**PCT** WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04L 12/28, 12/56

A1

(11) International Publication Number: **WO 98/06201**

(43) International Publication Date: 12 February 1998 (12.02.98)

(21) International Application Number: PCT/US97/13897

(22) International Filing Date: 8 August 1997 (08.08.97)

(30) Priority Data:
08/694,244 8 August 1996 (08.08.96) US

(71) Applicant: INTELLIGENCE AT LARGE [US/US]; Suite 230, 3508 Market Street, Philadelphia, PA 19104 (US).

(72) Inventors: REED, Cartwright; 260 Dupont Street, Philadelphia, PA 19128 (US). RICHTER, Andreas; 2615 Swain Street, Philadelphia, PA 19130 (US).

(74) Agent: D'AMICO, Thomas, J.; Dickstein Shapiro Morin & Oshinsky LLP, 2101 L Street, N.W., Washington, DC 20037 (US).

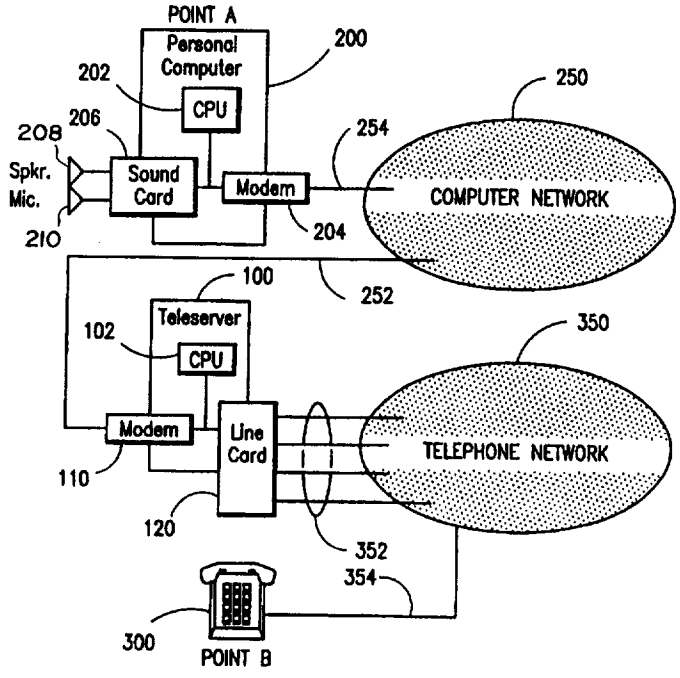
(81) Designated States: AU, CA, CN, JP, KP, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

**Published**
*With international search report.*
*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: TELESERVER FOR INTERCONNECTION OF COMMUNICATIONS NETWORKS

(57) Abstract

A teleserver (100) interconnected to a computer network (250) and a telephone network (350) permits communications to occur between subscribers (300) of the respective networks. The teleserver (100) receives computer messages from a computer subscriber (200) that contains communications data. The teleserver (100) identifies the communications data and formats it as a signal for transmission over the telephone network (350) to a telephone subscriber. Similarly, the teleserver receives a communications signal from the telephone subscriber (300), converts the signal to data and transmits the data to the computer subscriber (200) as computer messages.



*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AL** | Albania | **ES** | Spain | **LS** | Lesotho | **SI** | Slovenia |
| **AM** | Armenia | **FI** | Finland | **LT** | Lithuania | **SK** | Slovakia |
| **AT** | Austria | **FR** | France | **LU** | Luxembourg | **SN** | Senegal |
| **AU** | Australia | **GA** | Gabon | **LV** | Latvia | **SZ** | Swaziland |
| **AZ** | Azerbaijan | **GB** | United Kingdom | **MC** | Monaco | **TD** | Chad |
| **BA** | Bosnia and Herzegovina | **GE** | Georgia | **MD** | Republic of Moldova | **TG** | Togo |
| **BB** | Barbados | **GH** | Ghana | **MG** | Madagascar | **TJ** | Tajikistan |
| **BE** | Belgium | **GN** | Guinea | **MK** | The former Yugoslav Republic of Macedonia | **TM** | Turkmenistan |
| **BF** | Burkina Faso | **GR** | Greece | | | **TR** | Turkey |
| **BG** | Bulgaria | **HU** | Hungary | **ML** | Mali | **TT** | Trinidad and Tobago |
| **BJ** | Benin | **IE** | Ireland | **MN** | Mongolia | **UA** | Ukraine |
| **BR** | Brazil | **IL** | Israel | **MR** | Mauritania | **UG** | Uganda |
| **BY** | Belarus | **IS** | Iceland | **MW** | Malawi | **US** | United States of America |
| **CA** | Canada | **IT** | Italy | **MX** | Mexico | **UZ** | Uzbekistan |
| **CF** | Central African Republic | **JP** | Japan | **NE** | Niger | **VN** | Viet Nam |
| **CG** | Congo | **KE** | Kenya | **NL** | Netherlands | **YU** | Yugoslavia |
| **CH** | Switzerland | **KG** | Kyrgyzstan | **NO** | Norway | **ZW** | Zimbabwe |
| **CI** | Côte d'Ivoire | **KP** | Democratic People's Republic of Korea | **NZ** | New Zealand | | |
| **CM** | Cameroon | | | **PL** | Poland | | |
| **CN** | China | **KR** | Republic of Korea | **PT** | Portugal | | |
| **CU** | Cuba | **KZ** | Kazakstan | **RO** | Romania | | |
| **CZ** | Czech Republic | **LC** | Saint Lucia | **RU** | Russian Federation | | |
| **DE** | Germany | **LI** | Liechtenstein | **SD** | Sudan | | |
| **DK** | Denmark | **LK** | Sri Lanka | **SE** | Sweden | | |
| **EE** | Estonia | **LR** | Liberia | **SG** | Singapore | | |

# TELESERVER FOR INTERCONNECTION OF COMMUNICATIONS NETWORKS

The present invention relates to communications systems and, more particularly, to a method and apparatus which permits use of a data communications network for transmitting and receiving communications information, such as audio, facsimile, multimedia and computer data.

## BACKGROUND OF THE INVENTION

There is an ever increasing interest in providing low cost telecommunications services, particularly where a telecommunications service can capitalize on infrastructure already in place that was designed for another purpose. For example, cable television and power distributions systems are being configured to support telecommunications to provide competition among telecommunications service providers in the home. In the long distance telecommunications market, long distance computer networks have joined fiber optic and satellite systems as a service provider.

Recently, computer networks, such as the Internet, have been used to support telecommunications services. In a typical example, shown in FIG. 9, two computers X and Y are linked via a computer network Z. A CPU X1, Y1 in each computer X, Y runs software causing each computer to perform compatible signaling and transmit data in fixed formats. During a communications connection, audio information at computer X is captured by microphone X2, converted to a digital signal and transmitted to computer Y via computer network Z. At computer Y, the digital signal is converted to an analog signal and broadcast by speaker Y3. Similarly, sound at computer Y is captured by microphone Y2, converted to a digital signal and transmitted to computer X via computer network Z. Once received by computer X, the digital signal is converted to an analog signal and broadcast by speaker X3.

It should be appreciated, however, that communications using a computer network as just described is possible only between subscribers having computers which are interconnected with the respective computer network Z. Telecommunications access to subscribers who do not own computer equipment or who are not connected to the computer network Z is not possible. Further, communications are possible only if computers X and Y exchange data in precisely defined formats and perform compatible signaling, often requiring both computers to run compatible software simultaneously. Thus, communications services using computer networks suffer a disadvantage in that they can only provide access to a limited number of subscribers, unless a particular software package earns a substantial market share.

Thus, there is a need for a telecommunications service that advantageously not only provides communications services between subscribers of a computer, but also subscribers who may not own computer equipment. Further, there is a need for a communications system that advantageously uses computer networks to provide relatively inexpensive long distance communications services to a wider segment of the population.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a method and apparatus which allows telecommunications services to be established between a computer user and a telephone user, or even between two telephone subscribers over a computer network.

It is a further object of the present invention to provide a method and apparatus which provides a communications bridge between a computer network and a telephone network.

It is a further object of the present invention to provide a method and apparatus which provides communication services between a subscriber using a computer which executes a communications program and a telephone subscriber who has no computer equipment.

It is a further object of the present invention to provide a method and apparatus for enabling inexpensive long distance communication services over a computer network even when a subscriber has no computer equipment.

It is a further object of the present invention to provide a method and apparatus for interconnecting with a Private Branch Exchange and providing inter-office telecommunications services over a computer network.

It is a further object of the present invention to provide an interface between users at telephone subscribers and a computer network to permit the user to access and review information on the computer network and reply or amend such information.

These and other objects, advantages and features of the present invention are achieved by a method and apparatus which employs a telserver computer which interconnects a computer network with a telephone network. The telserver receives computer messages from a computer subscriber somewhere in the computer network, decodes the messages and converts the communications data within the messages into an audio signal for transmission to and over the telephone network; similarly, the telserver receives an audio communications signal from the telephone network and formats it as computer messages for transmission to the computer subscriber over the computer network. The telserver may include a central processing unit, a dedicated line or modem for exchanging computer messages with the computer network and

a line card for exchanging communications with the telephone network and converting between the telephone communications used in the telephone network and digital formats used by the telserver. The central processing unit also converts the communications information from one of the respective networks into a format appropriate for the other of the respective networks.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the present invention constructed in accordance with a first preferred embodiment.

FIG. 2 is a diagram showing some of the data fields present in message packets exchanged between the telserver and the computer subscriber illustrated in FIG. 1.

FIG. 3 is a diagram demonstrating the processing performed by the telserver of FIG. 1 during the creation and termination of a connection between subscribers.

FIG. 4 is a detailed block diagram of the telserver of FIG. 1.

FIG. 5 is a block diagram of the present invention constructed in accordance with a second embodiment.

FIG. 6 is a diagram of the signaling which occurs among a first telephone subscriber, first and second telservers, and a second telephone subscriber, also shown in FIG. 5.

FIG. 7 is a block diagram of the present invention constructed in accordance with a third embodiment.

FIG. 8 is a schematic diagram showing a known data communications system which transmits and receives audio information.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, there is shown a communications system constructed in accordance with a first embodiment of the present invention. A computer telserver 100 is in communication with a first computer subscriber 200 through a computer communications network 250. The telserver 100 is also in communication with a second telephone subscriber 300 through a telephone network 350. The first subscriber 200 and second subscriber 300 interconnect with different respective networks 250 and 350 which use disparate signaling formats to establish and terminate connections within their respective networks. Further, the first subscriber 200 and second subscriber 300 also use incompatible data formats during communications. The telserver 100, which is described in greater detail below, bridges the different data and signaling formats of the two networks 250 and 350 to permit communications between the computer subscriber 200 and the telephone subscriber 300.

In FIG. 1 full duplex communications are conducted between the computer subscriber 200, and the telephone subscriber 300. For purposes of this discussion, "computer subscriber" and "telephone subscriber" are used to denote representative computer equipment, e.g., a personal computer, at POINT A, telephone equipment, e.g., a telephone set, at POINT B respectively. It should be understood however that the present invention may be used with a variety of computer and telephone equipment and systems at each of points A and B. In addition, although FIG. 1 shows the computer subscriber 200 and telephone subscriber 300 as wired connections to their

respective networks, wireless communications may also be employed.

The telserver 100 includes a CPU 102 which executes a software program which dictates the operations performed by the telserver 100. The telserver also includes associated RAM and ROM memories 104 and 106 and other storage devices, and input/output drivers 108 (shown in FIG. 4). The telserver 100 is also provided with a modem 110 for communication with the computer network 250 over a data line 252. The telserver 100 connects to the telephone network 350 over one or more telephone lines 352 by way of a telephone line card 120.

It will be appreciated by those of skill that, while the drawing of FIG. 1 schematically discloses the telephone network 350 and the computer network 250 as separate entities, each may employ elements of the other. For example, communications may be accomplished using the Internet as the computer network 250. In the Internet example, individual node computers (not shown) within the computer network 250 may communicate with one another over dedicated data lines or over telephone lines. Likewise, the telephone network typically employs computers and computer networks for routing calls which are in digital format.

The computer network 250 may also constitute a local area network ("LAN") of interconnected computers. In a LAN embodiment, node computers of the computer network 250 may communicate over dedicated computer cables. In the LAN environment, the computer network 250 and the telephone network 350 may be maintained as physically separate from one another.

Computer network 250 and the telephone network 350 have their own signaling and data formats. For example, messages are sent throughout the computer network 250 as data

packets prepared by the transmitting subscriber such as subscriber 200. Each of these packets contains a field identifying an intended addressee for the message packet. The computer network 250 examines each packet, identifies the addressee therefrom and routes the packet to the addressee indicated. By contrast, subscribers to the telephone network 350, such as telephone subscriber 300, identify the addressee of the communications by dial signals transmitted before communications begin. Once a connection is established, the telephone network 350 does not thereafter examine the information content of signals from telephone subscriber 300 to determine the addressee of the communications; instead the telephone network 350 stores an identification of the addressee in memory and routes all communication from the telephone subscriber 300 to that addressee until the communications connection is terminated.

The computer subscriber 200 equipment may comprise a computer with a CPU 202, associated RAM and ROM memories, and other storage devices, input/output interfaces (not shown), and a sound card 206. CPU 202 executes software which that dictates the operations performed by the computer subscriber 200. The computer subscriber 200 is provided with a modem 204 that communicates with the computer network 250 over a data line 254. Alternatively, computer subscriber 200 may connect with the computer network 250 through a dedicated connection.

The sound card 206 includes a speaker 208 and a microphone 210. During communications, the microphone 210 captures voice or other audio information and the sound card 206 converts the audio information to a digital signal, and the CPU 202 formats this information and sends it to modem 204 which transmits the converted audio information to the computer network 250. The computer subscriber 200 may also transmit and receive other information signals to and from computer network 250, including computer data, fax

information, video information signals and other multimedia information. Similarly, voice and other audio data may be received from the computer network 250 and, if appropriate, played over speaker 208. The CPU 202 also processes other types of information received over computer network 250.

The telephone subscriber 300 is shown in FIG. 1 as an ordinary rotary or Touch-Tone telephone. However, a speaker phone, facsimile machine or a video phone or other device designed to interface with the telephone network 350 may also be used. For example, the telephone subscriber 300 may include computer equipment such as that described above with reference to the computer subscriber 200.

During a communications connection, voice or other data is routed from the computer subscriber 200 to the telserver 100 in packets 400, shown in FIG. 2. FIG. 2 identifies just some of the fields which may be present in each packet 400. The placement and number of the fields within the packets may be altered to accommodate error correction/detection codes, accommodate additional addresses, or otherwise optimize communication between the telserver 100 and the computer subscriber 200. Each packet 400 is a short digital message in relation to the total length of a communication. The packet 400 contains an addressee field 410 which identifies the intended recipient of the packet 400. The addressee field 410 is interpreted by the computer network 250 which performs all routing functions necessary to deliver packets 400 from the computer subscriber 200 to the telserver 100. Each packet 400 also contains a time stamp 420, identifying the time that the computer subscriber 200 issued the packet 400 to the computer network 250. Additionally, the packet 400 includes a message field 430 that carries either messaging data to be used by the telserver 100 or data for transmission during communications with the telephone subscriber 300.

Similarly, the telserver 100 creates and transmits packets to the computer subscriber 200. The structure of packets sent from the telserver 100 to the network subscriber 200 may be identical or similar to that of the packets 400 sent from the network subscribers 200 to the telserver 100. Each packet 400 issued by the telserver 100 contains at least an addressee field 410 identifying the computer subscriber 200 as the recipient, a time stamp field 420 indicating the time that the telserver 100 delivered the message to the computer network 250 and a message/data field 430.

During communications between the network subscriber 200 and the telephone subscriber 300, the telserver 100 decodes the time stamp field 430 of each packet 400 received from the computer subscriber 200 over the computer network 250. The routing of packets 400 from the computer subscriber 200 to the telserver 100 is performed by the computer network 250. The routing function performed by the computer network 250 typically adds delay to the transmission of data to the telserver 100, typically on the order of 1 ms. However, for individual packets, the delay may be erratic. For each packet 400 received by the telserver 100 over the computer network 250, the telserver 100 examines the time stamp 410 and telserver 100 may increase or decrease a delay of the transmission of the data contained in individual packets 400 to match a normalized delay. By normalizing the delay, the telserver 100 improves perceived continuity in the communications link.

The computer subscriber 200 also examines the time stamp 410 field of individual packets 400 of communications data received from the telserver over the computer network 250. As with packets 400 received by the telserver 100 from the computer network 250, packets 400 received by the computer subscriber 200 may not be uniformly delayed due to adaptive routing functions that may be performed by the computer

network 250. The computer subscriber 200 examines the time stamp field 410 of each packet and may increase or decrease a delay of individual packets 400 as necessary to maintain continuity in the audio communications connection.

FIG. 3 discloses the processing performed by the telserver 100 during the creation and termination of communications between a computer subscriber 200 and a telephone subscriber 300. When the telserver is between calls, it sits idle at step 1000. Communications may be initiated either by the computer subscriber 200 or by the telephone subscriber 300.

When calls are initiated by the computer subscriber 200, the telserver 100 receives a call request message from the computer subscriber 200 through the computer network 250 and over data line 252. Upon receipt of the call request message, the telserver 100 prompts the computer subscriber 200 for identification of the party to be called in Step 1010. The telserver receives a reply message from the computer subscriber 200 containing a phone number or other identification of the desired telephone subscriber 300 at Step 1020. For example, the call request message may identify a party to be called. The telserver performs address resolution to identify an appropriate method of communication between the calling party and the party to be called.

Where the call request message identifies a telephone subscriber 300 to be dialed, the telserver 100 determines whether it can establish a communications connection with the telephone subscriber 300 without accruing long distance charges. If so, it attempts to place the call. If not, the telserver 100 interrogates the computer network 250 to determine whether other telservers are connected to the computer network that can establish a communications connection with the telephone subscriber 300 without accruing

long distance charges. If a second telserver 150 is connected to the computer network 250 and can establish a "local" call to the desired telephone subscriber, the first telserver 100 sends a message to the network subscriber 200 identifying the second telserver 130 and instructing the network subscriber 200 to send a second call request to the second telserver 150. If no telserver connected to the computer network 250 can place a "local" call to the telephone subscriber 300, the first telserver 100 establishes a communications connection to the telephone subscriber 300 and incurs the toll charges.

To establish a communications connection with a telephone subscriber 300, telserver 100 seizes an available one of the telephone lines 352 and dials through the line card 120 the phone number of the telephone 300 by generating the appropriate DTMF tones in Step 1030. If the telephone network 350 returns a signal over the telephone line 352 indicating that the telephone subscriber 300 is busy, the telserver 100 decodes the signal, releases the telephone line 352 and sends a message to the computer subscriber 200 indicating that the telephone subscriber 300 is busy in Step 1040. If the network 350 returns a signal indicating that the telephone subscriber 300 is ringing, the telserver 100 begins a countdown timer in Step 1050. If the countdown timer expires before the telserver receives a signal from the telephone network 350 indicating that the telephone subscriber 300 has gone off hook, the telserver 100 releases the telephone line 352 and sends a message to the computer subscriber 200 indicating that the call request is denied because there is no answer at the telephone subscriber 300 in Step 1040. If the telserver 100 receives a message from the telephone network that the telephone subscriber 300 has gone off hook before the countdown timer expires, the telserver 100 establishes a communication connection with the computer subscriber 200 in Step 1060. At this point, the telserver 100 has established a data path between the computer subscriber 200 via the computer

network 250 and the telephone subscriber 300 via the telephone network 350. The telserver 100 then operates to translate data received from the computer subscriber 200 providing it in a suitable format to the telephone line card 120 for transmission over the seized telephone line to telephone subscriber 300. Likewise, the telserver 100 receives data from telephone subscriber 300 through the line card 120 and provides it in a suitable format to subscriber 200 and computer network 250.

Alternatively, a communications connection may be established at the request of a telephone subscriber 300. Because the telserver 100 may be configured to interface with the telephone network 350 as if it were an ordinary subscriber, that is, each telephone line 352 of the line card 120 may have its own associated telephone number. Telephone subscribers 300 phone the telserver 100 as they would any other subscriber. To establish communications with a computer subscriber 200, a telephone subscriber 300 must first establish communications with the telserver 100. The telserver 100 receives a ring signal over one of the telephone lines 352. In response to the ring signal, the telserver 100 generates a signal replicating a subscriber going off hook at Step 1100. At this point, communications are established between the telserver 100 and the telephone subscriber 300. The telserver prompts the telephone subscriber 300 for the identity of the computer subscriber 200 to be contacted by entering the called party's code on the Touch Tone keyboard, or by the rotary dial, in Step 1110. The telserver 100 decodes the DTMF tones or dial pulses from the telephone subscriber 300 at Step 1120. The telserver 100 then sends a calling message to computer subscriber 200 and establishes a communications connection with the computer subscriber 200 through the computer network 250 at Step 1130. At this point, the telserver 100 exchanges data between the computer

subscriber 200 via the computer network 250 and the telephone subscriber 300 via the telephone network 350.

Communications connections may be terminated by either the computer subscriber 200 or the telephone subscriber 300. Description of the processes employed by the telserver 100 for terminating communications connections is provided next.

Telephone subscribers 300 terminate communications connections by going on hook at Step 1250. When the telserver 100 receives a signal from the seized telephone line 352 that the telephone subscriber 300 has gone on hook, the telserver 100 releases telephone line 352 and sends a message to the computer subscriber 200 indicating that the telephone subscriber 300 terminated the communications connection at Step 1260. At this point, the telserver 100 ceases its bridging function between the computer subscriber 200 and the telephone subscriber 300 and returns to the idle state.

To terminate a communications connection, the computer subscriber 200 sends an end of communications message to the telserver 100. The telserver 100 decodes this message and again ceases the bridging function at Step 1200. At this point, the telserver 100 generates a signal on telephone line 352 replicating a subscriber that has gone on hook at Step 1210. The telserver 100 then releases telephone line 352 and returns to the idle state.

The telserver 100 may interconnect with a telephone network 350 in a variety of ways. In the first embodiment as just described, the telserver 100 interconnects with a telephone network 350 as an ordinary local loop subscriber, similar to telephone subscriber 300 shown in FIG. 1. In this embodiment, a caller dials a telephone number for the telserver 100. However the telserver 100 may also interconnect with a telephone network 300 through an ISDN line

and the telserver 100 may also interconnect with a branch exchange ("PBX"). The telserver 100 interconnects with the telephone network 350 and acts as a central office. Each of these embodiments are described in turn below.

In the first embodiment, the telserver 100 operates in an analog "local loop" mode using a line card 120. The details of the line card are shown in FIG. 4. In the local loop mode, the line card 120 may be a voice processing board such as the model no. D/41ESC Voice Processing Board manufactured by the Dialogic Corporation of Parsippany, New Jersey. The line card 120 includes a digital signal processor ("DSP") 122 and a control processor and interfaces with up to four telephone lines. The control processor 124 performs signaling operations under the direction of the telserver CPU 102 to generate supervisory signals to the telephone network 360.

Audio information from telephone subscriber 300 is input to the line card 120 of telserver 100 as an analog signal over, for example, telephone line 352-A. Within the line card 120, the analog voice signal is received by a telephone line interface 126 and routed to the CODEC 128. The CODEC 128 converts the analog voice signal to digital format. The CODEC 128 passes the digitized voice signal to the DSP 122.

The DSP 122 performs coding of the digitized voice signal using a variety of schemes. For example, the DSP 122 may code the digital voice signal as any one of:

24 kbps ADPCM @ 6 kHz sampling,
32 kbps ADPCM @ 8 kHz sampling,
48 kbps PCM @ 6 kHz sampling, or
64 kbps PCM @ 8 kHz sampling.

The DSP 122 may also perform voice compression, if desired, using any of the available compression techniques such as those based on linear predictive coding, subband coding, or

others. Once processed by the DSP 122, the control processor 124 transmits the coded speech to the telserver CPU 102.

Similarly, outbound speech for transmission to the telephone line 352-A is processed by the line card 120. The speech arrives at the line card 120 from the telserver 100 in a coded state as one of:

a 24 kbps ADPCM signal @ 6 kHz sampling,
a 32 kbps ADPCM signal @ 8 kHz sampling,
a 48 kbps PCM signal @ 6 kHz sampling, or
a 64 kbps PCM signal @ 8 kHz sampling.

the coded speech is decoded by the DSP 122 into a digital speech signal. If compressed speech was used, the speech is also decompressed. Once decoded, the CODEC 128 converts the digital signal to an analog signal for transmission to the telephone line 352-A. The telephone line interface 126 formats the analog signal for transmission through the telephone network 350 and transmits the analog signal to telephone line 352-A.

Signaling messages from the telephone line 352-A are routed to the control processor 124. The control processor 124 decodes the signaling message to determine which event has occurred, (i.e., on hook, ringing, caller ID) and reports the event to the telserver CPU 102 via a shared RAM 130. Similarly, signaling orders made by the telserver CPU 102 (i.e., seize a line, dial DTMF digits, etc.) are implemented by the control processor 124.

In a modified embodiment, the telserver may interconnect with the telephone network 350 as a digital local loop supporting ISDN signaling. Typical ISDN formats includes 64 kbps PCM data or 56 kbps PCM data.

FIG. 5 shows another variant of the invention in which a pair of telservers 500, 550 may be used to provide communication services between two ordinary telephone

subscribers 310, 320. In this "tandem telserver" embodiment, telephone subscriber 310 connects to a first telephone network 360 over a subscriber line 362. Telephone network 360 is connected to a telserver 500 via one or more telephone lines 364. Telserver 500 is connected to a computer network 250 via data line 256. Telephone subscriber 320 is connected to a second telephone network 370 over a subscriber line 372. The second telephone network 370 connects to the second telserver 550 via one or more sets of telephone lines 374. The second telserver 550 connects to computer network 250 via data line 258.

Telserver 500 bridges communications between the first telephone network 360 and the computer network 250, while telserver 550 bridges communications between the computer network 250 and the second telephone network 370. The two telservers 500, 550 are each connected to computer network 250 and thus are capable of establishing communications paths between local telephone subscriber 310 and local telephone subscriber 320.

The tandem telserver embodiment requires an extra layer of signaling during communications set-up and termination. FIG. 6 shows an example of the signaling which occurs to set up a connection. To illustrate this, Fig. 6 shows what occurs when telephone subscriber 310 places a call to telephone subscriber 320. Subscriber 310 begins by going off hook at Step 2000. When prompted by a dial tone from the telephone network, telephone subscriber 310 dials the telephone number corresponding to telserver 500 at Step 2010. The telephone network 360 establishes a connection between telserver 500 and subscriber 310. Telserver 500 prompts subscriber 310 for a phone number at Step 2020. Telephone subscriber 310 then enters DTMF tones identifying the telephone subscriber 320 at Step 2030. Telserver 500 acknowledges the entry by telephone subscriber 310 and

identifies telserver 550 as the telserver approximately located near subscriber 320 at Step 2040. Telserver 500 signals to telserver 550 over the computer network 250 to establish a communications path at Step 2050.

Upon receipt of the message from telserver 500, telserver 550 acknowledges the message at Step 2060, and signals to telephone network 370 to establish a communications connection with subscriber 320. At Step 2070, telephone network 370 rings telephone 320 and, if answered, establishes a communication connection between telserver 550 and telephone subscriber 320 at Step 2080. At this point, a communications connection is established between telserver 550 and telephone subscriber 320. Telserver 550 transmits a message to telserver 500 indicating that a communications connection has been established. Telserver 550 begins exchanging data between the computer network and the telephone subscriber 320. Upon receipt of the message from telserver 550, telserver 550 begins exchanging data between telephone subscriber 310 and the computer network 250. A communications connection has been established between telephone subscriber 310 and telephone subscriber 320.

As shown in FIG. 7, the telserver 100 may also be used to provide an interconnection between a computer subscriber and a private branch exchange ("PBX"). In this embodiment, the telserver 100 is coupled to a PBX 600 over one or more telephone lines 602. The telserver 100 also communicates with a computer subscriber 200 over a computer network 250 through the modem 110.

Typically, the PBX 600 is connected to a number of PBX subscribers 610 and additionally to a telephone network 350. The PBX 600 provides interconnection functions between the PBX subscribers 610 and telephone subscribers 300 through the telephone network 350. Additionally, the PBX 600

interconnects PBX subscribers 610 with other PBX subscribers 610 and may provide enhanced features such as intercom, call transfer, call forwarding, and voice mail features. The telserver 100 interfaces with the PBX 600 and accommodates these features. As will be appreciated in the art, a PBX 600 may communicate with PBX subscribers 610 using either analog or digital signaling. For an analog PBX, the telserver 160 interconnects to the PBX 100 as an analog local loop subscriber. For a digital PBX, the telserver 160 interconnects to the PBX 600 using a communications port configured to match the format of the PBX 600; the line card 120 typical to the local loop embodiment may be omitted.

The telserver 100 performs address resolution shown in FIG. 8, when the call request message identifies a party to be called to identify appropriate means for communication between that party and the calling part. Where the call request message identifies the party to be called by something other than a telephone number, the telserver 100 begins an address resolution process to determine how to identify and establish communications with a party to be called. Typically, before address resolution begins, the telserver 100 prompts the calling party to identify itself by entering an identification code and personal identification number or password. Step 3000. Once the identification information is confirmed, the telserver 100 prompts the calling party for information regarding the party to be called. Step 3010. Such information may include the party's name, a phone number, a network address such as an e-mail address or internet protocol number or other information that includes a name and a directory service from which the identifying information may be obtained. Note that, at the present time this, directory services exist on the internet at the following URL locations:

http://www.microsoft.com/ntserver/ldapmb.htm
http://www.psgroup.com/news/19951nc1095o.htp
http://www.four11.com
http://s15.bigyellow.com

The telserver 100 queries each of these databases and obtain a phone number for telephone communication with the party to be called. Step 3020. Also, other network databases may be queried by the telserver 100, including internet web pages. For example, it will be appreciated that many universities maintain telephone directories of their faculty on web pages; these web pages may provide office telephone numbers tied to office hours. Other applications, such as mobile employees who travel from office location to office location may be recorded in such a database. In a preferred embodiment, the telserver 100 queries one of the URL locations identified above unless the calling party identifies another network database for use to determine a phone number to use when performing address resolution.

Beyond a telephone number, network databases may include information that identifies how the party to be called desires to be contacted. Step 3030. Instead of being contacted at a home or office number provided in a database, the party to be called actually may be located at a different number than listed, even if only for a short time. Alternatively, the party to be called may choose not to be contacted by telephone at all and may prefer to have calling parties leave audio or text messages for delivery at a particular network address, such as an e-mail address. Further, the party to be called may instruct that calls be forwarded to another party instead of a telephone number provided in the database. Each circumstance will be described in turn.

The database entry may identify one or more than one telephone number for the party. In many cases, the telephone numbers may identify locations where the party may reached, depending on the day and the week. The telserver 100 examines each entry and compares it to a date and time stamp resident with the CPU 102 to identify the telephone number that should

be called. Once an appropriate telephone number is identified, the telserver 100 establishes communications with the network or telephone subscriber 200 or 300 according to the procedures identified above. Step 3100.

The telserver 100 is configured to recognize a designation from the database that the party to be called does not want to be called at all, but rather prefers that a message be delivered to an e-mail or other network address. Step 3200. In this case and where a network subscriber 200 is the originating party, the telserver 100 examines the database entry to determine whether the party to be called has specified an audio or text message as a preferred medium for messages. If so, the telserver 100 provides the network subscriber 200 with the destination e-mail or network address and prompts the network subscriber 200 to record an audio or text file as appropriate. Step 3210. The network subscriber 200, in response, records the message delivers the file directly to the destination address. If not, the telserver 100 provides the network subscriber 200 with the network address specified in the database record and prompts the network subscriber 200 to record a message for delivery to the e-mail address. However, in this latter case, the party at the network subscriber 200 is given discretion of whether to record an audio or text message.

Note, as an alternative, that the telserver 100 and network subscriber 200 may be configured to place the telserver 100 in a "middle man" position when delivering text or audio files to network addresses -- first, the network subscriber 200 composes and delivers files to the telserver 100; second, the telserver 100 adds a pre-amble to the file and transmits the file to the designated address. Although not shown in FIG. 8, this configuration may be preferable from a marketing perspective as it will be possible to add promotional, marketing-oriented messages to the message to be

delivered. However, the middle-man configuration increases the processing load upon the telserver 100.

When the database entry for the party to be called indicates that calls are to be forwarded to another party, the address resolution process repeats to determine where telephone calls to the second party are to be placed. Step 3300. For example, the telserver 100 queries the network database to obtain information regarding the party to whom the call should be forwarded. Step 3310. As will be appreciated, the address resolution process may progress through several iterations before the calling party succeeds in establishing communications.

The telserver 100 may be configured to enable a telephone subscriber 300 to review information contained within a computer network 250. In such a situation, the telserver 100 acts as an interface to the computer network 250, much as any other computer subscriber, but the telserver 100 converts the digital download information into a stream of audio data and transmits the audio data to the telephone subscriber 300. For example, in the embodiment where the Internet is the computer network 250, the telserver 100 may access one or more web pages through an Internet services provider (not shown) in a known format, such as HTML. Once the HTML information is received, the telserver 100 converts the HTML information to audio information and transmits the audio information to the telephone subscriber 300 over the telephone lines 352. The telserver 100 may also be configured to recognize HTML extensions or other inputs and to assign keypad key strokes to the extensions. For each such download, once the audio information of the web pages is transmitted to the telephone subscriber 300, the telserver 100 generates additional audio information which identifies to the user at the telephone subscriber 300 to enter keystrokes to traverse a particular extension. The telserver 100 monitors the

telephone line 352 from the telephone subscriber 300 to detect such a keystroke and traverses the HTML extension when the keystroke is made. Of course, the Internet embodiment described above is merely one of a variety of applications for this functionality of the telserver 100. In addition to HTML formats, the telserver 100 similarly operates on other database information which includes correlative information to traverse the database.

The telserver 100 also includes functionality to permit users at telephone subscribers 300 to access e-mail messages resident in the database, whether textual or audio, and generate replies to such e-mail messages. Once communications are established between the telserver 100 and the telephone subscriber 300, the party at telephone subscriber 300 may enter a command to access e-mail messages. Such commands may require the use of validating passwords and the like. Once validated, the telserver 100 downloads the e-mail messages resident with the computer network 250 and relays the messages to the telephone subscriber. For textual messages, the telserver 100 generates an audio stream from the text using known techniques. The telserver 100 is configured to enable the party at the telephone subscriber 300 to reply to such e-mail messages. For replies, the telserver 100 records audio messages as an audio file and delivers the file to the e-mail address at the conclusion of the recording.

Additionally, the telserver 100 is configured to permit users at telephone subscribers 300 to access administrative information used by the telserver 100. For example, where the telserver 100 is configured to maintain an independent database about certain parties to be called, one may reconfigure the information resident in the telserver's database about one's self to update that information. Where a user no longer desires to be telephoned directly but wishes that messages be delivered to e-mail addresses, the telserver

100 is configured to recognize commands from that user at a telephone subscriber 300 and update its records accordingly. Thus, mobile users may update the method by which they prefer to be contacted merely from a standard touch tone telephone.

The telserver 100 is adapted to receive administrative information from the telephone networks 350 themselves. For example, a telephone network 350 may be configured to transmit information about the telephone subscriber 300 being used in addition to the audio information recorded at the telephone subscriber 300. "Caller ID" is a commercially recognizable example of such a phenomenon. The telserver 100 may be configured to recognize such information and identify a geographic area in which the telephone subscriber 300 resides. When the telserver 100 identifies the location of the telephone subscriber 300, the telserver 100 may access databases that associate advertisers by geographic area of interest and amend the database to include an identification of the telephone subscriber 300. Such functionality is not limited to the telephone subscriber's geographic origin, of course. Other examples include keywords provided in the content of e-mail messages and web pages that may be browsed by the telephone subscriber 300. Once such keywords are identified by the telserver 100 from communications with the telephone subscriber, the telserver 100 may search databases on the computer network 250 to determine whether such keywords are used by advertisers as a basis to identify targets of their advertisements; if so, the telserver 100 amends the database to target the telephone subscriber with appropriate advertising.

For the ease of the reader, the above description has described the invention from a context in which two subscriber are engaged in ordinary telephone conversation and exchange audio information. It must be understood that the invention transcends the form and format of particular information

types; the invention is applicable to all forms of communication information. As such, it accommodates audio, facsimile, multimedia and computer data. While the invention may be optimized for voiced communication, as shown for example in the linear predictive coding example, the invention is not so limited.

While exemplary embodiments of the invention have been described and illustrated in connection with the accompanying drawings, the invention is not limited by the description and drawings but is only limited by the scope of the appended claims.

WE CLAIM:

1. An apparatus for enabling audio communications between at least one subscriber on a computer network and at least one subscriber on a telephone network comprising:

a first interface for interconnection with said computer network and for receiving input data from the computer network and for providing output data to said computer network,

a second interface for interconnection with a telephone network for receiving input audio information from and sending output audio information to the telephone network, and

a processor device connected to each of said first and second interfaces, said processor device establishing a real-time connection between a subscriber connected to said computer network and a subscriber connected to said telephone network and passing information to and from said subscribers through said interfaces.

2. The apparatus of claim 1, wherein:

the second interface receives an input analog audio information signal from the telephone network and converts the input analog audio information signal into a digital format for processing by the processor device,

the processor device places the digital format audio information signal into output messages for transmission through the computer network, and

the first interface transmits the output messages to the computer network.

3. The apparatus of claim 2, wherein said computer network is at least partially formed by the Internet.

4. The apparatus of claim 2, wherein said computer network is at least partially formed by a local area network.

5. The apparatus of claim 2, wherein the second interface is connected to a telephone network as a callable local loop subscriber.

6. The apparatus of claim 2, wherein said second interface is connected to a private branch exchange.

7. The apparatus of claim 2, wherein the second interface converts the input along audio information signal to a PCM digital format.

8. The apparatus of claim 2, wherein the second interface converts the input along audio information signal to an ADPCM digital format.

9. The apparatus of claim 2, wherein the second interface converts the input along audio information signal to a digital signal using a linear predictive coding technique.

10. A communications system, comprising:

a computer network,

a telephone network,

a telserver connected with the computer network and with the telephone network,

a computer subscriber interconnected with the telserver over the computer network, said computer subscriber transmitting first digital messages to the telserver including first communications data and receiving second digital messages including second communications data,

a telephone subscriber interconnected with the telserver over the telephone network, said telephone subscriber transmitting a first communications signal to the telserver and receiving a second communications signal from the telserver,

said telserver comprising:

a first interface for interconnection with the computer network and adapted to receive the first digital messages from the computer network and transmit second digital messages to the computer network,

a second interface for interconnection with the telephone network, and adapted to receive the first communications signal from the telephone network and convert the first communications signal into second communications data and to receive first communications data and connect it to a second communications signal, and

a processor interconnected with each of said first and second interfaces,

said processor examining the first digital messages from the computer subscriber, identifying the first communications data therein and transmitting the first communications data to the second interface,

said second interface formatting the first communications data into said second communications signal and transmitting the second communications signal to the telephone subscriber through the telephone network,

said the processor placing the second communications data into second digital messages and transmitting the second communication data to the first interface, and

wherein the first interface transmits the second digital messages to the computer subscriber through the computer network.

11. The communications system of claim 10, wherein

each of the first messages includes a time stamp indicating a time the computer subscriber transmits the respective first message to the computer network,

the processor examines the time stamp of each first message received from the computer network and adjusts the time of transmission of the communications data therein to the second interface to maintain continuity of the communications signal.

12. The communications system of claim 10, wherein the computer subscriber comprises:

a network interface for interconnection with the computer network,

a processor in communication with the network interface, and

a sound card in communication with the processor for connecting digital information to and from the computer network from and to audio information.

13. The communications system of claim 10, wherein the telephone subscriber includes a telephone wired to said telephone network.

14. The communications system of claim 10, wherein the telephone subscriber includes a wireless telephone.

15. The communications system of claim 10, wherein the computer network is at least partially formed by the Internet.

16. The communications system of claim 10, wherein the computer network is at least partially formed by a local area network.

17. The communications system of claim 10, wherein the telserver connects to the telephone network as a local loop subscriber.

18. The communications system of claim 10, wherein the telserver connects to a private branch exchange.

19. In an apparatus for communicating between a calling party at a first network location and a party to be called at an undefined network location, an address resolution method for identifying a network location for communications with the party to be called, comprising the steps of:

receiving information that identifies the party to be called,

interrogating a database with the identification information, and

receiving connection information related to the party to be called, wherein

when the connection information identifies a network location for communications, instituting communications between the first network location and the network location identified by the connection information,

when the connection information identifies a network location for messages to be sent, providing the calling party with the network location identified by the connection information and prompting the calling party to transmit a message to such network location, and

when the connection information identifies that communications should be forwarded to a third party, repeating the interrogating and receiving connection information steps with identification information of the third party.

20. The method of claim 19 wherein the network locations of the calling party, party to be called, third party, and messages may be on one or more desperate networks.

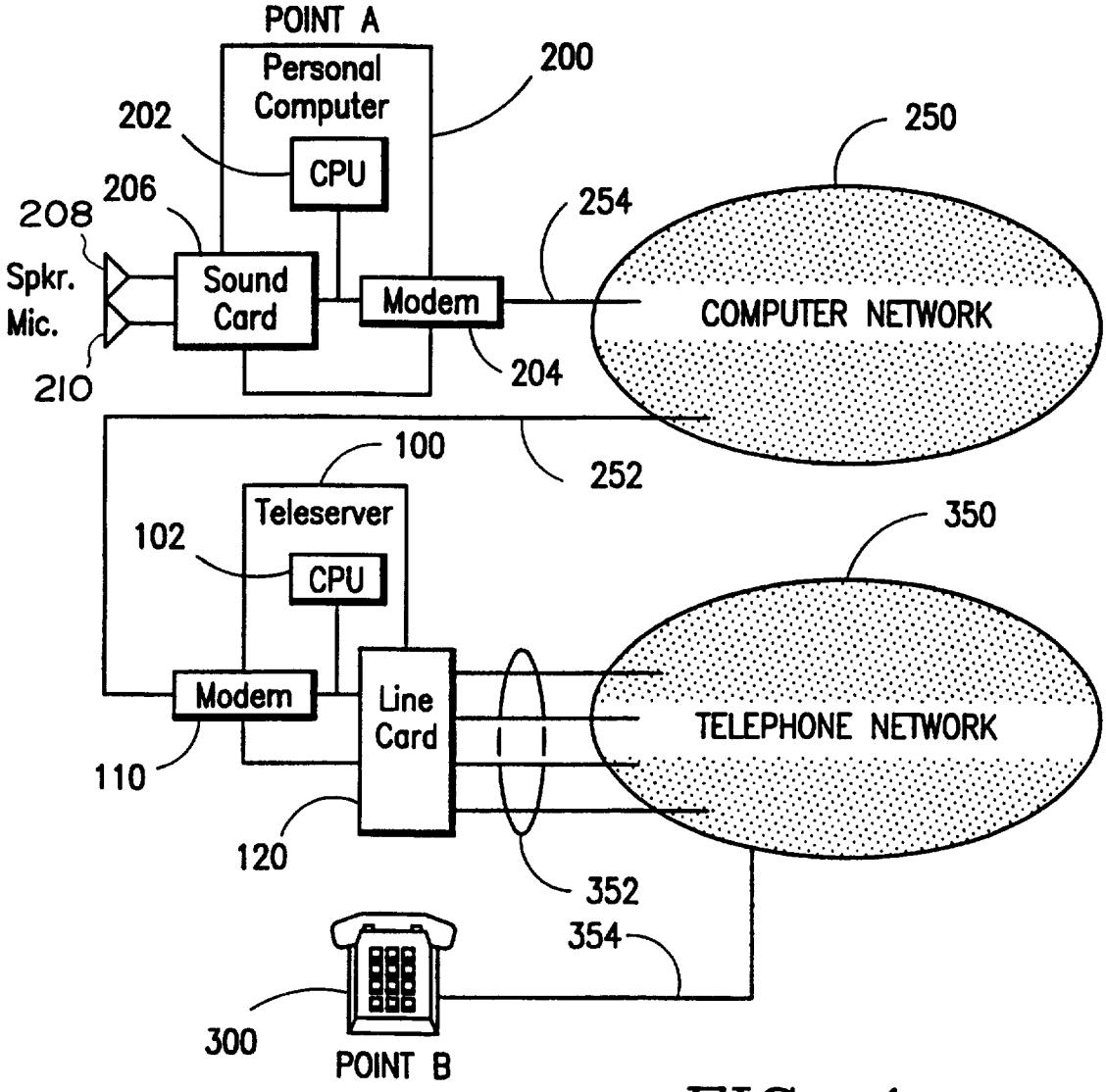

POINT A
Personal Computer
200
202
CPU
250
206
208
254
Spkr.
Mic.
Sound Card
Modem
COMPUTER NETWORK
210
204
252
100
Teleserver
102
CPU
350
Modem
Line Card
TELEPHONE NETWORK
110
120
352
354
300
POINT B

FIG. 1

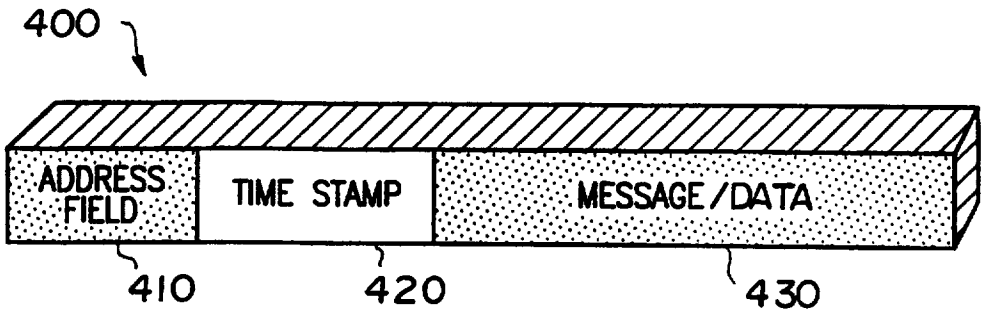

400
ADDRESS FIELD
TIME STAMP
MESSAGE/DATA
410
420
430

FIG. 2

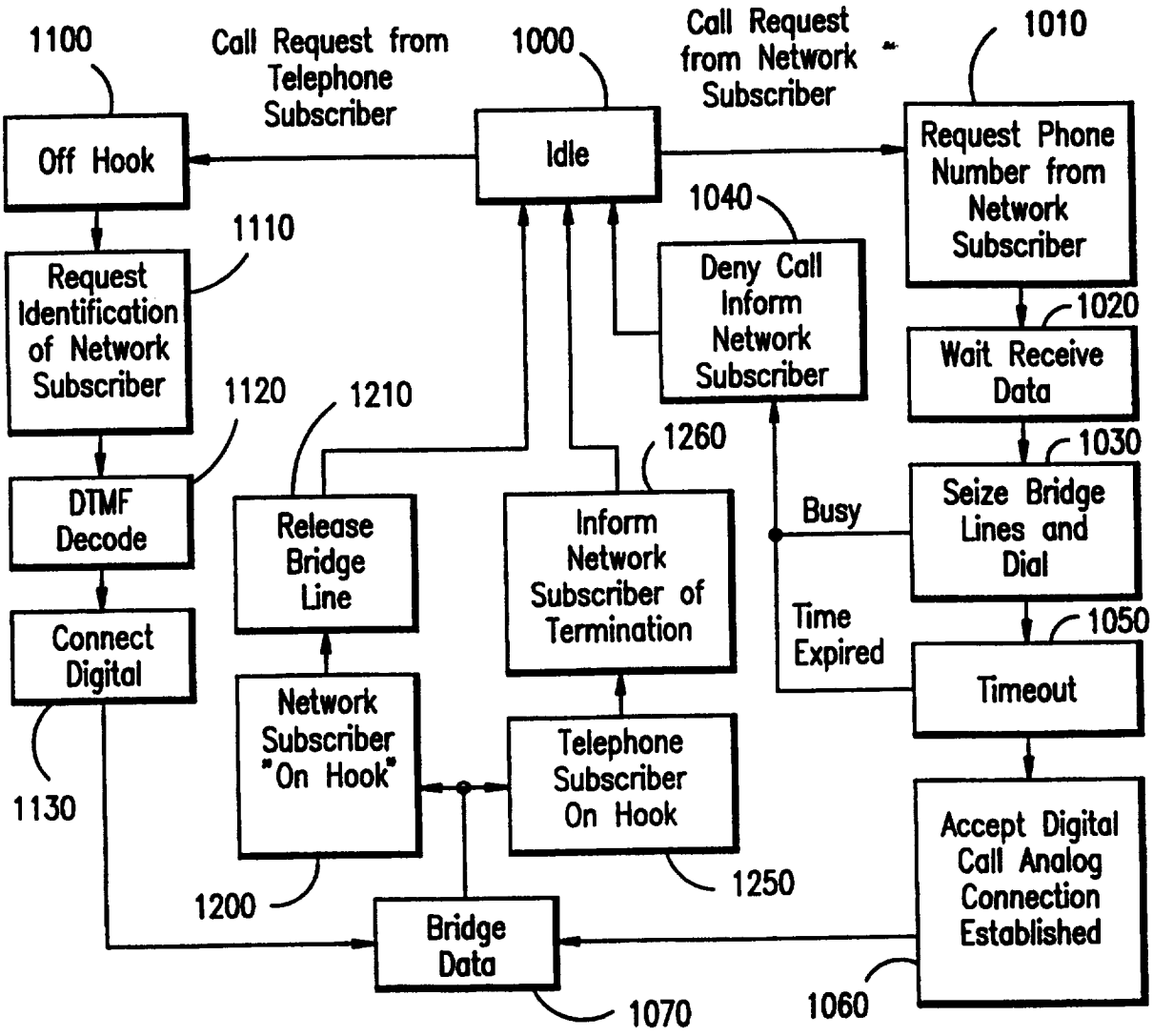

1100
Call Request from Telephone Subscriber
1000
Call Request from Network Subscriber
1010
Off Hook
Idle
Request Phone Number from Network Subscriber
1040
1110
Request Identification of Network Subscriber
Deny Call Inform Network Subscriber
1020
Wait Receive Data
1120
1210
1260
1030
DTMF Decode
Release Bridge Line
Inform Network Subscriber of Termination
Busy
Seize Bridge Lines and Dial
Time Expired
1050
Connect Digital
Network Subscriber "On Hook"
Telephone Subscriber On Hook
Timeout
1130
1200
1250
Accept Digital Call Analog Connection Established
Bridge Data
1070
1060

FIG. 3

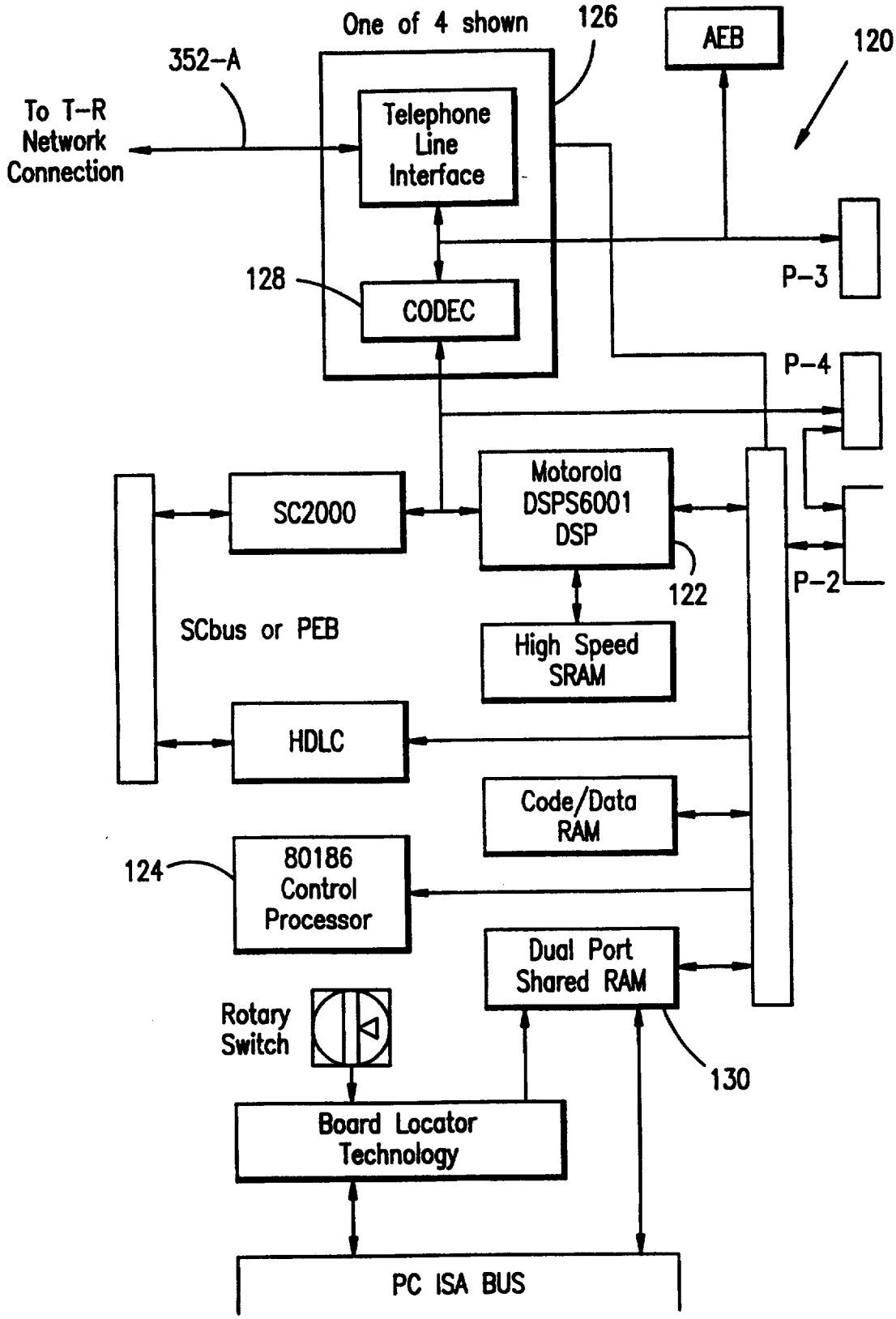

One of 4 shown
126
AEB
120
352-A
To T-R
Network
Connection
Telephone
Line
Interface
128
CODEC
P-3
P-4
SC2000
Motorola
DSPS6001
DSP
122
P-2
SCbus or PEB
High Speed
SRAM
HDLC
Code/Data
RAM
124
80186
Control
Processor
Dual Port
Shared RAM
Rotary
Switch
130
Board Locator
Technology
PC ISA BUS

FIG. 4

FIG.5

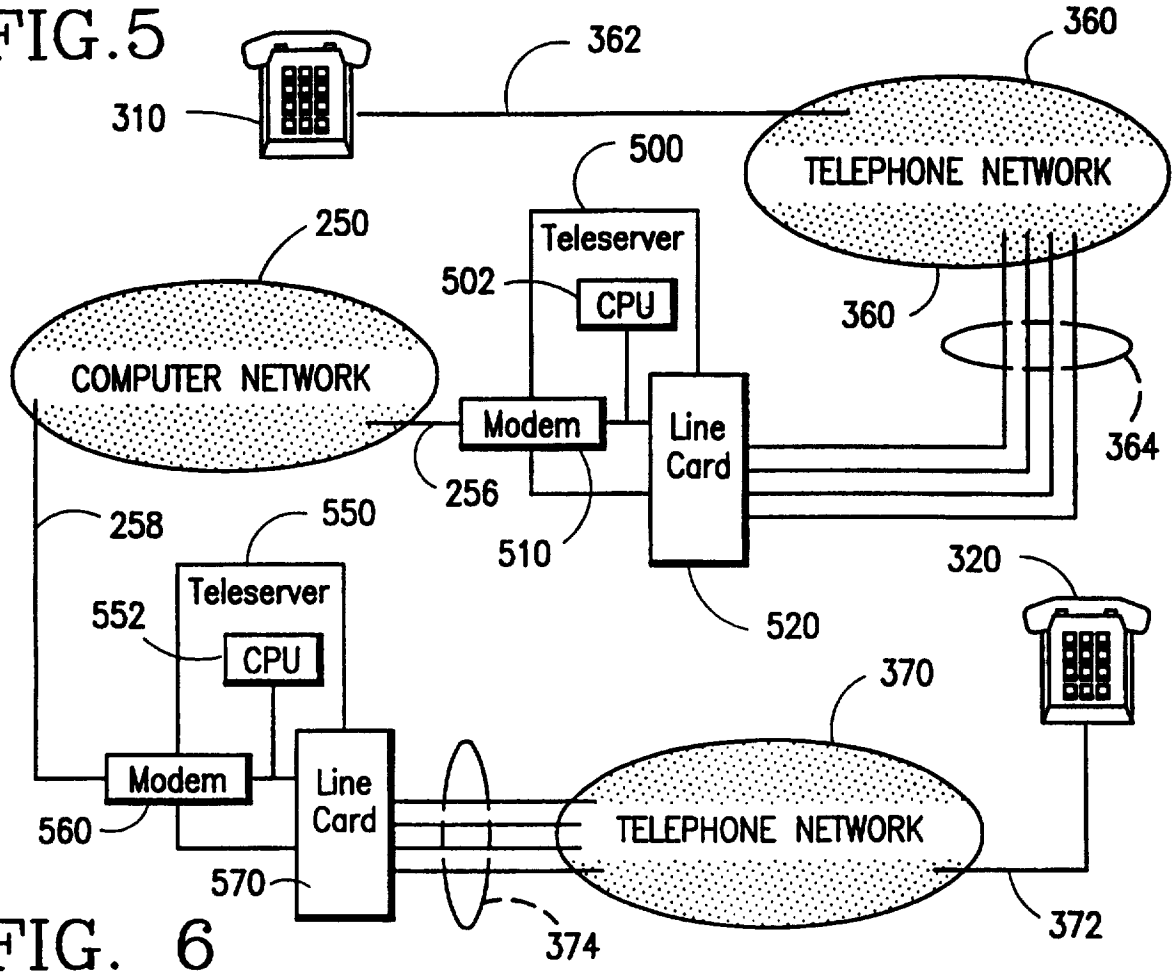



FIG. 6

| Subscriber 310 | Teleserver 400 | Teleserver 450 | Subscriber 320 |
|---|---|---|---|
| OFF HOOK STEP 2000 DIAL TELESERVER 400 STEP 2010 | | | |
| | ANSWER–PROMPT FOR ADDRESSEE STEP 2020 | | |
| ENTER DTMF PHONE NUMBER STEP 2030 | | | |
| | ACKNOWLEDGE; LOOK UP SUBSCRIBER STEP 2040 ADDRESS TELESERVER 450 STEP 2050 | | |
| | | ACKNOWLEDGE STEP 2060 LOOK UP SUBSCRIBER 320–DIAL STEP 2070 | |
| | | | ANSWER STEP 2080 |
| CONNECT | CONNECT | CONNECT | CONNECT |

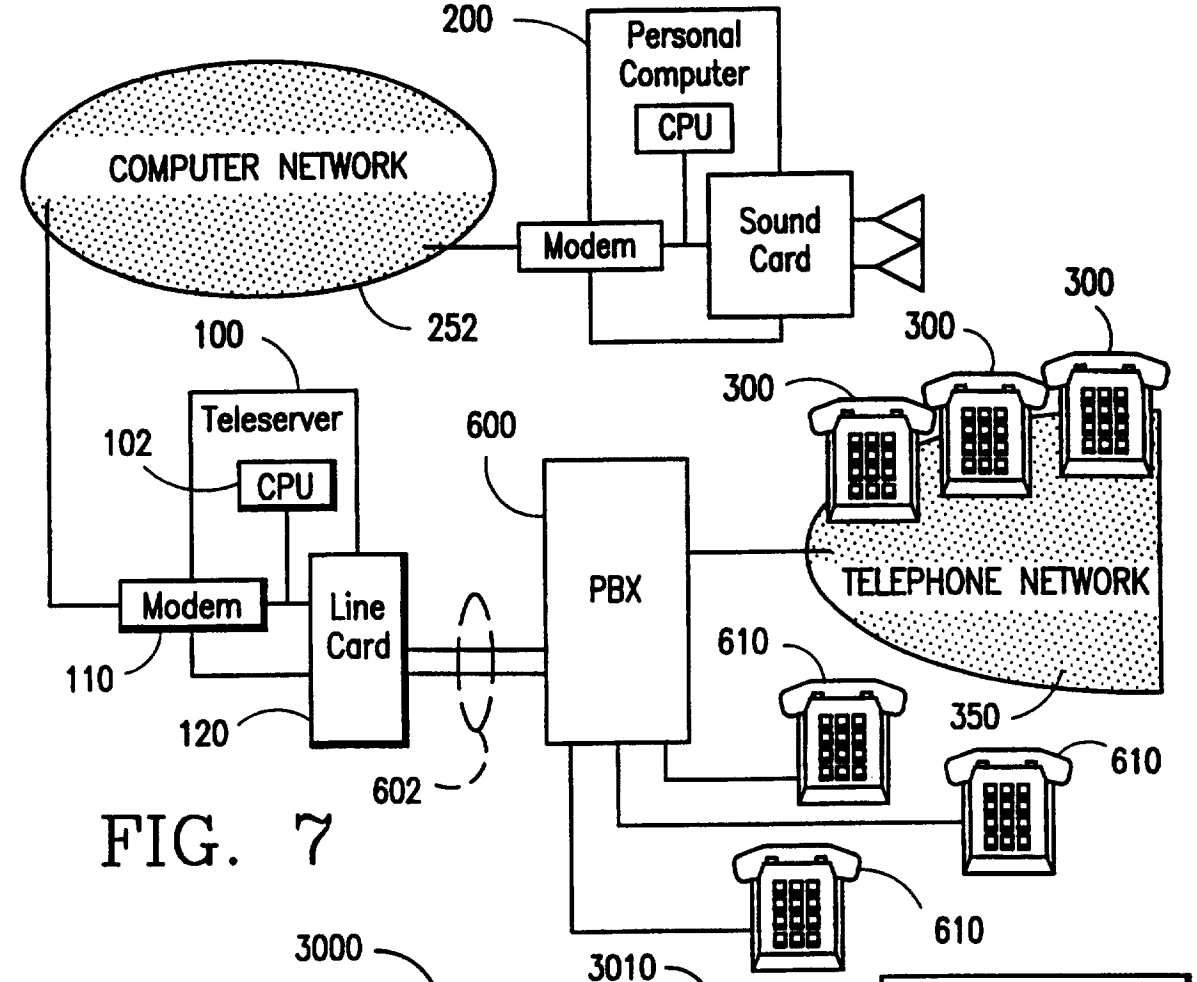

200
Personal Computer
CPU
COMPUTER NETWORK
Modem
Sound Card
252
100
Teleserver
102
CPU
Modem
110
Line Card
120
600
PBX
602
300
300
300
TELEPHONE NETWORK
610
350
610
610

FIG. 7

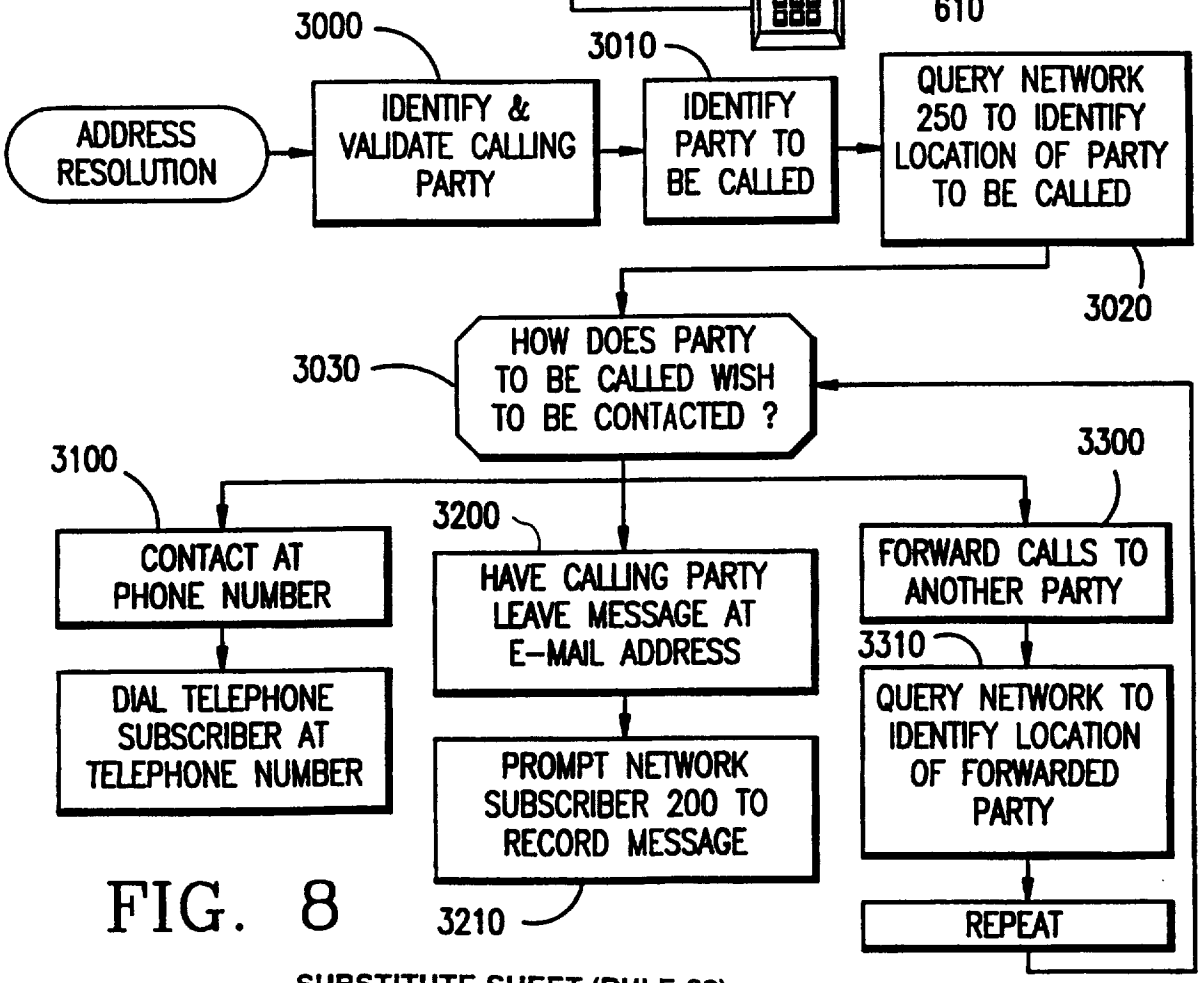

3000
ADDRESS RESOLUTION
IDENTIFY & VALIDATE CALLING PARTY
3010
IDENTIFY PARTY TO BE CALLED
QUERY NETWORK 250 TO IDENTIFY LOCATION OF PARTY TO BE CALLED
3020
3030
HOW DOES PARTY TO BE CALLED WISH TO BE CONTACTED ?
3100
CONTACT AT PHONE NUMBER
DIAL TELEPHONE SUBSCRIBER AT TELEPHONE NUMBER
3200
HAVE CALLING PARTY LEAVE MESSAGE AT E-MAIL ADDRESS
PROMPT NETWORK SUBSCRIBER 200 TO RECORD MESSAGE
3210
3300
FORWARD CALLS TO ANOTHER PARTY
3310
QUERY NETWORK TO IDENTIFY LOCATION OF FORWARDED PARTY
REPEAT

FIG. 8

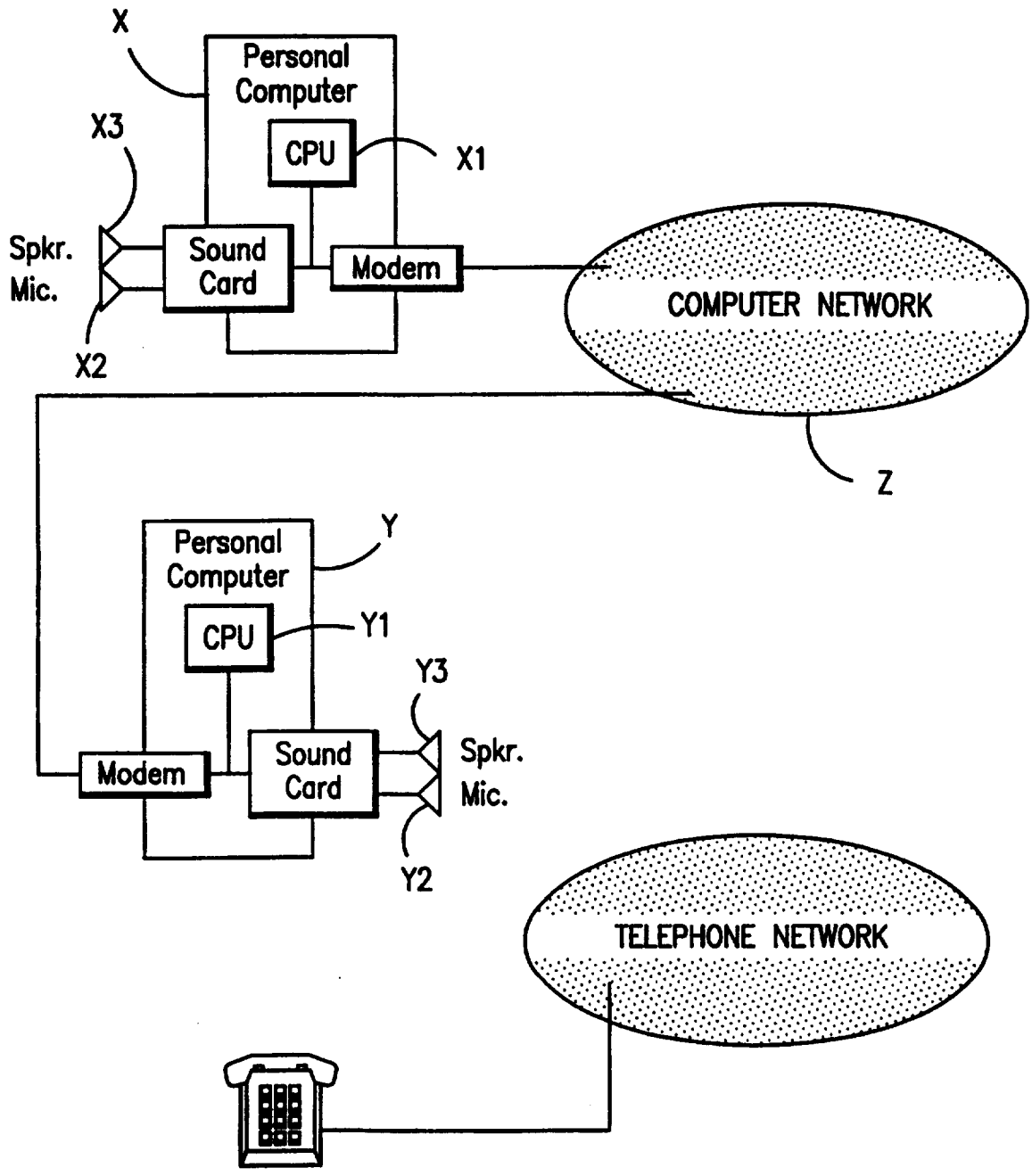

X
Personal Computer
CPU
X1
X3
Spkr.
Mic.
Sound Card
Modem
X2
COMPUTER NETWORK
Z
Y
Personal Computer
CPU
Y1
Y3
Modem
Sound Card
Spkr.
Mic.
Y2
TELEPHONE NETWORK

FIG. 9

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/13897

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :H04L 12/28, 12/56
US CL :370/389
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/389, 392, 352, 485, 353, 396, 401, 404; 379/90.01, 93.01, 93.05, 93.09, 100.15, 100.16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS (teleserver, computer network, telephone network, subscriber, time stamp, PBX, call center, server, interface, access node, local node, router, ISP)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | YANG, C. INETPhone-Telephone Services and Servers on Internet. April 1995. RFC 1789. pages 1-6. | 1-20 |
| X | US 4,771,425 A (BARAN et al) 13 September 1988, col. 4, lines 50-56; col. 5, line 21 to col. 6, line 42. | 1-20 |
| Y,P | US 5,610,910 A (FOCSANEANU et al) 11 March 1997, col. 2, line 59 to col. 3, line 23; col. 9, lines 14-40; col. 14, lines 13-37. | 1-20 |
| Y,P | US 5,608,786 A (GORDON) 04 March 1997, col. 3, lines 9-63; col. 7, lines 41-67; col. 8, line 62 to col. 9, line 17. | 1-20 |
| A | US 4,969,184 A (GORDON et al) 06 November 1990. | 1-20 |

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

| | | | |
|---|---|---|---|
| * | Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" | document defining the general state of the art which is not considered to be of particular relevance | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| "E" | earlier document published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" | document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" | document member of the same patent family |
| "O" | document referring to an oral disclosure, use, exhibition or other means | | |
| "P" | document published prior to the international filing date but later than the priority date claimed | | |

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 18 NOVEMBER 1997 | 23 DEC 1997 |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703) 305-3230 | Authorized officer<br>WELLINGTON CHIN<br>Telephone No. (703) 305-3900 |

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/13897

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5,526,353 A (HENLEY et al) 11 June 1996. | 1-20 |
| A | US 4,100,377 A (FLANAGAN) 11 July 1978. | 1-20 |