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(54) **METHOD AND SYSTEM FOR
COMPUTER-BASED PRIVATE BRANCH
EXCHANGE**

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(57) **ABSTRACT**

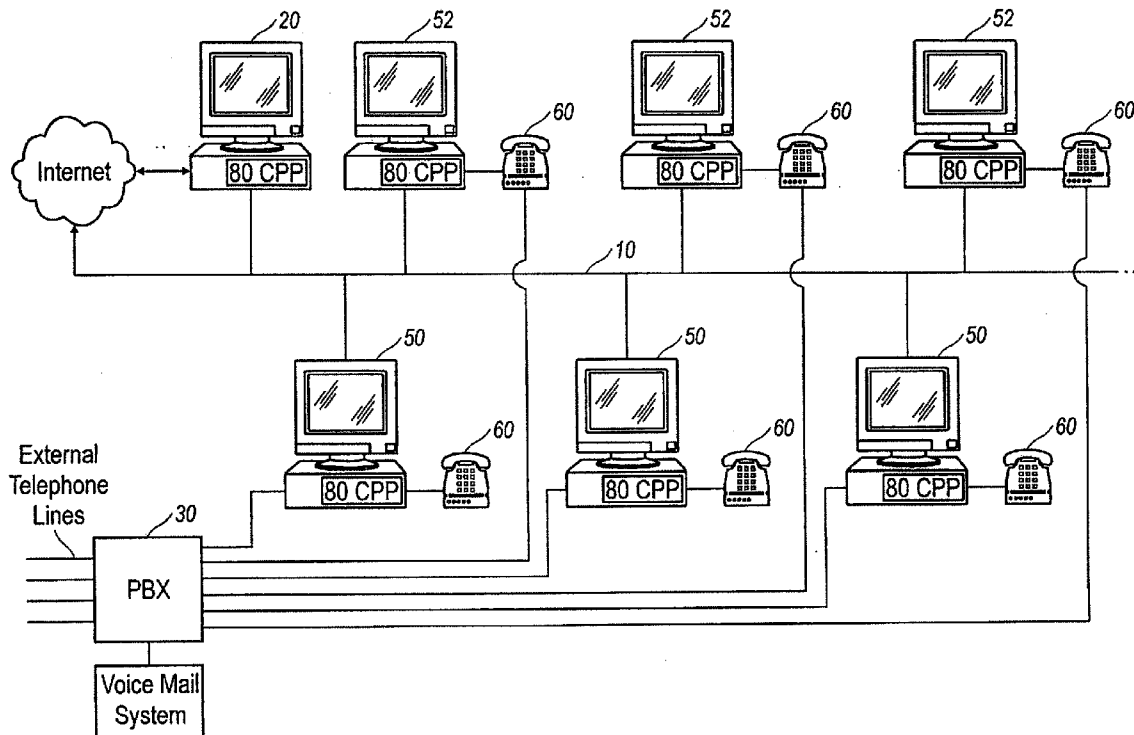
(21) **Appl. No.: 12/563,482**

A computer-based distributed private branch exchange (PBX). Preferred embodiments route calls and perform other functions of a PBX as well as performing services not commonly available on a PBX, such as Internet telephony. In one embodiment, the invention control and operations is distributed among several computers or Personal Computers (PCs) on a computer network.

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Related U.S. Application Data

(63) Continuation of application No. 10/283,183, filed on Oct. 30, 2002, now Pat. No. 7,616,754.



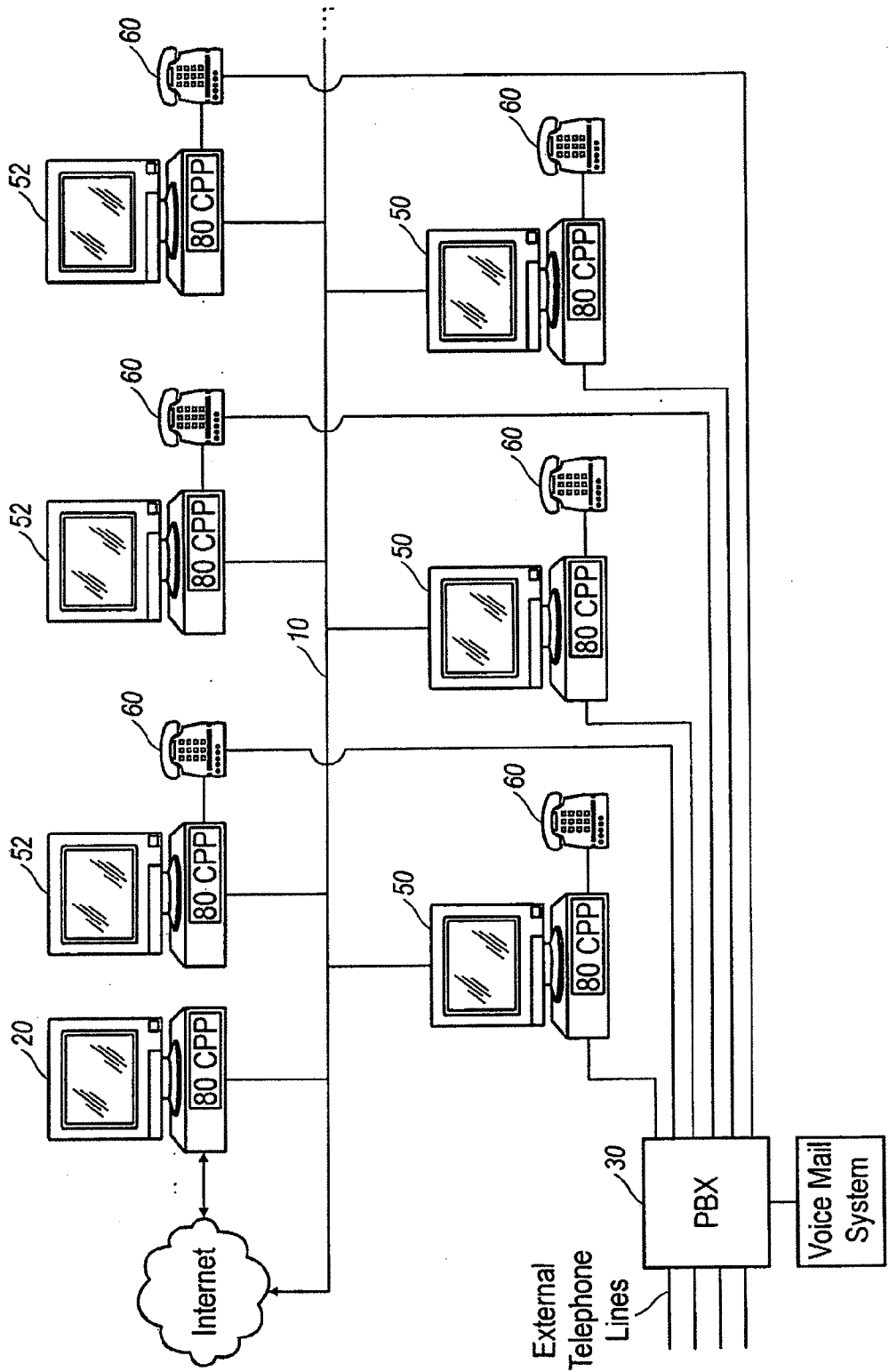


FIG. 1

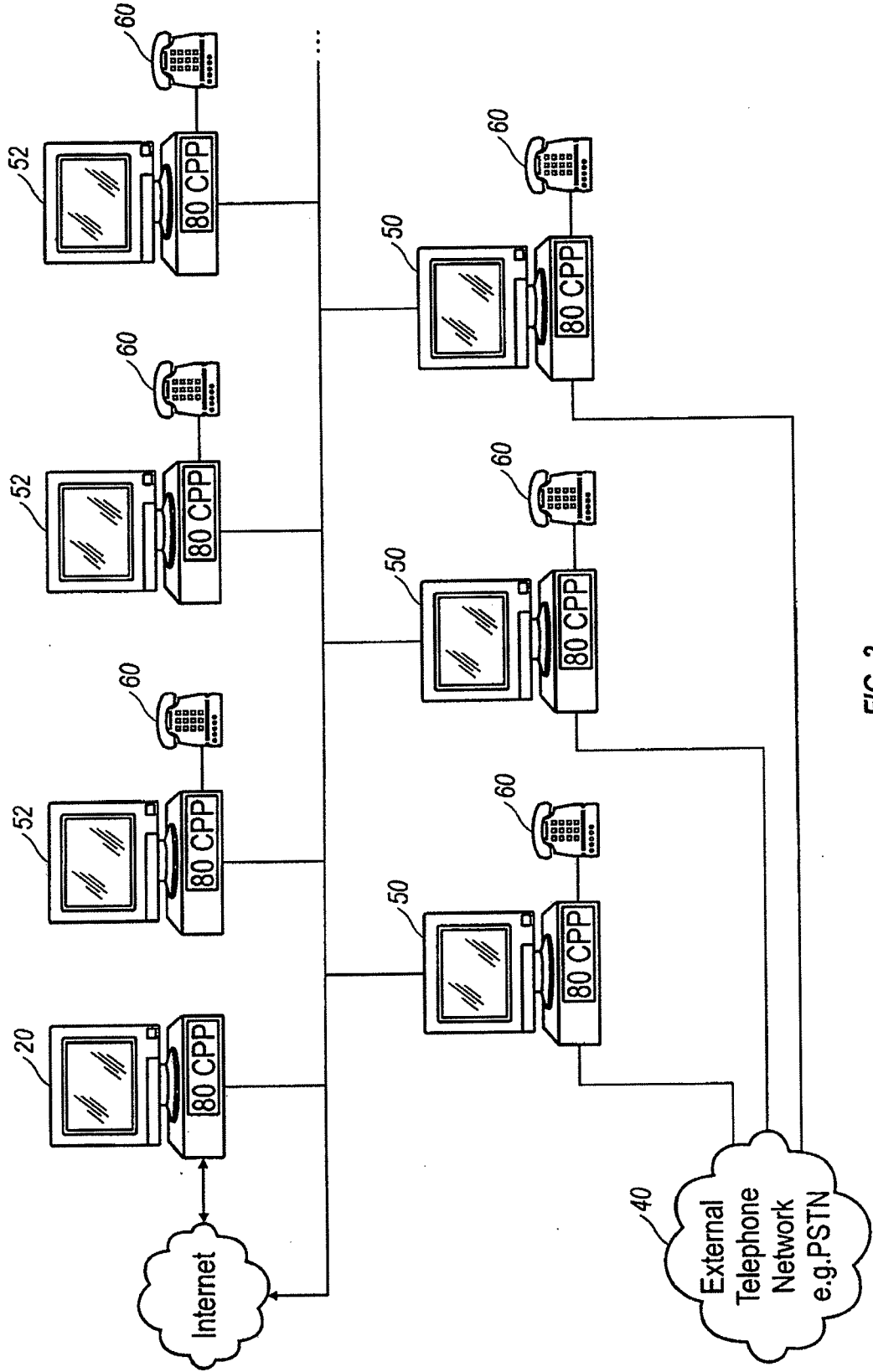


FIG. 2

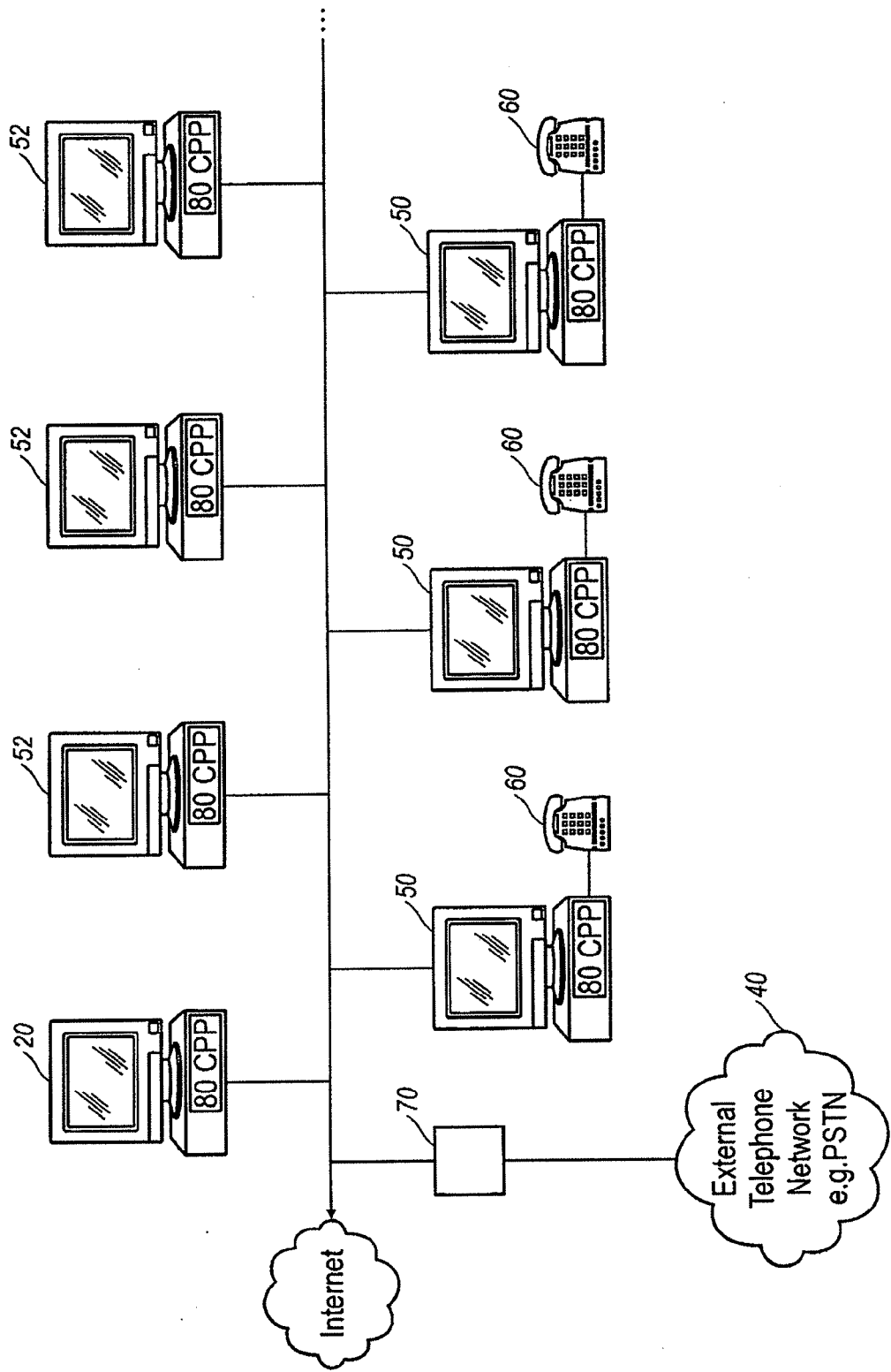


FIG. 3

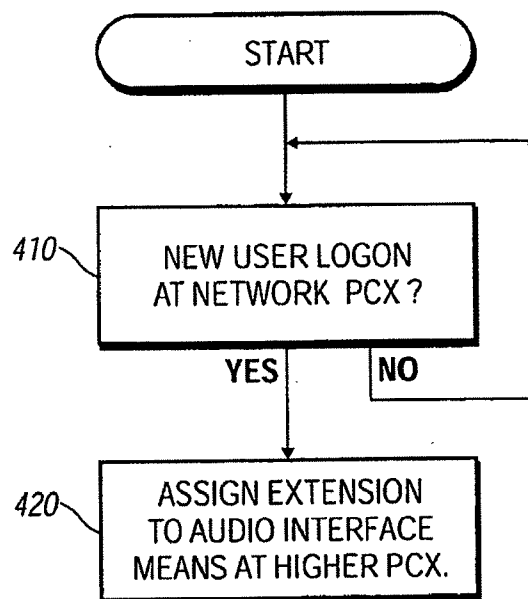


FIG. 4

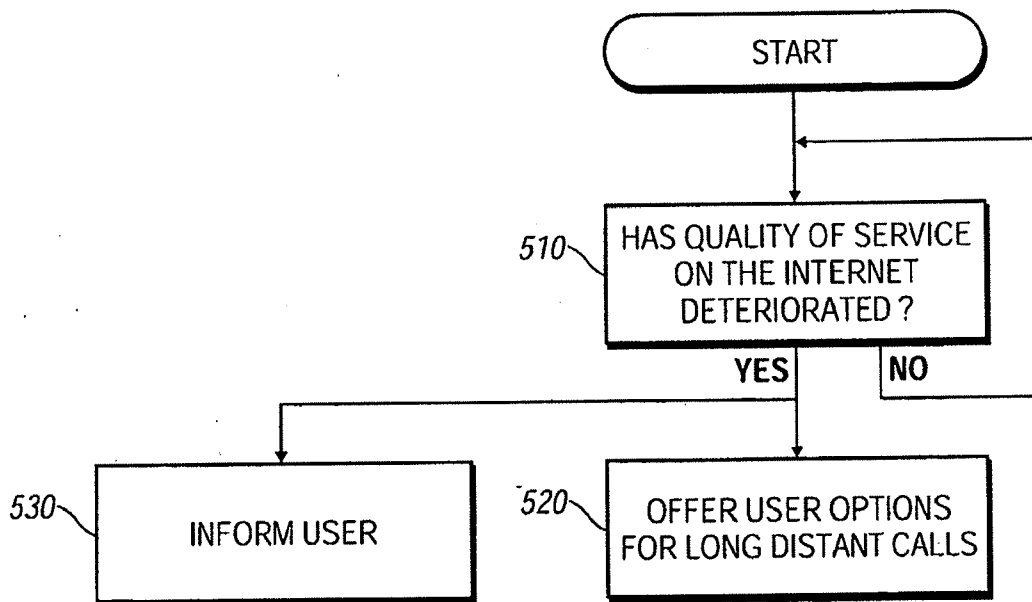


FIG. 5

**METHOD AND SYSTEM FOR
COMPUTER-BASED PRIVATE BRANCH
EXCHANGE**

**CROSS REFERENCE TO RELATED
APPLICATIONS**

[0001] This application claims priority to U.S. Provisional Patent Application 60/344,508 filed Nov. 9, 2001, and U.S. patent application Ser. No. 10/283,183, filed Oct. 30, 2002, the entirety of which are hereby incorporated by reference.

BACKGROUND

[0002] 1. Field of the Invention

[0003] This invention relates to a design of a private branch exchange (PBX) using a computer network to route calls.

[0004] 2. Description of Related Art

[0005] Private branch exchanges are expensive hardware equipment that most companies with more than a few employees typically buy and use. The cost can be several tens of thousands of dollars for a PBX with few lines. A common design of an office computer and PBX system is shown in FIG. 1. In some instances, systems including dedicated PBX server hardware have been used.

[0006] There are computer programs that enable long distance phone calls to be made over the Internet at a very low or no cost apart from the cost of the Internet connection. Internet telephony standards are emerging. Equipment that connects a single phone line or multiple lines to a computer or a computer network is available and relatively inexpensive. The figures show Ethernet 10 interconnecting the Personal Computers (PCs), as Ethernet is a common network technology; but other types of networking are available. The Internet can be connected via a server 20 and firewall, or can be directly connected to the network 10, which connects the PCs.

[0007] A typical PBX 30, along with associated hardware, performs at least the following functions: accepts incoming calls and directs these calls to the intended recipient on an internal line; enables an internal line to connect to an outgoing line and make a call; enables an internal line to connect to another internal line and make a call; transfers outgoing calls or incoming calls from one internal line to another; adds a line to existing call (conference calls); responds with voice mail system when a line is busy or does not answer; allows calls to be held temporarily without being connected, and later to be connected to a line upon request or when a line becomes available; services held calls with an audio broadcast or other announcements; records calls, and executes speed dial functions.

SUMMARY OF THE INVENTION

[0008] Embodiments of the present invention disclose a computer-based distributed private branch exchange (PBX). Preferred embodiments route calls and perform other functions of a PBX as well as performing services not commonly available on a PBX, such as Internet telephony. In one embodiment, the invention control and operations are distributed among several computers or Personal Computers (PCs) on a computer network.

**DESCRIPTION OF THE SEVERAL VIEWS OF
THE DRAWING(S)**

[0009] FIG. 1 illustrates the relationship between conventional PBX and a computer network.

[0010] FIG. 2 illustrates an embodiment of the present invention where external phone lines are connected directly to one or more networked computers.

[0011] FIG. 3 illustrates an embodiment of the present invention where one or more phone lines are connected to a network.

[0012] FIG. 4 is a flowchart that illustrates the PBX CPP's role in the dynamic assignment of extensions at user login to a network computer corresponding to the audio interface means according to one embodiment of the present invention.

[0013] FIG. 5 is a flowchart illustrating a method for enabling a user to select between use of the Internet and a public switched telephone network based at least in part on the quality of service of the Internet connection according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] Preferred embodiments of the present invention perform each of the above-described functions, and more, by a virtual system operating on a computer network, a "Computer Based PBX" or "Distributed PBX." Referring to FIG. 2, there are three external phone lines 40 connected to three PCs 50 via internal or external modems. There is a total of six PCs 50, 52 and one network application/internet server 20 (as opposed to the dedicated PBX server) shown. This configuration can service a small office with six employees. In general, N incoming phone lines can service M people with X number of PCs; where M does not have to equal N.

[0015] As stated above, embodiments of the present invention are implemented as a virtual system on a computer network. As such, systems of the invention include at least one PBX computer program product 80, which embodies a substantial portion of the functionality of the system. Beyond the typical functions of a PBX, as noted in the background, the computer program product 80 is involved in functions such as dynamic assignment of an extension number to audio interface means, e.g., 60 of the system. As illustrated in FIG. 4, this assignment 420 can be initialized on user login 410 to a network computer corresponding to the particular audio interface means.

[0016] In a preferred embodiment, when an incoming call arrives on one of the external phone lines 40, a system of the present invention detects the incoming call and answers with a request to the caller to dial the number of the internal line. The caller can also be prompted to say the extension number or the name of the person he is calling. More than six people can use the PCs 50, 52 in FIG. 2 at different times, and each user can set a different active extension number to each computer. The PC receiving the call will route this call to the correct person. The PC that the person is using will ring and display a window that allows the person to accept the call, transfer it to a different person, or transfer it to the answering service. When answering, the person can elect to use an audio interface means, e.g., the standard microphone and speakers attached to the PC (not shown), a special-made handset or headset 60 that is attached to a port on the PC, or a traditional telephone instrument adapted for interface to the PC. Unanswered incoming calls or calls that are intended for a person that does not have an active PC at the time the call arrives can be directed to the answering service.

[0017] Outgoing calls can be originated from any PC, using any available external phone line. Internal calls within the group of PCs can originate from any PC.

[0018] After the call is connected, the person answering or making the call can add another person to the call by requesting a connection on the window servicing the phone system. He can transfer the call to another person or to the voice mail system, put the call on hold, or terminate the call. A call can be recorded by a request or automatically. Saved messages can be played during a call.

[0019] In some embodiments of the present invention, control of the invention is distributed among the computers—e.g., PCs **50**, **52**, the network applications/internet server **20**, etc. The user interface is also on the PC's screen. From a window on his PC, a person can control his use of the invention.

[0020] In other embodiments of the invention, the external phone lines can be connected directly to the network using a special network modem **70**. This configuration is shown in FIG. **3**. However, in preferred embodiments, the routing of calls is done from the PCs **50** as shown in FIG. **2**.

[0021] In some embodiments, the PCs need not be all in one location. Several locations are possible with a private network interconnecting these locations, or with the public Internet connection. A person working from home can have one or two PCs connected to the Internet and embodiments of the present invention will service him as if he was in the office. During travel, each time a laptop PC is connected to the Internet it can become part of the distributed system.

[0022] Preferred embodiments of the present invention allow the answering service function to be performed from each PC for the user or users of the PC. The answering service feature is flexible in structure, and in some embodiments, the user can select the use of a PC or server. If the PC is a portable PC, e.g. a laptop, the PC can perform the answering service while connected to the network, otherwise any other PC, or the server, can perform this service. Upon connecting to the network, the portable PC can collect all the saved messages and updated settings from the server. Any PC on the network, or the server, can act as an automatic backup for saving messages to any other PC on the network.

[0023] The window (or a part of a window) on each PC that operates the answering service can change the settings of the answering service, save outgoing messages, and playback messages. Stored messages can be displayed with the caller ID if available, with the caller name if he was prompt to say his name, or with a transcription of the message.

[0024] There are services of Internet telephony available today where a person can initiate a call on the Internet and access the public telephone system from a line that is near the call destination. This allows the caller to avoid paying tolls. The present invention can utilize such services to generate outgoing calls and to accept incoming calls over the Internet. A large company can have many local offices and outgoing calls can be routed to access the public telephone system at a beneficial location. Alternatively, as illustrated in FIG. **5**, if the quality of service on the Internet deteriorates **510**, a caller can select to enter the public telephone system within his local area and pay the cost of making the call this way. In preferred embodiments, the present invention offers the user options for long distance calls **520** so he can choose what service he wants. The invention can check the current quality of service on the Internet and inform the user **530**.

[0025] Telephone lines that enter the site can be terminated at the standard telephone sets and be used directly if the network or some of the PCs are not functioning or are out of order. This telephone connection will be in parallel to the

connection to the PC as shown in FIG. **2** or the connection to network modems as shown in FIG. **3**.

[0026] It is well known that basic service on the Public Switched Telephone Network (PSTN) is typically limited to voice grade channel (VGC) bandwidth. Due to the high network capacity, all calls that are not connected to the public telephone system can have high audio quality (Hi-Fi). Embodiments of the invention are operative to route those calls not destined for interaction with the telephone network at greater than voice grade channel bandwidth. Video-telephone services can be enabled. Such services can have the full spectrum of phone connectivity and services on the PBX. Video-mail can be added to voice-mail, etc. There are some small differences for a video-telephone service, like the need for a camera to be connected to the PC and the need to split the display window in a conference call.

[0027] If a distributed computer-based PBX is used in a call center, there can be more external phone lines than PCs. In such a case, the distributed PBX will manage the line of callers, service music, and announcements to the people waiting for their calls to be answered, and other common services of a call server.

1. A private branch exchange comprising:
 - a first network interface configured to communicate with a communications network comprising a plurality of computers, each of the plurality of computers configured to receive audio signals from an audio interface means;
 - a second network interface configured to communicate with an external network;
 - a processor configured to communicate with the first network interface and the second network interface;
 - a processor configured to:
 - receive a call;
 - determine the recipient of the call; and
 - determine which computer of the plurality of computers the recipient of the call is logged on to, and connect the call to that computer.
2. The private branch exchange of claim **1**, wherein the communication network is associated with a call center.
3. The private branch exchange of claim **1**, wherein the call originates from one of the plurality of computers connected to the communications network.
4. The private branch exchange of claim **1**, wherein the call originates from a device connected to the external network.
5. The private branch exchange of claim **1**, wherein the external network comprises one or more of: an Internet connection or a public switched telephone network connection.
6. The private branch exchange of claim **1**, wherein the audio interface means comprises a telephone.
7. The private branch exchange of claim **1**, wherein the audio interface means comprises a microphone and a speaker.
8. The private branch exchange of claim **1**, wherein the processor is further configured to connect one or more additional computers to the call.
9. The private branch exchange of claim **1** wherein the processor is further configured to:
 - determine that the recipient is currently on another call;
 - and
 - place the received call on hold.
10. The private branch exchange of claim **9**, wherein the processor is further configured to play a prerecorded audio message while the call is on hold.
11. The private branch exchange of claim **9**, wherein the processor is further configured to:

determine that the recipient is no longer on another call;
and
connect the received call to the recipient's computer.

12. The private branch exchange of claim **1**, wherein the processor is further configured to retrieve a voice mail message.

13. The private branch exchange of claim **1**, wherein the processor is further configured to switch between multiple external networks.

14. The private branch exchange of claim **13**, wherein the processor is further configured to determine a quality of service of each of the external networks and switch between the external networks based at least in part on the quality of service.

15. The private branch exchange of claim **14**, wherein the multiple external networks comprise one or more of: an Internet connection or a public switched telephone network connection.

16. A method for operating a private branch exchange comprising:

receiving a call from a computer connected to an internal network, the internal network comprising a plurality of computers, each of the plurality of computers configured to receive audio signals from an audio interface means;

determining an external network to connect the call to, wherein the external network comprises one of the Internet or a public switched telephone network, and wherein selecting the external network is based at least in part on the quality of service of the Internet connection; and connecting the call to the external network.

17. The method of claim **16**, wherein the quality of service of the Internet connection comprises a measure of the bandwidth available on the Internet connection.

18. A method for operating a private branch exchange comprising:

receiving a call from an external network;
determining the recipient of the call;
determining which computer of a plurality of computers connected to a communications network, the recipient is logged on to;
connecting the call to the computer that the recipient is logged on to.

19. The method of claim **18**, wherein the external network comprises the Internet.

20. The method of claim **18**, further comprising:
determining whether the recipient is on another call; and
placing the received call on hold until the recipient is no longer on another call.

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