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**Rieley et al.**

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(54) **METHOD AND APPARATUS FOR TRANSMISSION AND RETRIEVAL OF FACSIMILE AND AUDIO MESSAGES OVER A CIRCUIT OR PACKET SWITCHED NETWORK**

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(\* ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(51) **Int. Cl.**<sup>7</sup> ..... **H04L 12/66; H04M 7/00**

(52) **U.S. Cl.** ..... **370/354; 370/401; 379/88.17; 379/100.08; 379/221; 709/227**

(58) **Field of Search** ..... **370/352, 354, 370/428, 396, 401; 379/88.17, 100.01, 100.08, 100.17, 100.12, 265, 221, 89; 709/217, 218, 227, 219; 341/20**

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*Primary Examiner*—Hassan Kizou

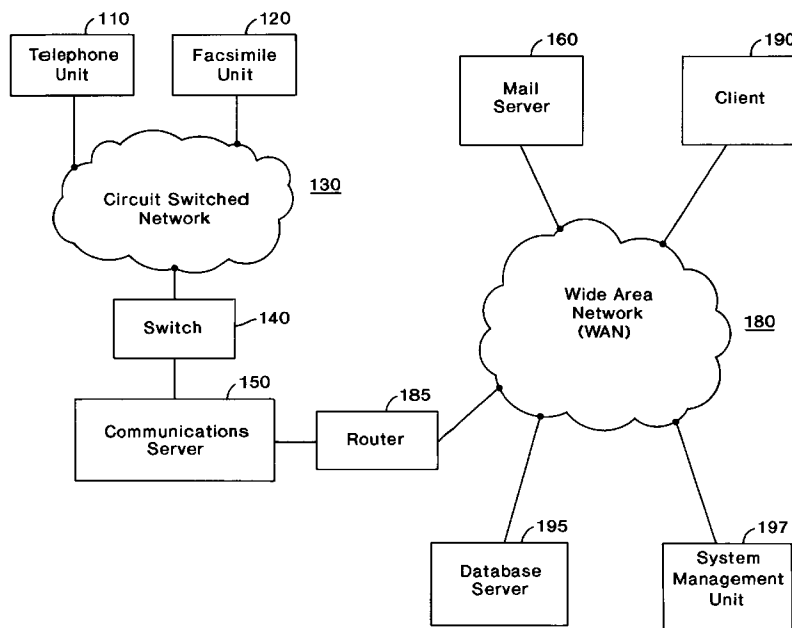
*Assistant Examiner*—John Pezzlo

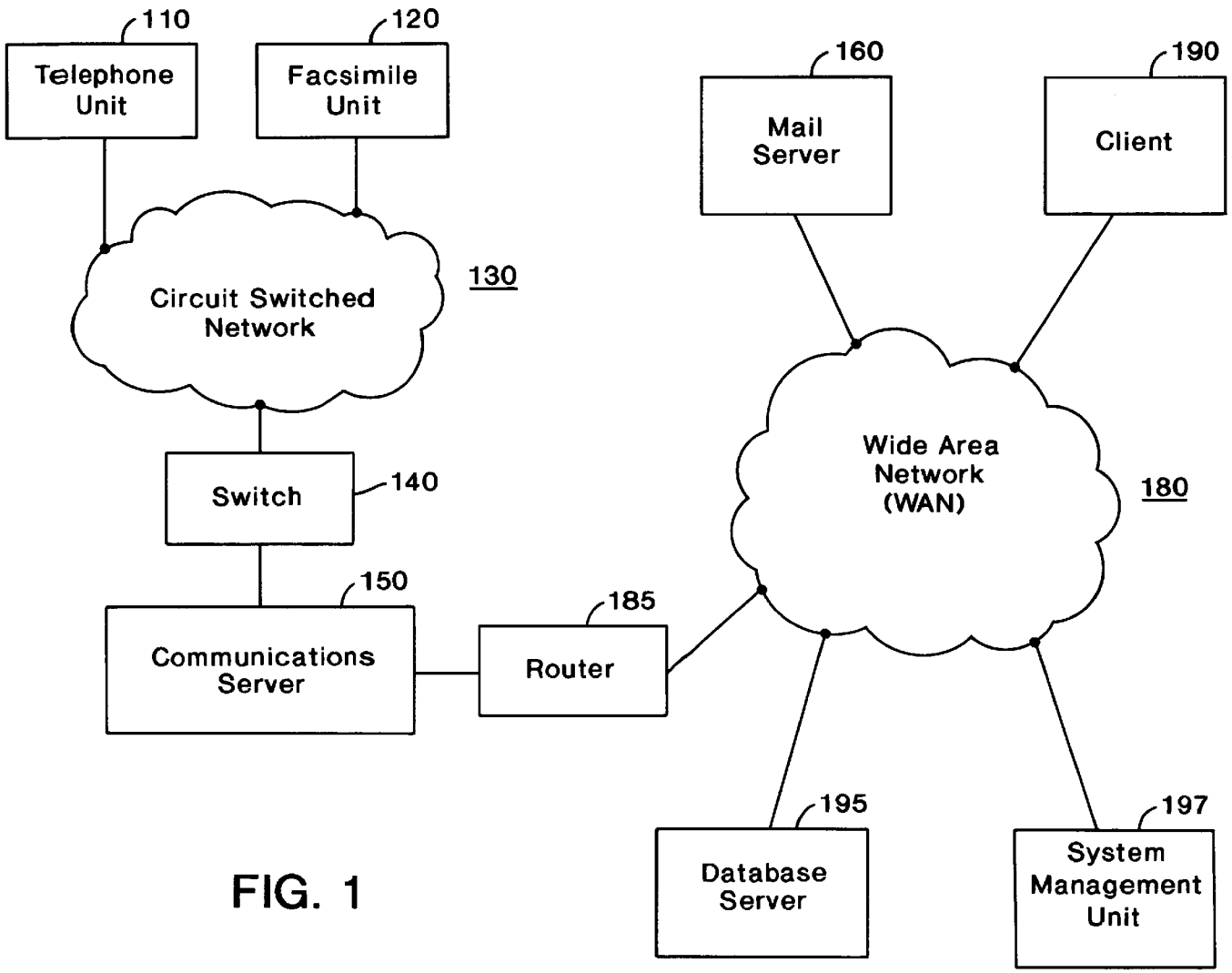
(74) *Attorney, Agent, or Firm*—Blakely Sokoloff Taylor & Zafman

(57) **ABSTRACT**

A method and apparatus for accepting an incoming message over a circuit switched network and transmitting it over a packet switched network. The apparatus including means for implementing the steps of receiving an incoming call signal along with a inbound address; determining a user account and a final address on said packet switched network associated with said inbound address; allocating a message processing resource; processing said incoming call into a processed message; and, sending said processed message to said final address.

**22 Claims, 3 Drawing Sheets**





**FIG. 1**

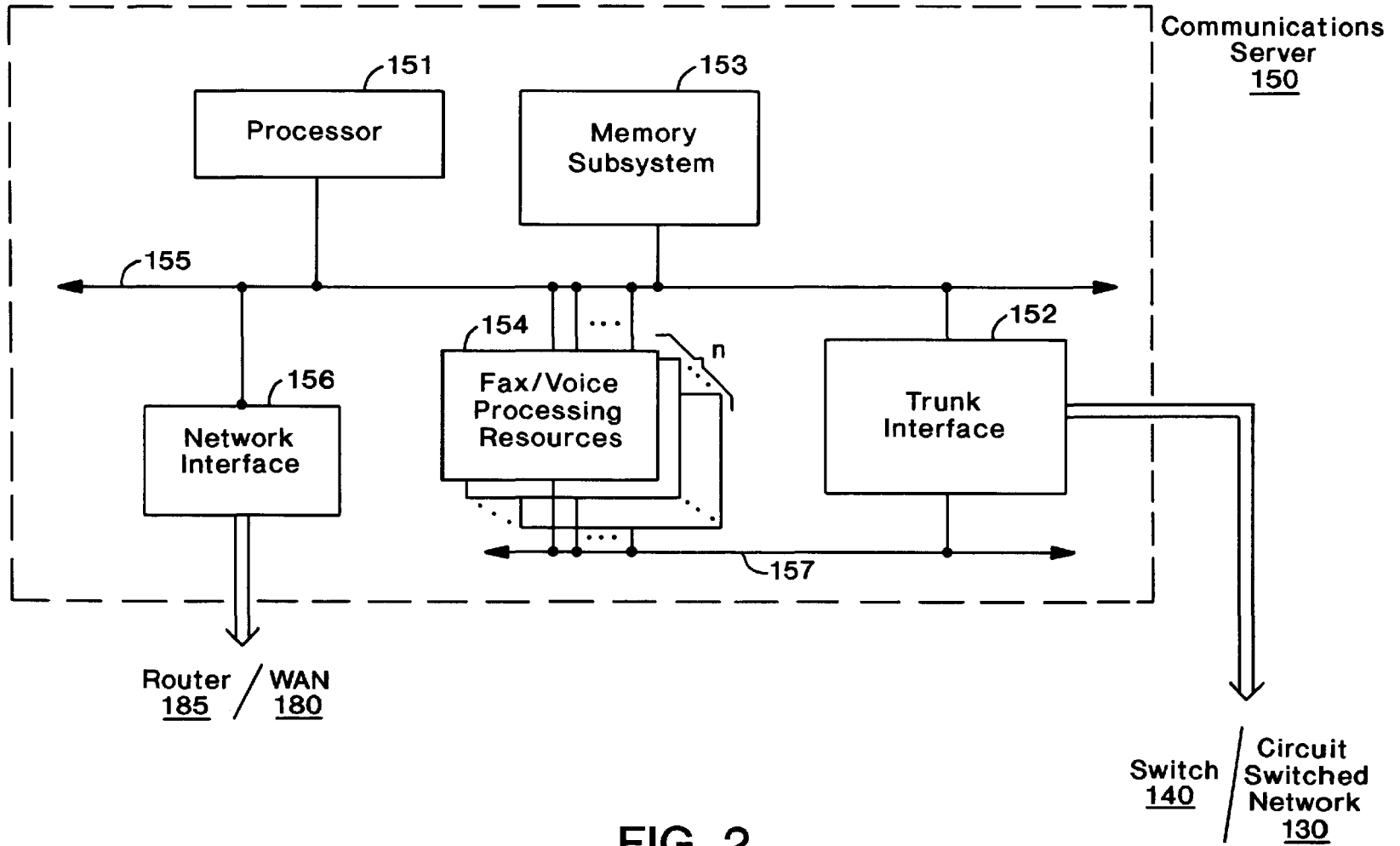


FIG. 2

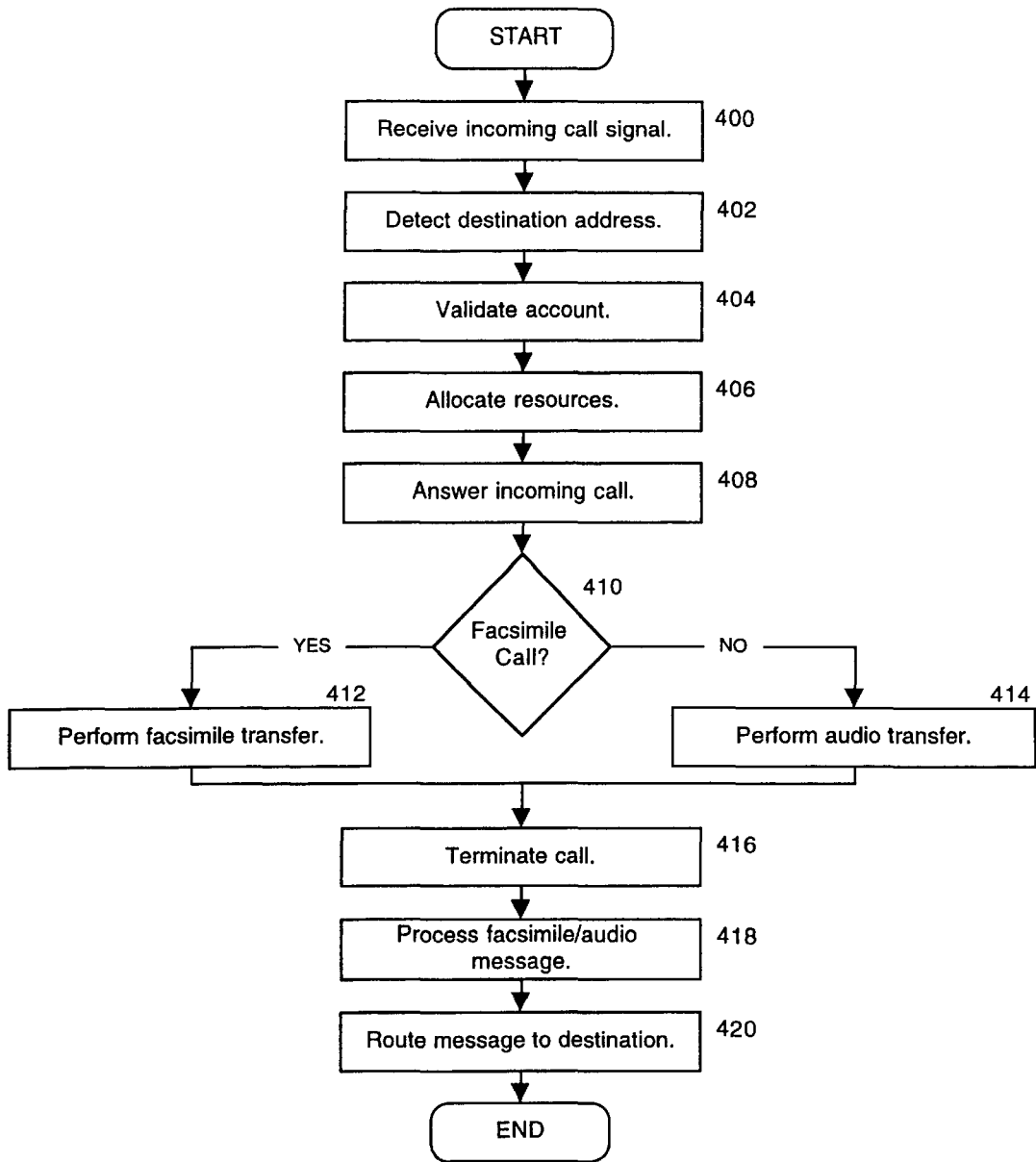


FIG. 3

**METHOD AND APPARATUS FOR  
TRANSMISSION AND RETRIEVAL OF  
FACSIMILE AND AUDIO MESSAGES OVER  
A CIRCUIT OR PACKET SWITCHED  
NETWORK**

**BACKGROUND OF THE INVENTION**

**1. Field of the Invention**

The present invention relates to the field of message receipt/transmission and delivery using computer networks. Specifically, the present invention relates to the subject of facsimile and voice transmission and retrieval over circuit/packet switched voice/data networks.

**2. Description of Related Art**

Voice and data communications systems such as the public switched telephone network (PSTN) are currently used to transfer image and text data transmitted by facsimile ("fax") machines in addition to the normally carried voice traffic. These faxed images are usually transmitted through the PSTN and received for printout or storage of the image on a destination fax machine or computer for the use by the recipient. Since the destination machine has typically been a fax, computer, printer or other such large capacity storage and output device, there has not been a need to compress the fax significantly for the destination output device. Furthermore, as the traditional destination has been either a full size print-out, computer monitor or mass storage media, no attempt has been made to facilitate the delivery of fax messages using other methods so as not to require the recipient to be physically close to the device which is coupled to the telephone line in order to receive the fax message.

For example, where user A has a fax machine connected to the PSTN using a telephone line with a number "XXX-YYY-ZZZZ" (where "XXX" represents the area code of the number, "YYY" the prefix of the number, and "ZZZZ" the remainder of the number), in order for user A to view a received fax message, user A must be physically located in the same area as the fax machine.

Similarly, audio messages are stored on fixed destination devices such as answering machines and "voice-mail" systems. To retrieve such audio messages, a recipient would either have to dial into the destination device or physically activate the play-back of audio messages through manipulation of the controls of an answering machine.

Thus, the ability to access both voice and fax messages from additional locations which would not require a user to either (1) be physically stationed near the receiving fax machine; or (2) to have to manually call a device to retrieve audio messages; would be desirable.

In addition, as a sender currently has to call or fax directly to the destination phone or fax machine, the sender incurs additional charges imposed by one or more telephone companies handling the call. Depending on the length of the fax or audio message, the telephone company charges can be substantial as calls are billed based on the time connected.

Hence, to be able to provide a sender with multiple phone numbers to which to send a message would be desirable, allowing the sender to choose the number which would be closest, and, thus, the least expensive, to dial into.

**SUMMARY OF THE INVENTION**

To provide for the receipt and transmission of audio and fax information by a first user over a circuit switched network such as the PSTN to a second user over a packet

switched network such as the Internet, a communications server is connected both to the circuit switched network and a packet switched network.

The communications server contains resources to receive and process incoming audio and facsimile calls from the circuit switched network into a format suitable for transmission over the packet switched network to the second user's address. In addition, a link is first determined between the second user's address on the circuit switched network and the second user's address on the packet switched network, and then an appropriate route to the second user's address on the packet network is determined. With the system being maintained in a distributed and redundant fashion, reliable receipt and transfer of all messages is ensured.

Thus, this electronic messaging system allows for the transfer of messages such as facsimile and audio messages from the circuit switched network to be collected and routed over the packet switched network.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a system diagram of a network configured pursuant to a preferred embodiment of the present invention containing a message server.

FIG. 2 is a block diagram illustrating the message server configured in accordance with the preferred embodiment of the present invention.

FIG. 3 is a flow diagram illustrating the operations of the preferred embodiment of the present invention.

**DETAILED DESCRIPTION OF THE  
INVENTION**

The present invention provides a method and apparatus for allowing the receipt and transmission of audio and fax information between a circuit switched network and a packet switched network. For purposes of explanation, specific embodiments are set forth to provide a thorough understanding of the present invention. However, it will be understood by one skilled in the art, from reading this disclosure, that the invention may be practiced without these details. Further, although the present invention is described through the use of circuit switched and packet switched networks, most, if not all, aspects of the invention apply to all networks in general. Moreover, well-known elements, devices, process steps and the like are not set forth in detail in order to avoid obscuring the present invention.

FIG. 1 contains a block diagram illustrating a system configured in accordance with a preferred embodiment of the present invention containing a communications server **150** connected to a circuit switched network **130** and a wide area network (WAN) **180**. In the preferred embodiment, circuit switched network **130** is a circuit switched network such as the PSTN while WAN **180** is a packet switched network such as the Internet. It is to be noted that circuit switched network **130** can also be a network such as the generalized switched telephone network (GSTN), which encompasses PSTN networks, cellular telephone networks, and the other networks with which they are in communication.

Communications server **150** is connected to circuit switched network **130** via a switch **140** and to WAN **180** through the use of a router **185**. As described in further detail below, in a preferred embodiment, switch **140** and router **185** are interfaced to communications server **150** using two separate hardware interfaces. In an alternate embodiment, switch **140** and router **185** can be interfaced to communications server **150** through the use of one hardware unit.

Connected to circuit switched network **130** is both a telephone unit **110** and a facsimile unit **120**. Telephone unit **110** is a standard telephone capable of converting audio signals into electrical signals suitable for transmission over circuit switched network **130**. Similarly, facsimile unit **120** is a standard facsimile machine capable of transmitting and receiving facsimile messages over circuit switched network **130**. Each of these devices can be connected to circuit switched network **130** using either wired or wireless technology.

Connected to WAN **180** is a database server **195**, a system management unit **197**, a mail server **160**, and a client **190**. Each of these systems communicate with each other and with communications server **150** via WAN **180** using such protocols such as simple network management protocol (SNMP) and hyper-text transport protocol (HTTP)—packetized using a protocol such as the transmission control protocol/internet protocol (TCP/IP).

In the preferred embodiment, each one of database server **195**, system management unit **197**, mail server **160**, and client **190**, are stand-alone computers or workstations containing the hardware and software resources to enable the operation of the present invention. In alternate embodiments, the functions provided by each one of database server **195**, system management unit **197**, mail server **160**, and client **190**, are provided by any number of computer systems.

In the preferred embodiment, mail server **160** is a server providing e-mail receipt and transmission using a protocol such as the simple mail transfer protocol (SMTP) and post office protocol (POP). Moreover, client **190** is configured to be able to communicate over WAN **180** using SMTP or POP in order to retrieve email from mail server **160** or another suitably configured server.

System management unit **197** communicates with communications server **150** to monitor: (1) the processes on communications server **150**; (2) the status of the trunk line connected to communications server **150**; and (3) the connection between the various servers connected to WAN **180**. As described below, if any processes on communications server **150** or connection to the circuit switched network **130** is interrupted, system management unit **197** can allocate resources, or cause the re-routing of a call or message via one or more redundant resources or connections, ensuring that the call or message is routed to the final destination.

Communications server **150** contains user data needed to receive and route incoming messages received from circuit switched network **130**. The same information is also stored on database server **195**. In the preferred embodiment, communications server **150** stores an inbound address, a set of final destination addresses; and an account status for each user. The inbound address corresponds to the telephone number assigned to the user. As further discussed below, the inbound address is the number that a message sender dials on telephone unit **110** or facsimile unit **120** to leave a message for the user. The set of final destination address contain one or more e-mail addresses where the user account status information indicates whether the inbound address is either active and or inactive—i.e., whether the user is able to receive messages using the system.

Database server **195** stores a duplicate copy of the inbound address, the set of final destination addresses; and the account status for each user. Database server **195** also stores additional information for each user such as mailing address and billing information which are not used in the operation of the present invention but are note herein for

completeness only. Thus, the information that is stored on communications server **150** is a subset of the information that is stored on database server **195**, and if communications server **150** were to become inoperable or otherwise unable to handle incoming messages, database server **195** can configure another communications server to accept those calls.

In the preferred embodiment, system management unit **197** is responsible for monitoring the status of communications server **150** and re-assigning the users being handled by communications server **150** if communications server malfunctions or becomes overloaded with incoming calls. In the former case, system management unit **197** would re-assign all users being handled by communications server **150** to another communications server. In the latter case, system management unit **197** would only off-load the only those incoming calls for which communications server **150** does not have the available resources to process.

FIG. 2 is a block diagram of communications server **150** configured in accordance with the preferred embodiment of the present invention, containing a processor **151** coupled to a memory subsystem **153** through the use of a system bus **155**. Also coupled to system bus **155** is a network interface **156**; a trunk interface **152**; and a set of fax/voice processing resources **154**. Set of fax/voice processing resources **154** and trunk interface **152** are also coupled to a bus **157**.

Bus **157** is a bus that supports time division multiplex access (TDMA) protocols to optimize the flow of real time traffic between set of fax/voice processing resources **154** and trunk interface **152**.

Memory subsystem **153** is used to store information and programs needed by communications server **150**. The functioning of memory subsystems in computer design are well known to those of ordinary skill in the art and thus will not be further discussed herein.

In the preferred embodiment, trunk interface **152** is a trunk line interface, such as a T-1 or E-1 line, to switch **140** and can handle up to 24 channels of communications. Trunk line signaling is well known to those of ordinary skill in the art of telecommunication and thus will not be further discussed herein except as necessary for describing the invention.

Set of fax/voice processing resources **154** are made up of multiple fax/voice processing cards. Each of these processing cards contain processing units which are capable of receiving and transmitting facsimiles according to established protocols, and which are capable of digitizing voice or other audio data, also according to established protocols. In the preferred embodiment, there are three fax/voice processing cards in set of fax/voice processing resources **154**, each fax/voice processing card containing eight processing units capable of handling a channel from trunk interface **152**. Thus, communications server **150** can communicate on twenty-four channels concurrently.

The storage of destination addresses on both circuit switched network **130** and WAN **180** is controlled by a database located either on communications server **150** or on database server **195**. Keeping this information separate from communications server **150** allows communications server **150** to be a resource that can be allocated on demand. Hence, a number of communications servers could be used, along with one or more database servers, to allow a fully redundant and scalable system. In addition, system management unit **197** monitors the status and connection of all the communication and database servers.

FIG. 3 is a flow diagram illustrating the operations of the preferred embodiment of the present invention when a call

originating from a source on the circuit switched network **130**. For example, either telephone unit **110** or facsimile unit **120** can initiate the call.

In block **400**, an incoming call signal is received by communications server **150** from switch **140**. The incoming call signal is initiated by telephone unit **110** or facsimile unit **120** over circuit switched network **130** and is routed to communications server **150** via switch **140**. Communications server **150** detects the incoming call signal using trunk interface **152**. Operation would continue with block **402**.

Continuing with block **402**, trunk line interface unit **152**, in addition to receives signals to indicate that there is an incoming call from switch **140**, also receives signals indicating the circuit destination address of the incoming call. The destination address is captured by trunk interface **152** and is determined by trunk line signaling using mechanisms such as direct-inward-dial, or dual tone multifrequency (DTMF) tones.

Continuing with block **404**, to determine whether or not to process the incoming call, processor **151** searches the list of inbound addresses contained in memory subsystem **153** for the destination address. If processor **151** finds the destination address in the inbound address list, processor **151** will then look up the account status for the user who owns the inbound address to determine if the account of that user is a valid user account. In an alternate embodiment, the validation is performed through the use of a database maintained by a separate entity such as database server **195**. If the account is found to be inactive, communications server **151** will play a prepared message indicating that the number to which the incoming message was sent is an invalid account.

In block **406**, once the validity of the user account has been established, processor **151** will attempt to allocate one fax/voice processing resource from set of fax/voice processing resources **154** and also determine the availability of other resources required for the receipt and processing of the incoming call. These other resources include the processing capacity of processor **151**, the storage capacity of memory subsystem **153**.

If it is determined that the appropriate resources are not available, then the call will be routed to a different communications server that is capable of allocating the necessary resources. The routing of calls is accomplished by trunk line signaling via switch **140** and is managed by system management unit **197**.

Also, it should be noted that the call will only come from switch **140** to communications server **150** if there are no problems with the line. Otherwise the call will get routed to a different communications server. In the preferred embodiment, fault detection and correction happens in one of two ways. First, on the telephone network side, switch **140** can be set up to independently route a call to another line if it is determined that one of the lines is bad. Second, if communications server **150** detect that the trunk line coming into trunk interface **152** is down, communications server **150** will notify system management unit **197** to reallocate the users for whom communications server **150** is responsible onto another communications server. Thus, system management unit **197** will transfer the duplicate user information contained in database server **195** into a different communications server.

In block **408**, communications server **150** "answers" the incoming call by having trunk interface **152** go "off-hook" on the trunk line.

In block **410**, if the fax/voice processing resource of set of fax/voice processing resources **154** which is processing the

call determines that the incoming call is a fax transmission, then operation will continue with block **412**. Otherwise, operation will continue with block **414**. For example, if the call is a fax, a fax protocol is initiated, and the fax is received by one of the fax/voice processing resources of set of fax/voice processing resources **154**. If the call is a voice call, the voice is recorded by one of the fax/voice processing resources of set of fax/voice processing resources **154**.

In block **412**, the fax/voice processing resource of set of fax/voice processing resources **154** responsible for processing the incoming call will perform the fax transfer and store the incoming message as a temporary file in memory subsystem **153**. In the preferred embodiment, the incoming fax is saved into a file which follows the group 3 facsimile file format. Operation will then continue with block **416**.

In block **414**, where it is determined that the incoming message is an audio message, the fax/voice processing resource of set of fax/voice processing resources **154** allocated to process the call will initiate an audio recording of the incoming voice message. In the preferred embodiment, the audio message is digitized and stored in memory subsystem **153** as a temporary file in a pulse code modulated format. After the incoming call has been digitized and stored, operation will then continue with block **416**.

In block **416**, trunk interface **152** will terminate the call. Operation will then continue with block **418**.

In block **418**, the incoming message, which has been stored as a temporary file in memory subsystem **153**, is processed by processor **151**. In the preferred embodiment, the temporary file is processed according to the type of the incoming call. If the incoming call was a fax transmission, then the temporary file, which has been stored as a group 3 facsimile file, will be converted into a file which follows the tagged image file format (TIFF), or a format that is suitable for transmission over WAN **180**. Optionally, the temporary fax file can also be compressed at this stage. If the incoming call was an audio message, then the temporary file would be compressed using a compression scheme such as the scheme defined in the global system for mobile-communications (GSM) standard. In alternate operations, compressing and other processing of the incoming message is performed as the same time the incoming message is being received and being placed in memory subsystem **153**.

In block **420**, communications server **150** uses the inbound address to determine the set of final destination addresses, which are destinations on WAN **180** (i.e., the packet switched network), to send the processed incoming message. Communications server **150** then sends an electronic mail (e-mail) with the processed incoming message as an attachment to all the destinations in the set of final destination addresses.

For example, the e-mail containing the attachment is transferred to, and stored in, a server such as mail server **160**. The e-mail is then retrieved by client **190** whenever the user wishes. In an alternate embodiment, client **190** can retrieve the e-mail directly from communications server **150**, without the storing operation of mail server **160**.

While the present invention has been particularly described with reference to the various figures, it should be understood that the figures are for illustration only and should not be taken as limiting the scope of the invention. Many changes and modifications may be made to the invention, by one having ordinary skill in the art, without departing from the spirit and scope of the invention.

What is claimed is:

1. A system comprising:

a set of switches coupled to a circuit switched network for receiving a set of incoming call signals, wherein the incoming call signal includes an inbound address, and wherein a switch in the set of switches redirects an incoming call signal from a first communications server to a second communications server if a first condition occurs; and,  
 a set of communications servers coupled to the set of switches for receiving the set of incoming call signals, each communications server being coupled to a network and containing a message processing resource configured to process a received audio message into a digital representation, wherein each communications server further comprises a trunk line interface to extract the inbound address and stores the inbound address, a set of final destination addresses and account status, and the message processing resource is further configured to determine, based on the inbound address, a user account and a destination on a packet switched network and send the digital representation to the destination,

wherein the inbound address is assigned to the user account and the outbound address comprises at least one email address.

2. The system of claim 1, where the first condition occurs if the first communications server sends a rejection signal to the switch.

3. The system of claim 1, where the first condition occurs if the first communications server is unable to process the incoming call signal.

4. The system of claim 1, where the incoming call signal signals an incoming call and the first condition occurs if the first communications server is unable to process the incoming call.

5. The system of claim 1, further comprising a system management unit for setting the first condition.

6. The system of claim 1, further comprising a system management unit, and the first condition occurs if the system management unit determines that the second communications server should receive the incoming call signal.

7. The system of claim 1, where the set of switches includes a second switch, and the first communications server is coupled to the switch and the second communications server is coupled to the second switch.

8. The system of claim 7, where the switch redirects the incoming call signal to the second switch.

9. The system of claim 1, where the inbound address is a circuit destination address.

10. The system of claim 1, where the message processing resource is further configured to validate the inbound address.

11. The system of claim 1, where the audio message is a facsimile message and the digital representation of the audio message is a graphics file.

12. The system of claim 1, where the message processing resource further comprises a processor to:

determine if the audio message contains a facsimile message or a voice message; and,

digitize the audio message if the audio message contains the voice message and receive the facsimile message if the audio message contains the facsimile message.

13. A method comprising:

receiving a first incoming call signal destined for a first communications server for processing of an audio message into a digital representation;

determining if a first condition has occurred;

redirecting the first incoming call signal from the first communications server to a second communications server based on the determining of the first condition, wherein the incoming call signal includes an inbound address;

extracting the inbound address;

determining, based on the inbound address, a user account status and a destination on a packet switched network; and,

sending the digital representation to the destination, wherein the inbound address is assigned to the user account and the destination comprises at least one email address.

14. The method of claim 13, where determining the first condition includes determining that the first communications server sends a rejection signal.

15. The method of claim 13, where determining the first condition includes determining that the first communications server is unable to process the incoming call signal.

16. The method of claim 13, where the incoming call signal signals an incoming call and determining the first condition includes determining that the first communications server is unable to process the incoming call.

17. The method of claim 13, where determining the first condition includes determining that a system management unit selects the second communications server for receiving the incoming call signal.

18. The method of claim 13, where redirecting the first incoming call signal includes using a switch to redirect the first incoming signal from the first communication server to the second communication server.

19. The method of claim 13, where the inbound address is a circuit destination address.

20. The method of claim 13, further including validating the inbound address.

21. The method of claim 13, where the audio message is a facsimile message and the digital representation of the audio message is a graphics file.

22. The method of claim 13, further including:

determining if the audio message contains a facsimile message or a voice message; and,

digitizing the audio message if the audio message contains the voice message and receiving the facsimile message if the audio message contains the facsimile message.

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UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,208,638 B1  
DATED : March 27, 2001  
INVENTOR(S) : Rieley et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

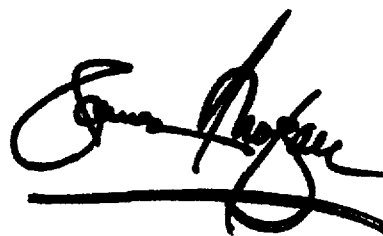
Claim 1,

Line 6, please delete "can" and insert -- call--.

Signed and Sealed this

Twelfth Day of March, 2002

Attest:

A handwritten signature in black ink, appearing to read "James E. Rogan", written over a horizontal line.

Attesting Officer

JAMES E. ROGAN  
Director of the United States Patent and Trademark Office