

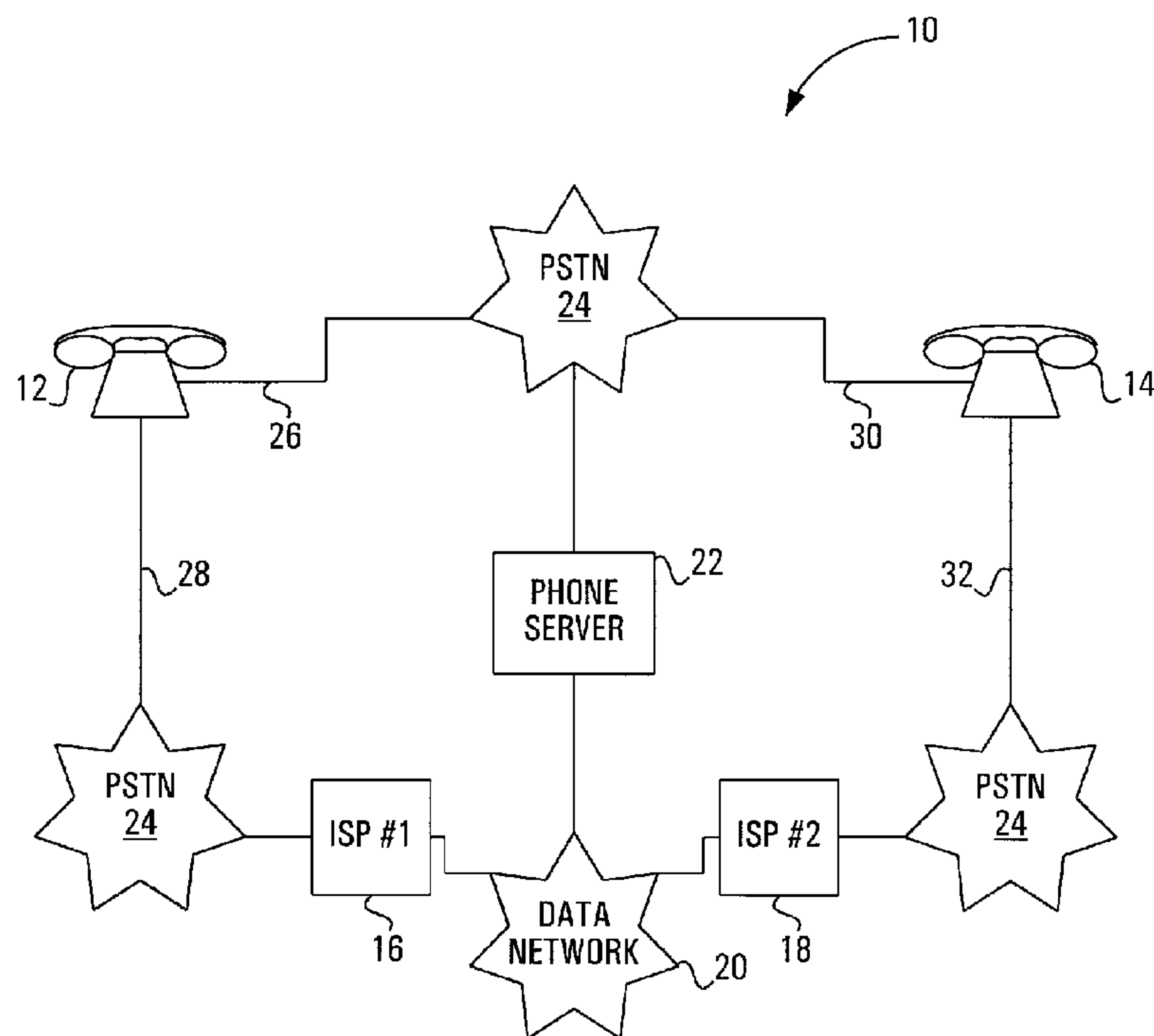


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(51) Int.Cl.⁶ H04L 12/12, H04M 11/06

(54) **ETABLISSEMENT D'UNE CONNEXION DE NOEUDS POUR
RESEAU DE DONNEES**

(54) **DATA NETWORK NODE CONNECTION ESTABLISHMENT**



(57) A method and apparatus for establishing a connection between nodes on a data network. The apparatus carries out the method by establishing a data network connection between a first node and a data network services provider, at an IP address provided by the data network services provider, transmitting an FSK message to a second node, the FSK message including the IP address, receiving the FSK message at the second node, extracting the IP address from the FSK message and establishing a connection through the data network between the second node and the first node, through the IP address.

DATA NETWORK NODE CONNECTION ESTABLISHMENT**ABSTRACT**

A method and apparatus for establishing a connection between nodes on a data network. The apparatus carries out the method by establishing a data network connection between a first node and a data network services provider, at an IP address provided by the data network services provider, transmitting an FSK message to a second node, the FSK message including the IP address, receiving the FSK message at the second node, extracting the IP address from the FSK message and establishing a connection through the data network between the second node and the first node, through the IP address.

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DATA NETWORK NODE CONNECTION ESTABLISHMENT**FIELD OF THE INVENTION**

5 This invention relates to the establishment of a connection
between remotely located data network nodes or customer
premises equipment operable to send packets of data to each
other. More particularly, such packets may include packets
of voice data to enable voice communications on a data
10 network, such as an internet or intranet.

BACKGROUND OF THE INVENTION

With the advent of the internet, the possibility exists to
transmit files between remotely located computers, several
15 miles or several hundred miles apart. Currently, the
technology exists for conducting voice communications over
such distances using the public switched telephone network
and conventional voice line technology.

20 Data networks, however, such as the internet, permit files
to be transmitted between computers in a manner in which
the sender is not charged on the basis of the distance
between sites and the amount of time spent conducting the
call. Consequently, it would be desirable to conduct voice
25 communications using this medium.

It is well-known that when a computer connects to an
internet services provider, the internet services provider
sends back to the computer an internet protocol address
30 uniquely identifying an address on the internet temporarily
assigned to the connecting computer. As such addresses are
temporary, it is not possible to predict in advance, the IP
address that will be assigned to a connecting computer.
Consequently, in order to be able to connect two computers
35 together to facilitate transfer of voice packets between
each, the IP address, of at least one computer, must be
conveyed to the other.

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The present invention addresses this need and the need to conduct voice communications or file transfer between two remotely located computers having no fixed IP addresses.

5 **SUMMARY OF THE INVENTION**

In accordance with one aspect of the invention, there is provided a method of establishing a connection between nodes on a data network. The method includes the steps of:

10

a) establishing a data network connection between a first node and a data network services provider, at an IP address provided by the data network services provider

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b) transmitting an FSK message to a second node, the FSK message including the IP address;

c) receiving the FSK message at the second node;

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d) extracting the IP address from the FSK message; and

e) establishing a connection through the data network between the second node and the first node, through the IP address.

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Preferably, the method includes the step of transmitting a message from the first node to a telephone server connected to the data network.

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Desirably, the method includes the step of transmitting the FSK message from the phone server to the second node through the public switched telephone network.

35 Preferably, the method includes the step of transmitting the FSK message under a modified ring class of service.

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Desirably, the method includes the step of establishing a voice call between the first and second nodes.

5 Preferably, the method includes the step of transmitting the FSK message from the first node to the second node during the voice call.

10 Desirably, the method includes the step of transmitting voice packets between the first and second nodes on the data network, through the IP address.

15 In accordance with another aspect of the invention, there is provided an apparatus for establishing a connection between nodes on a data network. The apparatus includes at least one data network services provider operable to provide an IP address of a connection made to equipment connected thereto through the data network, first and second nodes operable to establish respective data connections to respective data network services providers including at least one data network services provider, provisions for establishing a data network connection between the first node and at least one data network services provider, at an IP address provided by the data network services provider, provisions for transmitting an FSK message to the second node, the FSK message including the IP address, provisions for receiving the FSK message at the second node, provisions for extracting the IP address from the FSK message and provisions for establishing a connection through the data network between the second node and the first node, through the IP address.

35 Preferably, the apparatus includes a telephone server in communication with the telephone network and provisions for transmitting a message from the first node to the telephone server.

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Desirably, the apparatus includes provisions for transmitting the FSK message from the phone server to the second node through the public switched telephone network.

- 5 Preferably, the apparatus includes provisions for transmitting the FSK message under a modified ring class of service.

10 Desirably, the apparatus includes provisions for establishing a voice call between the first and second nodes.

15 Preferably, the provisions for establishing a voice call includes respective telephone line interfaces at the first and second nodes.

20 Desirably, the apparatus includes provisions for transmitting the FSK message from the first node to the second node during the voice call.

Preferably, the apparatus includes provisions for transmitting voice packets between the first and second nodes on the data network, through the IP address.

- 25 In accordance with another aspect of the invention, there is provided an apparatus for establishing a connection between nodes on a data network. The apparatus includes at least one data network services provider operable to provide an IP address of a connection made to equipment
30 connected thereto through the data network, first and second nodes operable to establish respective data connections to respective data network services providers including at least one data network services provider, a processor and communications interface at the first node
35 for establishing a data network connection between the first node and at least one data network services provider, at an IP address provided by the data network services

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provider, a transmitter in communication with at least one data network services provider for transmitting an FSK message to the second node, the FSK message including the IP address, a receiver at the second node for receiving the FSK message at the second telephone, a processor at the second node for extracting the IP address from the FSK message and a communications interface at the second node for establishing a connection through the data network between the second node and the first node, through the IP address.

Desirably, the apparatus includes a telephone server in communication with the telephone network and preferably, the processor at the first node is programmed to transmit a message from the first node to the telephone server.

Desirably, the phone server includes the transmitter for transmitting the FSK message from the phone server to the second node and preferably, the transmitter is operable to transmit the FSK message through the public switched telephone network.

Desirably, the phone server has a modified ring connection interface for transmitting the FSK message to the second node under a modified ring class of service.

Preferably, the first and second nodes have respective telephone line interfaces further for establishing a voice call between the first and second nodes.

Desirably, the first node has an FSK transmitter for transmitting the FSK message from the first node to the second node during the voice call.

Preferably, the first and second nodes have voice packet communications applications for transmitting voice packets

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between the first and second nodes on the data network, through the IP address.

5 In accordance with another aspect of the invention, there is provided a telephone including a line interface for connecting to first and second telephone lines, the line interface including an FSK transmitter for transmitting FSK signals on at least one of the first and second telephone lines. The telephone further includes a telephony
10 microcontroller for controlling audio communications on at least one of the first and second telephone lines, a modem for conducting data communications on at least one of the first and second telephone lines, and a system processor for controlling the modem to establish communications with
15 a data network services provider and for receiving from the data network services provider an address assigned to the modem by the data network services provider, and for controlling the FSK transmitter to transmit an FSK message including the address to a telephone in communication with
20 the telephone.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

25 Figure 1 is a schematic diagram of a system for establishing a connection between remotely located nodes on a data network, according to a first embodiment of the invention;

30 Figure 2 is a schematic representation of each of first and second telephones according to the first embodiment of the invention;

Figure 3 is a block diagram of a central office line
35 interface in each of the first and second telephones shown in Figure 2;

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Figure 4 is a tree diagram of a directory structure of file directories within each of the first and second telephones;

5 Figure 5 is a schematic representation of storage areas in RAM of each of the first and second telephones shown in Figure 2;

10 Figure 6 is a schematic representation of a program architecture in a system microprocessor in each of the first and second telephones;

15 Figure 7 is a flowchart of an on hook data network call establishment routine run by the system microprocessor of the first telephone;

20 Figure 8 is a flowchart of a network driver run by the system processor of each of the first and second telephones;

Figure 9 is a flowchart of a phone server task run by a phone server shown in Figure 1;

25 Figure 10 is a schematic representation of an FSK message transmitted by the phone server;

30 Figure 11 is a schematic representation of a central office switch, the phone server and a second telephone shown in Figure 1;

Figure 12 is a flowchart of an event parser thread run by a system processor of the second telephone shown in Figure 1;

35 Figure 13 is a flowchart of a main event handler thread run by the system processor of the second telephone; and

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Figure 14 is a flowchart of an event dispatcher run by the system processor of the telephone;

5 Figure 15 is a flowchart of a receive voice call routine run by a system microprocessor of the second telephone shown in Figure 1;

10 Figure 16 is a flowchart of a portion of a voice communication thread run by the system microprocessor in each of the first and second telephone; and

15 Figure 17 is a flowchart of an off hook data network call establishment routine according to a second embodiment of the invention, run by the system microprocessor of the first telephone.

DETAILED DESCRIPTION

Figure 1

20 Referring to Figure 1, a system for establishing a connection between remotely located nodes on a data network, according to a first embodiment of the invention is shown generally at 10. The system includes first and second telephones 12 and 14, first and second Internet
25 services providers (ISPs) 16 and 18, a data network 20, a phone server 22 and the public switched telephone network (PSTN) 24. The first and second telephones act as first and second network nodes.

30 The first telephone 12 is connected to the public switched telephone network by first and second telephone lines 26 and 28 respectively. The second telephone 14 is connected to the public switched telephone network 24 by third and fourth lines 30 and 32 respectively. In this embodiment,
35 the first and second telephones are identical.

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The first telephone 12 and second telephone 14 use the first and third telephone lines 26 and 30 to communicate with other telephones connected to the PSTN 24 in a voice mode in which voice conversations between the first and second telephones 12 and 14 can be conducted. The second and fourth telephone lines 28 and 32 are used to establish connections through the PSTN to respective internet services providers 16 and 18 which act as data network services providers operable to provide an IP address of a connection made to equipment connected thereto through the data network.

Thus, the first and second nodes are operable to establish respective data connections to respective data network services providers.

The phone server 22 is connected to both the data network 20 and the public switched telephone network 24 and acts as a telephone server in communication with the telephone network.

Figure 2

Referring to Figure 2, the structure of each of the telephones 12 and 14 is shown. Each telephone includes a system microprocessor 40, a telephony microcontroller 42, and a central office line interface 44 in communication with both the system microprocessor 40 and the telephony microcontroller 42. The system microprocessor is connected to a keyboard interface 46 and a keyboard 48, for receiving user input for commanding the system microprocessor 40 to effect certain functionality. The system microprocessor is further connected to a display interface 50 which is further connected to a display 52, for displaying output to a user.

The telephony microcontroller 42 is in communication with the system microprocessor 40 by a plurality of signal lines

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54 and by a codec 55 which provides bi-directional coding and decoding of signals from the telephony microcontroller 42 to and from the system microprocessor 40. The telephony microcontroller is further in communication with a handset interface 56 for controlling signals to and from a conventional handset 58 and a hands-free interface 60 for providing conventional speakerphone functionality to the telephone. The codec provides for conversation of analog audio signals from the handset interface 56 or from the handsfree interface 60 to digital signals useable by the system microprocessor 40.

The telephony microcontroller 42 is further in communication with a dial pad 62 of the conventional type, for enabling a user to enter and dial telephone numbers at the telephone.

Figure 3

Referring to Figure 3, the central office line interface is shown in greater detail at 44. The central office line interface has first and second telephone line inputs 70 and 73 which are connected to the first and second telephone lines 26 and 28 respectively in the case of the first telephone 12 and to the third and fourth telephone lines 30 and 32 respectively in the case of the second telephone 14.

The first line input 70 is connected to a line 1 modem terminal 75, a two to four wire interface terminal 71, an on-hook extension in use detector 79 and a ring detector 81. The modem terminal 75 is connected to a line selector switch shown generally at 83 having a selector terminal 84 and a line 2 modem terminal 86. The line selector switch 83 is controlled by a line selector control circuit 88 to connect the selector terminal to either the line 2 modem terminal 86 or the line 1 modem terminal 75. The selector terminal 84 is further connected to a modem hook switch 90

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which is controlled by a modem 92 in communication with the system microprocessor 40, shown in Figure 2.

Referring back to Figure 3, the modem hook switch 90 is
5 connected to a data access arrangement 94 which isolates the modem from the telephone line and provides a DC path for seizing the line. The data access arrangement 94 is in communication with the modem 92, to provide analog signals to and from the modem 92, for communication to the system
10 microprocessor 40.

The central office line interface further includes a line hook switch 96 and a two wire to four wire hybrid circuit 98. The hook switch 96 is controlled by a line hook switch
15 control circuit 100 which opens and closes the hook switch 96 thereby connecting and disconnecting the first telephone line 26 to and from the two to four wire hybrid circuit 98.

The two to four wire hybrid circuit 98 has a transmit input
20 102 and a receive output 104. The transmit input 102 is connected to Frequency Shift Keying (FSK) transmitter 106, a Dual Tone Multifrequency (DTMF) generator 108 and a transmit output of an audio circuit 110. The FSK transmitter 106 is operable to transmit FSK messages on the
25 first telephone line 26 in a manner similar to that in which calling line ID information is transmitted on conventional telephone lines.

The dual tone multi-frequency DTMF generator 108 is
30 operable to provide tones to the transmit input 102 to provide DTMF tones on the first telephone line 26 in the case of the first telephone 12 and on the third telephone line 30 in the case of the second telephone 14.

35 The receive output 104 of the two to four wire hybrid circuit 98 is connected to a receive input of the audio

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circuit **110**, and is further connected to an FSK receiver **112** and a caller alerting signal receiver **114**.

5 The on-hook extension in use detector **79** monitors the first telephone line **26** to provide a signal indicating whether or not an extension is in use on the first telephone line (or third telephone line) when the hook switch **96** is in the open position.

10 The line selector control circuit **88**, the line hook switch circuit **100**, the FSK transmitter **106** and the DTMF generator **108** are operable to receive signals from the telephony microcontroller **42** shown in Figure 2, to control the state of the line selector switch **83**, to control the state of the
15 line hook switch **96** to transmit FSK messages on the first telephone line **26** and to provide DTMF signals to the two to four wire interface for transmission on the first telephone line (or third telephone line), respectively.

20 The audio circuit **110** is in bi-directional communication with the telephony microcontroller **42** which effectively provides a mutable audio path, with audio signal processing, to the codec **55**, the handset interface **56** or hands-free interface **60** shown in Figure 2. The telephony
25 microcontroller is thus operable to mute the audio path on command from the system processor to prevent signals on the first (or third) telephone lines from being heard at the handset or handsfree speaker.

30 The FSK receiver **112**, caller alerting signal receiver **114** and on-hook extension in use detector **79** provide FSK, CAS, off-hook Extension-in-Use (EIU) and on-hook EIU signals respectively to the telephony microcontroller **42**.

35 Referring back to Figure 2, the system microprocessor **40** is further in communication with FLASH memory **120** and random access memory (RAM) **122**.

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Figure 4

Referring to Figure 4, the FLASH memory 120 holds a directory structure as shown generally at 130. The directory structure includes a base directory having a hardware abstraction layer file 132, an operating system file 134, a system subdirectory 136, a data directory 138, a Java subdirectory 140 and a temporary subdirectory 142.

The hardware abstraction layer file 132 includes basic boot commands for booting up the system processor and for directing it to load the operating system file 134 into RAM, where it is run by the processor.

The operating system file 134 contains operating system commands for establishing basic operation of the system microprocessor 40. The operating system commands include a Board Support Package (BSP) and drivers which direct the processor to interact with the central office line interface 44, the telephony microcontroller 42, the keyboard interface 46 and the display interface 50 shown in Figure 2. In this embodiment, the operating system is known as VXWorks (tm) provided by Windriver of Alameda, California.

The operating system file further includes code implementing a Java (tm) virtual machine and a graphics layer known as RTX X-Windows server (tm) by Visicom of San Diego, California. The Java virtual machine includes core Java packages including Java.lang, Java.io, Java.applet, Java.net and Java.awt which, in connection with the operating system files create a Java run time environment at the system microprocessor 40 shown in Figure 2.

Referring back to Figure 4, the system subdirectory 136 includes an applications subdirectory 150. The applications subdirectory 150 includes a telephone subdirectory 152 containing files for directing the system

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microprocessor **40** to cooperate with the telephony microcontroller **42** to provide telephony functionality. The applications subdirectory **150** further includes a network call directory **154** including an on-hook data network call establishment routine file **156**, an off-hook data network call establishment routine file **158**, a voice communication routine file **160** and a voice call receive file **162**.

The applications subdirectory further includes an event parser subdirectory **164** containing event parser files, a main event handler subdirectory **166** containing main event handler files, a browser subdirectory **168** containing browser files, a public interface subdirectory **170** containing public interface method files **172** and a handler subdirectory **174** containing handler files.

The data subdirectory **138** includes a configuration data subdirectory **180** containing configuration files including a CPE ID file **182** and an event code lookup table file **184**. The CPE ID file **182** holds a CPE ID of the telephone, to identify the telephone from other telephones which may be connected to the same telephone line. The event code lookup table file **184** contains an event code lookup table having parameter type and IP address event code fields **186** and **188** respectively, for associating parameter types with IP address event codes.

The Java subdirectory **140** includes Java class files of the type classes.jar, for establishing a Java virtual machine at the system microprocessor **40**.

The temporary subdirectory **142** is used to store applets, HTML pages and files which may be downloaded over one of the telephone lines **26** and **28** shown in Figure 3.

35

Figure 5

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Referring to Figure 5, the RAM 122 is used to maintain an FSK receive buffer 200, a variable buffer 202, a main event handler buffer 204, an event queue buffer 206, a routing table 208, an FSK transmit buffer 210 and an IP address message buffer 212.

The FSK receive buffer 200 is of sufficient length to receive FSK messages and includes a message type field 220, a total length field 222, a CPE ID field 224, a parameter type field 226, a parameter length field 228 and a data field 230.

The variable buffer 202 and the main event handler buffer 204 hold variable and main event records respectively. The variable records include a parameter type field 232 and a data field 234 and the main event records include a parameter type field 236 and a data field 238. The event queue buffer 206 is a variable length buffer for storing various event queue records, each of which includes an event code field 240 and a data field 242.

The routing table 208 includes an ISP address field 244 and an IP address field 246 for storing the IP address of the Internet services provider and the IP address assigned to the telephone by the Internet services provider. The operating system maintains the routing table 208 for maintaining details of connections established through the central office line interface 44 on the second telephone line 28 shown in Figure 2.

The FSK transmit buffer 210 includes a message type field 250, a total length field 252, a CPE ID field 254, a parameter type field 256, a parameter length field 258, and a data field 260. This buffer is used to store messages which are transmitted by the FSK data network call establishment routine 156 of Figure 4.

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The IP address message buffer 212 includes a message type field 262, a total length field 264, a data 1 field 266, a data 2 field 268, a checksum field 270 and an end character field 272. The data 1 field 266 is used to hold an IP address of the telephone, which is obtained from the IP address field 246 of the routing table 208. The data 2 field 268 is used to store a telephone number of a telephone with which a connection is desired to be made, in this case the second telephone 14.

Figure 6

Referring briefly to Figure 2, the system microprocessor 40, FLASH memory 120, and RAM 122 together form a computer architecture. Referring to Figure 6, this architecture is shown generally at 280.

Operation

Figure 7

When a user of the first telephone 12 desires to establish a data network call, the on-hook data network call establishment routine shown in Figure 7 is invoked at the first telephone 12. This routine includes a first instance 300 which directs the system processor to establish a connection to the first Internet services provider 16. To achieve this, the processor is directed to the network driver shown at 302 in Figure 8.

Figure 8

Referring to Figure 8, the network driver includes a first instance 304 which directs the system microprocessor 40 to pend awaiting a connection request from an application such as the on-hook data network call establishment routine.

On receiving a connection request, instance 306 directs the system microprocessor 40 to check the routing table 208 shown in Figure 5 to determine whether or not a network connection has already been established. Referring to

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Figure 8, if no connection has been established, instance 300 directs the system microprocessor 40 to command the modem 92 to connect to the second telephone line 28 to place a telephone call on the second telephone line 28 via public switched telephone network, to the first Internet services provider 16 shown in Figure 1.

Referring back to Figure 8, establishment of a connection with the Internet services provider involves a handshaking instance 310.

On establishing a connection with the Internet services provider, instance 312 directs the processor to negotiate a point to point protocol (PPP) connection with the Internet services provider and to store the details of the PPP connection including storing the IP address of the ISP 16 in the ISP ADD field 244 and storing the IP address assigned to the telephone 12 by the ISP 16, in the IP ADD field 246 in the routing table 208. A network connection is thus created. Thus, the network driver and processor in the first node act as means for establishing a data network connection between the first node and at least one data network services provider, at an IP address provided by the data network services provider.

Instance 314 then directs the system microprocessor 40 to notify the requesting application of the connection to the ISP 16.

On completion of transmission of the details to the application thread, the system microprocessor 40 is directed back to instance 304 where it pends on receipt of a further connection request from the application or another application.

It should be noted that at instance 306, where the processor is directed to determine whether or not a

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connection has already been established, if such a connection has already been established, the processor is directed directly to instance 314 where it notifies the requesting application of such connection.

5

Referring back to Figure 7, upon receiving connection details from the network driver, instance 303 directs the system processor to generate an IP address message in the IP address message buffer shown in Figure 5. To do this, referring to Figure 5, the system microprocessor 40 loads a predefined code into the message type field 262, calculates a total length value for the entire message and stores the total calculated in the total length field 264, copies the IP address of the telephone from the IP address field 246 of the routing table 208 into the data 1 field 266 of the IP address message buffer 212 and loads a previously stored telephone number of the party with whom a desired telephone call is to be made into the data 2 field 268. A checksum is then calculated and stored in the checksum field and an end-of-message character is stored in the end character field 272. The system microprocessor 40 then directs the modem 92 to transmit the contents of the IP address message buffer 212 to a predefined web address corresponding to that of the phone server 22 shown in Figure 1, through the first Internet services provider 16 and the data network 20. Thus, the phone server 22 receives an IP address message from the first telephone 12. The system processor, modem and the on-hook data network call establishment routine act as means for transmitting a message from the first node to the telephone server.

30

Figure 9

Referring to Figure 9, the phone server 22 shown in Figure 1 runs a phone server task shown generally at 320 in Figure 9. The phone server task includes a first instance 322 which receives the IP address message transmitted from the first telephone 12. In response, a second instance 324

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directs the phone server to generate a modified ring access (MRA) FSK message as shown at 330 in Figure 10.

Figure 10

5 Referring to Figure 10, the modified ring access message includes a message type field 332, a total length field 334, a CPE ID field 336, a parameter type field 338, a parameter length field 340, and a data field 342. The message type field 332 identifies the message as an FSK
10 message containing an IP address identifying a fixed internet address to which the recipient of the FSK message is to connect. Predefined codes are used to identify predefined message types. The total length field 334 is used to hold a value representing the total length of the
15 FSK message. The CPE ID field 336 is loaded with a value representing a CPE ID, which in this embodiment is zero. The parameter type field 338 is used to identify the type of data stored in the parameter data field 342 and, in this embodiment, the parameter type field 338 stores a
20 predefined code representing that the contents of the parameter data field 342 hold an IP address. The parameter length field 340 is used to identify the length of the parameter data field 342. The parameter data field 342 is, in this embodiment, used to hold an IP address identified
25 by the first internet services provider 16.

Referring back to Figure 9, a third instance 350 directs the phone server to transmit the MRA FSK message to the second telephone 14, via the public switched telephone
30 network 24 and conventional voice lines, shown in Figure 1.

Figure 11

Referring to Figure 11, in this embodiment, the phone server 22 includes an FSK transmitter 344. The FSK
35 transmitter 344 is connected to a central office switch 354 by at least one trunk 356 having a suppressed ring access class of service.

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In general, the phone server 22 receives IP address messages from requesting telephones and produces on the trunk 356 suppressed ringing connection (SRC) messages in an FSK format, as shown generally at 330 in Figure 10. The suppressed ringing connection messages are thus FSK messages.

Still referring to Figure 11, the central office switch 354 includes a program driven digital switch including a switching network 358, a program controlled processor 360, a trunk unit 362 and a plurality of subscriber interfaces, only two of which are shown at 364 and 366.

The trunk unit 362 senses activation by the phone server and signals the program controlled processor 360, to indicate such activation. The program controlled processor then controls the switching network 358 to provide voice path connections for communicating suppressed ring access messages from the phone server 22 to the desired subscriber telephone, in this case the second telephone 14. Communication between the central office switch and the second telephone is carried out by a line unit 368, a digital loop carrier 370 at the switch location, a transmission path 372, a digital loop carrier 374 at a remote location and a subscriber line 30.

Generally, the trunk 356 has a class of service which identifies to the central office switch 354 that the connections being requested by the phone server are to be made with ringing suppressed, ie., with no ringing signal transmitted or with a burst of ringing signal transmitted of sufficient length to activate the digital loop carriers 370 and 374 but of insufficient length to be present for any significant time after connection is completed.

Accordingly, the phone server 22 can establish connections through the central office switch 354 to the subscriber

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locations, and such connections are accompanied by no or little (ie., short) ringing. These connections facilitate the transmission of suppressed ring access messages in an FSK format to the telephone. In other words, the phone
5 server 22 places a call through the central office switch 354 on a trunk line 356 having a special class of service. The central office switch 354 detects that a call is being made on the special trunk line and activates the digital loop carriers 370 and 374 for the line to which the call is
10 being made, to enable communication between the phone server and the second telephone 14, without activation (suppressed ringing) or with minium activation (single ring) of ring tone generation circuitry (not shown) in the central office. Thus, a communication link is established
15 between the phone server 22 and the second telephone 14 to permit the FSK suppressed ring access message to be transmitted from the phone server 22 to the second telephone 14. Thus, the phone server acts as a transmitter in communication with at least one network services
20 provider or means for transmitting an FSK message including the IP address from the phone server to the second node through the public switched telephone network. More particularly, the trunk 356 acts as means for transmitting the FSK message under a modified ring class of service.

25

Referring to Figures 1 and 9, after transmitting the SRA FSK message to the second telephone, at instance 350, instance 352 directs the phone server 22 to transmit back to the first telephone 12 through the Internet services
30 provider 16, an FSK message dispatch acknowledgement message. The phone server task is thus ended.

Referring to Figures 1 and 7, the FSK message dispatch acknowledgement message is received at instance 380 which
35 is followed by instance 382 which directs the system processor to wait for notification of contact from the second telephone 14. When such notification is received,

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the system processor in the first telephone 12 is directed to spawn a voice communications thread as shown in Figure 16.

5 Referring back to Figure 11, at the second telephone 14, the SRA FSK message from the phone server 22 is received through the central office line interface 44 and system microprocessor 40 under the control of the event parser files in the event parser directory 164 shown in Figure 4.

10

Figure 12

Referring to Figure 12, the event parser files in the event parser directory of the second telephone 14 establish an event parser thread as shown generally at 390. The event
15 parser thread includes a read comm port instance 392 which directs the system microprocessor 40 shown in Figure 2, to communicate with the telephony microcontroller 42 to read the FSK receiver 112 to determine whether or not an FSK message is being received at the FSK receiver 112. If a
20 message is not being received, the event parser thread is blocked on the read comm port instance 392. If the FSK receiver 112 is receiving an FSK message, such message is passed to the system microprocessor and stored in the FSK receive buffer 200 shown in Figure 5. Thus, the FSK
25 receiver and system microprocessor act as a receiver or means for receiving the FSK message at the second node.

The event parser thread then includes a checksum instance 394 which directs the processor to read the contents of the
30 FSK receive buffer 200 to determine whether or not the message was received properly. If the message was not received properly, it is ignored and the processor is directed back to the read comm port instance 392.

35 Referring to Figures 4, 5 and 12, if the message was received properly, the processor is directed to a CPE ID match instance 396 in which the contents of the CPE ID

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register 182 stored in the FLASH memory 130 is compared against the contents of the CPE ID field 224 of the FSK message stored in the FSK receive buffer 200. If the CPE IDs do not match, the processor is returned to the read
5 comm port instance 392.

If the CPE IDs match, the processor is directed to a store parameter type instance 398 which directs the processor to store the contents of the parameter type field 226 and the
10 contents of the data field 230, that is, the IP address of the first telephone in the variable buffer 202. Thus, the system processor and event parser files act as means for extracting the IP address from the FSK message. The system microprocessor 40 is then directed to a copy instance 400
15 which directs it to copy the contents of the variable buffer 202 to the main event handler buffer 204. The processor is then returned back to the read comm port instance 392 where it blocks until a further FSK message is received.

20

Figure 13

Main event handler thread

Referring to Figure 13, the main event handler files in the main event handler subdirectory 166 establish a main event
25 handler thread as shown generally at 410. The main event handler thread includes a buffer loaded instance 412 which directs the system microprocessor 40 to determine whether or not the main event handler buffer 204 shown in Figure 5 is full. If this buffer is not loaded then the processor
30 blocks on the buffer loaded instance 412.

If the main event handler buffer is loaded, the processor is directed to a lookup table instance 414 which directs the processor to find an event code record in the event
35 code lookup table 184 shown in Figure 4, having parameter type field 186 contents corresponding to the contents of

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the parameter type field 236 in the main event handler buffer 204 shown in Figure 5.

On finding such an event code record, the system
5 microprocessor 40 is directed to a copy event code instance
416 which directs the processor to copy the contents of the
event code field 188 from the event code lookup table into
the event code field 240 of the event queue buffer 206
shown in Figure 5 and also to copy the contents of the data
10 field 238 of the main event handler buffer 204 shown in
Figure 5 to the data field 242 of the event queue buffer
206 in association with the event code. Thus, the
processor stores, in the event queue buffer 206, a first
event record including an event code from the event code
15 lookup table 184 and data from the data field 238 of the
main event handler buffer 204 shown in Figure 5.

Figure 14

Referring to Figures 4 and 14, the event dispatcher files
20 in the main event handler subdirectory 166 shown in Figure
4 establish an event dispatcher thread as shown generally
at 430. The event dispatcher thread includes a first
instance 432 which directs the system processor to address
the next event code record in the event queue buffer 206
25 shown in Figure 5. The system processor is then directed
to instance 434 which directs it to determine which threads
have registered for the event code record addressed at
instance 432. The registration of threads with event code
records is assumed to have been previously accomplished
30 according to conventional practices. After having
determined which threads have registered for the current
event code record, instance 436 directs the processor to
communicate the current event code record from the event
queue buffer 206 to the registered threads. In this
35 manner, data is passed from the event queue buffer 206 to
appropriate threads.

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Figure 15

Referring to Figure 15, a receive voice call routine run by the system processor at the second telephone 14 is shown generally at 450. The voice call receive routine includes
5 a first instance 452 which directs the system processor to pend on a receipt of an IP address FSK message from the event dispatcher. On receiving such an event code corresponding to an IP address FSK message, the system processor is directed to instance 454 which directs it to
10 make a network connection as described in connection with Figure 8. If a connection is successfully established, instance 456 directs the system processor to establish a connection with the first telephone 12 through the first and second Internet services providers 16 and 18, by
15 transmitting a request to connect to the IP address contained in the IP address FSK message received at the second telephone 14.

Referring back to Figure 7, the establishment of such
20 connection is detected by instance 382 which then directs the system processor in the first telephone to begin the voice communications routine shown in Figure 16.

Referring back to Figure 15, after the connection has been
25 established with the first telephone 12, instance 460 directs the system processor of the second telephone 14 to determine whether or not a connection has been properly established with the first telephone 12. If a connection has been properly established, then instance 462 directs
30 the second telephone 14 to spawn a voice communication routine thread, as shown in Figure 16.

If, at instance 456, a connection to the second Internet services provider 18 is not properly established, or, if at
35 instance 460, a connection was not established between the second and first telephones 14 and 12 through the second and first Internet services provider 18 and 16, the system

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processor is directed to an error banner instance **464** which directs the system processor to control the display at the second telephone **14** to display an error banner to indicate that a connection could not be established.

5

Thus, the system processor and receive voice call routine together act as a communications interface at the second telephone or means for establishing a connection through the data network between the second node and the first node, through the IP address.

10

Figure 16

Referring to Figure **16**, at this point it should be appreciated that if a successful connection is made between the second telephone **14** and the first telephone **12**, both of these telephones are running their own voice communication threads, each of which is represented by the voice communication thread shown in Figure **16**.

15

For the purposes of simplifying the explanation, the voice communication thread will be described from the perspective of the first telephone **12**, it being understood that similar events occur at the second telephone **14**.

20

Referring to Figure **16** therefore, the voice communication thread is shown generally at **470** and includes a first instance **472** which directs the system processor to digitize voice received from the handset interface **56** or hands-free interface **60** shown in Figure **2**. Such voice is digitized to produce raw digital voice data.

25

30

Instance **474** then directs the system processor to prepare a voice packet including the raw digitized voice data received from the telephony microcontroller **42** via the codec **55**. Instance **476** then directs the system microprocessor **40** to control the modem **92** shown in Figure **3** to transmit the voice packet to the second telephone **14**

35

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through the first and second Internet services providers **16** and **18** and the data network **20**.

5 The system processor in the first telephone **12** then is directed by instance **478** to wait for a voice packet to be sent back from the second telephone **14** through the first and second Internet services providers **16** and **18** and the data network **20**.

10 Instance **480** then directs the system processor **40** to send the raw digital values received in the voice packet at instance **478**, to the codec **55** which converts these signals into analog signals which are provided to the telephony microcontroller **42** with a request to play them through the
15 handset interface **56** or the hands-free interface **60**, as shown at instance **482**.

Thus, the system processor and voice communications thread act as means for transmitting voice packets between the
20 first and second nodes on the data network, through the IP address. The voice communications thread thus acts as a voice packet communications applications for transmitting voice packets between the first and second nodes on the data network, through the IP address.

25 If a conventional telephone call has already been established between the first telephone **12** and the second telephone **14**, through the respective central office interfaces and telephony microcontrollers in each
30 telephone, the off-hook data network call establishment routine shown in Figure **17** is run, in place of the on-hook data network call establishment routine shown in Figure **7**. It will be appreciated, therefore, that the respective central office line interfaces and telephony
35 microcontrollers act as means for establishing a voice call between the first and second nodes includes respective telephone line interfaces at the first and second nodes.

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Figure 17

Referring to Figure 17, the off-hook data network call establishment routine is run by the system processor at the first telephone 12 and is shown generally at 500 and begins with a first instance 502 which directs the system processor in the first telephone 12 to establish a connection to the first Internet services provider 16, as described in connection with instance 300 in Figure 7.

Referring back to Figure 17, instance 504 then directs the system processor to produce an FSK message in the FSK transmit buffer 210 shown in Figure 5. In particular, the IP address of the connection to the first telephone 12 as indicated in the IP address field 246 of the routing table 155 is loaded into the data field 260 of the FSK transmit buffer 210. The system microprocessor 40 then directs the telephony microcontroller 42 to mute the audio path between the first telephone line 26 and the hands-free or handset interfaces 60 and 56 and to actuate the FSK transmitter 106 shown in Figure 3 to transmit the contents of the FSK transmit buffer 210 shown in Figure 5, in a FSK format, over the first telephone line 26, through the public switched telephone network 24 onto the third telephone line 30 to the second telephone 14. Thus, the system processor, telephony microcontroller and FSK transmitter act as means for transmitting the FSK message from the first node to the second node during the voice call.

The second telephone receives the FSK message in the manner described in connection with Figures 12, 13 and 14 to pass the IP address to the routine shown in Figure 15 which directs the second telephone 14 to establish a connection with the first telephone 12 through the second and first Internet services providers 18 and 16 and the data network 20.

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Referring back to Figure 17, when a connection has properly been established between the second telephone 14 and the first telephone 12, a notification to this effect is received at the first telephone 12 from the second Internet
5 services provider 18 as indicated at instance 506.

Upon establishment of a connection between the first and second telephones 12 and 14 through the respective Internet services providers 16 and 18, instance 508 directs the
10 system processor to terminate the voice call on the first telephone line 26 by effectively controlling the line hookswitch control circuit 100 shown in Figure 3 to open the hook switch 96 while maintaining the modem hookswitch 90 closed to maintain the modem in communication with the
15 network.

The system processor in the first telephone 12 is then directed to the voice communication thread 470 shown in Figure 16 where the first telephone 12 interacts with the
20 second telephone 14 running a similar voice communication thread as described in connection with Figure 16.

In the above manner, a voice communication path is established through a data network such as the internet,
25 eliminating the need to conduct voice communications using the conventional public switched telephone network in the conventional manner.

Alternatively, the voice packets transmitted between the
30 first and second telephones 12 and 14 may be replaced with data packets, whereby data is passed between the first and second telephones. In general, therefore, it will be appreciated that the invention provides a way of establishing a connection or communication path between
35 remotely located nodes on a data network such as an internet and in particular it provides a way of establishing voice communications over an internet such as

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the global internet of which the public switched telephone network is a part.

5 While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only and not as limiting the invention as construed in accordance with the accompanying claims.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of establishing a connection between nodes on
5 a data network, the method comprising the steps of:
 - a) establishing a data network connection between a
first node and a data network services provider,
at an IP address provided by said data network
10 services provider
 - b) transmitting an FSK message to a second node,
said FSK message including said IP address;
 - 15 c) receiving said FSK message at said second node;
 - d) extracting said IP address from said FSK message;
and
 - 20 e) establishing a connection through said data
network between said second node and said first
node, through said IP address.
2. A method as claimed in claim 1 further including the
25 step of transmitting a message from said first node to
a telephone server connected to said data network.
3. A method as claimed in claim 2 further including the
step of transmitting said FSK message from said phone
30 server to said second node through the public switched
telephone network.
4. A method as claimed in claim 2 further including the
step of transmitting said FSK message under a modified
35 ring class of service.

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5. A method as claimed in claim 1 further including the step of establishing a voice call between said first and second nodes.
- 5 6. A method as claimed in claim 5 further including the step of transmitting said FSK message from said first node to said second node during said voice call.
- 10 7. A method as claimed in claim 1 further including the step of transmitting voice packets between said first and second nodes on said data network, through said IP address.
- 15 8. An apparatus for establishing a connection between nodes on a data network, the apparatus comprising;
- 20 a) at least one data network services provider operable to provide an IP address of a connection made to equipment connected thereto through said data network;
- 25 a) first and second nodes operable to establish respective data connections to respective data network services providers including said at least one data network services provider;
- 30 a) means for establishing a data network connection between said first node and said at least one data network services provider, at an IP address provided by said data network services provider;
- 35 b) means for transmitting an FSK message to said second node, said FSK message including said IP address;
- c) means for receiving said FSK message at said second node;

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- d) means for extracting said IP address from said FSK message; and
- e) means for establishing a connection through said data network between said second node and said first node, through said IP address.
- 5
9. An apparatus as claimed in claim 8 further including a telephone server in communication with said telephone network and means for transmitting a message from said first node to said telephone server.
- 10
10. An apparatus as claimed in claim 9 further including means for transmitting said FSK message from said phone server to said second node through the public switched telephone network.
- 15
11. An apparatus as claimed in claim 9 further including means for transmitting said FSK message under a modified ring class of service.
- 20
12. An apparatus as claimed in claim 8 further including means for establishing a voice call between said first and second nodes.
- 25
13. An apparatus as claimed in claim 12 wherein said means for establishing a voice call includes respective telephone line interfaces at said first and second nodes.
- 30
14. An apparatus as claimed in claim 13 further including means for transmitting said FSK message from said first node to said second node during said voice call.
- 35
15. An apparatus as claimed in claim 8 further including means for transmitting voice packets between said

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first and second nodes on said data network, through said IP address.

16. An apparatus for establishing a connection between nodes on a data network, the apparatus comprising;
- a) at least one data network services provider operable to provide an IP address of a connection made to equipment connected thereto through said data network;
 - b) first and second nodes operable to establish respective data connections to respective data network services providers including said at least one data network services provider;
 - c) a processor and communications interface at said first node for establishing a data network connection between said first node and said at least one data network services provider, at an IP address provided by said data network services provider;
 - d) a transmitter in communication with said at least one data network services provider for transmitting an FSK message to said second node, said FSK message including said IP address;
 - e) a receiver at said second node for receiving said FSK message at said second telephone;
 - f) a processor at said second node for extracting said IP address from said FSK message; and
 - g) a communications interface at said second node for establishing a connection through said data

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network between said second node and said first node, through said IP address.

- 5 **17.** An apparatus as claimed in claim **16** further including a telephone server in communication with said telephone network and wherein said processor at said first node is programmed to transmit a message from said first node to said telephone server.
- 10 **18.** An apparatus as claimed in claim **17** wherein said phone server includes said transmitter for transmitting said FSK message from said phone server to said second node and wherein said transmitter is operable to transmit said FSK message through the public switched telephone network.
- 15
- 19.** An apparatus as claimed in claim **17** wherein said phone server has a modified ring connection interface for transmitting said FSK message to said second node under a modified ring class of service.
- 20
- 20.** An apparatus as claimed in claim **16** wherein said first and second nodes have respective telephone line interfaces further for establishing a voice call between said first and second nodes.
- 25
- 21.** An apparatus as claimed in claim **20** wherein said first node has an FSK transmitter for transmitting said FSK message from said first node to said second node during said voice call.
- 30
- 22.** An apparatus as claimed in claim **16** wherein said first and second nodes have voice packet communications applications for transmitting voice packets between said first and second nodes on said data network, through said IP address.
- 35

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23. A telephone comprising:

- 5 a) a line interface for connecting to first and second telephone lines, said line interface including an FSK transmitter for transmitting FSK signals on at least one of said first and second telephone lines;
- 10 b) a telephony microcontroller for controlling audio communications on at least one of said first and second telephone lines;
- 15 c) a modem for conducting data communications on at least one of said first and second telephone lines;
- 20 d) a system processor for controlling said modem to establish communications with a data network services provider and for receiving from said data network services provider an address assigned to said modem by said data network services provider, and for controlling said FSK transmitter to transmit an FSK message including said address to a telephone in communication with
25 said telephone.

July 6, 1998

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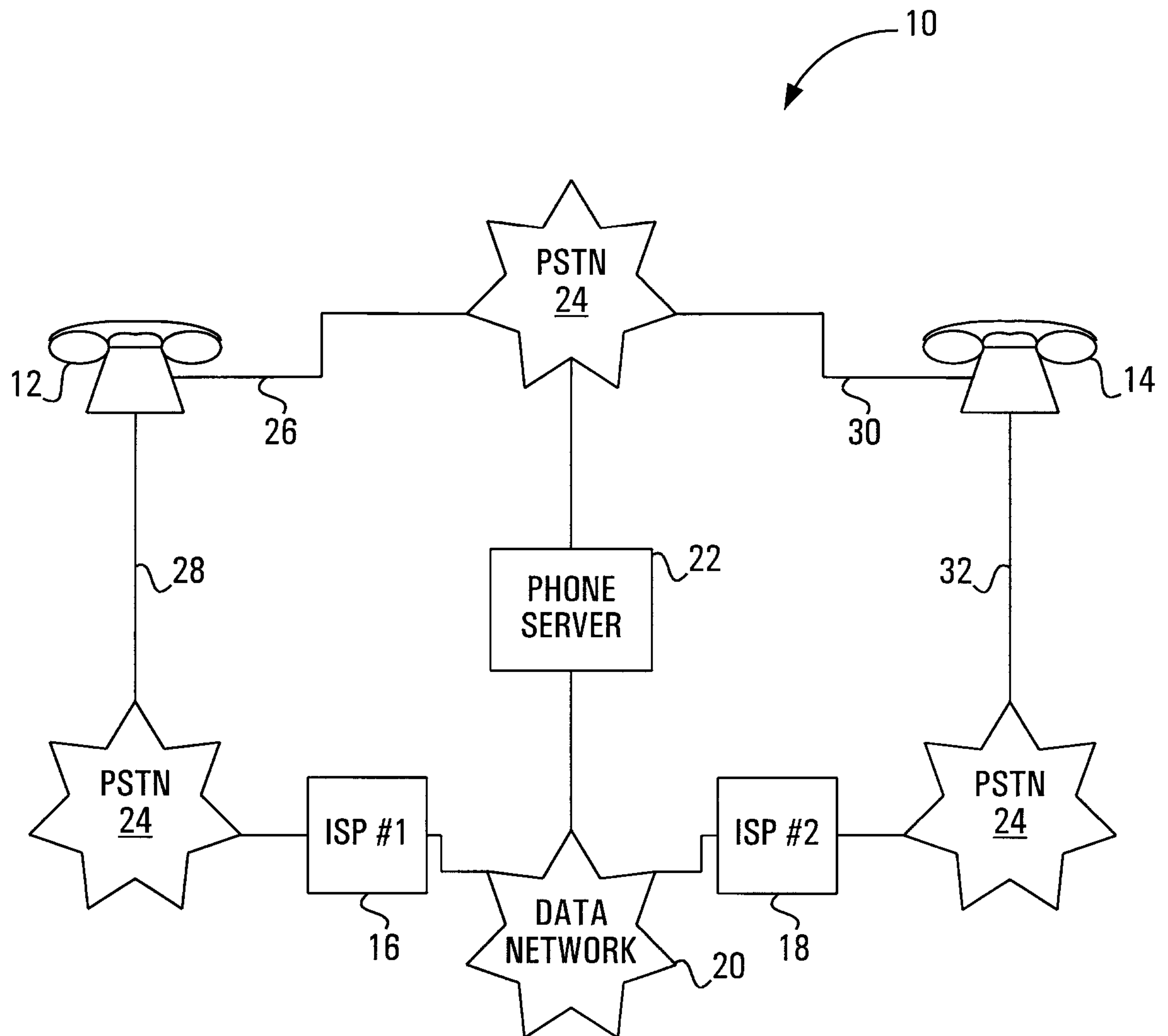


FIG. 1

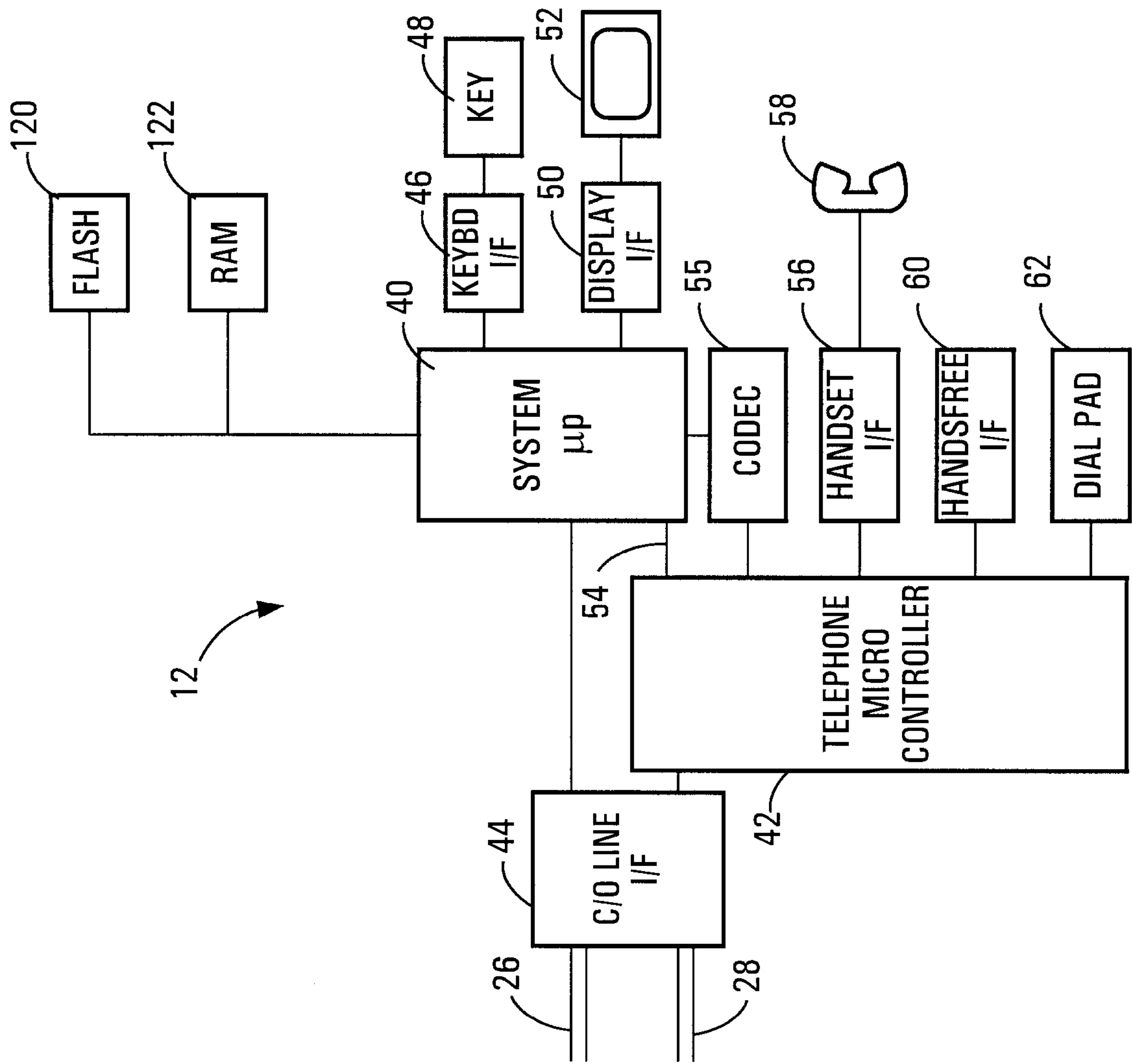


FIG. 2

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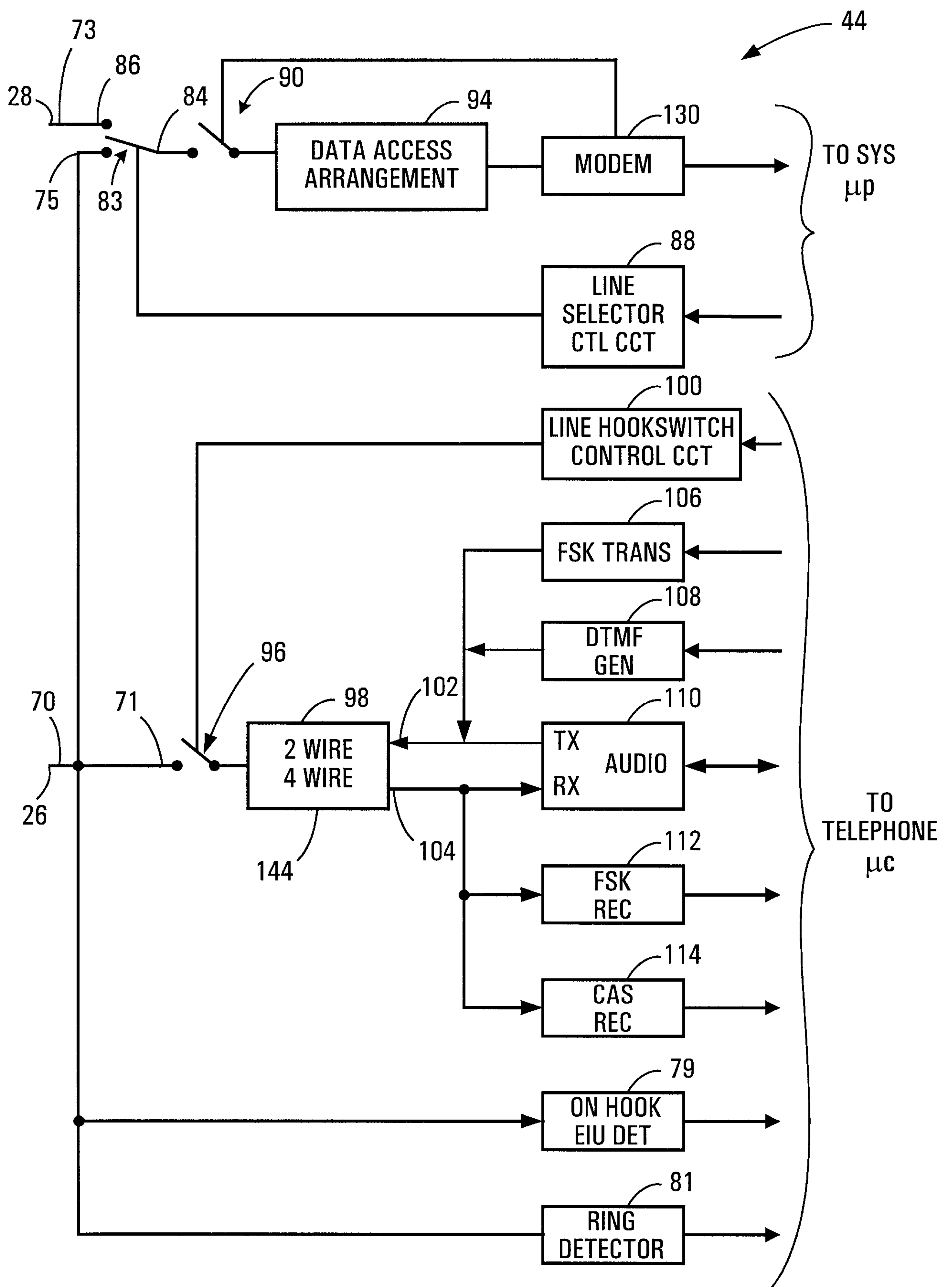


FIG. 3

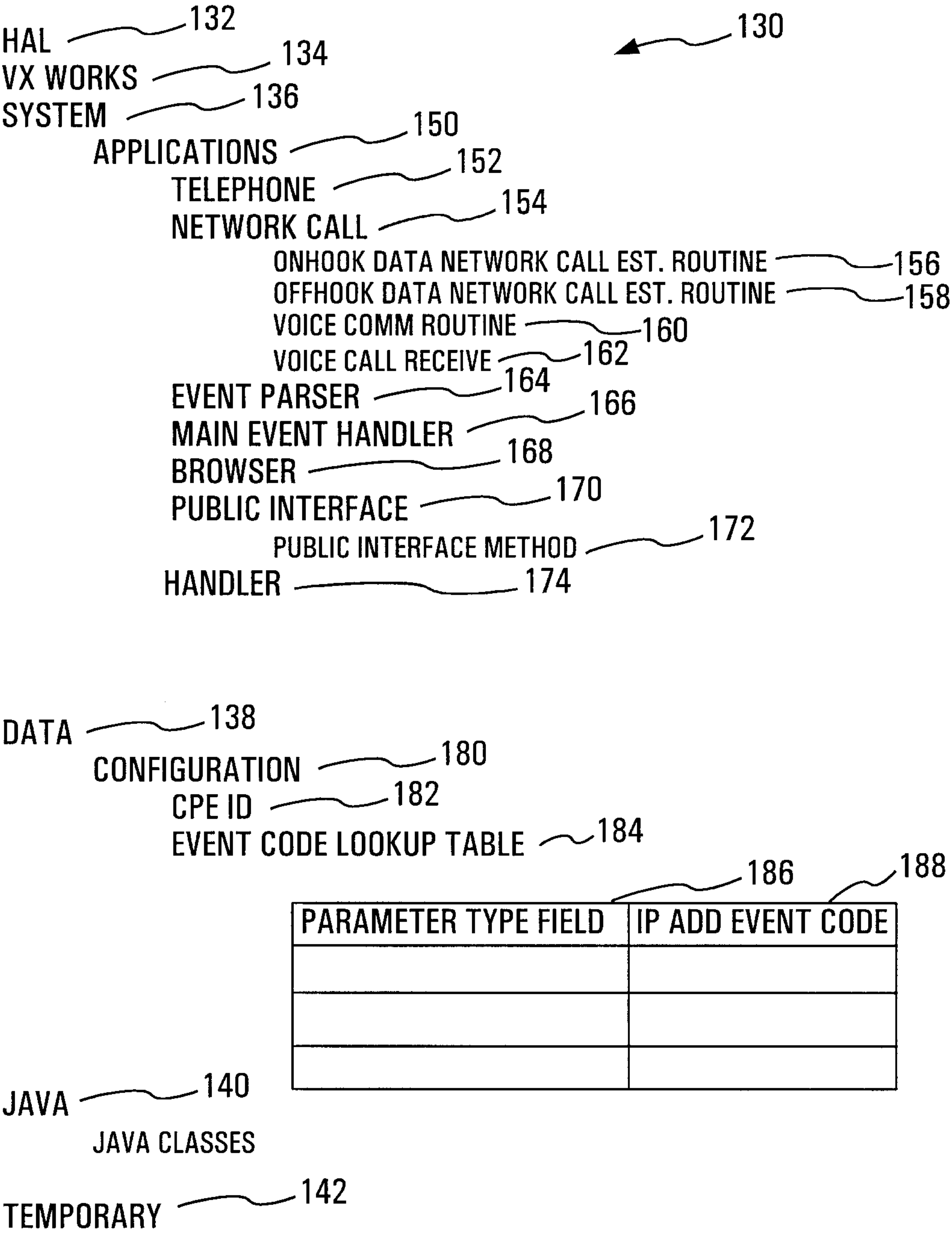
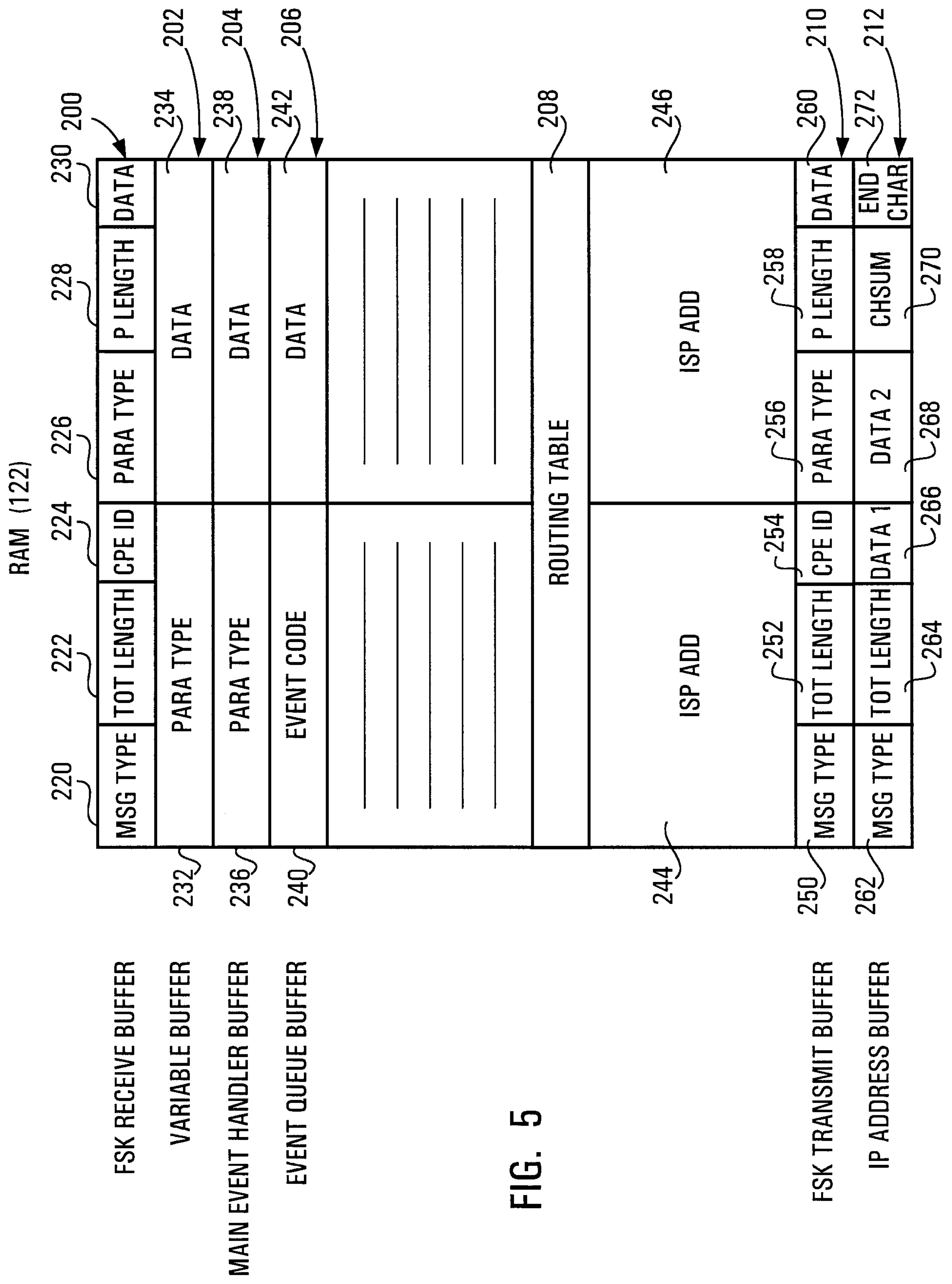


FIG. 4



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280 

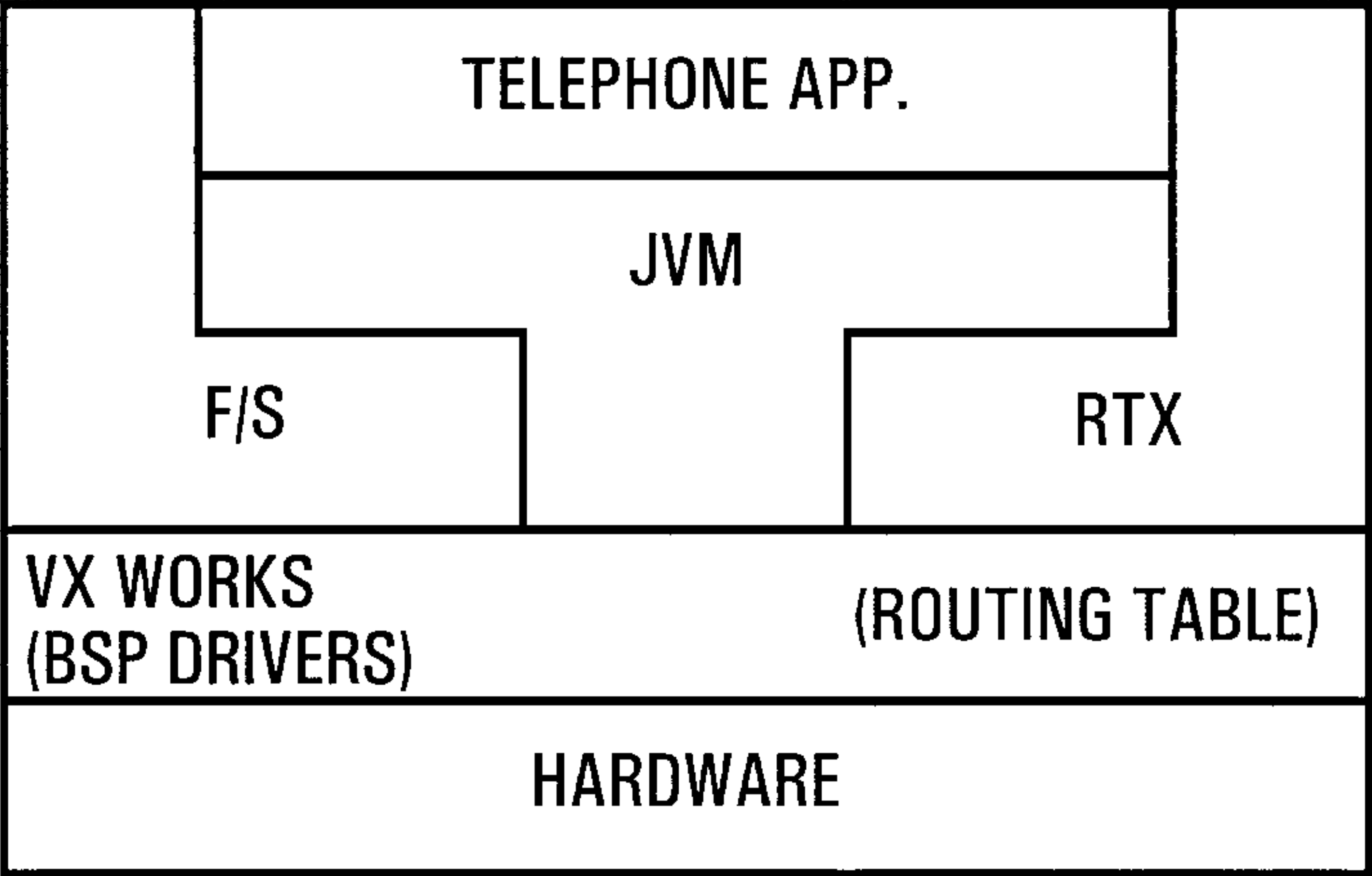


FIG. 6

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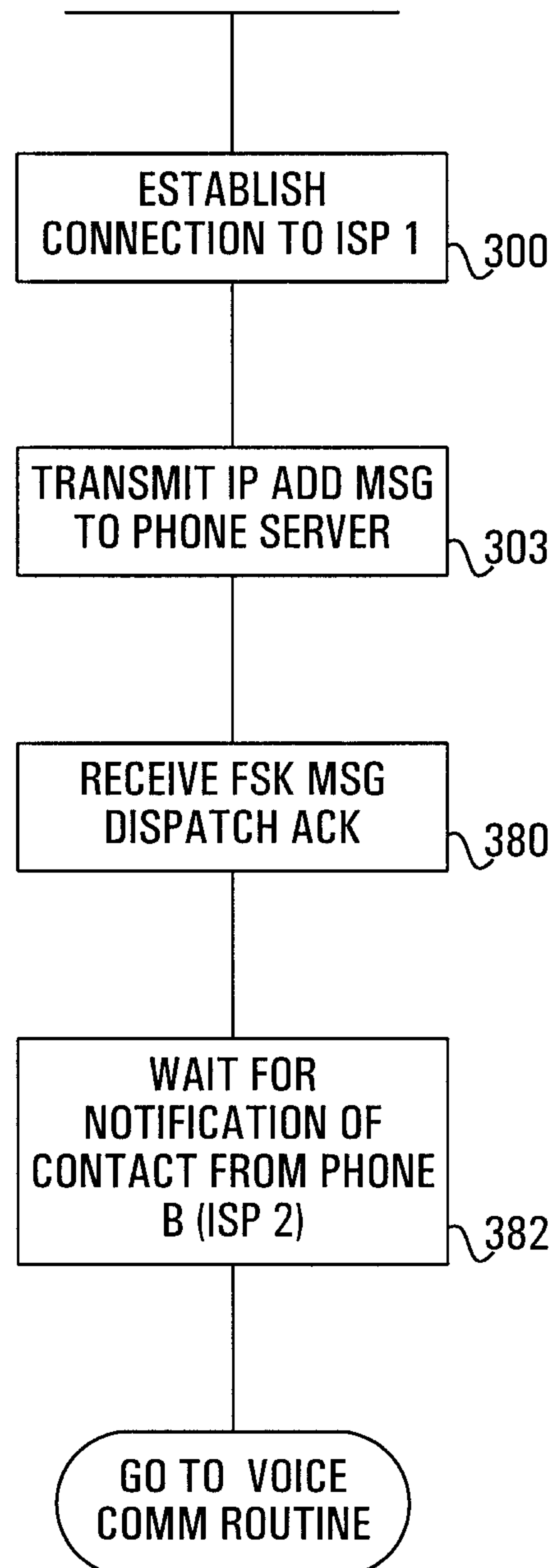
ON HOOK DATA NETWORK CALL
ESTABLISHMENT ROUTINE

FIG. 7

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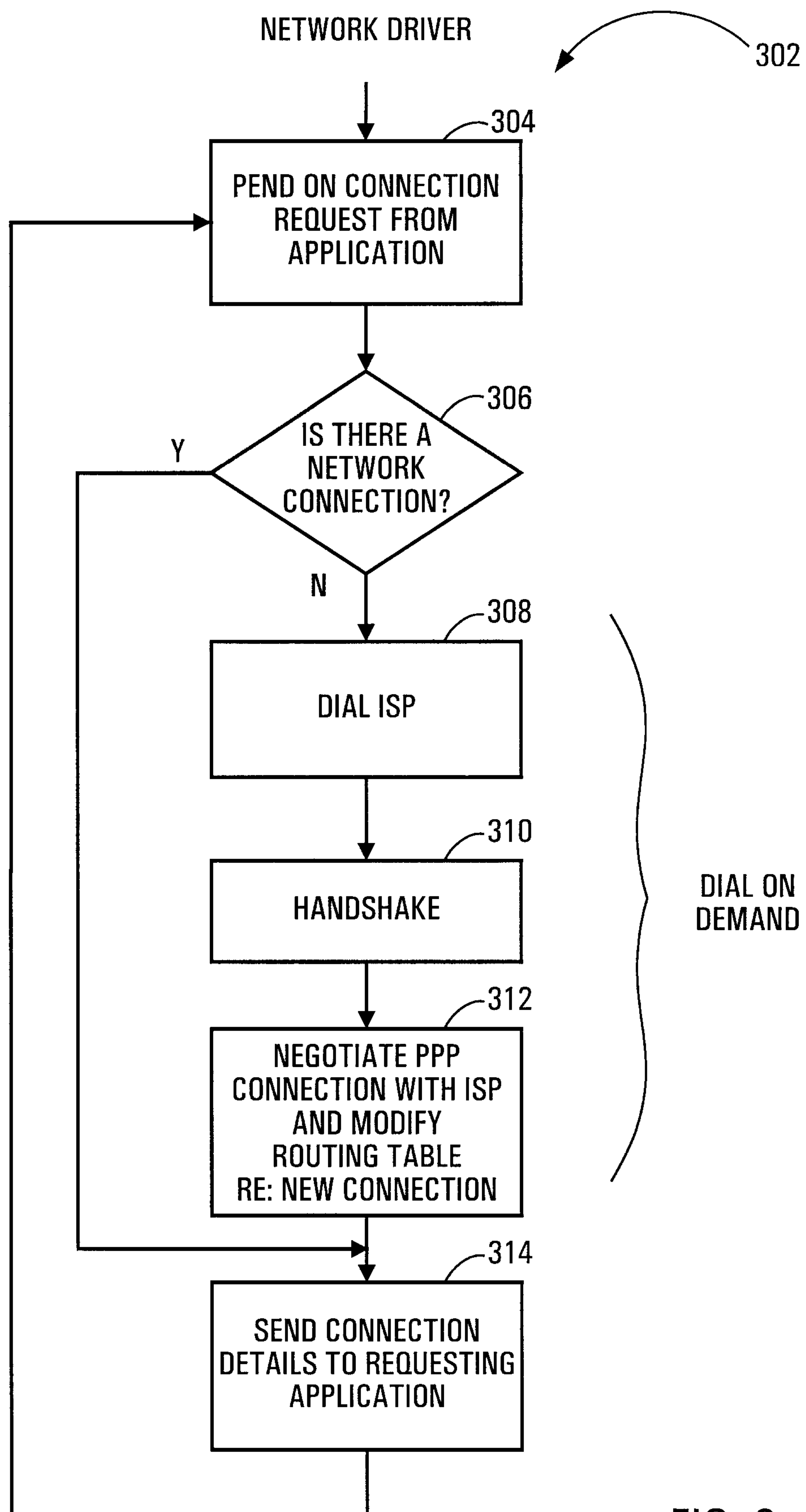


FIG. 8

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PHONE SERVER TASK

320

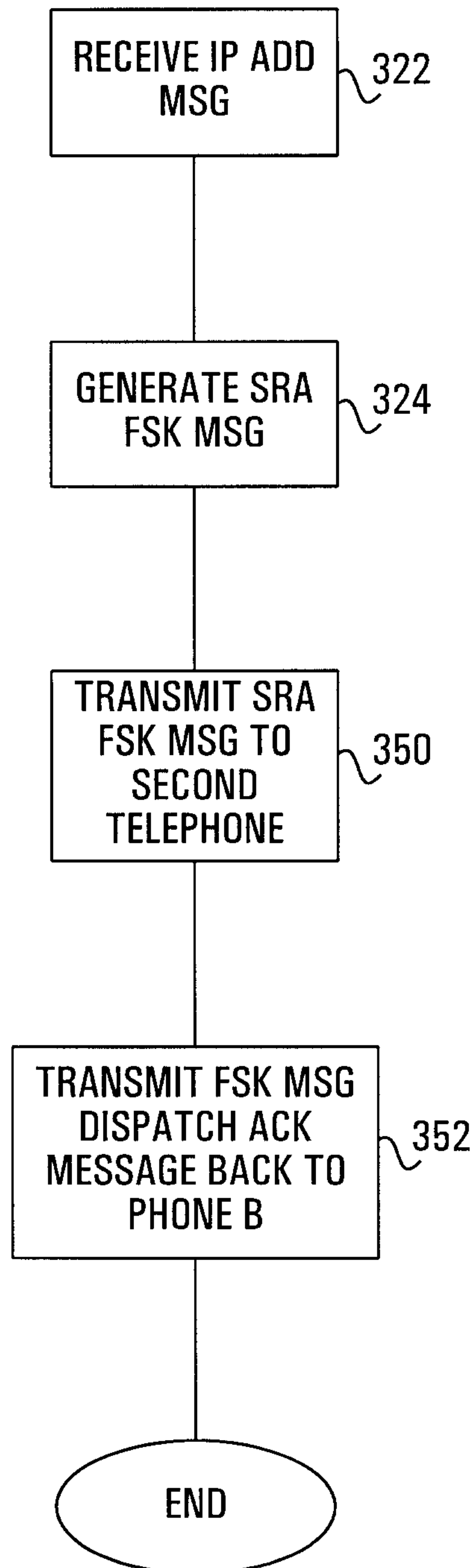


FIG. 9

MRA FSK MSG

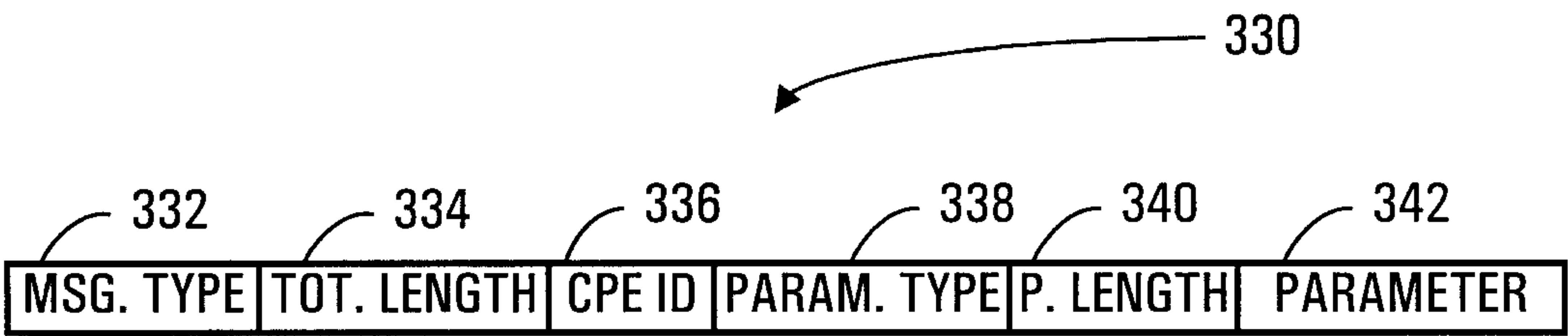


FIG. 10

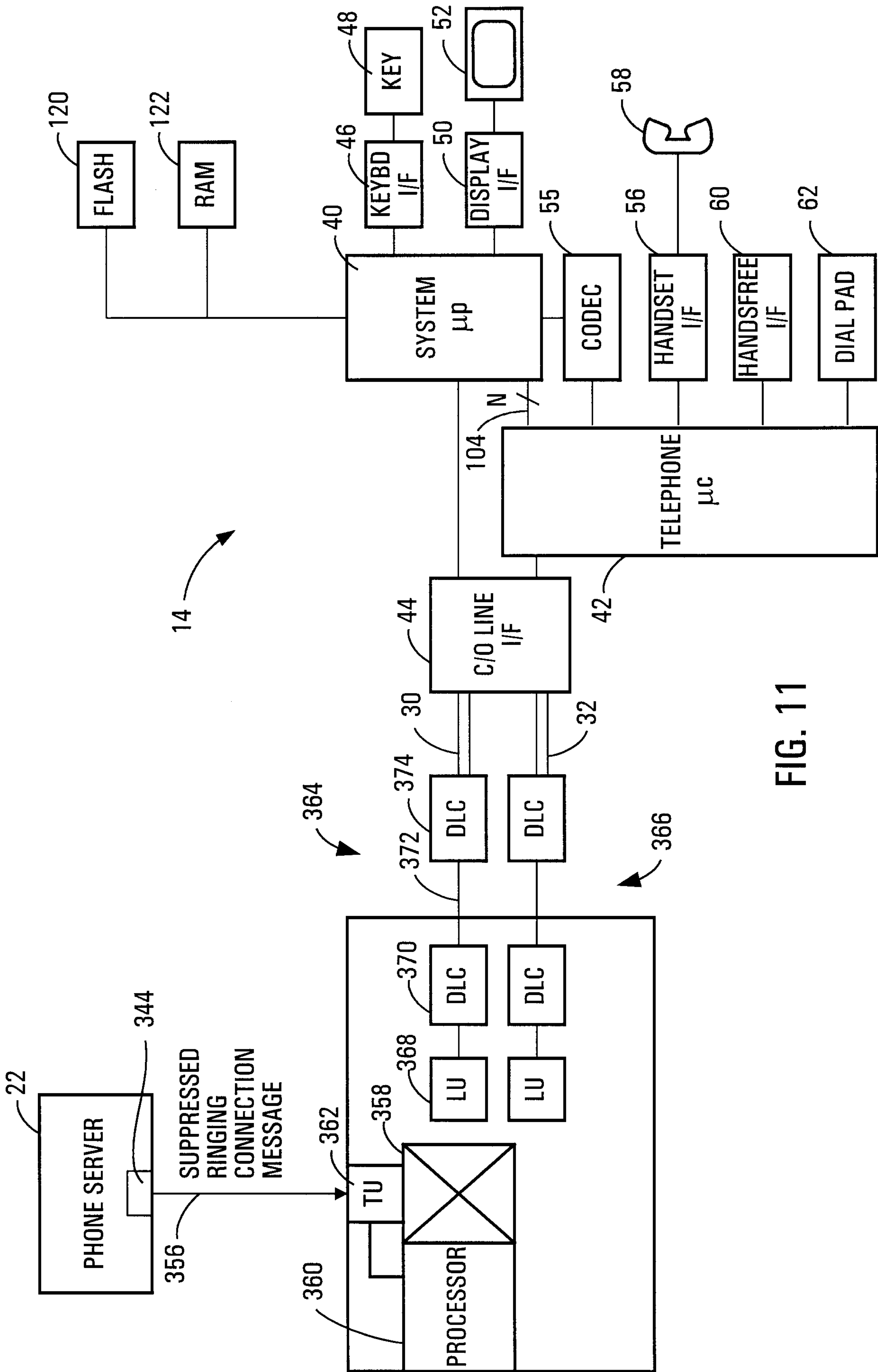


FIG. 11

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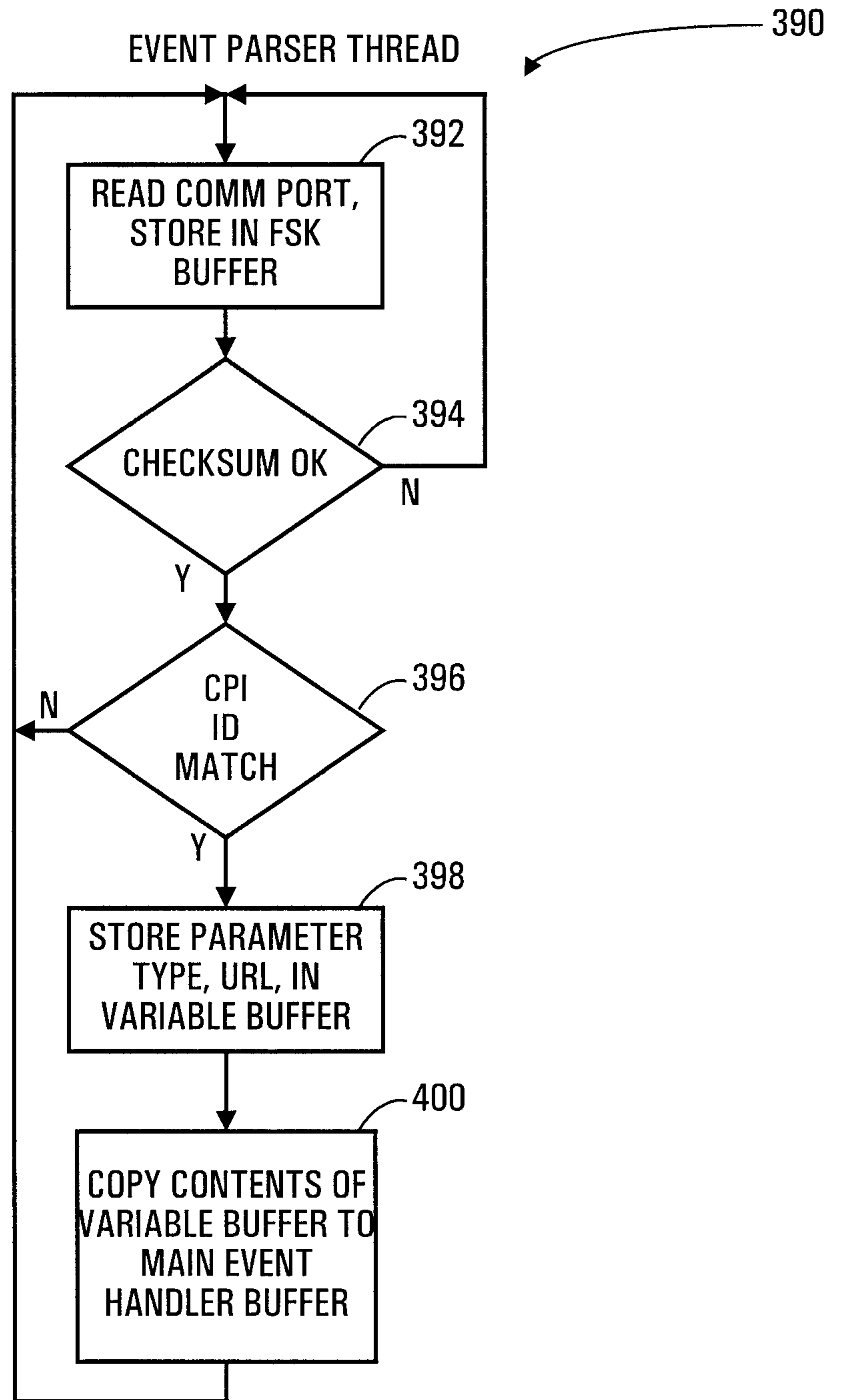


FIG. 12

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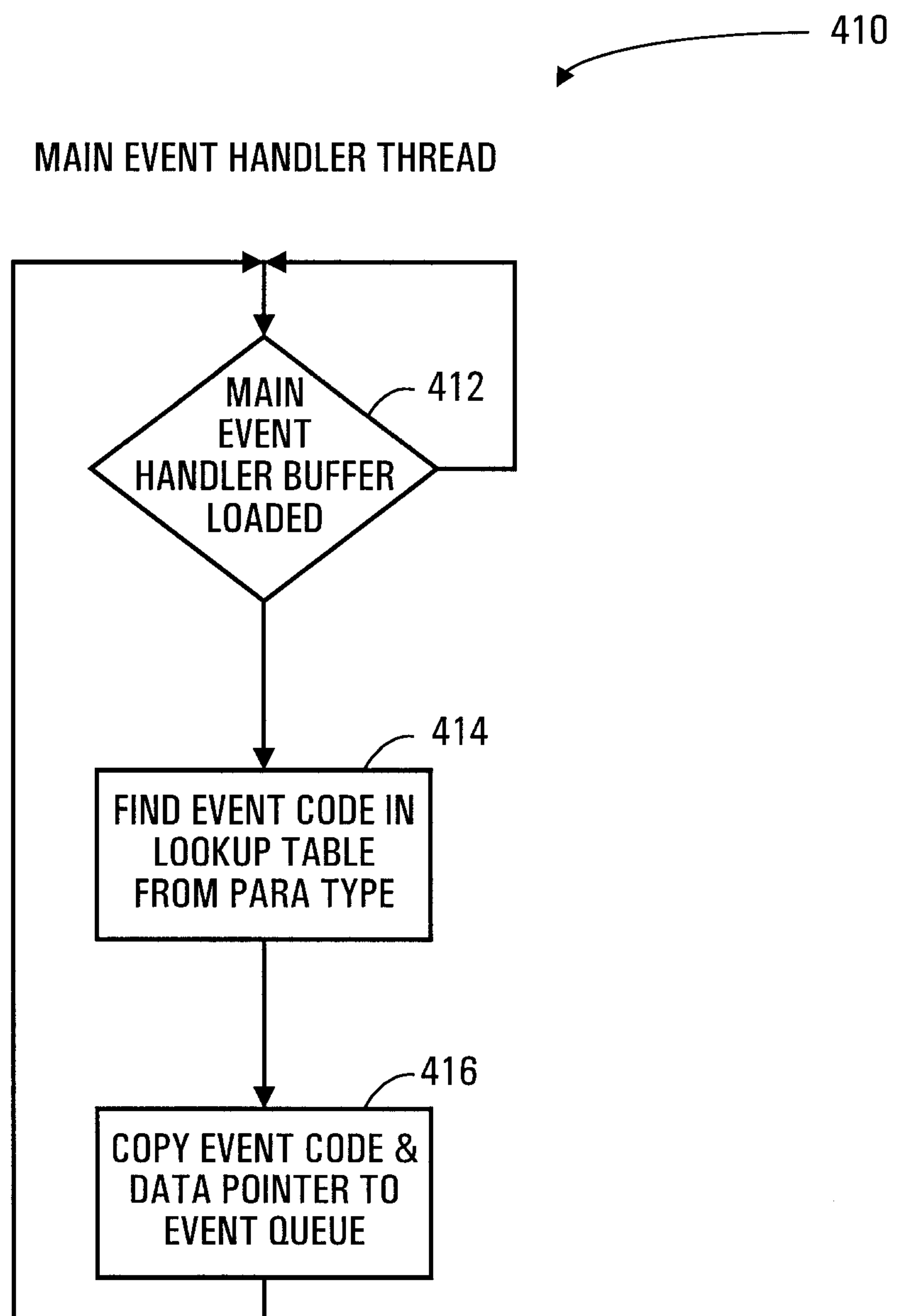


FIG. 13

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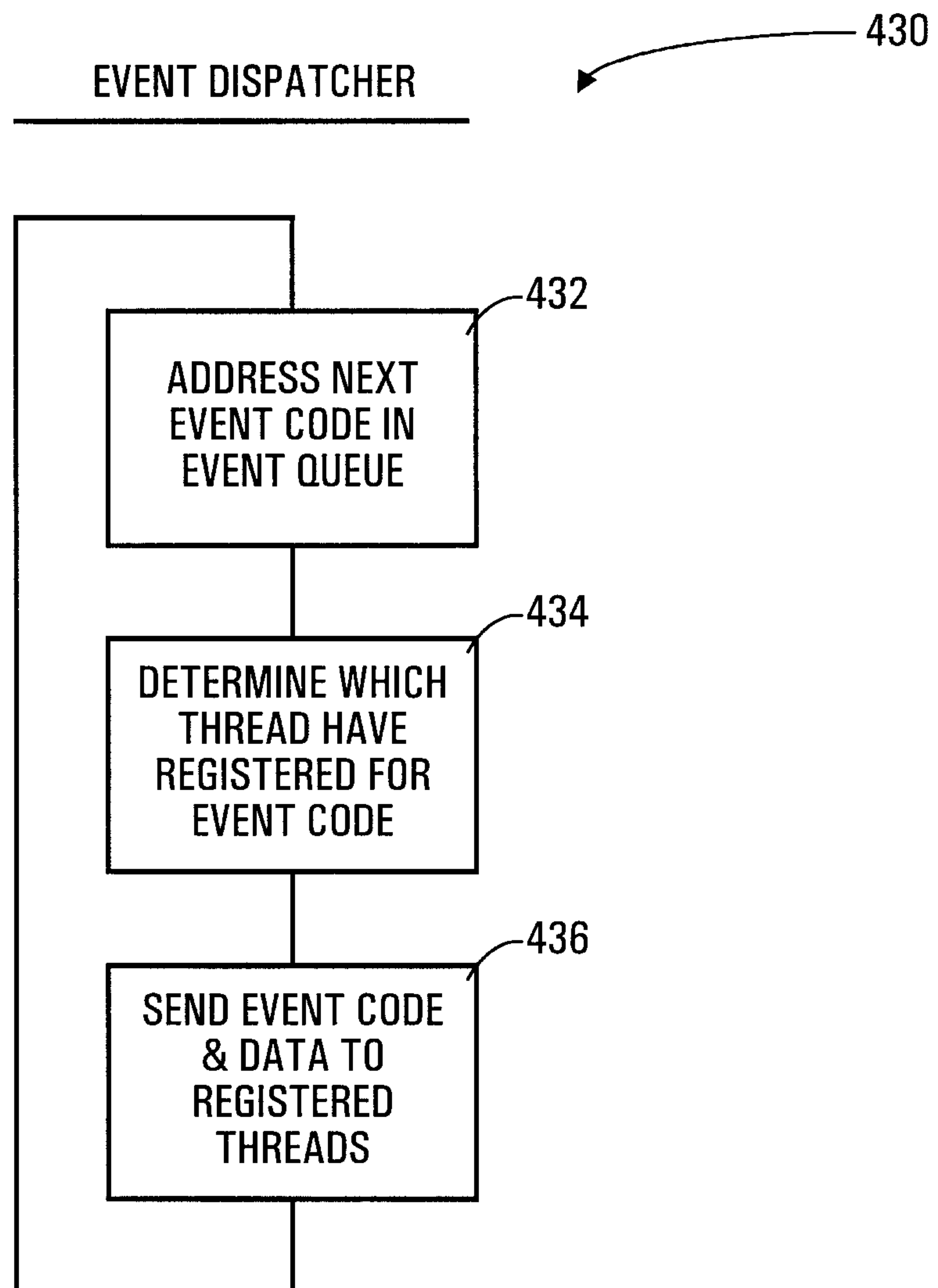


FIG. 14

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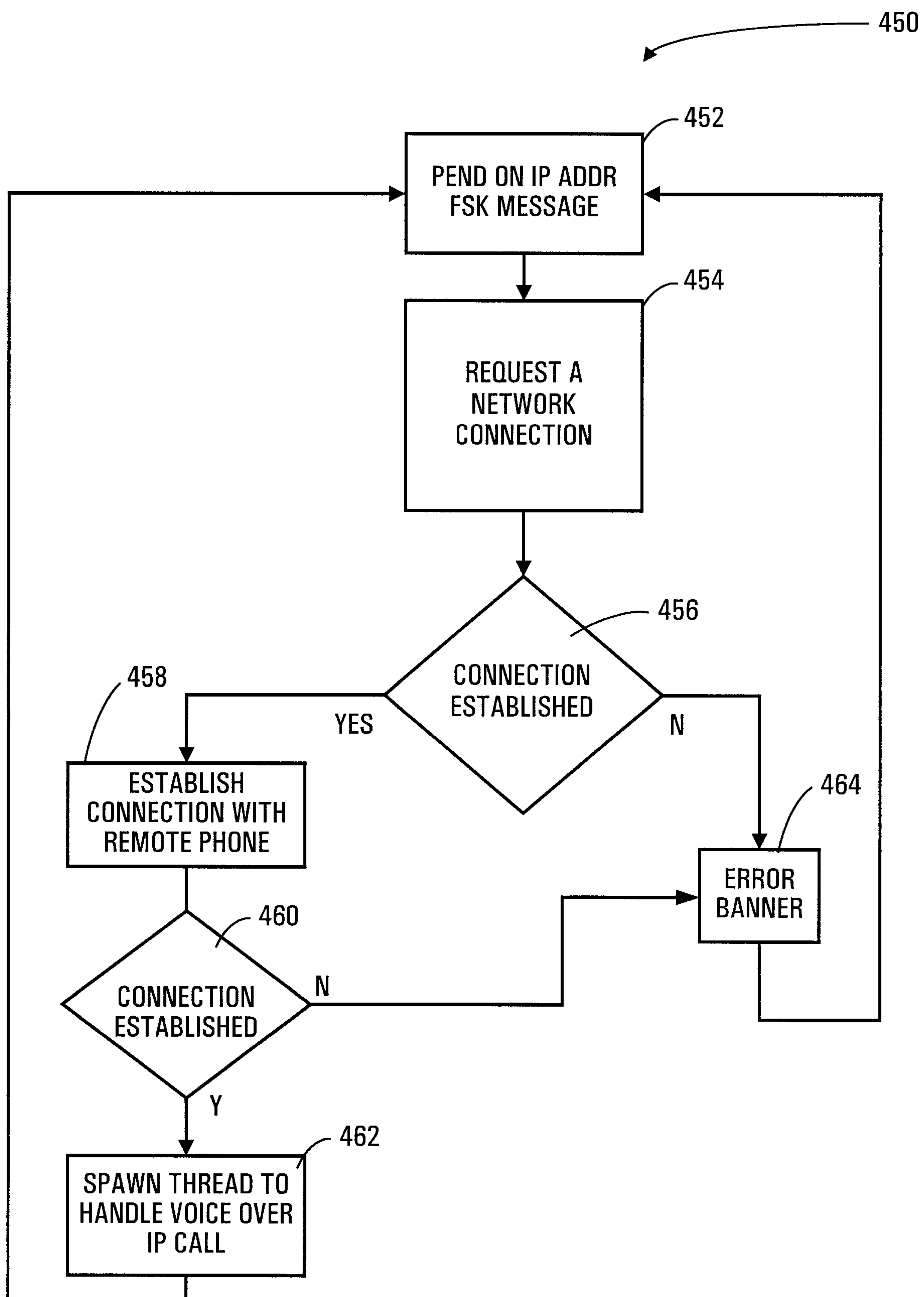


FIG. 15

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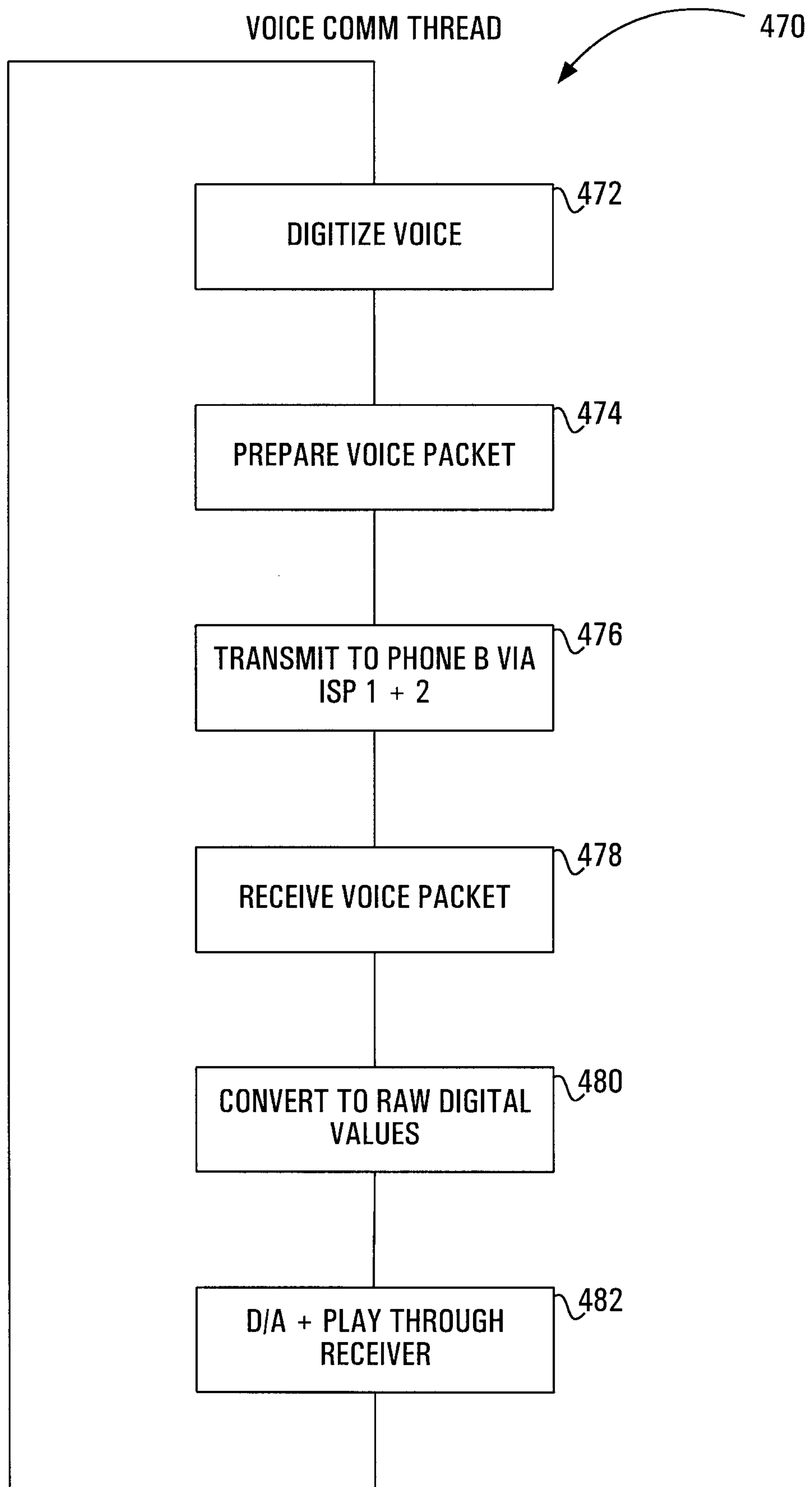


FIG. 16

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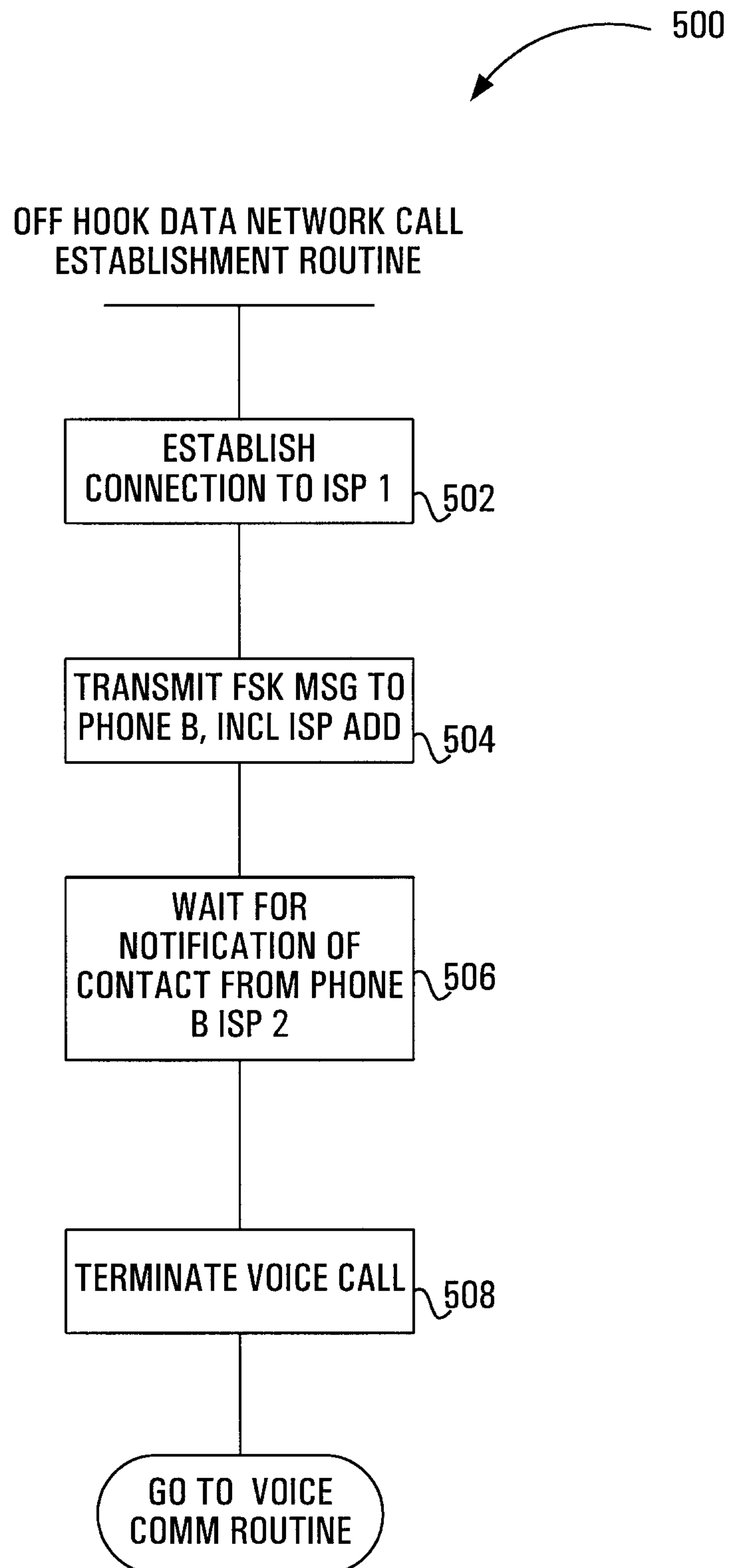


FIG. 17