

**APPARATUS AND METHOD FOR COMPUTER TELEPHONE
INTEGRATION IN PACKET SWITCHED TELEPHONE NETWORKS**

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is a continuation-in-part of each of pending United States Patent Application Nos. 09/723,747, filed November 28, 2000, and 09/805,501, filed March 13, 2001, each of which is itself a continuation-in-part of United States Patent Application No. 08/955,834, filed on October 21, 1997, now issued as Patent No. 6,201,805, and of United States Patent
10 Application No. 10/092,832, filed March 7, 2002.

TECHNICAL FIELD

 This invention relates to computer telephone integration (CTI) and, more specifically, to an improved method and apparatus for utilizing CTI
15 techniques in a packet switched telephone network. In specific enhanced embodiments, the invention allows advanced data networking features to be utilized for telephone calls routed over the Internet, and also allows telephony functions to be implemented in conjunction with remote applications computers over a data network utilizing a variety of packet telephony
20 protocols. An interface point on the packet telephony network is utilized to exchange information with an applications computer for the purpose of making routing decisions, performing load balancing, etc.

BACKGROUND OF THE INVENTION

25 Telephony over packet networks, particularly over wide area networks such as the Internet, has received considerable attention recently.

 Specifically, it is now possible to route voice, data, and video over data networks such as the Internet, and long distance telephone calls may now be
30 routinely routed over the Internet. The transmission of such information streams over packet switched networks such as the Internet can be more cost efficient than traditional telephony, which requires a dedicated circuit between the calling and called party.

Computer telephone integration (CTI) has been widely applied to traditional telephony methods and apparatus, but has not as yet been successfully applied to the methods and apparatus used for packet network telephony. More specifically, although it is common to control a Private
5 Branch Exchange (PBX) or similar equipment from a remote applications computer, the use of such remote applications computers is in its early stages in the field of packet telephony.

Several protocols exist that define methods and apparatus to convey
10 calls over packet switched data networks, such as the Internet. One possible set of methods and apparatus for completing calls over a packet switched network, which calls can handle voice and other information streams, is defined by ITU recommendation H.323. The H.323 standard is available from the International Telecommunications Union, Geneva and is well known in the
15 relevant industry. The H.323 standard defines various protocols dealing with call control, call setup, call termination, and other similar techniques known to those in the packet network telephony art.

The H.323 standard defines a functional entity called a gatekeeper.
20 The gatekeeper handles network functions such as bandwidth control, zone management, address translation, and admissions control for a designated set of network terminals.

The gatekeeper function provides services analogous to the call
25 processing function within a private branch exchange (PBX) in conventional telephony. In traditional telephony, CTI features are provided by creating an interface between external application software and the call processing function within the PBX. By contrast, in the known packet network telephony art, interfaces to the gatekeeper are only defined from other gatekeepers, end
30 points, and other network entities.

A second protocol for performing packet telephony control functions is the Session Initiation Protocol (SIP) defined by IETF RFC 2543. Like H.323,

SIP includes a plurality of functions that establish, modify and terminate multimedia sessions. The SIP methodologies include a variety of functions that go beyond those described by H.323. For example, SIP includes the ability to support mobile users, the use of standardized HTTP syntax and URLs, the ability to have multiple SIP connections through a single TCP/IP session, the use of "proxy servers" (defined further below) and a variety of other robust features discussed in more detail below.

United States Patent No. 6,201,805 ("the 805 patent"), from which the present application descends, is directed to an H.323 or other packet telephony system in which an applications computer is connected to a Gatekeeper for performing basic call monitoring and control functions. Although the '805 patent and some further pending related applications greatly improve the capabilities of packet telephony systems utilizing CTI, no known prior art can provide routing flexibility in such CTI systems.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 shows a conceptual overview of an exemplary embodiment of the present invention as incorporated into a packet network telephony system;

Figure 2 shows exemplary message flow between system elements during the establishment of an inbound call that is detected by an external software application using the packet network telephony system as enhanced and extended by the present invention, and the H.323 protocol;

Figure 3 shows an exemplary message flow diagram utilizing the invention to establish an outbound call requested by an external software application in a similar environment;

Figure 4 shows a signal diagram of a direct connection from a calling terminal to a called terminal using the Session Initiation Protocol (SIP);

Figure 5 shows two different embodiments of an SIP implementation in a network;

5 Figure 6 shows a signal diagram using proxy servers and the SIP protocol;

Figure 7 depicts a computer telephony integration (CTI) applications computer interfacing with a network implementing SIP;

10 Figure 8 shows another signal diagram for an exemplary embodiment of the invention;

Figure 9 shows a flowchart of a method for implementing call routing in accordance with an exemplary embodiment of the present invention; and

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Figure 10 is a flow chart of an exemplary implementation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

20 A technical advance is achieved in accordance with the present invention that relates to a packet network telephony call processing device (e.g.; an H.323 gatekeeper, a SIP proxy server, and/or a "pass-through" server) that is arranged to interface with a plurality of external call processing applications programs that may be located on one or more remote computers.

25 Regardless of the protocol utilized, we term herein as the CTI interface the server or computer and associated software that interfaces to the third party applications computer from the packet telephony environment. As explained below, in a SIP situation, this CTI interface may be, for example, the proxy server or "pass through" server, and in the H.323 environment, such CTI

30 interface is preferably the gatekeeper.

In accordance with the teachings of the present invention, a call processing application computer is connected via a data network to a CTI

interface, and these two entities exchange messages in the manner specified by the invention. The CTI interface may be locally or remotely located with respect to either of the endpoint terminals that will participate in the call, or with respect to the applications computer.

5 The CTI interface and applications computer(s) communicate with one another in order to perform various call control functions over the data network and to provide call information and control to a user of the applications computer. As packet switched telephone connections are set up between various terminals or other nodes, the CTI interface communicates
10 with one or more application computers in order to provide the call information and call control functions required by the computer telephony applications residing on the application computers. Examples of these functions include establishing and tearing down calls, transferring calls, call conferencing, associating the applications computer with one or more specific locally
15 registered endpoints for monitoring and control, determining the state of calls at a given end point, and various other functions. For purposes herein, an endpoint may be a user terminal or may be an individual port on an SIP enabled device.

20 In connection with the SIP protocol, additional functions such as keeping track of mobile users, performing DNS mapping, interfacing with redirect and proxy servers (defined below) and monitoring the results of calls implemented by such proxies, and plural other enhanced functions described below, are implemented.

25 In a still further enhanced embodiment of the present invention, the applications computer is utilized to perform call routing services. More specifically, and utilizing the H.323 gatekeeper example for purposes of explanation only, calls may arrive at the gatekeeper to be completed to a
30 “virtual” called party, or “virtual” number. The term virtual number as used herein means a called number that does not correspond to a called terminal, but which will be translated to one or more actual called numbers corresponding to physical terminals by an applications computer.

In accordance with the invention, the gatekeeper receiving the call contacts the applications computer, which executes an algorithm that determines to where the call should actually be routed. Such algorithm may include, as more fully described below, any type of call routing, load balancing, skill based routing, etc. The invention leaves the decision regarding to which final terminal the call is actually routed up to the applications computer. Such an arrangement provides flexibility in that a customer may change the called terminal to which a call is routed by updating the applications computer instead of having to change network routing tables.

Figure 1 illustrates an overview of the interconnection of the gatekeeper computer 102 with the applications computer 103 according to the teachings of the present invention and utilizing the H.323 standards and terminology. To enable such interconnection, gatekeeper computer 102 is enhanced and extended by the addition of software whose functions are described below. Communications path 105 may be any type of data communications path.

The arrangement of Figure 1 includes several external telephony applications systems 104, typically implemented as software, which may be located on applications computer 103 or on separate computers connected via any communications network to applications computer 103. Typically, the applications computer may be collocated with one of the end points described below.

The arrangement of Figure 1 also includes end points 106, which may be personal computers, network computer devices (NCs), or any other node capable of interconnection to the packet network telephony environment.

In operation, a command is issued from an applications computer 103 requesting certain telephony services which will be described below. The message requesting such a service is transmitted through path 105 to

gatekeeper computer 102 for processing. The message sent to gatekeeper 102 causes gatekeeper 102 to exchange appropriate signaling messages with other packet network telephony environment nodes in a manner as described for example in the incorporated H.323 standard. As a result of this sequence
5 of events, the combined system is able to implement the call processing functionality requested by applications computer 103 on behalf of applications 104.

During operation, various call control functions requested by
10 applications computer 103 are performed by the gatekeeper 102. Additionally, by making appropriate requests of gatekeeper 102, applications computer 103 may monitor the outcome of various call control functions and transmit such outcome to any of applications 104.

15 Figure 2 shows an exemplary message flow diagram for detecting an inbound call from a remote end point (e.g., terminal) to a local end point supervised by an external computer telephony application using the present invention. The specific example shown in Figure 2 is the monitoring of an incoming call to end point 202 using packet network telephony methods and
20 apparatus as described in the H.323 standard, enhanced by the present invention to permit the participation of an external software application 201. End points 202 and 204 represent audio terminals, for example, computer systems equipped as H.323 compliant telephone devices. Gatekeeper 203 is as described, for example, in the H.323 standard and as further enhanced by
25 the present invention, and the external application 201 may be present on a separate computer as previously discussed.

In operation, the call initially proceeds according to the methods of the packet network telephony environment. A bandwidth request message 205 is
30 sent to gatekeeper 203 and bandwidth is granted by the gatekeeper at message 206. A call setup request, message 207, is issued by the initiating end point 204, and gatekeeper 203 causes call setup request message 208 to be transmitted to receiving end point 202. A call proceeding message 209

is transmitted by the receiving end point back to gatekeeper 203 and relayed to initiating end point 210 as shown.

At approximately the same time gatekeeper 203 relays the call proceeding indication to the initiating end point using message 210,
5 gatekeeper 203 also transmits to external application 201 a notification that an inbound call is being received by the receiving end point 202. Gatekeeper 203 sends this message because external application 201 has previously indicated that it requires notification of telephony events occurring at receiving
10 end point 202.

In order to connect the inbound call, receiving end point 202 requires network bandwidth, and such bandwidth is requested from and allocated by the gatekeeper 203 using messages 212 and 213. Next, the terminal at
15 monitored end point 202 rings to alert the user to the arriving call, and an indication of such ringing is transmitted through messages 214 and 215 to initiating end point 204 through the gatekeeper 203. When the call is connected at the receiving end point 202 because of user action, end point 202 informs gatekeeper 203 via message 216.

20 At this point, gatekeeper 203 sends an answer notification to the external application 201 via message 217.

At approximately the same time, gatekeeper 203 indicates to the
25 initiating end point 204 that the requested call has been connected via message 218.

In accordance with the protocol described hereinbefore, the detection of the call by an external application is accomplished via a protocol of
30 messages transmitted between the gatekeeper and the end points to be connected, as well as between the gatekeeper 203 and the external application 201, thus enabling gatekeeper 203 to inform external application 201 regarding the progress of relevant calls in the packet telephony network.

Figures 3a and b show another example of an external call processing application requesting the establishment of an outbound call from initiating end point 386 to receiving end point 390. Many of the messages involved in this operation are substantially similar to those previously set forth with respect to the monitoring of the inbound call described in Figure 2. New messages not previously discussed in Figure 2 are described below. As with the discussion of Figure 2, the external application 392 in Figures 3a and 3b is assumed to have previously communicated with gatekeeper 388 in accordance with other methods described by this invention to indicate its intention to issue call control requests with respect to initiating end point 386.

In Figures 3a and 3b, gatekeeper 388 also includes the conference control point function as currently known to the packet network telephony art. This function is used by the invention to interconnect two call segments, namely the segment between the initiating end point 386 and the conference control point; and between the conference control point and the receiving end point 390. For clarity of description, the combined gatekeeper and conference control point apparatus is referred to as "gatekeeper 388."

The sequence of messages begins with a new message 301, specified by the current invention, through which the external application 392 makes a request that the first segment of the call be established from gatekeeper 388 to initiating end point 386.

Next, according to known packet network telephony art, messages 302 and 303 are exchanged between gatekeeper and initiating end point 386 in order to set up that first leg of the call.

Next, the gatekeeper 388 sends a new message 304 to external application 392 to alert it that the call request has been received and is being processed. Much of the remaining signaling, relating to the establishment of that segment of the call between initiating end point 386 and gatekeeper 388

in Figures 3a and 3b, is substantially similar to that previously described with respect to Figure 2 and thus will not be repeated. Similarly, once the first leg of the call has been set up, gatekeeper 388 proceeds in similar fashion to set up the second leg of the call from itself to receiving end point 390.

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However, during the process depicted in Figures 3a and 3b, gatekeeper 388 sends new messages to the external application 392 at relevant stages of call processing, including:

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1. Message 305 indicating that initiating end point 386 has acquired the necessary network bandwidth to place the call;

2. Message 306 indicating that receiving end point 390 is processing the request for the call;

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3. Message 310 indicating that receiving end point 390 is alerting its user to the arriving call; and

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4. Message 312 indicating that receiving end point 390 has answered the call and a connection has been established.

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5. Any other messages relating to exceptions, status, or control. The application systems 104 may then provide monitoring and control as desired, and as described in the parent application, now U.S. Patent No. 6,201,805. Thus, the system provides for monitoring and control of H.323 calls.

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Moreover, as described more fully below with respect to Figure 9, the gatekeeper 388 may receive virtual numbers that are conveyed to an applications computer for translation to actual numbers.

Figure 4 shows an alternative embodiment of the present invention utilizing the Session Initiation Protocol (SIP) in place of H.323. In SIP, callers

and callees can establish calls in one of three manners; (1), the caller directly contacts the callee, as shown in Figure 4; (2), the caller contacts the callee through a proxy server, as shown in Figure 5A; or (3) the caller contacts the callee through a re-direct server shown in Figure 5B. As will be explained further below, the signaling sequence for the three methodologies is very similar, except that the information required to contact the callee is derived from different sources for the three different cases.

More specifically, in the direct contact of Figure 4, the caller is aware that the SIP Universal Resource Location ("URL") of the callee maps to a specific known Internet protocol ("IP") address. In the arrangement on Figure 5A, the caller is not aware of the IP address of the callee. Therefore, the caller 502 sends a request to the proxy server 503 to call the desired SIP URL of the called party, and proxy server 503 translates the SIP URL to the IP address of called party 504. The proxy server 503 then forwards the request over a data network to the called party 504.

Finally, the use of a re-direct server 506 allows the SIP URL to be translated by redirect server 506, but rather than transmit the request to the called user as in the case of the proxy server in Figure 5A, the translated address is returned back to the caller 509 for a direct connection through appropriate servers to called party 510.

In the Figure 5A example of a proxy server, the exemplary called terminal's SIP URL could be, for example, Joe@acme.com, and the proxy server would translate that address to the appropriate top-level SIP server for the acme.com domain into a more standardized Internet address, such as 33.65.43.85. The standardized address is then used to route the data through the network utilizing standardized protocols such as TCP/IP and the like.

Of the three types of SIP calls described, the least common would be that of Figure 4. Normally the caller will not have the appropriate IP address

for the called party and would require the translation services of a server. While most systems would normally operate utilizing either a proxy server 503 or redirect server 506, for purposes of explanation herein, and not by way of limitation, we utilize the example of Figure 5A wherein a proxy server 503 is implemented.

Referring to Figure 5A, when an SIP client 502 attempts to initiate a call, it sends an SIP Invite message to proxy server 503 specifying the SIP URL of the desired called party 504. The proxy server 503 must initiate the task of resolving this SIP URL to the IP address of called party 504. The proxy server may use the standardized domain name system to resolve such address, or any other resolution scheme desired. Additionally, at the stage in call processing where proxy server 503 receives the Invite message from caller 502, any policy management desired may be applied. For example, proxy server may read the calling terminal identification ("ID") to ensure that the caller is authorized to make the call, that the appropriate network bandwidth is available, that any reporting, or logging of information takes place, etc.

After any such initial local processing by proxy server 503, proxy server 503 translates the desired called party name into an address and forwards the resolved address with the request through one or more further servers 505 to called party 504. The sequence is shown more clearly in Figure 6. The invite message 601 is received from the outbound proxy and forwarded through one or more servers to ultimately reach the called party terminal. The vertical line 602 represents the domain acme to which the request is forwarded, and the vertical line 603 represents the subdomain, which ultimately forwards the request to the called terminal. For example, vertical line 602 may represent the domain name acme.com, and vertical line 603 would represent the sales department, or subdomain, sales.acme.com.

In response to receiving the Invite message, the SIP OK return message is forwarded back through the same path substantially as previously

described with respect to the direct connection of Figure 4. Next, as shown, the ACK message gets sent from calling terminal 503 to the called terminal 504 again as previously described. It is noted that as the call set up messages are exchanged between the caller and called party, messages may
5 follow the same path, or they follow different paths through different servers. SIP includes appropriate commands to force use of the same path, as discussed further below.

In accordance with the teachings of the present invention, it is
10 desirable to insert into the arrangement of Figure 5A a system which can utilize Computer Telephony Integration (CTI) applications to monitor and control calls by connecting into the system. Since the proxy server 503 is also likely to handle call requests attempting to call terminal 502 (i.e., when the calling party in the previous example is later the called party) it appears
15 initially that all information regarding inbound and outbound calls would traverse proxy server 503, and thus, the proxy server 503 is the appropriate place in the system to interface the applications computer previously discussed. That is, the CTI interface should be the proxy server 503, which gets connected to the applications computer. However, several issues arise:

20 (1) It may be undesirable to integrate all of the software for interfacing with an applications computer directly with the proxy server software that is already functional.

25 (2) Proxy server 503 may process the initial call set up message, but subsequent messages are likely to be communicated directly between the caller and called party through servers other than the proxy server 503. Therefore, if the applications computer is connected to the proxy server 503, proxy server 503 will only have limited view of the ongoing
30 call, and would not even be aware, for example, of a call being disconnected.

(3) Requests for calls are typically made by a calling terminal 502. If

the applications computer were responsible for the initiation of the call, a mechanism must be found to have the application computer signal the proxy server 503 to initiate calls on behalf of the terminal 502.

5 Each of the foregoing issues must be addressed in order to integrate the CTI applications computer with the SIP system.

One possible architecture for interfacing an applications computer with an SIP proxy is depicted logically in Figures 7 and 8. A new entity termed a
10 pass through proxy 801 is depicted. The pass through proxy is software which may physically run on proxy server 503 but which is interposed logically between the software, which would otherwise be resident on proxy server 503 in a SIP environment without CTI, and terminal 502. Alternatively, the pass through proxy 801 may be a separate device interposed logically and
15 physically between proxy server 503 and terminal 502. In Figure 7, we show an example of the latter, which we shall utilize for explanation purposes herein.

In operation, a pass through proxy 801 would typically service plural
20 user terminals (e.g., 502) and one proxy server 503. Just as the standard SIP protocol allows plural terminals to register with it, the pass through proxy 801 provides for registration as well. When the pass through proxy 801 receives a Register request from a terminal, it records the contact details but otherwise forwards the request unchanged to the proxy server 503. This recording
25 permits the pass through proxy to have knowledge of which terminals are associated with a particular proxy server 503 but otherwise leaves all the forwarding information unchanged. Thus, neither the terminal 502 or proxy server 503 needs substantial modification to work with the CTI interface. Terminals which are to be monitored and controlled by the application
30 computer 701 will require reconfiguration of their specified sip Registrar/Outbound Proxy.

Assuming a single pass through proxy 801 is associated with each

proxy server, recording each Register request results in a list of terminals that constitute the entire domain for which the pass through proxy 801 would be responsible. In other words, the Register list in pass through proxy 801 represents some subset of that known to proxy server 503 of Figure 7.

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Similarly, when an Invite message is received, the pass through proxy adds a header to the request and then forwards it to the SIP proxy 503. The "Via" header, part of the known SIP protocol, should be used for this purpose. The additional header added upon the first message for a specific call being set up from a calling terminal 502 causes subsequent
10 result/acknowledgement messages to be transmitted through the pass through proxy 801. Such system provides that for all outbound call set up messages, any status and control information required to be monitored by applications computer 701 will be transferred through pass through proxy
15 801. This provides a full view of the outbound call set up, acknowledgement messages at the pass through proxy 801, and thus, to the applications computer 701 that interfaces to pass through proxy 801. Moreover, such a solution does not require rewriting of normal SIP proxy software, since the pass through proxy hardware and/or software may be implemented entirely
20 separately from the SIP proxy server.

The foregoing mechanism provides a solution for outbound call setup, control and monitoring, and tear down, but there is still an issue remaining for inbound calls. More specifically, in order for the applications computer 701 to
25 insure access to all information regarding inbound calls, such information must pass through proxy server 503 and pass through server 801.

Otherwise, as shown in Figure 7, application computer 701 cannot monitor or control such call. The solution to this problem is similar to the
30 previous solution. When a terminal is registered with any proxy server in the entire system, a special header is added to its contact address. The "maddr" header in the SIP protocol should be used for this purpose. The header affects the address translation process when other proxy servers associated

with calling terminals attempt to contact the particular called terminal associated with the subject address.

5 More specifically, this header instructs proxy server 503 to redirect all inbound call setup requests addressed to that contact address to the address specified in the "maddr" header.

10 The previously defined solutions cause all inbound and outbound call signaling to be transmitted through the proxy server 503 and pass through proxy 801. As shown in Figure 7, since the applications computer 701 interfaces to pass through server 801, there is now full access to all call data, and the system has not altered the proxy server 503 in any substantial way as to cause rewriting of the software or even reconfiguration of the proxy server 503.

15 While the above technique insures that pass through proxy 801 has access to call setup messages for inbound and outbound calls, the headers may also require that all messages concerning the call (e.g. hold/retrieve, call hang-up, etc.) are transmitted through the pass through proxy. In general, the pass through proxy 801 and/or proxy server 503, utilizing the techniques of the present invention, add headers to insure that the functions desired to be monitored and controlled pass through the separate logical portion of the system that monitors and controls those functions. The "record-route" header should be utilized to ensure that all control messages after call setup (e.g. disconnect) are routed through the pass through proxy. This header should be added to call-setup messages as they pass through 801. It should be noted that the pass through proxy 802 should not be a redirect server, as this would not receive call signaling messages for monitored and controlled calls after call setup.

30 Moreover, the fact that call-setup messages pass through the pass through proxy 801 does not necessarily mean that all resulting calls should be monitored and recorded. The pass through proxy 801 can be configured via

software to only monitor and record messages if and when instructed to do so by the applications computer 701, such as when applications computer 701 is operable, or to only record calls relating to devices known to the application computer 701.

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As noted from the above, the pass through server has certain information in common with the proxy server. The pass through server will either contain a subset of the information in the proxy server, or may contain all of the information in the proxy server. For purposes of explanation herein,
10 we describe the pass through server as mirroring the proxy server to refer to the fact that the pass through and proxy servers contain some common information.

The final issue that needs to be addressed is the ability of the
15 application computer 701 to initiate calls. The issue is solved by having the applications computer 701 indicate to the pass through server that it should signal the calling terminal 502 as if it were receiving an inbound call from the pass through server. This "fake" inbound call is intended to prepare the
20 calling terminal 502 to enter a state where it can listen to (an as yet undefined) media stream to be set up in a subsequent outbound call to the called terminal 504, described below.

When calling terminal 502 has answered the call, it has a call set up to the pass through proxy with no media channels. On receiving the
25 acknowledgement to this call, the pass through proxy then initiates the outbound leg of the call as usual (via the proxy server) to the intended called party 504. When the pass through proxy receives an acknowledgement for this leg of the call it can then update the calling terminal 502 with the new media channel information in another Invite message for the original call.

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In response to receipt of the fake inbound call from application computer 701, calling terminal 502 will perform its normal processing on inbound calls, typically examining information associated with the calling

party. The calling party information filled in by pass through server 801 is the pass through server 801 address itself. This initial message is sent to the calling terminal 502 instructs the calling terminal 502 to initiate a phone call to called terminal 504 in accordance with the techniques previously described.

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It is noted that several variations of the basic process described above is also contemplated by the present invention. One or more of the terminals 502, 504 may actually be cellular or satellite terminals not connected via a hardwire connection to the network. Such terminals, which may use
10 standardized Internet languages and syntax, are already known in the art.

Moreover, while there is an authorization process discussed herein related to checking the calling terminals authority to make calls, the authorization process may be more detailed. For example, certain terminals
15 to be called may implement call blocking by instructing the proxy server accordingly. Selective call blocking from particular calling terminals may also be implemented.

Additionally, the SIP protocol is defined such that multiple SIP
20 connections may exist within a single TCP/IP session. This means that effectively, multiple telephone calls can take place over the same TCP/IP connection, and that pass through server 801 may monitor one TCP/IP connection and then demultiplex out information concerning multiple calls. Each SIP session would be identified separately, as it presently is defined by
25 the SIP specifications.

In another enhanced embodiment, the point-to-point call shown in Figure 5 is replaced with a conference call wherein information may be shared among three or more terminals. Such Internet conferencing methods
30 require that the servers conveying the media stream after call set up simply duplicate messages and transmit them to two or more different addresses. End users then have control over exiting or entering conferences by entering specified codes and passwords, in accordance with known techniques.

An additional embodiment provides the application computer 701 (in the case of SIP) or the Gatekeeper 102 (in the case H.323) with the ability to dynamically route inbound calls to virtual destinations. For purposes of explanation of this additional embodiment, we use the example of the SIP protocol, with the understanding that the invention is not limited to any specific protocol. In an H.323 system, the functionality required to implement call routing would preferably be executed in a gatekeeper, rather than in a pass through server as in the case of the SIP protocol.

A virtual destination is an address called by a calling party but which does not represent an actual physical called terminal. Instead, the call to a virtual destination triggers pass through server 801 to suspend processing of the incoming call and contact application computer 701 for further routing instructions. Such further routing instructions may include, for example, a specific address of a person with a given department.

If the application computer supplies further routing information within a configured time period, this information is used to resume call processing and routing of the call to the specified destination or possibly another virtual destination. If no further information is provided by the application computer within the time period, the pass through server should provide some default routing for the call. Figure 10 shows the typical flow of messages for the SIP environment, and is described in further detail later herein.

Alternatively, the further instructions may include time varying routing information, causing the virtual number to be translated to a different called terminal at different times of day. Such a procedure would involve maintaining a table of entries within applications computer 701 that includes one or more time frames corresponding to each of a plurality of such virtual numbers. For each such virtual number, when a call arrives, the table lookup is performed, and the actual call routing instructions may be transferred to the Pass Through Server 801.

Any type of routing algorithm may be used in connection with application computer 701. Thus, load balancing may be implemented. One or more virtual numbers may represent a sales department, and all calls coming in for the sales department would thus be sent to the applications computer 701 for the purpose of determining an actual called terminal to which the call should be routed. The applications computer may distribute the incoming calls among plural actual called terminals, allowing the full incoming call load distribution to be balanced among all available resources.

Alternatively, applications computer 701 may include a skills based routing algorithm. In such an algorithm, application computer 701 may examine the incoming call and ascertain the skills required to process same. For example, if the incoming call is from a telephone number that is associated with a Spanish speaking customer, applications computer 701 may conclude that the terminal to which the call should be routed is that of a Spanish speaking customer agent. Other skills based routing may be utilized wherein the skills of customer agents are matched against available information regarding skills required to service a particular call or contact.

Figure 9 depicts a flow chart of how an applications computer 701 would interface with an appropriate CTI interface for implementing an exemplary embodiment of the present invention. It is noted that the flow chart of Figure 9 does not represent any specific protocol, and that the protocol for implementing the flow chart of Figure 9 may be SIP, H.323, or any other protocol, and may utilize a variety of message exchange scenarios between an applications computer and a CTI interface.

In operation, the method is started at 901 and control is transferred to the published block 902. At block 902, the pass through server 801 publishes virtual address to one or more proxy servers 503. The virtual addresses represent addresses that may be called but which do not correspond to a specific actual called terminal, but instead to a varying address that may be

defined by the application computer 701.

At block 903, the application computer 701 enables the call routing by sending an appropriate signal to a CTI interface associated with the packet switched telephony network. This allows the packet switched telephony network to know that a computer application is currently able to route calls for this virtual address.

During operation of the network, the pass through proxy receives a call to a virtual number at block 904. Recognizing that the call is to a virtual number, the application computer 701 is contacted at block 905 and instructions are sought as to how to route the call. Since the actual called terminal corresponding to the virtual called number varies dynamically, contacting the application computer at the time of the call insures up to date routing information. At decision point 906, a decision is made by the CTI interface as to whether or not the application computer 701 has in fact provided appropriate routing information. If not, a default routing is utilized at block 908, which may be a predefined destination for virtual called numbers in all situations where no routing information is supplied. On the other hand, should application computer 701 provide appropriate routing information, block 907 will cause such routing information to be utilized before the call is completed at block 909. Thereafter, normal call processing, monitoring, and control proceeds as previously described.

Notably, the monitoring and/or control functions of application computer 701 may be invoked whether the dialed number is an actual number or a virtual number. However, in the preferred embodiment, routing functions are handled by the applications computer 701 only in the case of virtual numbers. With respect to routing functions for actual numbers, the proxy server 503, pass through server 801, or other interface server, such as gatekeeper 102, may implement the routing functions. In this manner, the routing capabilities as they exist prior to the addition of an applications computer may be maintained, without significant change in the required

software.

5 It is noted that the inventive techniques are embodied in software, and may be stored on a medium. A machine-accessible medium includes any mechanism that provides (i.e., stores and/or transmits) information in a form accessible by a machine (e.g., a computer, network device, personal digital assistant, manufacturing tool, any device with a set of one or more processors, etc.). For example, a machine-accessible medium includes recordable/non-recordable media (e.g., read only memory (ROM); random access memory (RAM); magnetic disk storage media; optical storage media; 10 flash memory devices; etc.), as well as electrical, optical, acoustical or other form of propagated signals (e.g., carrier waves, infrared signals, digital signals, etc.); etc.

15 It is noted that while the above describes the preferred embodiment of the invention, various other modifications will be apparent to those of skill in the art. Different manners for interfacing the application computer to the SIP system may be utilized. Such variations are intended to be covered by the claims appended hereto.

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WHAT IS CLAIMED IS:

1. A system comprising:
 - a proxy server to receive and store a first table for address translation and registration of plural terminals associated therewith, each terminal being capable of participating in a telephone call to be implemented over a packet switching data network, said proxy server being connected to a data network; and
 - a pass through server connected to said data network and through which information between said proxy server and any of said terminals passes, said pass through server including a second table that mirrors said first table, said pass through server also being configured to communicate information to and from an applications computer, said applications computer including software to at least control or monitor calls among said terminals over said data network, said applications computer and said pass through server exchanging information in a manner that translates a virtual number received from a calling party to one or more physical numbers representing called parties.
2. The system of claim 1 wherein at least some of said terminals are configured to modify addressing information to cause incoming control and monitoring information to be routed through said proxy server.
3. The system of claim 1 wherein said proxy server and said pass through server are resident on the same hardware platform.
4. The system of claim 1 wherein said proxy server is arranged to receive an address in a first form from one of said terminals, translate said address into a second form, and return said address in said second form to said terminal from which said address in said first form was received, and wherein said second form of address is a virtual address that is later translated by a second proxy server into one or more actual addresses.

5 5. The system of claim 1 wherein said proxy server is arranged to receive an address in a first form from one of said terminals, translate said address into a second form, and send said address in said second form to a second server.

10 6. The system of claim 5 wherein said second server communicates with an applications computer to translate said address in said second form to one or more different addresses.

15 7. The system of claim 6 wherein multiple SIP sessions are contained within a single TCP/IP session, and wherein said proxy server or said pass through server can distinguish among said multiple SIP sessions.

20 8. The system of claim 6 wherein said proxy server or said pass through server includes software to determine whether a particular call is authorized prior to completing said particular call.

25 9. The system of claim 8 wherein said proxy server or said pass through server contains software to implement multiparty conferences.

30 10. A method comprising:
 transmitting a call initiation message to a proxy server or a pass through server;
 in response to receipt of said call initiation message,
 transmitting from said pass through server or said proxy server a fake inbound call message to a calling terminal specified in said call initiation message; and
 in response to said fake inbound call message, initiating an Internet telephone call from said calling terminal, said phone call being initiated to a virtual number that does not correspond to an actual called terminal unless and until translated by an applications computer.

11. The method of claim 10 further comprising each of plural calling

terminals registering with said proxy server and said pass through server.

12. The method of claim 11 wherein said initiating an Internet telephone call includes transmitting an Invite message of the Session
5 Initiation Protocol (SIP) through a pass through server and a proxy server.

13. The method of claim 12 wherein said pass through server or said proxy server translate a called terminal address from a first form to a second form and transmit said address back to said calling terminal or to a
10 separate server, and wherein said separate server communicates with the applications computer to translate a virtual number to an actual called number corresponding to a called terminal.

14. The method of claim 13 wherein said pass through server
15 communicates with a Computer Telephony Integration (CTI) applications computer.

15. The method of claim 14 further comprising issuing instructions from said applications computer to instruct said pass through server to
20 monitor or control a call with specified parameters.

16. The method of claim 15 further comprising issuing a disabling command to cease specified monitoring and control functions at specified
times.

25 17. An article of manufacture comprising:
a machine-accessible medium having associated data, wherein the data, when accessed, results in a machine performing;
receiving commands from an applications computer to
30 implement computer telephony integration (CTI) functions;
communicating with a pass through server or a proxy server to convey parameters received in said command from said applications computer; and
causing one or more terminals to initiate Internet telephone calls

in response thereto, and

translating virtual numbers called when said telephone calls are initiated into actual numbers corresponding to called terminals.

5 18. The article of manufacture of claim 17, wherein the machine-accessible medium further includes data, when accessed, results in the machine performing:

 instructions to cause specified monitoring and control
 information concerning said calls to be conveyed to and from said
10 applications computer.

 19. The article of manufacture of claim 18 further comprising instructions to cause a proxy server or a pass through server perform authentication functions.

15 20. The article of manufacture of claim 19 further comprising instructions to duplicate packets associated with a call to implement a multiparty conference.

20 21. The article of manufacture of claim 20 further comprising a instructions for implementing plural SIP sessions in a single TCP/IP session.

 22. A method comprising:
 transmitting over a data network, from an application computer to a
25 gatekeeper computer, information indicative of monitoring and control of telephony functions desired by a user of said application computer, said application computer being located separately from any of said at least two nodes of said packet data network;

 arranging for said packetized telephone communications session
30 between said at least two nodes of said packet data network, said arrangement being accomplished through said gatekeeper computer;

causing said packetized telephone communications session between said at least two nodes of said packet data network to occur by translating at least one virtual number into one or more actual numbers; and

5 reporting information indicative of said session occurring to said application computer from said gatekeeper computer over said data network.

23. The method of claim 22 wherein said arranging comprises the following steps:

10 allocating bandwidth for at least a first endpoint of said packet data network;

notifying said application computer from said gatekeeper computer that said call is processing;

15 allocating bandwidth to at least a second endpoint to participate in said session;

connecting said second endpoint with said first endpoint; and

notifying said application computer from said gatekeeper computer over said data network of said connection.

24. The method of claim 23 wherein said translating is performed in
20 accordance with a load balancing or skills based routing algorithm.

25. A system comprising:

at least once calling terminal and at least one called terminal, said calling terminal and said called terminal being capable of communicating with each other via a data network;

25 at least one computer telephony integration (CTI) interface server,

said CTI server being capable of completing calls to actual called numbers and of recognizing virtual called numbers; and

an applications computer to process virtual called numbers, translate said virtual called numbers into one or more actual called numbers, and transmit said actual called numbers back to said CTI server.

26. The system of claim 25 wherein said CTI server is a gatekeeper.

27. The system of claim 26 wherein said CTI server is a pass through proxy server.

28. The system of claim 25 wherein said CTI server is capable of processing both actual called numbers and virtual called numbers.

29. The system of claim 28 wherein said applications computer translates said virtual numbers using a load balancing technique.

30. The system of claim 28 wherein said applications computer translates said virtual numbers using a skills based routing algorithm.

31. The system of claim 28 wherein said applications computer translates a single virtual number in plural actual numbers.

32. Apparatus comprising:

an applications computer to implement computer telephony applications and to communicate with a computer telephony interface node on a packet switched computer telephony network, the applications computer being arranged to monitor and/or control, but not route, packet switched telephone calls to an actual called number, the applications computer also being arranged to route calls to a virtual called number, and

a computer telephony interface arranged to communicate with said applications computer.

33. The apparatus of claim 32 wherein said applications computer routes calls by performing load balancing.

5 34. The apparatus of claim 33 wherein said applications computer routes calls using a skills based routing algorithm.

35. The apparatus of claim 32 wherein the applications computer routes calls using a skills based routing algorithm.