(54) SEAMLESSLY NETWORKED END USER DEVICE

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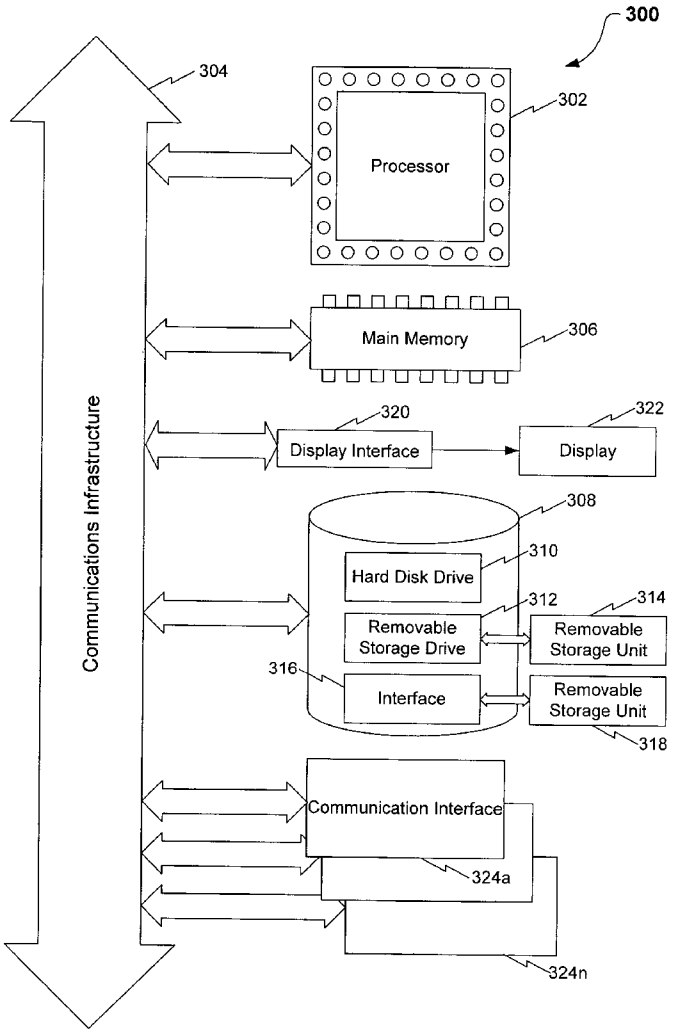
(57) **ABSTRACT**

An end user device is provided that supports a connection to a plurality of data communication networks. The end user device detects which data communication networks are available, and selectively determines which of the plurality of data communication networks provides the most optimal communication channel. The end user device also provides for seamless transitions between different data communication networks, thus permitting all network communication tasks to be performed in a seamless, uninterrupted manner regardless of the location of the device, the type of network connection being used, or the form of data communication being carried out. The end user device further provides for simultaneous communication over a plurality of data communication networks utilizing a single network identity.



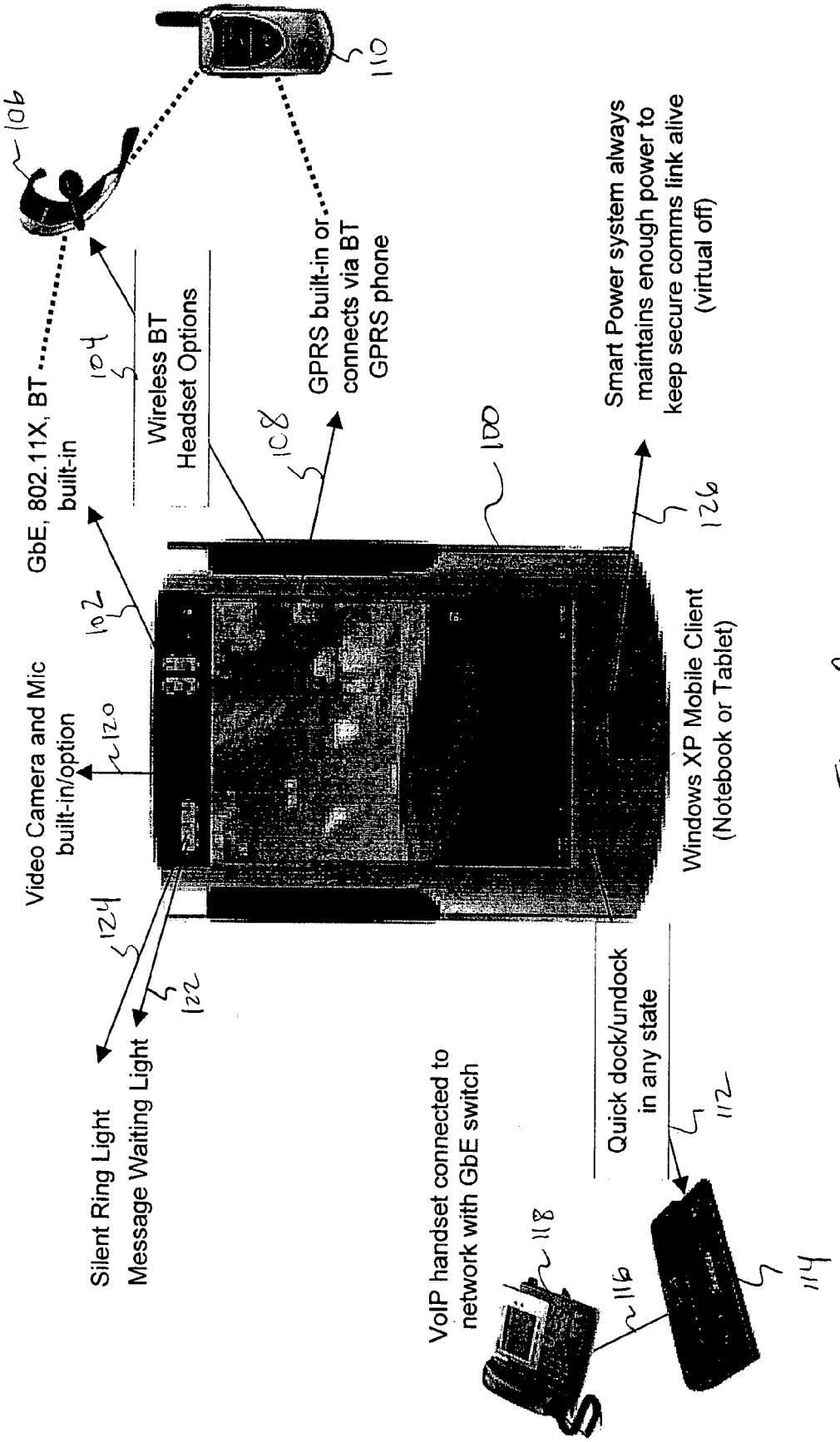

106
110
GbE, 802.11X, BT
built-in
104
Wireless BT
Headset Options
108
GPRS built-in or
connects via BT
GPRS phone
100
Smart Power system always
maintains enough power to
keep secure comms link alive
(virtual off)
126
102
Video Camera and Mic
built-in/option
120
Windows XP Mobile Client
(Notebook or Tablet)
124
122
Silent Ring Light
Message Waiting Light
VoIP handset connected to
network with GbE switch
118
116
Quick dock/undock
in any state
112
114

FIG. 1

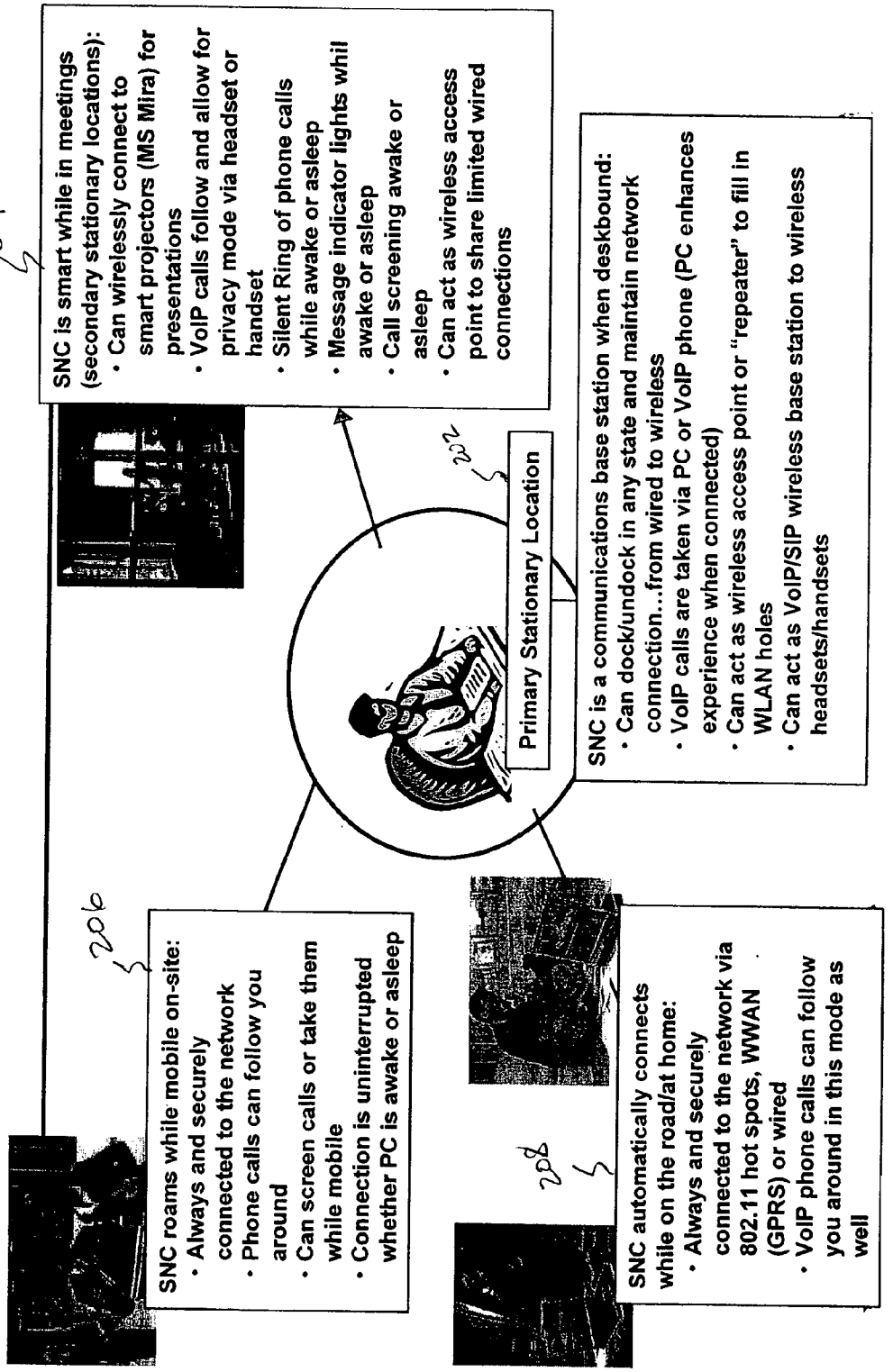

204
SNC is smart while in meetings (secondary stationary locations):
• Can wirelessly connect to smart projectors (MS Mira) for presentations
• VoIP calls follow and allow for privacy mode via headset or handset
• Silent Ring of phone calls while awake or asleep
• Message indicator lights whil awake or asleep
• Call screening awake or asleep
• Can act as wireless access point to share limited wired connections
202
Primary Stationary Location
SNC is a communications base station when deskbound:
• Can dock/undock in any state and maintain network connection...from wired to wireless
• VoIP calls are taken via PC or VoIP phone (PC enhances experience when connected)
• Can act as wireless access point or "repeater" to fill in WLAN holes
• Can act as VoIP/SIP wireless base station to wireless headsets/handsets
206
SNC roams while mobile on-site:
• Always and securely connected to the network
• Phone calls can follow you around
• Can screen calls or take them while mobile
• Connection is uninterrupted whether PC is awake or asleep
208
SNC automatically connects while on the road/at home:
• Always and securely connected to the network via 802.11 hot spots, WWAN (GPRS) or wired
• VoIP phone calls can follow you around in this mode as well

FIG. 2

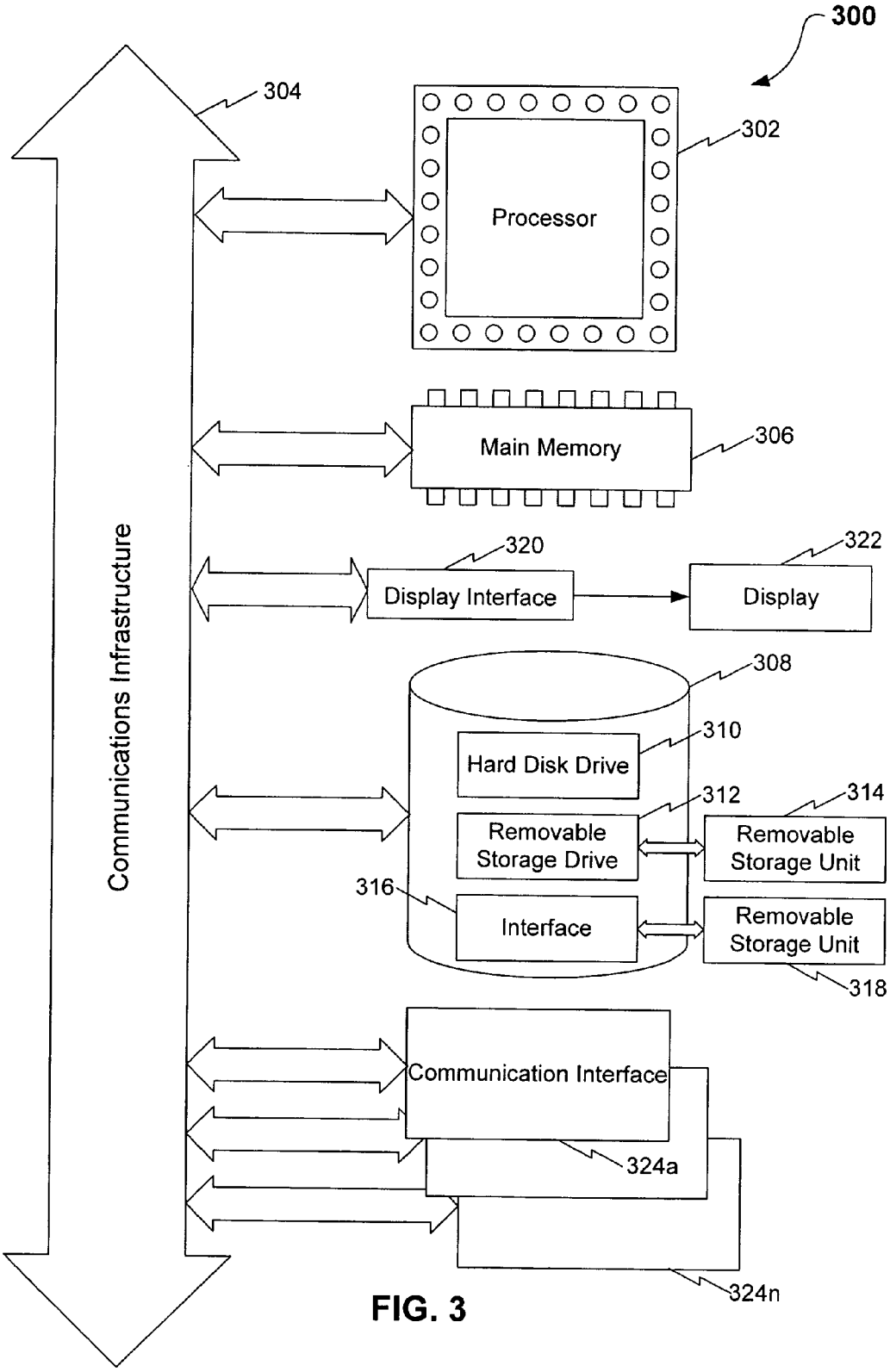

300
304
302
Processor
Main Memory
306
320
322
Display Interface
Display
308
310
Hard Disk Drive
312
314
Removable Storage Drive
Removable Storage Unit
316
Interface
Removable Storage Unit
318
Communications Infrastructure
Communication Interface
324a
324n

FIG. 3

SEAMLESSLY NETWORKED END USER DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/409,959, filed Sep. 12, 2002.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention is generally related to data communication networks. More specifically, the present invention is related to end user devices that are capable of interfacing with more than one data communication network.

[0004] 2. Background

[0005] A variety of data communication networks and protocols exist for transmitting data to and from an end user device. For example, conventional notebook or tablet personal computers (PCs) may communicate with a local area network (LAN) via a wired Ethernet connection or a wireless 802.11x connection, or may communicate with a wide area network (WAN) via a V.90 connection or a wireless General Packet Radio Service (GPRS) connection. Such devices may also connect to one or more communication peripherals, such as to a Voice over Internet Protocol (VOIP) phone via a wired network with Ethernet switch, or to a headset or GPRS phone via a wireless Bluetooth™ connection.

[0006] Depending on where the end user is located and the type of network application being used, each of these connection types may provide distinct advantages or disadvantages. For example, if the end user is in a primary stationary location, such as the office, and the end user device is docked, then a wired Ethernet connection may provide the most efficient data communication. However, if the end user is in a mobile mode, then a wireless connection may be necessary.

[0007] In conventional devices, transitioning between one type of network connection to another typically requires user intervention to terminate one network connection to initiate another. This makes transitioning from a mobile mode to a stationary mode or vice versa more difficult for the user. Furthermore, in conventional mobile computing devices, the cessation of a network connection (either through user action such as undocking the station, through a loss of power such as expired battery or disconnect from power source, or loss of signal in a wireless environment) can result in lost data and require the user to reinitiate the network connection.

BRIEF SUMMARY OF THE INVENTION

[0008] An end user device in accordance with embodiments of the present invention supports a connection to a plurality of data communication networks. The end user device detects which data communication networks are available, and selectively determines which of the plurality of data communication networks provides the most optimal communication channel. Whether a communication channel is optimal may be based on the type of data to be communicated (e.g., voice, video or computer data), the error rate associated with each available network, the number of anticipated "hops" between the end user device and the remote network entity to which it needs to communicate, the cost associated with establishing and maintaining a network link, the best path, and/or anticipated power consumption.

[0009] An end user device in accordance with embodiments of the present invention also provides for seamless transitions between different data communication networks, thus permitting all network communication tasks to be performed in a seamless, uninterrupted manner regardless of the location of the device, the type of network connection being used, or the form of data communication being carried out.

[0010] An end user device in accordance with embodiments of the present invention further provides for simultaneous communication over a plurality of data communication networks, thereby enabling enhanced error control capabilities, delivery of different data types (e.g., video, voice, and computer data) over separate channels to enhance efficiency and/or quality of data communication, increased communication speed through transmission of a data request over multiple data communication networks and acceptance of the fastest response, improved reliability through the automatic migration to a new data communication network when a first network connection fails, packet verification, guaranteed on-time packet delivery for applications that require a minimal Quality of Service (QOS), improved interactivity with a user base, and/or the ability to report problems occurring on a first data communication network over a second data communication network.

[0011] An end user device in accordance with an embodiment of the present invention also supports "in session" hand-offs between access points in a wireless data communication network.

[0012] An end user device in accordance with an embodiment of the present invention additionally utilizes a single network identity, such as a single log-in, Internet Protocol (IP) address, or telephone number, to simultaneously access a plurality of data communication networks.

BRIEF DESCRIPTION OF THE DRAWINGS/FIGURES

[0013] The accompanying drawings, which are incorporated herein and form a part of the specification, illustrate the present invention and, together with the description, further serve to explain the principles of the invention and to enable a person skilled in the pertinent art to make and use the invention.

[0014] **FIG. 1** is a high-level diagram of an end user device in accordance with an embodiment of the present invention.

[0015] **FIG. 2** illustrates functions of an end user device in accordance with embodiments of the present invention during stationary and mobile modes of operation.

[0016] **FIG. 3** depicts an example end user device in accordance with an embodiment of the present invention.

[0017] The present invention will now be described with reference to the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally

similar elements. Additionally, the left-most digit(s) of a reference number identifies the drawing in which the reference number first appears.

DETAILED DESCRIPTION OF THE INVENTION

I. Overview

[0018] An end user device in accordance with an embodiment of the present invention provides a new and simpler user experience in mobile computing. In particular, the device enables new levels of end user productivity by performing all network communication tasks in a seamless, uninterrupted manner regardless of the location of the device, the type of network connection being used, or the form of data communication being carried out.

[0019] The end user device may comprise any device capable of communicating data to or from a data communication network in accordance with one or more wired and/or wireless communication protocols. Wired and wireless networks supported by an end user device in accordance with embodiments of the present invention may include: (1) cellular networks, including but not limited to AMPS and N-AMPS, CDMA, TDMA, GSM, iDEN, PCS 1900, PCD, and PHS; (2) public packet-radio networks, including but not limited to CDPD and CS-CDPD, DataTAC 4000, DataTAC 5000, Modacom, DataTAC 6000, DataTAC/IP, GPRS (GSM), Mobitex, Mobitex/IP, and PDC-P; (3) Internet connections, including but not limited to cable modem, DSL, and ISP; (4) Dial-up connections, including but not limited to DIkL/TCP, ISDN, PPP, and PSTN (POTS); (5) private packet networks, including but not limited to Dataradio and Motorola Private Data TAC; (6) satellite networks, including but not limited to Norcom; and (7) LAN connections, including but not limited to Ethernet, Token Ring and Wireless LAN.

[0020] For example, the end user device may comprise a notebook or tablet PC with or without a docking interface, that provides one or more of the following network connection capabilities: (1) connectivity to a wired Ethernet network, wireless LAN (WLAN) and/or wireless WAN (WWAN); (2) voice and/or video connectivity, including but not limited to VOIP connectivity and/or Session Initiation Protocol (SIP) connectivity; (3) connectivity with wired and/or wireless phone hand/headsets; and (4) connectivity with secure networks and clients, including but not limited to virtual private networks (VPN) and Trusted Computing Platform Alliance (TCPA) networking and communication platforms.

[0021] **FIG. 1** depicts a high-level diagram of an exemplary end user device **100** in accordance with an embodiment of the present invention. As shown in **FIG. 1**, exemplary end user device **100** comprises a mobile client device, such as a notebook or tablet PC, operating under the Microsoft Windows™ XP operating system.

[0022] As shown in **FIG. 1**, exemplary end user device **100** includes a number of built-in network interfaces **102** for communicating over one or more data communication networks in accordance with one or more associated communication protocols. These network interfaces **102** include a Gigabit Ethernet (GbE) interface, an 802.11x interface, and a Bluetooth™ interface. End user device **100** also includes a Bluetooth™ interface **104** (which may comprise one of the previously identified network interfaces **102** or may alternately comprise an additional interface) that supports the use of a wireless Bluetooth™ headset **106** for placing and receiving VoIP phone calls and the like. End user device **100** further supports GPRS connectivity through the use of a built-in GPRS interface **108** or through a Bluetooth™ connection to a GPRS phone **110**.

[0023] Exemplary end user device **100** further comprises an interface **112** for connection to a docking station **114**. Docking station **114** provides device **100** with a stationary connection to a network **116**, such as a wired Ethernet LAN. As shown in **FIG. 1**, network **116** also connects end user device **100** to a VoIP phone **118** via a GbE switch for the routing and handling of VoIP calls received by end user device **100**.

[0024] Exemplary end user device **100** further comprises: a silent ring light **124** that provides a visual indication to an end user of incoming message or VoIP call, a message waiting light **122** that provides a visual indication to an end user that they have received a voice and/or text message, and an optional built-in video camera and microphone **120** for enabling video teleconferencing and the like. While in a mobile (i.e., undocked) mode, power management for exemplary end user device **100** is provided via a "smart power" system **126** that ensures that at least enough power is provided to device **100** to ensure that all secure network communication links are kept active. This mode of operation may be referred to as a "virtual off" mode.

[0025] **FIG. 2** illustrates functions of an end user device in accordance with embodiments of the present invention during various stationary and mobile modes of operation, including operation at primary and secondary stationary locations as well as mobile on-site and off-site operation.

[0026] As shown in **FIG. 2**, when docked at a primary stationary location **202**, such as at an office desk, the end user device (which for purposes of **FIG. 2** is denoted a "seamlessly networked client" or "SNC"), operates as a communications base station. In this mode of operation, the end user device can be docked and undocked in any state while still maintaining a network connection. Thus, for example, the end user device can transition from a wired to wireless state while maintaining an active network connection. While at the primary station location, the end user device can also accept VoIP calls or route them to a network-attached VoIP phone while providing additional features to enhance the VoIP call, act as a wireless access point or "repeater" to facilitate communication between other end user devices and a WLAN, and act as a VoIP or SIP wireless base station for wireless handsets or headsets.

[0027] As further shown in **FIG. 2**, when located at a secondary stationary location **204**, such as an office conference room, an end user device in accordance with an embodiment of the present invention can wirelessly connect to smart projectors, such as those enabled by Microsoft Mira™-based technology, for presentations. While at the secondary stationary location, the end user device can continue to receive VoIP calls and allows for such calls to be received in a privacy mode via a headset or handset. Furthermore, while at the secondary stationary location, whether in an "awake" or "asleep" mode, the end user device provides a silent ring signal to alert an end user to

incoming phone calls, a message indicator light to indicate that a voice or text message has been received, as well as call screening functionality. In addition, the end user device can act as a wireless access point at the secondary stationary location to share limited wired connections.

[0028] During mobile operation while roaming on-site **206**, such as roaming in an office, the end user device continues to provide secure connections to the office network that are uninterrupted regardless of whether the device is in an "awake" or "asleep" mode. While in this mode, the end user device can continue to receive and screen VoIP calls.

[0029] During mobile operation while roaming off-site **208**, such as while in transit or at home, the end user device continues to provide secure connections to the network via an 802.11x connection, a GPRS connection to a WWAN, or via a wired connection. During this mode, the end user device can continue to receive VoIP calls.

[0030] Usage modes of an end-user device in accordance with embodiments of the present invention maybe divided into the following categories of operation:

[0031] desk-bound at a primary office location, mobile while roaming within a campus network, mobile while roaming outside of the campus network, in a meeting room (secondary location), or at home (secondary location).

[0032] While desk-bound at a primary office location, an end user device in accordance with embodiments of the present invention provides one or more of the following functions: provides a connection to a LAN/WLAN; may be docked or undocked; provides continuous network connection while transitioning from a wired to wireless connection, or vice versa; provides continuous network connection during docking and undocking regardless of the state of the end user device or physical network transitions; and permits extension of WLAN coverage by operating as an access point or a repeater in background mode. Furthermore, while desk-bound at a primary office location, an end user device in accordance with embodiments of the present invention provides one or more of the following phone and/or messaging-related functions: the end user device processes VoIP calls with "dumb" hand/headsets or routes the call to a VoIP phone, while providing additional functions that enhances the phone experience; call screening, voicemail forwarding, and/or unified mailbox functionality; enabling of video and voice calls; and call relay to a wireless hand/headset to permit roaming in local hallways.

[0033] In a mobile mode while roaming within a campus network, an end user device in accordance with embodiments of the present invention provides one or more of the following functions: seamlessly transitions from a LAN connection to a WLAN connection; provides continuous network connection while roaming regardless of the power state of the end user device; and permits extension of WLAN coverage by operating as an access point or a repeater in background mode. Furthermore, while in a mobile mode roaming within a campus network, an end user device in accordance with embodiments of the present invention provides one or more of the following phone and/or messaging-related functions: reception of phone calls and video calls without latency regardless of the state of the end user device; call screening, voicemail forwarding, and/or unified mailbox functionality; enabling of video and voice calls; call relay to a wireless hand/headset to permit roaming in local hallways; generation of a silent ring indicator in all power states of the end user device; and generation of a message waiting indicator in all power states of the end user device.

[0034] In a mobile mode while operating outside a campus network, an end user device in accordance with embodiments of the present invention provides one or more of the following functions: seamlessly transitions from a WLAN connection to a WWAN connection; provides continuous network connection while transitioning from a WLAN connection to a WWAN connection, or vice versa; and ability to use a WWAN connection to permit extension of WLAN coverage by acting as an access point in background mode. Furthermore, while in a mobile mode operating outside a campus network, an end user device in accordance with embodiments of the present invention provides one or more of the following phone and/or messaging related functions: use of a WWAN connection as either a standard phone connection or as transport for VoIP packets; call screening, voicemail forwarding, and/or unified mailbox functionality as available in VoIP mode; and enabling of video and voice calls in either a standard phone connection mode or a VoIP mode.

[0035] In a secondary location such as a meeting room, an end user device in accordance with embodiments of the present invention provides one or more of the following functions: provides a connection to a LAN or WLAN; maintains a network connection that stays present when going from a wired to wireless connection, or vice versa; permits extension of WLAN coverage by operating as an access point or a repeater in background mode; and provides for a wireless connection to "smart projectors," such as those enabled by Microsoft Mira™-based technology, for conducting presentations. Furthermore, while operating in a secondary location such as a meeting room, an end user device in accordance with embodiments of the present invention provides one or more of the following phone and/or messaging related functions: call relay to a wireless hand/headset that connects to the end user device; enabling of video and voice calls; generation of a silent ring indicator in all power states of the end user device; and call screening, including call screening in a "meeting mode" in which a caller is notified of an end user's intent to pick up the call, thus providing the end user with time to move to privacy without interrupting a meeting.

[0036] In a secondary location such as at home, an end user device in accordance with embodiments of the present invention provides one or more of the following functions: provides a continuous network connection while transitioning from a WWAN to a home LAN or WLAN; provides continuous connectivity to office VPN; and the ability to take advantage of home network functions and capabilities, such as personal video recording (PVR), digital media networking, and the like. Furthermore, while operating in a secondary location such as the home, an end user device in accordance with embodiments of the present invention provides one or more of the following phone and/or messaging related functions: enabling of video and voice calls via both an office VoIP network and/or a home network; and ability to indicate which network originated a phone call (e.g., office or personal) via distinctive ring or display functionality.

II. Architecture

[0037] **FIG. 3** depicts an example end user device **300** in accordance with an embodiment of the present invention. As shown in **FIG. 3**, the example end user device includes a processor **302** for executing software routines in accordance with embodiments of the present invention. Although a single processor is shown for the sake of clarity, the end user device **300** may also comprise a multi-processor device. The processor **302** is connected to a communication infrastructure **304** for communication with other components of the end user device **300**. The communication infrastructure **300** may comprise, for example, a communications bus, cross-bar, or network.

[0038] The end user device **300** further includes a main memory **306**, such as a random access memory (RAM), and a secondary memory **308**. The secondary memory **308** may include, for example, a hard disk drive **310** and/or a removable storage drive **312**, which may comprise a floppy disk drive, a magnetic tape drive, an optical disk drive, or the like. The removable storage drive **312** reads from and/or writes to a removable storage unit **314** in a well known manner. Removable storage unit **314** may comprise a floppy disk, magnetic tape, optical disk, or the like, which is read by and written to by removable storage drive **312**. As will be appreciated by persons skilled in the art, the removable storage unit **314** includes a computer usable storage medium having stored therein computer software and/or data.

[0039] In alternative embodiments, secondary memory **308** may include other similar means for allowing computer programs or other instructions to be loaded into the end user device **300**. Such means can include, for example, a removable storage unit **318** and an interface **316** Examples of a removable storage unit **318** and interface **316** include a program cartridge and cartridge interface (such as that found in video game console devices), a removable memory chip (such as an EPROM, or PROM) and associated socket, and other removable storage units **318** and interfaces **316** which allow software and data to be transferred from the removable storage unit **318** to the end user device **300**.

[0040] The end user device **300** further includes a display interface **320** that forwards graphics, text, and other data from the communication infrastructure **304** or from a frame buffer (not shown) for display to a user on a display unit **322**.

[0041] The end user device **300** also includes a plurality of communication interfaces **324***a*-**324***n*. The communication interfaces **324***a*-**324***n* permit data, including but not limited to voice, video, and/or computer data to be transferred between the end user device **300** and external devices via a plurality of data communication networks. The communication interfaces **324***a*-**324***n* may comprise, for example, a Gigabit Ethernet (GbE) interface, an 802.11x interface, and a Bluetooth™ interface.

[0042] As used herein, the term "computer program product" may refer, in part, to removable storage unit **314**, removable storage unit **318**, a hard disk installed in hard disk drive **310**, or a carrier wave carrying software over a communication path (wired or wireless) to any of communication interfaces **324***a*-**324***n*. A computer useable medium can include magnetic media, optical media, or other recordable media, or media that transmits a carrier wave or other signal. These computer program products are means for providing software to the end user device **300**.

[0043] Computer programs (also called computer control logic) maybe stored in main memory **306** and/or secondary memory **308**, as well as in a memory internal to processor **302** (not shown in **FIG. 3**). Computer programs can also be received via any of communications interfaces **324***a*-**324***n*. In an embodiment, such computer programs, when executed, enable the end user device **300** to perform the features of the present invention as discussed herein. In particular, the computer programs, when executed, enable the processor **302** to perform features of the present invention. Accordingly, such computer programs represent controllers of the end user device **300**.

[0044] In an alternate embodiment, the features of the present invention are implemented by one or more of the communication interfaces **324***a*-**324***n*. In a still further embodiment, the features of the present invention are implemented by the processor **302**, via the execution of computer programs, in combination with one or more of the communication interfaces **324***a*-**324***n*.

III. Network Detection

[0045] An end user device in accordance with an embodiment of the present invention performs a network detection function in order to determine which of the plurality of networks supported by the device, if any, are available for data communication.

[0046] The network detection function is preferably performed automatically by the end user device. For example, the network detection function may be performed automatically: (1) as part of the power-up sequence of the end user device to determine which network(s) are initially available to the end user device; (2) when the end user initiates a network-related task, such as sending an e-mail, initiating a VoIP phone call, or storing/retrieving a file to/from a remote database, to determine which network(s) are available for performing the task; (3) one or more times during an active network connection to determine if the current communication path is still satisfactory, and to determine if alternate, potentially more optimal, network connections are available; and/or (4) when a network connection is lost, in order to determine which network(s) are available for re-establishing data communication. In an embodiment, the network detection function may also be initiated by the end user to identify available network(s), for example, as part of a system diagnostic function.

[0047] An end user device in accordance with an embodiment of the present invention is preferably configured to cease performing network detection if an active network connection is determined to be optimal. By curtailing network detection when an optimal network connection has been achieved, embodiments of the present invention conserve the system resources necessary for performing network detection functions.

[0048] Various algorithms may be used to determine which of the plurality of networks supported by the end user device should be subject to network detection, and in which order each of these networks should be tested for availability. For example, the network detection function may search for available networks by first searching for the network that provides the fastest expected transfer rate, and if that network is unavailable, searching for the network that provides the second fastest expected transfer rate, and so on, in order

to detect the fastest network connection possible. In an alternate embodiment, the network detection function may perform network availability testing based on the type of data that the end user device needs to communicate.

IV. Network Selection

[0049] After the network detection function has been performed, an end user device in accordance with an embodiment of the present invention selects one of the one or more network(s) determined to be available for performing a data communication task. The end user device may select an available network for data communication based on one or more predefined criteria.

[0050] For example, an end user device in accordance with an embodiment of the present invention may select an available network based on the type of data that it needs to communicate.

[0051] An end user device in accordance with an embodiment of the present invention may select the available network based on the expected bit error rate or signal-to-noise ratio associated with each available network, wherein the end user device selects the network with the lowest expected bit error rate or signal-to-noise ratio. The bit error rate or signal-to-noise ratio of a particular network may be determined: (1) by the end user device itself, through the execution of a network-specific testing protocol; (2) by a remote network entity, such as a remote access point or host, which transmits the information to the end user device; (3) from a table stored in memory by the end user device that maps network connection types to expected error rates or signal-to-noise ratios, wherein each of the expected error rates or signal-to-noise ratios may be fixed, or ascertained, either at selected predetermined times or periodically, by either of methods (1) or (2) as previously described.

[0052] An end user device in accordance with an embodiment of the present invention may also select an available network based on the number of expected "hops," i.e., intervening network entities, between the end user device and the remote network entity to which it needs to communicate, wherein the end user device selects network connection that requires the fewest "hops."

[0053] An end user device in accordance with an embodiment of the present invention may select an available network based on the cost associated with establishing and maintaining a network link, wherein the end user device selects the least expensive network connection. For example, the end user device may avoid connections via cellular networks or ISPs that charge access fees when there are network connections available at a lower cost.

[0054] An end user device in accordance with an embodiment of the present invention may select an available network based on the "best path" available for data communication.

[0055] An end user device in accordance with an embodiment of the present invention may select an available network based on the anticipated power consumption for maintaining a network connection, wherein the end user device selects the network connection that will consume the least amount of power. This method is preferably used when the end user device is running on a limited power supply, such as a battery.

[0056] There may be an identity between network detection functions and the collection of information necessary to perform network selection. For example, an end user device in accordance with an embodiment of the invention may perform a test protocol to determine the bit error rate over a given network, where the failure to achieve a connection or the detection of a bit error rate that exceeds a predetermined threshold both signify unavailability of the network.

V. Utilizing Multiple Networks

[0057] An end user device in accordance with an embodiment of the present invention supports simultaneous communication over a plurality of data communication networks. This functionality may be referred to as "parallel channel delivery."

[0058] For example, an end user device in accordance with an embodiment of the present invention supports simultaneous communication over a plurality of data communication networks to provide: (1) enhanced error control capabilities; (2) UDP on channel (Toss Packets) and error re-Sends; (3) delivery of different data types, such as video, voice, or data, over separate channels to enhance efficiency and/or quality of data communication; (4) increased communication speed through transmission of a data request over multiple data communication networks and acceptance of the fastest response; (5) improved reliability through the automatic migration from a first data communication network to a second data communication network when a connection to the first data communication network drops below a predetermined channel quality or is lost entirely; (6) verification of packets; (7) guaranteed on-time packet delivery for applications that require a minimal Quality of Service (QOS), such as VOIP applications or streaming video; (8) improved interactivity with a user base, such as the provision of field-upgradeable firmware; and/or (9) the ability to report problems, such as transmission errors, occurring on a first data communication network over a second data communication network.

[0059] An end user device in accordance with an embodiment of the present invention further supports "in session" hand-offs between access points in a wireless data communication network, such that a connection between the end user device and the wireless data communication network is maintained even as the end user device leaves the communication range of a first wireless access point and enters the communication range of a second wireless access point. For example, an end user device in accordance with an embodiment of the present invention supports hand-offs between "hot spots" in an 802.11x wireless data communication network.

[0060] An end user device in accordance with an embodiment of the present invention utilizes a single network identity, such as a single log-in, Internet Protocol (IP) address, or telephone number, to simultaneously access a plurality of data communication networks. The use of a single network identity in this manner can simplify billing where access fees are accrued for the use of multiple networks.

VI. Conclusion

[0061] While various embodiments of the present invention have been described above, it should be understood that

they have been presented by way of example only, and not limitation. It will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined in the appended claims. Accordingly, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

What is claimed is:

1. A method for network communication in an end user device comprising a plurality of network interfaces for communicating over a corresponding plurality of networks, the method comprising:

detecting a plurality of available networks;

selecting an optimal network from said plurality of available networks;

initiating data communication with a remote device over said optimal network via a first one of the plurality of network interfaces; and

when said data communication over said optimal network is terminated, continuing said data communication without interruption over another of said plurality of available networks via a second one of the plurality of network interfaces.

2. The method of claim 1, wherein said detecting said plurality of available networks is performed as part of a power-up sequence of the end user device.

3. The method of claim 1, wherein said detecting said plurality of available networks is performed when a task related to network communication is initiated on the end user device.

4. The method of claim 1, wherein said detecting said plurality of available networks comprises searching for available networks in an order based on expected transfer rate.

5. The method of claim 1, wherein said detecting said plurality of available networks comprises searching for available networks based on a type of data to be communicated.

6. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on a type of data to be communicated.

7. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on an expected bit error rate for each of said plurality of available networks.

8. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on an expected signal-to-noise ratio for each of said plurality of available networks.

9. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on an expected number of intervening network entities between the end user device and said remote device for each of said plurality of available networks.

10. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on an expected cost associated with communicating over each of said plurality of available networks.

11. The method of claim 1, wherein selecting said optimal network comprises selecting said optimal network based on an anticipated power consumption associated with communicating over each of said plurality of available networks.

12. The method of claim 1, further comprising:

establishing a connection with said remote device over said another of said plurality of available networks via said second one of the plurality of network interfaces prior to said termination of said data communication over said optimal network.

13. An end user device, comprising:

a plurality of network interfaces for communicating over a corresponding plurality of networks; and

a processor coupled to said plurality of network interfaces, said processor configured to detect a plurality of available networks, to select an optimal network from said plurality of available networks, and to initiate data communication with a remote device over said optimal network via a first one of said plurality of network interfaces;

wherein said processor is further configured to continue said data communication without interruption over another of said plurality of available networks via a second one of said plurality of network interfaces when said data communication over said optimal network is terminated.

14. The end user device of claim 13, wherein at least one of said plurality of network interfaces comprises a wireless network interface.

15. The end user device of claim 13, wherein at least one of said plurality of network interfaces comprises a wired network interface.

16. The end user device of claim 13, wherein at least one of said plurality of network interfaces comprises a local area network interface.

17. The end user device of claim 13, wherein at least one of said plurality of network interface comprises a wide area network interface.

18. The end user device of claim 13, wherein said processor is configured to detect said plurality of available networks as part of a power-up sequence.

19. The end user device of claim 13, wherein said processor is configured to detect said plurality of available networks in response to initiation of a task related to network communication.

20. The end user device of claim 13, wherein said processor is configured to detect said plurality of available networks by searching for available networks in an order based on expected transfer rate.

21. The end user device of claim 13, wherein said processor is configured to detect said plurality of available networks by searching for available networks based on a type of data to be communicated.

22. The end user device of claim 13, wherein said processor is configured to select said optimal network based on a type of data to be communicated.

23. The end user device of claim 13, wherein said processor is configured to select said optimal network based on an expected bit error rate for each of said plurality of available networks.

24. The end user device of claim 13, wherein said processor is configured to select said optimal network based on an expected signal-to-noise ratio for each of said plurality of available networks.

25. The end user device of claim 13, wherein said processor is configured to select said optimal network based on an expected number of intervening network entities between the end user device and said remote device for each of said plurality of available networks.

26. The end user device of claim 13, wherein said processor is configured to select said optimal network based on an expected cost associated with communicating over each of said plurality of available networks.

27. The end user device of claim 13, wherein said processor is configured to select said optimal network based on an anticipated power consumption associated with communicating over each of said plurality of available networks.

28. The end user device of claim 13, wherein said processor is further configured to establish a connection with said remote device over said another of said plurality of available networks via said second one of said plurality of network interfaces prior to said termination of said data communication over said optimal network.

29. A computer program product comprising a computer useable medium having computer program logic recorded thereon for enabling a processor to perform network communication in an end user device comprising a plurality of network interfaces for communicating over a corresponding plurality of networks, said computer program logic comprising:

means for enabling the processor to detect a plurality of available networks;

means for enabling the processor to select an optimal network from said plurality of available networks;

means for enabling the processor to initiate data communication with a remote device over said optimal network via a first one of the plurality of network interfaces; and

means for enabling the processor to continue said data communication without interruption over another of said plurality of available networks via a second one of said plurality of network interfaces when said data communication over said optimal network is terminated.

30. The computer program product of claim 29, wherein said means for enabling the processor to detect said plurality of available networks is invoked as part of a power-up sequence of the end user device.

31. The computer program product of claim 29, wherein said means for enabling the processor to detect said plurality of available networks is invoked when a task related to network communication is initiated on the end user device.

32. The computer program product of claim 29, wherein said means for enabling the processor to detect said plurality of available networks comprises means for enabling the processor to search for available networks in an order based on expected transfer rate.

33. The computer program product of claim 29, wherein said means for enabling the processor to detect said plurality of available networks comprises means for enabling the processor to search for available networks based on a type of data to be communicated.

34. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on a type of data to be communicated.

35. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on an expected bit error rate for each of said plurality of available networks.

36. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on an expected signal-to-noise ratio for each of said plurality of available networks.

37. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on an expected number of intervening network entities between the end user device and said remote device for each of said plurality of available networks.

38. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on an expected cost associated with communicating over each of said plurality of available networks.

39. The computer program product of claim 29, wherein said means for enabling the processor to select said optimal network comprises means for enabling the processor to select said optimal network based on an anticipated power consumption associated with communicating over each of said plurality of available networks.

40. The computer program product of claim 29, further comprising:

means for enabling the processor to establish a connection with said remote device over said another of said plurality of available networks via said second one of the plurality of network interfaces prior to said termination of said data communication over said optimal network.

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