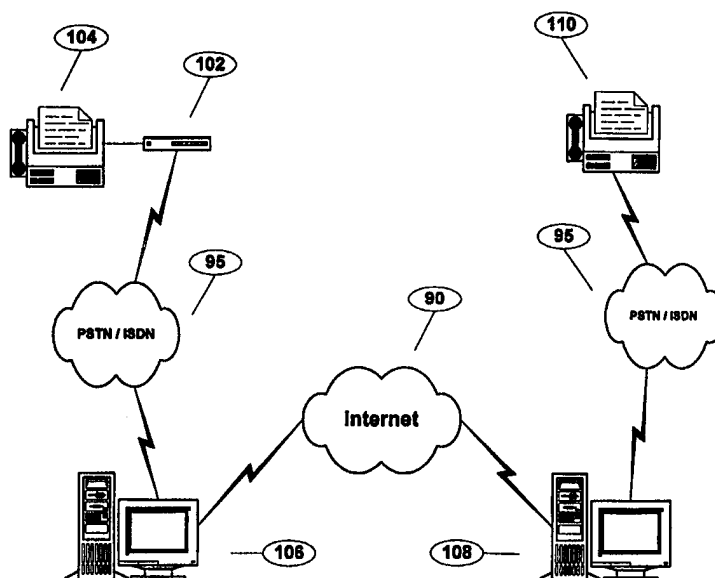




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(54) Title: A SYSTEM AND METHOD FOR REAL-TIME FACSIMILE TRANSMISSION



(57) Abstract

A system and method for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via an Internet Protocol (IP) network is provided. The method includes establishing a local communication gateway and at least one termination gateway, establishing a communication link via a Fax Protocol Enhancer between the originating fax machine and the destination fax machine, transmitting a fax image and on receipt of the fax image, the destination fax machine transmits a status report to the originating fax machine. The local and termination gateways are connectable to the IP network and each gateway has its own identifying IP address. The Fax Protocol Enhancer ensures that an open line is maintained between the originating fax machine and the local communication gateway and thence to the destination fax machine.

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A SYSTEM AND METHOD FOR REAL TIME FACSIMILE TRANSMISSION

FIELD OF THE INVENTION

The present invention relates to the transmission of facsimile (fax) images via Internet Protocol (IP) network such as the Internet.

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BACKGROUND OF THE INVENTION

Long distance facsimile transmissions account for a substantial and increasing telephone expense to businesses and industry.

Facsimile (or Fax) machines are generally used to transfer printed or fixed graphic material via a telephone circuit. Reference is made to Figs. 1 and 2, which schematically illustrate the communication link between two facsimile machines, referenced 12 and 14, and the graphical representation of the transmission of the images between two facsimile machines. The transmitting fax machine 12 scans the material being sent and converts the information into signal waves. The signals are sent over a telephone circuit 16 such as an integrated services digital network (ISDN) or public switched telephone network (PSTN) to be received and converted back by the receiving facsimile machine 14.

Fig. 2 schematically illustrates the signal communication for a two-page fax, between the transmitting and receiving facsimile machines, 12 and 14, respectively. The transmitting machine 12 dials the receiving machine 14. When contact is made, the two facsimile machines exchange specific character configurations, known as handshaking, indicated by the waveform 20, to establish synchronization. The first page, indicated by the waveform 22, is then converted and transmitted, via the telephone circuit 16, to the receiving machine 14. After each page is received, the receiving machine 14 transmits a specific character signal (waveform 24) to the transmitting machine 12, the signal 24 confirming the receipt of the image signals sent. The subsequent page (waveform 26) is then transmitted and again signal (waveform 24) is transmitted to transmitting machine 12.

At the end of the fax transmission, a confirmation signal is sent by the receiving machine 14 and the transmitting machine 12 prints out a status report.

If, after a pre-determined time lapse, during which the transmitting machine 12 does not receive any communication from and loses contact with the receiving machine 14, the transmitting machine 12 disconnects itself from the network. The G3 fax protocol expects a signal from the receiving facsimile machine 14 within 3-5 seconds after the fax has been transmitted. If there is not any response within this short time frame, the transmitting facsimile machine assumes that the last page has not arrived, disconnects from the line and reports an error. This loss of contact can occur even if the page has been fully transmitted, due to noisy fax lines, for example.

In order to communicate over the Internet, calls are routed via a server connected to the Internet. In this case, there is not a direct open line between the remote users, and typically there are long and unpredictable delays. Thus, since the G3 fax protocol expects a result from the receiving facsimile machine 14 within 3-5 seconds after the fax has been transmitted, it is generally not possible to successfully transmit faxes in real-time with confirmation over the Internet. One method of trying to overcoming this problem is to assume, presumably on the basis that since the previous pages have been successfully transmitted, the last page is likely to be similarly successful. The status report is sent when the last page begins being transmitted and before completion the last page, that is while the originating machine is still transmitting. There is no control over the final status of the transmission and the status report is not necessarily correct.

SUMMARY OF THE INVENTION

An object of the present invention is to provide real-time fax transmission via an Internet Protocol (IP) network such as the Internet.

A further object of the present invention is to provide real-time
5 transmission of facsimile images between an originating fax machine and a destination fax machine via a communications link.

There is thus provided, in accordance with a preferred embodiment of the invention, a method for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via an Internet
10 Protocol (IP) network. The method includes the steps of:

- a) establishing a local communication gateway and at least one termination gateway, the local and at least one termination gateway being connectable to the IP network, each of the local and at least one termination gateway having an identifying IP address;
- 15 b) establishing a communication link via a Fax Protocol Enhancer between the originating fax machine and the destination fax machine; and
- c) transmitting a fax image and on receipt of the fax image, the destination fax machine transmitting a status report to the originating
20 fax machine.

The Fax Protocol Enhancer ensures that a line is kept open between the originating fax machine and the local communication gateway and thence to the destination fax machine.

Furthermore, in accordance with a preferred embodiment of the
25 invention, the Fax Protocol Enhancer is connected to the originating fax machine and connectable to the local gateway.

Furthermore, in accordance with a preferred embodiment of the invention, the method includes a private telephone exchange (PBX) connected to the originating fax machine, the Fax Protocol Enhancer being coupled to the local
30 gateway.

Furthermore, in accordance with a preferred embodiment of the invention, the originating fax machine is a personal computer having a fax card coupled thereto, the Fax Protocol Enhancer being coupled to the personal computer.

5 Additionally, in accordance with a preferred embodiment of the invention, the step of establishing a communication link includes the steps of:

- a) establishing a communication link from the Fax Protocol Enhancer to the local fax gateway via the telephone network;
 - b) identifying the termination fax gateway to communicate with the destination fax and establishing a communication link between the local fax gateway and the termination fax gateway via the IP network, the termination fax gateway having a second IP address; and
 - c) establishing a communication link via the telephone network from the termination fax gateway to the destination fax machine.
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Furthermore, in accordance with a preferred embodiment of the invention, the step of transmitting a fax image includes the steps of:

- a) for each page of fax image being received, by the local fax gateway, splitting each page into a multiplicity of strips;
 - b) the local fax gateway separately transmitting each of the multiplicity of strips in turn to the termination gateway; and
 - c) the termination gateway forwarding each of the multiplicity of strips in turn to the destination fax machine.
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Furthermore, in accordance with a preferred embodiment of the invention, the destination fax machine begins receiving each page of the fax image being transmitted before the originating fax machine has completed transmitting the each page.

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In addition, in accordance with a preferred embodiment of the invention, the method includes the step of restoring the communication link between the originating fax machine and the destination fax machine, whenever the originating fax machine is disconnected from the communication link.

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Furthermore, in accordance with a preferred embodiment of the invention, the step of restoring the communications link includes the step of the local fax gateway activating the Fax Protocol Enhancer to call-back to the originating fax machine. In a further embodiment, the step of restoring includes the step of the local fax gateway calling-back to the originating fax machine.

Additionally, in accordance with a preferred embodiment of the invention, each of the multiplicity of strips of data is encrypted prior to onward transmission.

Furthermore, in accordance with a preferred embodiment of the invention, the termination gateway stores the incoming fax until a status report confirming that all the pages have been received by the destination fax machine.

Furthermore, in accordance with a preferred embodiment of the invention, on the transmitted status report indicating a transmission error, the termination gateway re-transmits the stored fax .

In addition, in accordance with a preferred embodiment of the invention, the step of establishing a communication link includes the step of the local communications fax gateway determining the optimum least cost route for transmission of the fax from a maintained up-to-date database of routes.

Furthermore, in accordance with a preferred embodiment of the invention, the step of identifying the termination fax gateway includes the step of the local communications fax gateway determining the optimum least cost route for transmission of the fax from a maintained database of routes.

Furthermore, in accordance with a preferred embodiment of the invention, the Fax Protocol Enhancer includes a non-volatile memory unit and the local communications fax gateway transmits the updated optimum least cost route data to the non-volatile memory unit on being connected with the Fax Protocol Enhancer thereby allowing the Fax Protocol Enhancer to establish route calls from the Fax Protocol Enhancer to the local fax gateway via the least cost route telephone network.

Additionally, in accordance with a preferred embodiment of the invention, there is provided a system for real-time transmission of facsimile (fax)

images between an originating fax machine and a destination fax machine, via an Internet Protocol (IP) network. The system includes a Fax Protocol Enhancer (FPE) connected to the originating fax machine, for ensuring an open line between the originating fax machine and the destination fax machine, a local
5 communication gateway connectable to the Fax Protocol Enhancer (FPE) and at least one termination gateway connectable to the destination machine. The local and termination gateways are connectable to each other via the IP network, and have identifying IP addresses.

Furthermore, in accordance with a preferred embodiment of the
10 invention, the Fax Protocol Enhancer (FPE) includes a call-back unit for re-instating a disconnected communications link between the FPE to the originating fax machine.

Furthermore, in accordance with a preferred embodiment of the invention, the system includes a private telephone exchange (PBX) connecting
15 the originating fax machine to the Fax Protocol Enhancer. In an alternative embodiment of the invention, the originating fax machine is a personal computer having a fax card coupled thereto and wherein the Fax Protocol Enhancer is coupled to the personal computer.

Furthermore, in accordance with a preferred embodiment of the
20 invention, the local communication gateway includes a database of transmission routes.

Additionally, There is also provided, in accordance with a preferred embodiment of the invention, a method for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine via a
25 communications link. The method includes the steps of:

- a) connecting first and second Fax Protocol Enhancer to the originating and destination fax machines, respectively ;
- b) establishing a communication link between the first and second Fax Protocol Enhancer, thereby to open a line between the originating
30 and destination fax machines; and

c) maintaining the communication link on being disconnected by originating a call back from the first Fax Protocol Enhancer to the originating fax machine.

5 Additionally, in accordance with a preferred embodiment of the invention, there is provided a system for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via a communications network. The system includes a first Fax Protocol Enhancer (FPE) connected to the originating fax machine and a second FPE connected to the destination fax machine. The first and second FPE are in communication via
10 the communications network and the first Fax Protocol Enhancer ensures that a line is kept open between the originating fax machine and the destination fax machine

Furthermore, in accordance with a preferred embodiment of the invention, the system communications network is any one of a group including an
15 integrated services digital network (ISDN), public switched telephone network (PSTN); a satellite network, an Internet Protocol (IP) network and the INTERNET.

Additionally, in accordance with a preferred embodiment of the invention, there is also provided a method and a system for real-time transmission of facsimile (fax) images between an originating fax machine and an email
20 address via an Internet Protocol (IP) network. The method includes the steps of:

establishing a local communication gateway connectable to the IP network, the local communication gateway having an identifying IP address;

establishing a communication link via a Fax Protocol Enhancer between the originating fax machine and the Internet; and

25 transmitting a fax image by dialing a unique code followed by the email address.

Furthermore, in accordance with a preferred embodiment of the invention, the local communications fax gateway recognizes the unique code; and

translates the unique code to a regular Email attachment for transmitting
30 the fax as an Email.

The unique code is obtained from a conversion table stored on the local communications fax gateway.

Finally, in accordance with a preferred embodiment of the invention, the dialing is undertaken via a keyboard connected to the Fax Protocol Enhancer.

5

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the appended drawings in which:

Fig. 1 is a schematic illustration of the prior art communication link
10 between two facsimile machines;

Fig. 2 is a graphical representation of the signal transmission of images between two facsimile machines of Fig. 1;

Fig. 3 is a schematic illustration of a real-time system for sending facsimiles (faxes) via an IP network, in accordance with a preferred embodiment
15 of the invention;

Fig. 4 is a schematic block diagram illustration of the Fax Protocol Enhancer (FPE) of the system of Fig. 3;

Fig. 5 is flow chart illustration of the operation of the real-time fax transmission system;

Fig. 6 is a schematic block diagram illustrating the operational flow of a preferred embodiment of a local fax gateway of Fig. 3;

Fig. 7 is a flow chart illustration of the operation of the gateway of Fig.3;

Fig. 8 is a schematic illustration of a real-time system for sending facsimiles (faxes) via an IP network, in accordance with a further preferred
25 embodiment of the invention;

Fig. 9 is a schematic illustration of a real-time system for sending facsimiles (faxes) via an IP network, in accordance with a further preferred embodiment of the invention;

Fig. 10 is a flow chart diagram illustration of the protocol between a local
30 fax gateway and the Fax Protocol Enhancer of Fig.3;

Fig. 11 is a schematic illustration of a real-time system for sending facsimiles (faxes) via a PSTN telephone line, in accordance with a further preferred embodiment of the invention;

Fig. 12 is a schematic block diagram illustration of the Fax Protocol Enhancer (FPE) of the system of Fig. 9; and

Fig. 13 is a schematic block diagram illustrating the operational flow of a further preferred embodiment of local fax gateway.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Reference is made to Fig. 3 which is a schematic representation of a real-time system for sending facsimiles (faxes) via the Internet, referenced 90, in accordance with a preferred embodiment of the invention.

5 The real-time fax transmission system comprises at least one Fax Protocol Enhancer (FPE) 102 which is connected to the transmitting (or originating) facsimile machine 104, local and termination fax gateways, 106 and 108, respectively, and a receiving (or destination) facsimile machine 110. The local and termination fax gateways, 106 and 108, respectively act as the default
10 gateways for the transmitting and receiving facsimile machines 104 and 110, respectively. The fax gateways communicate with each other via the Internet 90, as will be described in greater detail below.

 Fax Protocol Enhancer 102 ensures that the line remains open at the end of the fax transmission until the originating facsimile machine 104 has
15 received the status report from the destination facsimile machine 108. FPE 102 functions as a dial-up router and routes long distance and international calls to the nearest gateway (local gateway 106) which makes contact with the termination gateway 108, closest to the receiving machine 110. Termination fax gateway 108 dials the receiving facsimile machine 110, thereby establishing a virtual line (via
20 the Internet) between the transmitting and receiving facsimile machines 104 and 110, respectively. In a manner similar to standard facsimile communication, after the fax image has been received, a status report from the receiving fax 110 is transmitted to the originating fax machine 104.

 It is a feature of the invention that all the functions of the fax machine
25 continue to be available and unaffected by the connection of the Fax Protocol Enhancer 102 and use of the fax gateways, 106 and 108, respectively. Furthermore, it is not essential that the receiving fax machine 110 be equipped with a Fax Protocol Enhancer to receive fax messages.

 Fax Protocol Enhancer (FPE) 102 is driven by software residing at the
30 local fax gateway 106. In addition to functioning as a dial-up router for routing

calls to the desired destination, FPE 102 ensures that the communication line between the fax machines 104 and 110 is kept open while the fax images are being transmitted and until the status report sent by the destination machine 110 has been received by and printed out by the originating fax machine 104.

5 Fax Protocol Enhancer (FPE) 102 comprises a housing 111 containing commercially available components. FPE 102 is schematically shown in Fig.4 to which reference is now made. FPE 102 includes at least a dual tone multiple frequency (DTMF) chip 112, EEPROM (electrically erasable programmable read only memory) 114 and a ringer 116 coupled together via a local CPU (central
10 processing unit) 115.

DTMF chip 112 is a standard commercially available chip for dialing a desired number. Ringer 116 is utilized for ringing the originating fax machine 104, as will be described later in greater detail. Fax Protocol Enhancer (FPE) 102 is programmable using the telephone keypad or the keypad attached to the fax
15 machine 102. The telephone prefixes of the areas and countries is input and the data is stored in EEPROM 114.

The Internet is a packet switched network, breaking up data into small packets prior to routing and sending the data by means of two protocols, commonly designated as TCP/IP, that is Transmission Control Protocol (TCP)
20 which handles the breaking up of the data and the Internet Protocol (IP) for routing the data to the destination address.

Local and termination fax gateways, 106 and 108, respectively, are essentially identical and features described with reference to one of the fax gateways are deemed to be applicable to the other fax gateway. Each fax
25 gateway acts as an IP router. The local fax gateway 106 is connected to the Internet provider, preferably via a frame relay or similar direct leased line in order to be constantly connected to the Internet.

The local fax gateway 106 on receiving the fax image breaks each page into approximately 40 "strips". Each strip is transmitted separately to the
30 termination gateway 108. As each "strip" is received by the termination gateway 108, it is forwarded to the destination fax machine 110. Thus, the fax is effectively

being received in real-time. Thus, in contrast to accepted fax transmission practices, the faxed page is not reassembled from the "strips" before being printed out at the receiving machine, in standard "store and forward" mode.

5 A further feature of the invention is the capability of incorporating security measures. For example, each "strip" of data can be sent via different Internet switches. Optionally, for increased security, each "strip" of data can also be encrypted before being sent over the Internet. In addition, the copy of the fax which is temporarily stored at the termination gateway 108, is deleted once the fax has been successfully received.

10 The status report is sent to the originating fax machine 102 after transmission of the fax. At the final handshake, in case the elapsed time was too long and the originating fax machine 104 was disconnected from the line, local gateway 106 originates a call-back request to Fax Protocol Enhancer 102 to reinstate a connection to the originating fax machine 104 to allow the printing out
15 of the status report

In an alternative embodiment, the termination gateway 108 stores the incoming fax until a status report confirming that all the pages have been received. In the event that an error has occurred and part or all of the fax has not been received, the fax is resent by the terminating gateway 108. It is not
20 necessary for the originating fax machine to resend it. Instead, the terminating gateway 108 stores the fax and forwards it to the receiving fax machine 110 at a later time. A status report confirming the successful receipt of the fax sent by the destination machine 110 is forwarded by the terminating gateway 108 via the Internet to the local gateway 106 which can then originate a call via the FPE 102
25 to the originating machine 104.

Reference is now made to Fig. 5 which is flow chart illustration of the operation of the real-time fax transmission system.

To send a fax, the telephone number of the destination is dialed (step 202). The telephone prefix number is checked by the Fax Protocol Enhancer
30 (FPE) 102 by referenced to the numbers previously entered and stored in EEPROM 114 (step 204). If the fax destination is local or should not be routed to

through the fax gateways, the Fax Protocol Enhancer (FPE) 102 is bypassed and the fax sent by normal channels (step 206).

If the fax should be routed through the fax gateways, the dial-up router of the Fax Protocol Enhancer (FPE) 102 calls the nearest local fax gateway 104 (step 208) and keeps the line open until it receives an instruction from the local gateway 104 to disconnect. The local fax gateway 104 identifies the termination gateway 106 and via the Internet 90 contacts the termination gateway 106 (step 210). Normally, the termination gateway selected is the gateway which is nearest to the destination fax 110. However, any available termination gateway may be chosen. The originating fax gateway 104 sends a string containing the telephone number of the destination fax 110 to the termination gateway 106, which then dials the number (step 212).

After the destination fax has answered, a line is opened between the termination gateway 106 and the destination fax 110 (step 214). Once the virtual line, via the Internet, has been established, the transmitting facsimile machine 104 begins transmitting (step 216). Each page is received by the local fax gateway 106 and split into a multiplicity of "strips", which are then sent one by one to the termination gateway 108 for onward transmission to the destination fax machine 110 (step 218).

At the end of the fax transmission, after all the fax pages have been sent, the originating fax machine 102 waits for the status report from the destination fax 110. If a report is not received within the short time frame (generally 3-5 seconds) expected by the G3 fax protocol, the transmitting facsimile machine 102 disconnects.

Once the complete fax image has been sent, a status report is sent from the destination fax machine 110 (step 220). If an error has occurred during the transmission and the fax has not been completely received, the status report will contain details of the error.

Once the fax has been successfully received, the status report is sent to the terminating fax gateway 108 which transmits the report to the local fax gateway 106 and thence to the originating fax machine 102 via the Fax Protocol

Enhancer 102. If the originating fax machine 102 has been disconnected (query box 222), Fax Protocol Enhancer (FPE) 102 dials the fax machine 102 to restore the line (step 224). The status report is then printed out (step 226) and the fax machine disconnected from the telephone circuit (step 228).

5 Reference is now made to Fig. 6 which is a schematic block diagram illustrating the operational flow of local fax gateway 106. Terminating fax gateway 108 contains similar components to local fax gateway 106 and it will be appreciated that the components of local fax gateway 106 are also applicable to terminating fax gateway 108.

10 Local fax gateway 106 comprises a fax/modem/voice board 130, a software driver 132, a central processing and management unit 134 for managing the fax gateway, an user authentication unit 136, a network / router management unit 148 and an Internet router 140.

 Central processing and management unit 134 (CPMU), which is similar
15 to a standard central processing unit (CPU), is connected to software driver 132, user authentication unit 136 and network/router management unit 148. Central processing and management unit 134 incorporates software for managing and controlling the operation of the components. Software driver 132, which is connected to fax/modem/voice board 130 and Internet router 140, for receiving
20 and transmitting faxes. Network/router management unit 148 is coupled to Internet router 140 and is controlled by central processing and management unit 134 for the selection of the optimum Internet route.

 The functional operation of local fax gateway 106 is illustrated by the flow chart of Fig. 7 to which reference is now also made. The incoming audio
25 signals (arrow 150) from the fax are converted to binary digital information by modem 130 (step 250). The digital signals are processed by software driver 132 (arrow 151) and CPMU 134 (arrow 152) (step 252). CPMU 134 checks out and authenticates the sender (step 254) transmitting the fax (arrow 154), and verifies the location of the addressee (destination fax) (step 256). The destination
30 address is then passed to the network/router management unit 148 (arrow 156) which ascertains the best route for onward transmission of the fax (step 258).

The CPMU 134 instructs the driver 132 (arrow 158) to transmit the fax (arrow 160) via the chosen route (step 260) which is made available to the network router 140 (arrow 162) by network/router management unit 148 at the time the fax is being transmitted.

5 Since the local fax gateway 106 is in communicable contact with the Fax Protocol Enhancer (FPE) 102, it will be appreciated that the local fax gateway 106 can be utilized to control the operation of the FPE. For example, the local fax gateway 106 can maintain updated data including least cost routing data regarding termination routes and local telephone routing between the FPE and
10 the local gateway. By adding a non-volatile memory unit (not shown) to the FPE, the updated least cost routing data can be downloaded to the FPE enabling the FPE to select the most favorable route for local dialing. The local fax gateway 106 selects the most favorable termination gateway and route to the destination fax machine 110 for onward transmission of the fax.

15 The main time critical obstacle during fax transmission is determined by the fax / modem board 130 on the gateway and the fax machine 104 itself. The fax / modem board 130 expects to receive a confirmation response within 6 seconds, otherwise it switches off the line to the fax machine. Standard fax machines disconnect if they have not received confirmation within about 14
20 seconds (this time is preset by the fax manufacturers and can not be altered).

 In an alternative embodiment, the maximum waiting time is extended before disconnection from 6 seconds (determined by the fax / modem board 130) to 14 seconds (the maximum waiting time allowed by the fax machine), a net gain of about 8 seconds. This 8 second period compensates for delays on the
25 Internet.

 The method for extending the waiting time on the gateway is briefly described as follows: At the end of the fax session, the control (on the gateway) of the confirmation signal to the fax machine, is taken by the voice function of the fax / modem / voice board 130. To enable the voice function of the fax / modem /
30 voice board 130 to provide the confirmation signal to the fax machine, a tone which simulates a fax confirmation is prerecorded on the gateway. As soon as

the confirmation arrives from the Internet, the board plays the tone towards the fax machine, which accepts it as a confirmation.

Reference is now made to Fig. 8 which is a schematic illustration of a further embodiment of the invention for sending facsimiles (faxes) via an IP network in real-time. Elements of this embodiment of the invention which are
5 similar to elements which have been previously described with respect to the preferred embodiment hereinabove, are similarly designated and will not be further described.

Fig. 8 is a schematic illustration of a real-time system, generally
10 designated 300, for sending facsimiles (faxes) via a private telephone exchange (PBX) 302.

Real-time fax system 300 comprises at least one originating facsimile machine, generally designated 304, connected via PBX 302 to a local fax gateway 306. Real-time fax system 300 further comprises a termination fax
15 gateway 108 connectable via a PSTN/ISDN telephone network 95 to a destination facsimile machine 110. Local and termination fax gateways, 306 and 108, respectively, are connectable via the Internet 90. Preferably, local fax gateway 306 is connected to the same PBX 302 as the facsimile machine 304.

Local fax gateway 306 combines the functions of fax gateway 106 and
20 Fax Protocol Enhancer (FPE) 102, described hereinabove with respect to Fig. 3. That is, the functional operations of Fax Protocol Enhancer (FPE) 102 (as described above with respect to Fig. 3) is software driven by local fax gateway 306, which ensures that the communication line between the PBX 302 and fax destination machine 110 is kept open while the fax images are being transmitted
25 and until the status report is received by the originating fax machine 304.

In this embodiment, calls are dialed by PBX 302 to local fax gateway 306, which uses the dial-up router function to route the call via the Internet 90 and termination gateway 108 to the destination fax machine 110. After receiving the fax, a status report is sent to the local fax gateway 306 which then transmits the
30 report to the originating machine 304. If the originating fax machine 304 has been disconnected, local fax gateway 306 calls the machine back to transmit the report.

Reference is now briefly made to Fig. 9 which is a schematic illustration of a further embodiment of a real-time system, generally designated 400, for sending facsimiles (faxes) from a personal computer (PC) 402 via an IP network 90 in real-time.

5 Real-time fax system 400 comprises at least one PC 402 connectable via a PSTN/ISDN telephone network 95 to a local fax gateway 406. Real-time fax system 400 further comprises a termination fax gateway 108 connectable via a PSTN/ISDN telephone network 95 to a destination facsimile machine 110. Local and termination fax gateways, 406 and 108, respectively, are connectable via the
10 Internet 90.

PC 402 is any commercially available computer having a fax/modem card (not shown) connected thereto and including applicable software for controlling the operation of the fax/modem card.

PC 402 further comprises the components of Fax Protocol Enhancer
15 (FPE) (similar to FPE 102) and software for driving the FPE. That is, the FPE software ensures that the communication line between the PC 402 and fax destination machine 110 is kept open while the fax images are being transmitted and until the status report is received by the PC 402 (the originating fax machine).

In this embodiment, calls are dialed and routed by the FPE software in
20 the PC to local fax gateway 406, then routes the call via the Internet 90 and termination gateway 108 to the destination fax machine 110.

Reference is now briefly made to Fig. 10 which is a flow chart diagram illustration of the protocol between a local fax gateway 106 and the Fax Protocol Enhancer (FPE) 102.

25 An incoming fax (from Fax Protocol Enhancer (FPE) 102, for example) is received by the local fax gateway 106 (step 602). The local fax gateway ascertains whether the sender is a valid user (query box 604). If not a valid user, the fax is ignored. If the user is authenticated, the gateway receives the fax, page by page (step 606) for transmission (step 218, as described hereinabove with
30 respect to Fig. 5). After all the pages have been received and transmitted (step 608), an "end of fax" message is sent to the destination fax machine (step 610).

The local fax gateway 106 waits to receive a status report (step 612) and on receipt, sends a dial request to the Fax Protocol Enhancer (FPE) 102 to reconnect the FPE to the originating fax machine (step 614). The status report is then transmitted to the originating fax machine (step 616). Once the status report transmission has been completed (query box 618), an instruction is sent by the local fax gateway 106 to the FPE to disconnect from the originating fax machine (step 620).

Reference is now made to Fig. 11 which illustrates a system, generally designated 500, for real-time transmission of faxes, which overcomes the problems associated with noisy telephone lines. System 500 comprises a first Fax Protocol Enhancer (FPE) 502 which is connected to the originating facsimile machine 104, and a second FPE 504 connected to the destination facsimile machine 110. The first and second FPEs 502 communicate via PSTN line, referenced 505.

Fax Protocol Enhancer (FPE) 502, schematically illustrated in Fig. 12, comprises the same components as Fax Protocol Enhancer (FPE) 102, described hereinabove with respect to Fig. 4. FPE 502 further comprises a call-back unit, referenced 506 coupled to CPU 115.

A "noisy" telephone line which disrupts the transmission and causes a delay, will cause the originating fax machine 104, in accordance with the G-3 fax protocol, to assume that the transmission has been completed and disconnect. Consequently, sending faxes to places having poor communications can be very problematic and frustrating with a low percentage of successful transmissions.

In the event of the originating fax machine 104 being disconnected, call-back unit 506 of first FPE 502 reconnects originating fax machine 104 to the open line.

Reference is now made to Fig. 13 which is a schematic block diagram illustrating the operational flow of an alternative embodiment of a local fax gateway 106 for sending a fax to an Email account. The embodiment of Fig. 13 is similar to the embodiment of Fig. 6 described hereinabove. Elements of this

embodiment of the invention which are similar to elements are similarly designated and will not be further described.

Thus, local fax gateway 106 comprises a fax/modem/voice board 130, a software driver 132, a central processing and management unit 134 for managing
5 the fax gateway, an user authentication unit 136, a network / router management unit 148 and an Internet router 140.

In addition, local fax gateway 106 comprises a "fax-to-Email" server 170 which is coupled to software driver 132 and a Email keyboard 173 connected to Fax Protocol Enhancer (FPE) 102.

10 A fax may be sent to an Email account either via keyboard 173 to the Fax Protocol Enhancer box 102 or by using a conversion table of email addresses.

To sent to an Email account via keyboard 173, the fax user dials a unique code, than enters the full Email address on the keyboard 173 and than
15 presses the send button (instead of dialing a regular fax number). This causes the following operational steps:

- a) The Fax Protocol Enhancer 102 dials the nearest Gateway;
- b) The Gateway recognizes from the unique code that the fax is addressed to an Email address and engages the "fax-to-Email"
20 server 170;
- c) Server 170 receives the image, translates it to a regular Email attachment, sends the Email via the Internet and sends back to the fax user a confirmation report.

Alternatively, a fax can be sent to an Email address without using the
25 keyboard 173 by the user pre-registering a list of the Email addresses he uses on the Gateway and obtaining a conversion table for each Email address with it's own designated unique number. The user then sends the fax to Email by keying a trigger code and after it the Email number obtained from the table. The operational steps a) to c) described hereinabove then occur.

This embodiment has the advantage of allowing a fax be sent to an Email address in the same manner as a regular fax, without the need of having any Internet connection.

5 It will be appreciated by person knowledgeable in the art that the real-time fax system is not limited to the transmissions via the Internet or public telephone networks as described hereinabove, but is also applicable to other forms of transmission, such as satellite communications.

10 It will be further appreciated that the present invention is not limited by what has been described hereinabove and that numerous modifications, all of which fall within the scope of the present invention, exist. Rather the scope of the invention is defined by the claims which follow:

CLAIMS

1. A method for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via an Internet Protocol (IP) network, the method comprising the steps of:
 - 5 establishing a local communication gateway and at least one termination gateway, said local and at least one termination gateway being connectable to said IP network, each of said local and at least one termination gateway having an identifying IP address;
 - establishing a communication link via a Fax Protocol
 - 10 Enhancer between said originating fax machine and said destination fax machine; and
 - transmitting a fax image and on receipt of said fax image, said destination fax machine transmitting a status report to said originating fax machine,
 - 15 wherein said Fax Protocol Enhancer ensures that a line is kept open between said originating fax machine and said local communication gateway and thence to said destination fax machine
2. A method according to claim 1 and wherein said Fax Protocol Enhancer is connected to said originating fax machine and connectable to said
- 20 local gateway.
3. A method according to claim 1 and further comprising a private telephone exchange (PBX) connected to said originating fax machine and wherein said Fax Protocol Enhancer is coupled to said local gateway.
4. A method according to claim 1 and wherein said originating fax machine
- 25 is a personal computer having a fax card coupled thereto and wherein said Fax Protocol Enhancer is coupled to said personal computer.
5. A method according to claim 1 wherein said step of establishing a communication link comprises the steps of:

establishing a communication link from said Fax Protocol Enhancer to said local fax gateway via the telephone network;

5 identifying the termination fax gateway to communicate with said destination fax and establishing a communication link between said local fax gateway and said termination fax gateway via the IP network, said termination fax gateway having a second IP address; and

establishing a communication link via the telephone network from said termination fax gateway to the destination fax machine.

10 6. A method according to claim 1 and wherein said step of transmitting a fax image comprises the steps of:

for each page of fax image being received, by said local fax gateway, splitting each page into a multiplicity of strips;

15 said local fax gateway separately transmitting each of said multiplicity of strips in turn to said termination gateway; and

said termination gateway forwarding each of said multiplicity of strips in turn to said destination fax machine.

20 7. A method according to claim 1 and wherein said destination fax machine begins receiving each page of the fax image being transmitted before said originating fax machine has completed transmitting said each page.

8. A method according to claim 1 and further comprising the step of restoring the communication link between said originating fax machine and said destination fax machine, whenever said originating fax machine is disconnected from said communication link.

25 9. A method according to claim 8 and wherein said step of restoring the communications link comprises the step of said local fax gateway activating said Fax Protocol Enhancer to call-back to said originating fax machine.

10. A method according to claim 8 and wherein said step of restoring comprises the step of said local fax gateway calling-back to said originating fax machine.
- 5 11. A method according to claim 6 and wherein each of said multiplicity of strips of data is encrypted prior to onward transmission.
12. A method according to claim 1 and wherein said termination gateway stores the incoming fax until a status report confirming that all the pages have been received by said destination fax machine.
- 10 13. A method according to claim 12 and wherein, on said transmitted status report indicating a transmission error, said termination gateway re-transmits said stored fax .
14. A method according to claim 1 and wherein said step of establishing a communication link comprises the step of said local communications fax gateway determining the optimum least cost route for transmission of
15 said fax from a maintained up-to-date database of routes.
15. A method according to claim 5 and wherein said step of identifying the termination fax gateway comprises the step of said local communications fax gateway determining the optimum least cost route for transmission of said fax from a maintained database of routes.
- 20 16. A method according to claim 14 wherein said Fax Protocol Enhancer comprises a non-volatile memory unit and wherein said local communications fax gateway transmits the updated optimum least cost route data to said non-volatile memory unit on being connected with said Fax Protocol Enhancer thereby allowing said Fax Protocol Enhancer to
25 establish route calls from said Fax Protocol Enhancer to said local fax gateway via the least cost route telephone network.
17. A system for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via an Internet Protocol (IP) network, the system comprising:

a Fax Protocol Enhancer (FPE) connected to said
originating fax machine, for ensuring an open line between said
originating fax machine and said destination fax machine;

5 a local communication gateway connectable to said Fax
Protocol Enhancer (FPE); and

and at least one termination gateway connectable to said
destination machine,

wherein said local and at least one termination gateway are connectable
to each other via said IP network, and wherein each of said local and at
10 least one termination gateway has an identifying IP address.

18. The system according to claim 17 and wherein said Fax Protocol
Enhancer (FPE) comprises a call-back unit for re-instating a
disconnected communications link between said FPE to said originating
fax machine.

15 19. The system according to claim 17 and further comprising a private
telephone exchange (PBX) connecting said originating fax machine to
said Fax Protocol Enhancer.

20 20. The system according to claim 17 and wherein said originating fax
machine is a personal computer having a fax card coupled thereto and
wherein said Fax Protocol Enhancer is coupled to said personal
computer.

21. The system according to claim 17 and wherein said local communication
gateway comprises a database of transmission routes.

25 22. A method for real-time transmission of facsimile (fax) images between an
originating fax machine and a destination fax machine via a
communications link, the method comprising the steps of:

connecting first and second Fax Protocol Enhancer to said
originating and destination fax machines, respectively ;

establishing a communication link between said first and second Fax Protocol Enhancer, thereby to open a line between said originating and destination fax machines; and

5 maintaining said communication link on being disconnected by originating a call back from said first Fax Protocol Enhancer to said originating fax machine.

23. A method according to claim 22 and further comprising a private telephone exchange (PBX) connecting said originating fax machine to said Fax Protocol Enhancer.

10 24. A method according to claim 22 and wherein said originating fax machine is a personal computer having a fax card coupled thereto.

25. A method according to claim 22 and further comprising the step of restoring the communication link between said originating fax machine and said destination fax machine, whenever said originating fax machine
15 is disconnected from said communication link.

26. A method according to claim 25 and wherein said step of restoring the communications link comprises the step of said Fax Protocol Enhancer calling-back to said originating fax machine.

20 27. A system for real-time transmission of facsimile (fax) images between an originating fax machine and a destination fax machine, via a communications network, the system comprising:

a. a first Fax Protocol Enhancer (FPE) connected to said originating fax machine; and

b. a second FPE connected to said destination fax machine,

25 wherein said first and second FPE are in communication via said communications network; and

wherein said first Fax Protocol Enhancer ensures that a line is kept open between said originating fax machine and said destination fax machine.

28. The system according to claim 27 and wherein said communications network is any one of a group including an integrated services digital network (ISDN), public switched telephone network (PSTN); a satellite network, an Internet Protocol (IP) network and the INTERNET.
- 5 29. The system according to claim 27 and further comprising a private telephone exchange (PBX) connecting said originating fax machine to said Fax Protocol Enhancer.
30. The system according to claim 27 and wherein said originating fax machine is a personal computer having a fax card coupled thereto and
10 wherein said Fax Protocol Enhancer is coupled to said personal computer.
31. A method for real-time transmission of facsimile (fax) images between an originating fax machine and an email address via an Internet Protocol (IP) network, the method comprising the steps of:
- 15 establishing a local communication gateway connectable to said IP network, said local communication gateway having an identifying IP address;
- establishing a communication link via a Fax Protocol Enhancer between said originating fax machine and the Internet; and
- 20 transmitting a fax image by dialing a unique code followed by the email address.
32. A method according to claim 31 and further comprising the steps of:
- said local communications fax gateway recognizing said unique code;
- 25 translating said unique code to a regular Email attachment and transmitting said fax as an Email.
33. A method according to claim 31 wherein said dialing is via a keyboard connected to said Fax Protocol Enhancer.

34. A method according to claim 31 wherein said unique code is obtained from a conversion table stored on said local communications fax gateway.
- 5 35. A system for real-time transmission of facsimile (fax) images between an originating fax machine and an email address via an Internet Protocol (IP) network, the system comprising:
- a. a Fax Protocol Enhancer (FPE) connected to said originating fax machine;
 - 10 b. a local communication gateway connectable to said Fax Protocol Enhancer (FPE); and
 - c. a keyboard connected to said Fax Protocol Enhancer (FPE) for dialing an unique code for facsimiles addressed to email addresses.
- 15 36. The system according to claim 35 and wherein said local communication gateway comprises a "fax-to-Email" server for translating said email addressed facsimiles to a regular Email attachment.

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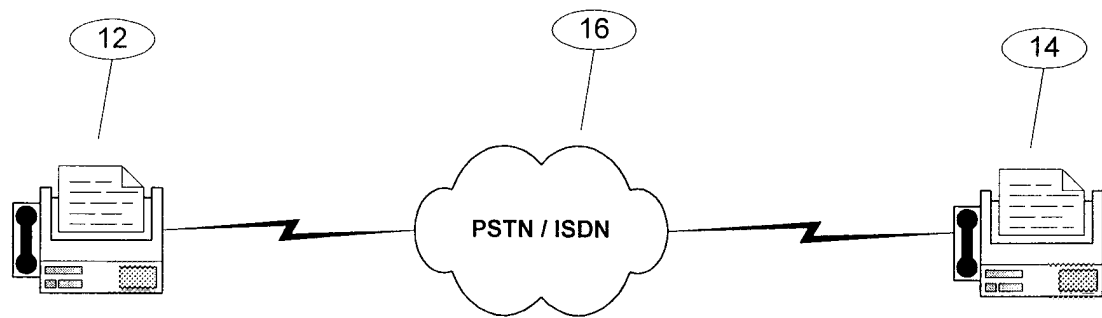


FIG. 1

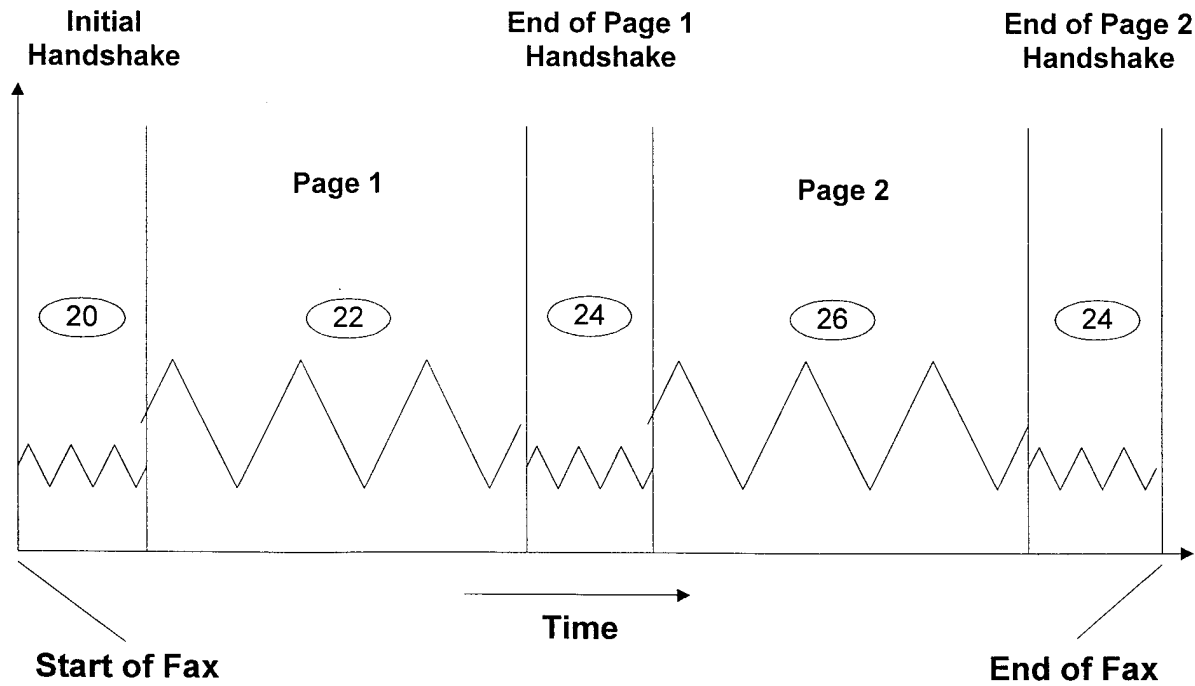
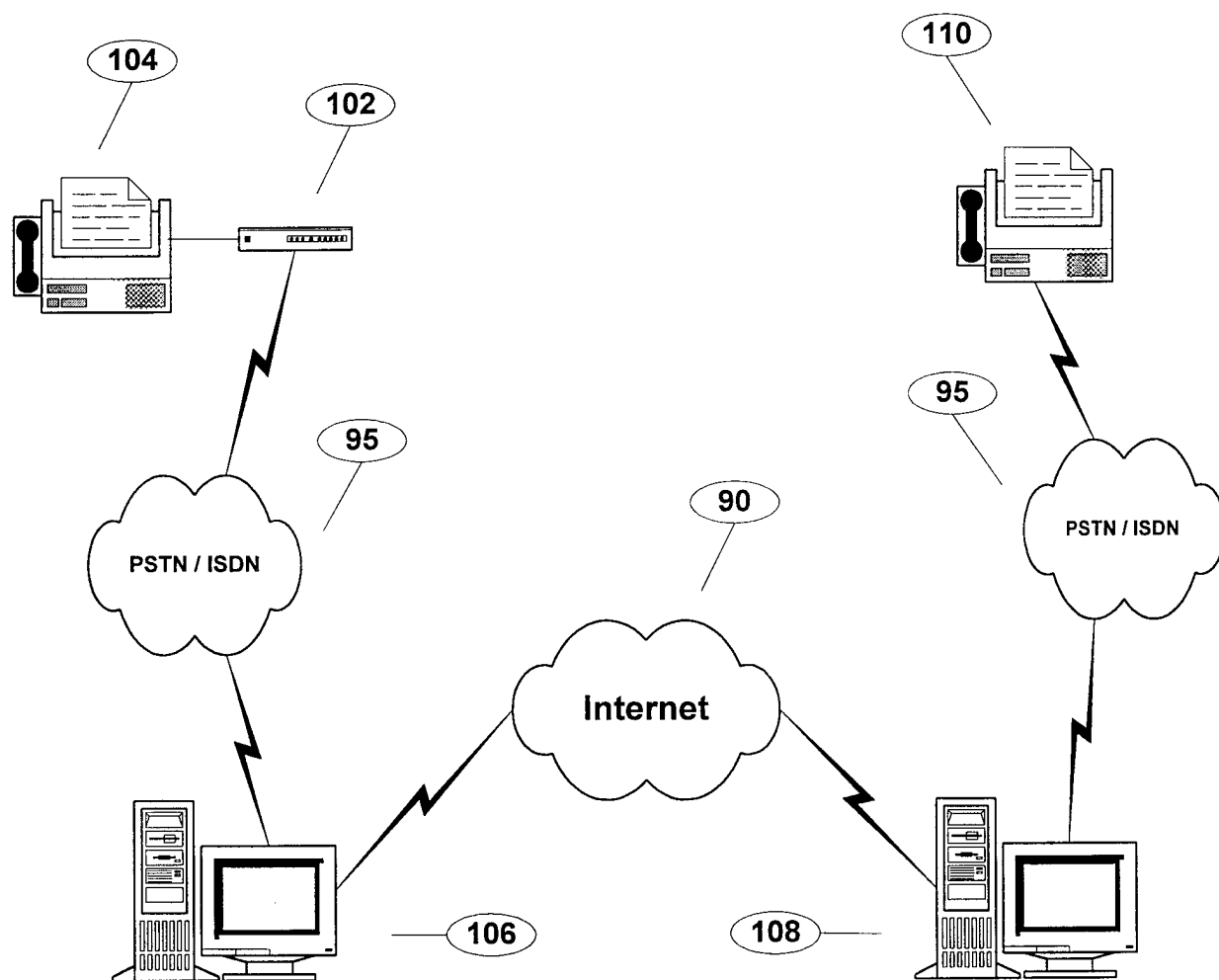


FIG. 2

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**FIG. 3**

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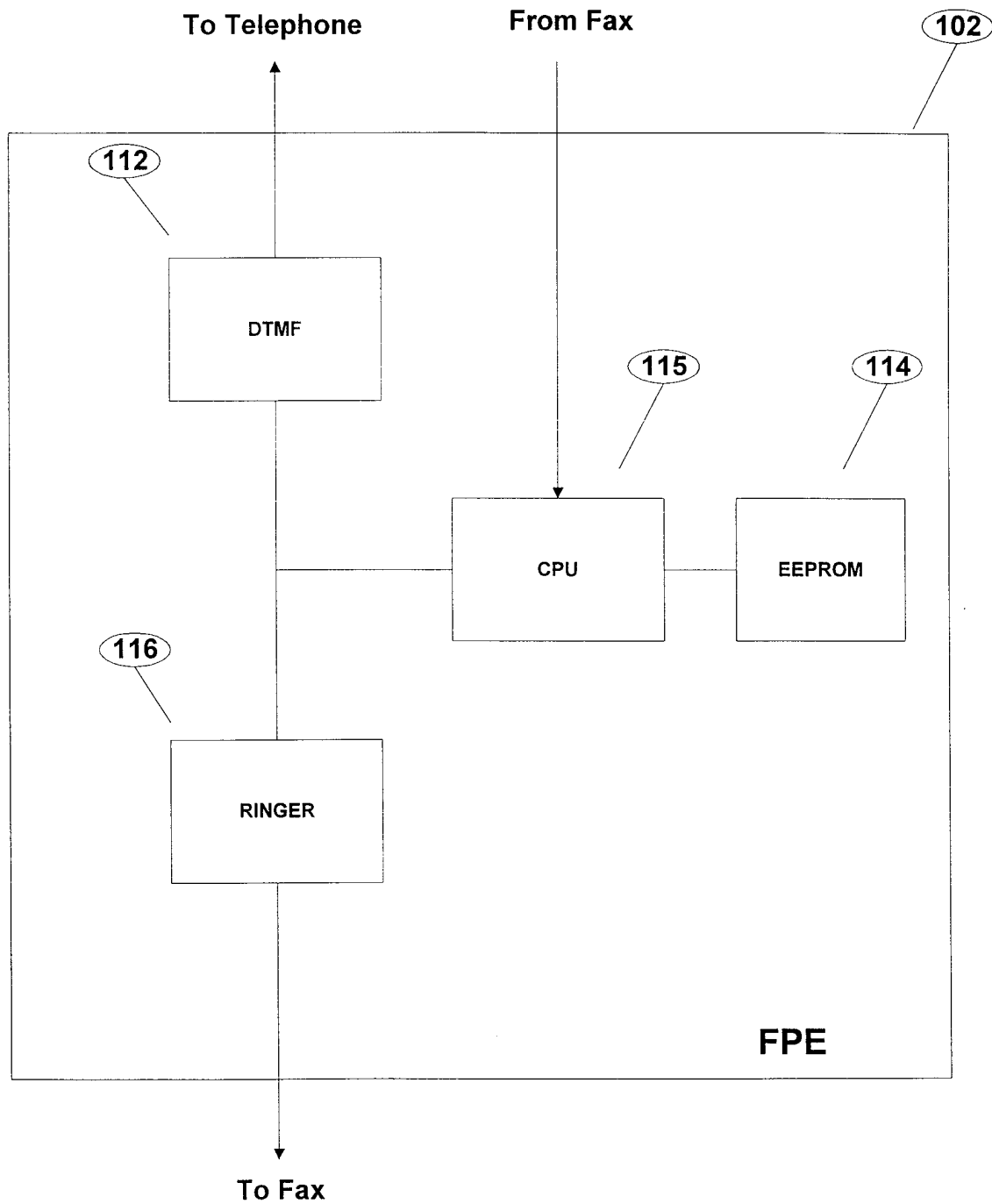


FIG 4

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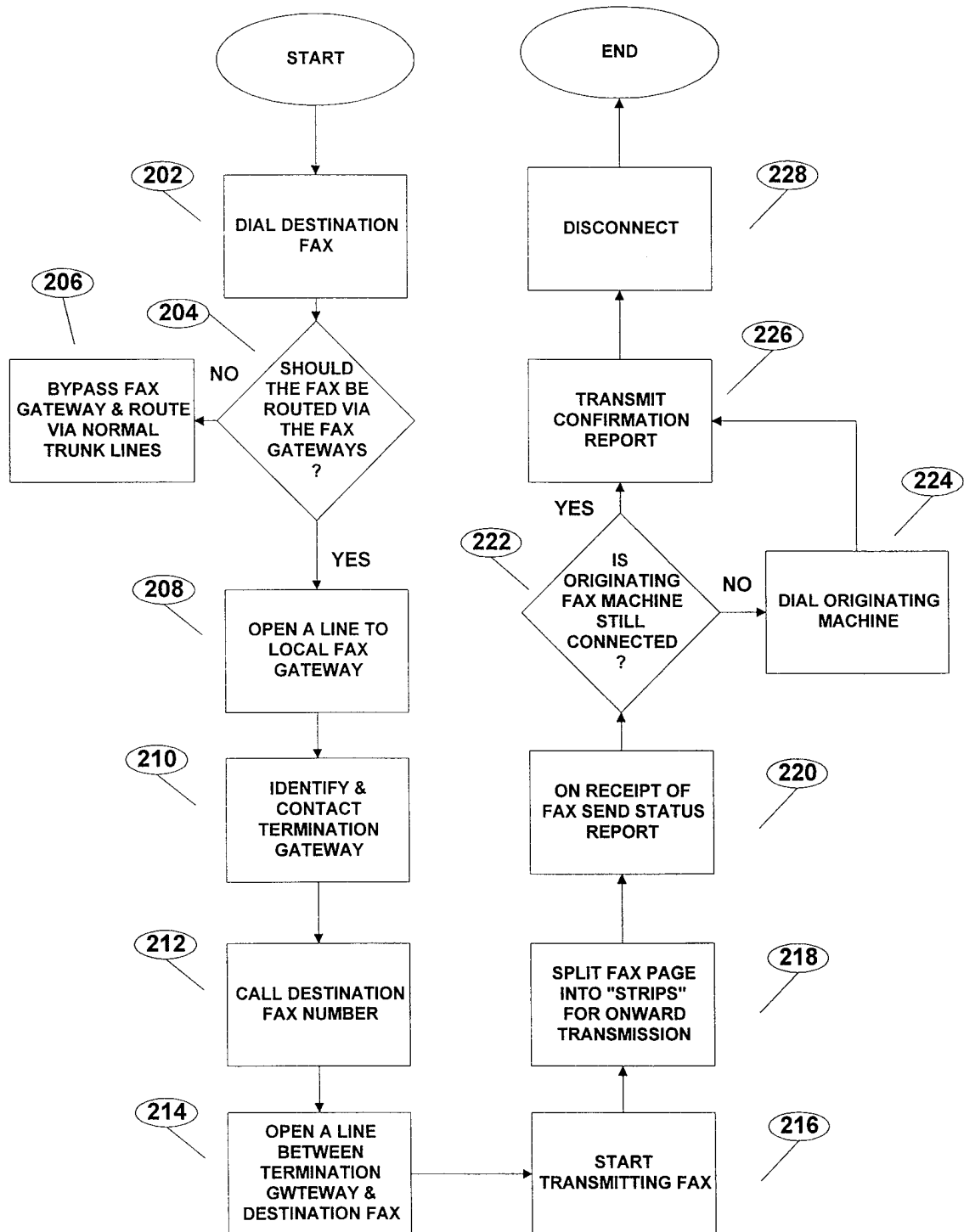


FIG. 5

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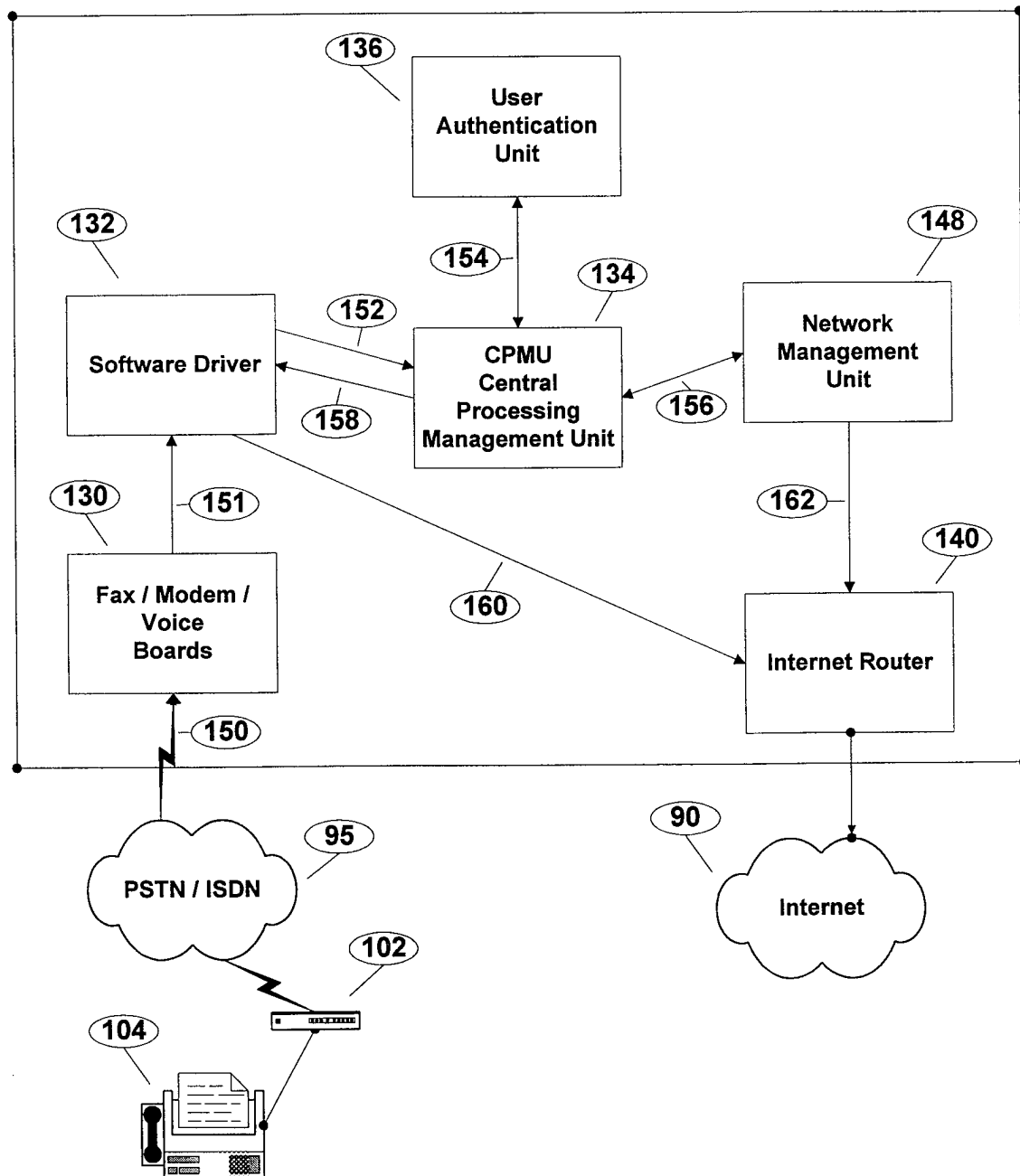
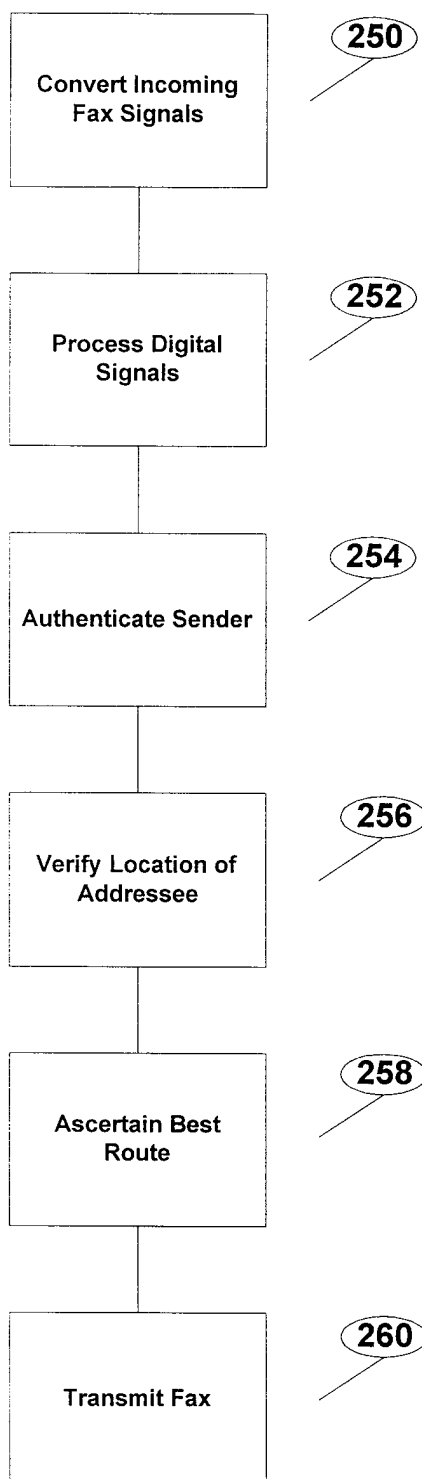


FIG. 6

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**FIG. 7**

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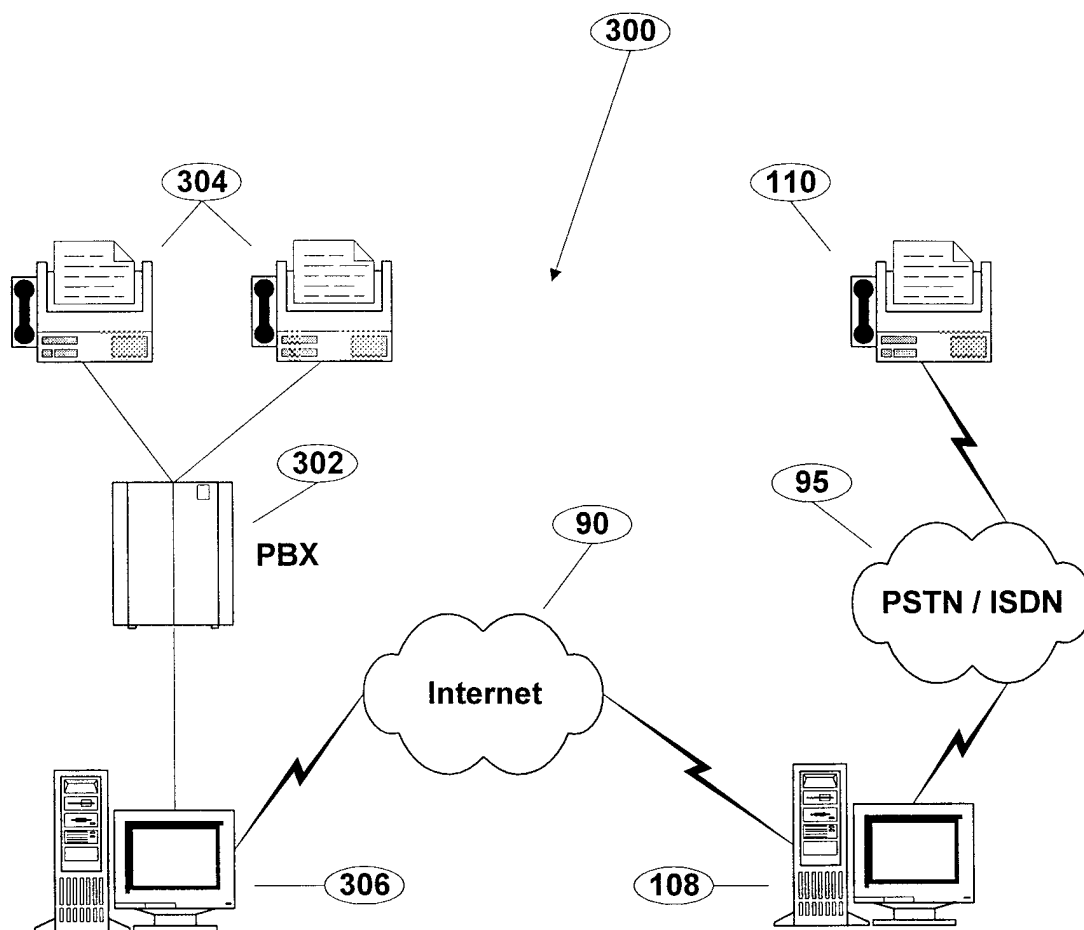
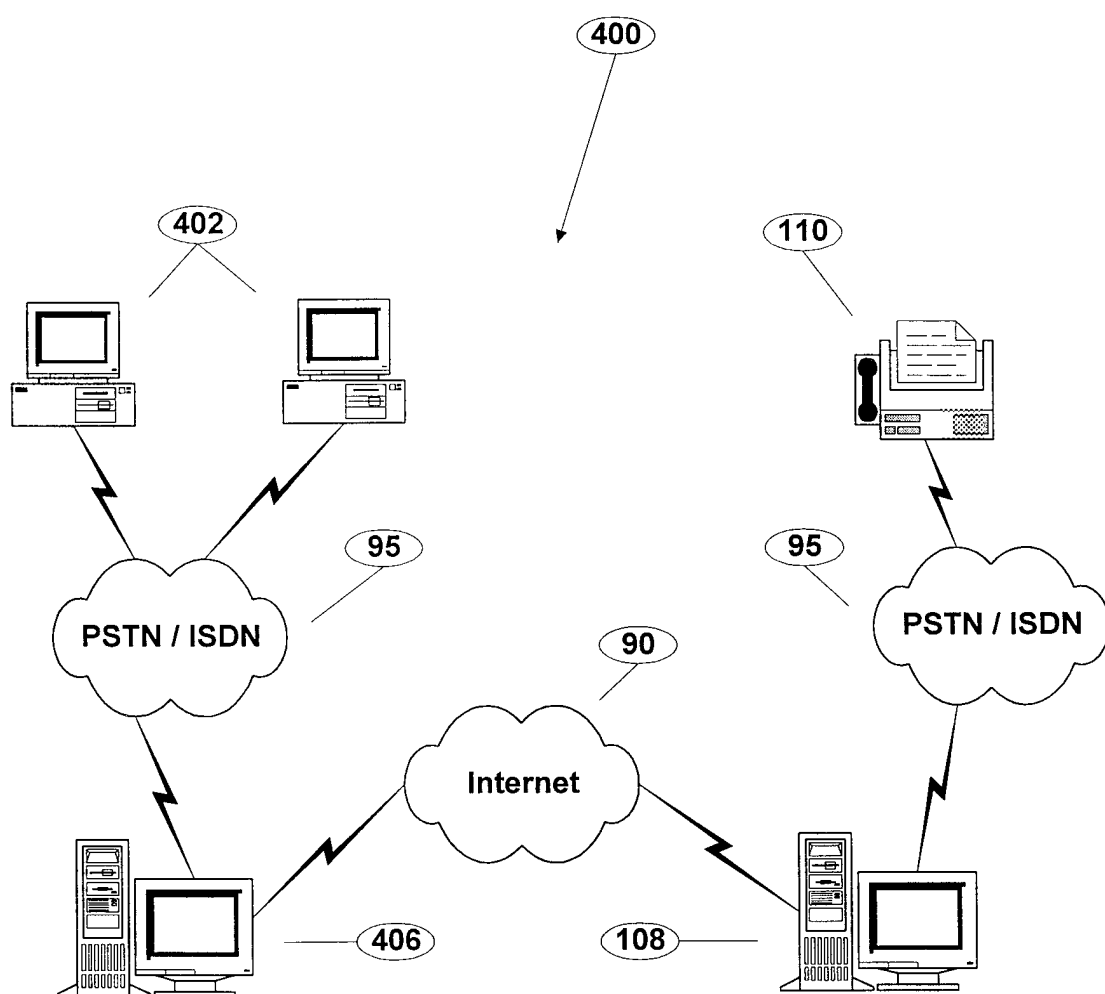


FIG. 8

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**FIG. 9**

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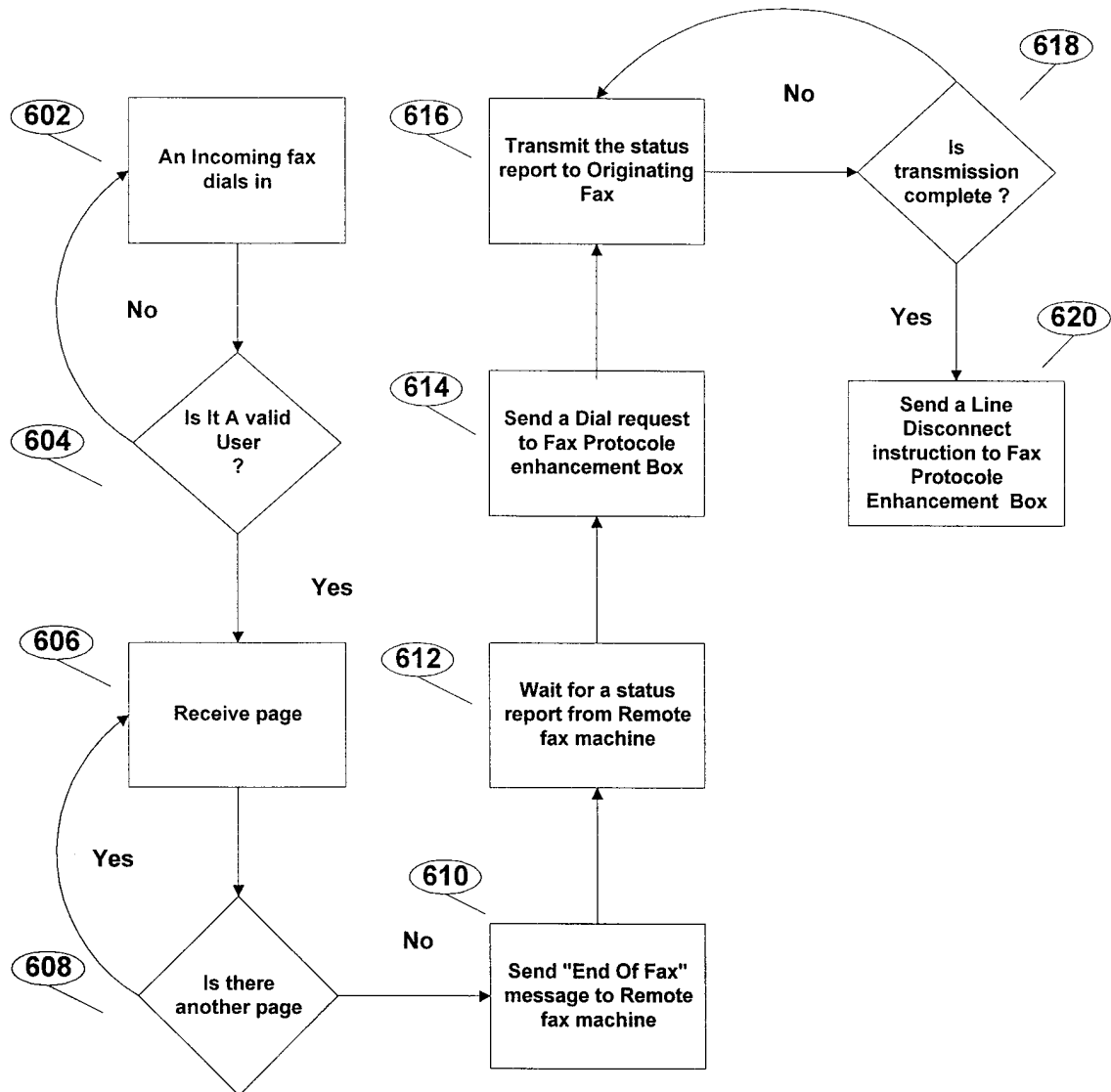


FIG. 10

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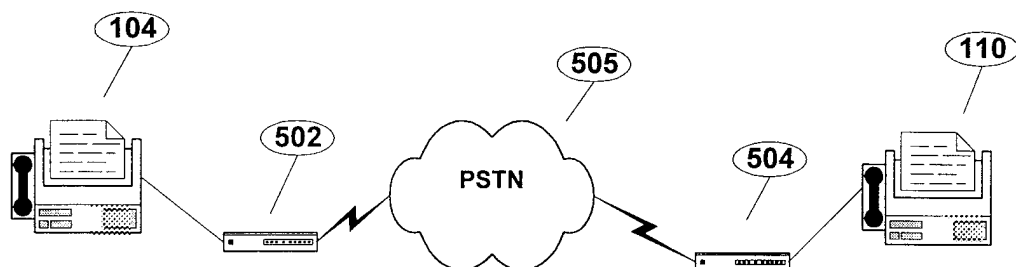


FIG. 11

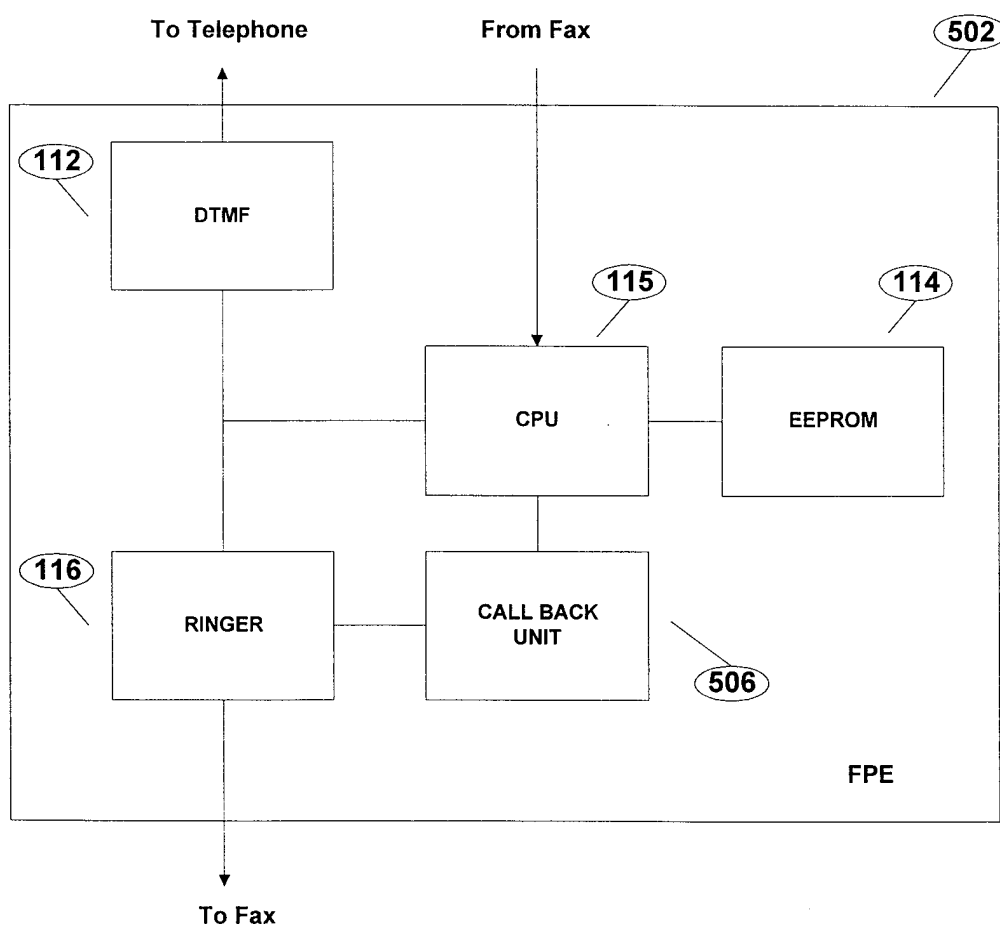


FIG. 12

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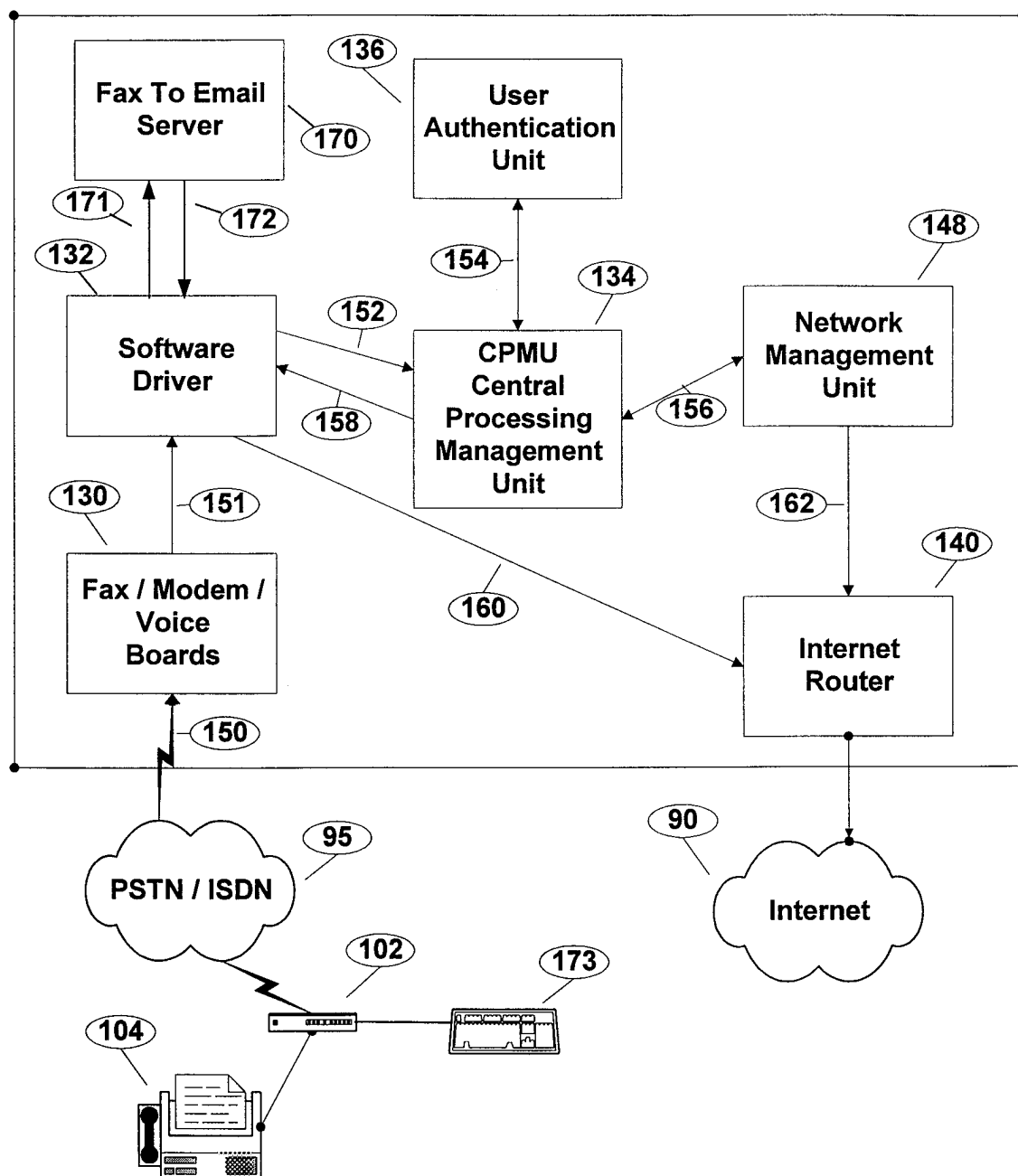


FIG. 13