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(72) Inventeurs/Inventors:
PERREAULT, CLAY, GB;
NICHOLSON, STEVE, GB;
THOMSON, ROD, CA;
BJORSELL, JOHAN EMIL VICTOR, CA;
ARAFA, FUAD, CA

(73) Propriétaire/Owner:
VOIP-PAL.COM, INC., US

(74) Agent: SMART & BIGGAR LLP

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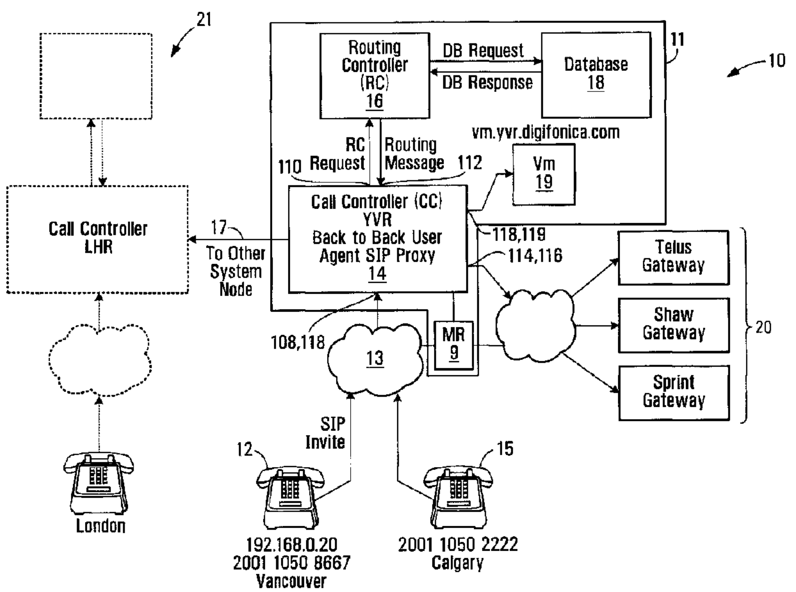


(57) Abrégé/Abstract:
Routing a communication between first and second participants involves causing a controller to receive on an IP network, from a first participant device, a first participant identifier and a second participant identifier to locate first and second participant profiles respectively. At least part of the second participant identifier is compared with at least one attribute contained in the first participant user profile and, based on the comparison, the communication is classified as a system communication or an external network communication whereupon a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant is produced, or an external network routing message identifying an Internet address of a gateway to an external network is produced. The produced routing message thus indicates how the communication should be routed.

ABSTRACT

Routing a communication between first and second participants involves causing a controller to receive on an IP network, from a first participant device, a first participant identifier and a second participant identifier to locate first and second participant profiles respectively. At least part of the second participant identifier is compared with at least one attribute contained in the first participant user profile and, based on the comparison, the communication is classified as a system communication or an external network communication whereupon a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant is produced, or an external network routing message identifying an Internet address of a gateway to an external network is produced. The produced routing message thus indicates how the communication should be routed.

PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS

BACKGROUND

1. Field

This invention relates to voice over IP communications and methods and apparatus for routing and billing.

2. Description of Related Art

Internet protocol (IP) telephones are typically personal computer (PC) based telephones connected within an IP network, such as the public Internet or a private network of a large organization. These IP telephones have installed “voice-over-IP” (VoIP) software enabling them to make and receive voice calls and send and receive information in data and video formats.

IP telephony switches installed within the IP network enable voice calls to be made within or between IP networks, and between an IP network and a switched circuit network (SCN), such as the public switched telephone network (PSTN). If the IP switch supports the Signaling System **7** (SS**7**) protocol, the IP telephone can also access PSTN databases.

The PSTN network typically includes complex network nodes that contain all information about a local calling service area including user authentication and call routing. The PSTN network typically aggregates all information and traffic into a single location or node, processes it locally and then passes it on to other network nodes, as necessary, by maintaining route tables at the node. PSTN nodes are redundant by design and thus provide reliable service, but if a node should fail due to an earthquake or other natural disaster, significant, if not complete service outages can occur, with no other nodes being able to take up the load.

Existing VoIP systems do not allow for high availability and resiliency in delivering Voice Over IP based Session Initiation Protocol (SIP) Protocol service over a geographically dispersed area such as a city, region or continent. Most resiliency originates from the provision of IP based telephone services to one location or a small number of locations such as a single office or network of branch offices.

SUMMARY

In one embodiment, there is provided a method for routing a communication in a communication system between an Internet-connected first participant device associated with a first participant and a second participant device associated with a second participant. The method involves in response to initiation of the communication by the first participant device, receiving, by a controller comprising at least one processor, over an Internet protocol (IP) network a first participant identifier and a second participant identifier. The method further involves causing the at least one processor to access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes. The method further involves comparing at least a portion of the second participant identifier, using the at least one processor, with at least one of the plurality of first participant attributes obtained from the user profile for the first participant. The method further involves causing the at least one processor to access the at least one database to search for a user profile for the second participant, and classifying the communication, based on the comparing, as a system communication or an external network communication, using the at least one processor. The method further involves when the communication is classified as a system communication, producing a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant, using the at least one processor, wherein the system routing message causes the communication to be established to the second participant

device. The method further involves when the communication is classified as an external network communication, producing an external network routing message identifying an Internet address associated with a gateway to an external network, using the at least one processor, wherein the external network routing message causes the communication to the second participant device to be established using the gateway to the external network.

In another embodiment, there is provided a non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method above.

In another embodiment, there is provided an apparatus for routing communications in a communication system that includes an Internet-connected first participant device associated with a first participant, wherein the first participant device is operable to initiate a communication to a second participant device associated with a second participant. The apparatus includes a controller comprising at least one processor in communication with at least one memory storing processor readable instructions. The at least one processor is operably configured by the processor readable instructions to, in response to initiation of the communication by the first participant device, receive over an Internet protocol (IP) network a first participant identifier and a second participant identifier, and access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes. The at least one processor is further operably configured by the processor readable instructions to compare at least a portion of the second participant identifier with at least one of the plurality of first participant attributes obtained from the user profile for the first participant to generate a comparison result, access the at least one database to search for a user profile for the second participant, and classify the communication, based on the comparison result, as a system communication or an external network communication. The at least one processor is further operably configured by the processor readable instructions to, when the communication is classified as a system communication, produce a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant, wherein the system routing message causes the communication to be established to the second participant device. The at least one processor is operably configured by the processor readable instructions to, when the communication is classified as an external network communication, produce an external network routing message identifying an Internet address associated with a gateway to an external network, wherein the external network routing message causes the communication to the second participant device to be established using the gateway to the external network.

In another embodiment, there is provided an apparatus for routing communications in a communication system that includes an Internet-connected first participant device associated with a first participant, the first participant device operable to initiate a communication to a second participant device associated with a second participant. The apparatus includes a controller comprising at least one processor in communication with at least one memory storing processor-readable instruction codes. The at least one processor is operably configured by the processor-readable instruction codes to, in response to initiation of the communication by the first participant device over the Internet, receive a first participant identifier and a second participant identifier, and access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes. The at least one processor is further operably configured by the processor-readable instruction codes to compare at least a portion of the second participant identifier with at least one of the plurality of first participant attributes obtained from the user profile for the first participant to generate a comparison result, and access the at least one database to search for a user profile for the second participant and communication blocking information for the second participant. The at least one processor is also operably configured by the processor-readable instruction codes to classify the communication, based on at least one of the comparison result and the communication blocking information for the second participant, as a system communication, an external network communication or a blocked communication, and when the communication is classified as a system communication, produce a system routing message identifying a first Internet address associated with the second participant device, causing the communication to be established entirely over an Internet protocol (IP) network. The at least one processor is operably configured by the processor-readable instruction codes to, when the communication is classified as an external network communication, produce an external routing message identifying an Internet address associated with a gateway to a network that is external to the communication system, causing a portion of a path taken by the communication to be established over a circuit switched network.

Other aspects and features of the embodiments described herein will become apparent to those ordinarily skilled in the art upon review of the following description in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments,

Figure **1** is a block diagram of a system according to a first embodiment;

Figure **2** is a block diagram of a caller telephone according to the first embodiment;

Figure **3** is a schematic representation of a SIP invite message transmitted between the caller telephone and a controller shown in Figure **1**;

Figure **4** is a block diagram of a call controller shown in Figure **1**;

Figure **5** is a flowchart of a process executed by the call controller shown in Figure **1**;

Figure **6** is a schematic representation of a routing, billing and rating (RC) request message produced by the call controller shown in Figure **1**;

Figure **7** is a block diagram of a processor circuit of a routing, billing, rating element of the system shown in Figure **1**;

Figures **8**A-**8**D is a flowchart of a RC request message handler executed by the RC processor circuit shown in Figure **7**;

Figure **9** is a tabular representation of a dialing profile stored in a database accessible by the RC shown in Figure **1**;

Figure **10** is a tabular representation of a dialing profile for a caller using the caller telephone shown in Figure **1**;

Figure **11** is a tabular representation of a callee profile for a callee located in Calgary;

Figure **12** is a tabular representation of a callee profile for a callee located in London;

Figure **13** is a tabular representation of a Direct-in-Dial (DID) bank table record stored in the database shown in Figure **1**;

Figure **14** is a tabular representation of an exemplary DID bank table record for the Calgary callee referenced in Figure **11**;

Figure **15** is a tabular representation of a routing message transmitted from the RC to the call controller shown in Figure **1**;

Figure **16** is a schematic representation of a routing message buffer holding a routing message for routing a call to the Calgary callee referenced in Figure **11**;

Figure **17** is a tabular representation of a prefix to supernode table record stored in the database shown in Figure **1**;

Figure **18** is a tabular representation of a prefix to supernode table record that would be used for the Calgary callee referenced in Figure **11**;

Figure **19** is a tabular representation of a master list record stored in a master list table in the database shown in Figure **1**;

Figure **20** is a tabular representation of a populated master list record;

Figure **21** is a tabular representation of a suppliers list record stored in the database shown in Figure **1**;

Figure **22** is a tabular representation of a specific supplier list record for a first supplier;

Figure **23** is a tabular representation of a specific supplier list record for a second supplier;

Figure **24** is a tabular representation of a specific supplier list record for a third supplier;

Figure **25** is a schematic representation of a routing message, held in a routing message buffer, identifying to the controller a plurality of possible suppliers that may carry the call;

Figure **26** is a tabular representation of a call block table record;

Figure **27** is a tabular representation of a call block table record for the Calgary callee;

Figure **28** is a tabular representation of a call forwarding table record;

Figure **29** is a tabular representation of a call forwarding table record specific for the Calgary callee;

Figure **30** is a tabular representation of a voicemail table record specifying voicemail parameters to enable the caller to leave a voicemail message for the callee;

Figure **31** is a tabular representation of a voicemail table record specific to the Calgary callee;

Figure **32** is a schematic representation of an exemplary routing message, held in a routing message buffer, indicating call forwarding numbers and a voicemail server identifier;

Figures **33**A and **33**B are respective portions of a flowchart of a process executed by the RC processor for determining a time to live value;

Figure **34** is a tabular representation of a subscriber bundle table record;

Figure **35** is a tabular representation of a subscriber bundle record for the Vancouver caller;

Figure **36** is a tabular representation of a bundle override table record;

Figure **37** is a tabular representation of bundle override record for a located master list ID;

Figure **38** is a tabular representation of a subscriber account table record;

Figure **39** is a tabular representation of a subscriber account record for the Vancouver caller;

Figure **40** is a flowchart of a process for producing a second time value executed by the RC processor circuit shown in Figure **7**;

Figure **41** is a flowchart for calculating a call cost per unit time;

Figure **42** is a tabular representation of a system operator special rates table record;

Figure **43** is a tabular representation of a system operator special rates table record for a reseller named Klondike;

Figure **44** is a tabular representation of a system operator mark-up table record;

Figure **45** is a tabular representation of a system operator mark-up table record for the reseller Klondike;

Figure **46** is a tabular representation of a default system operator mark-up table record;

Figure **47** is a tabular representation of a reseller special destinations table record;

Figure **48** is a tabular representation of a reseller special destinations table record for the reseller Klondike;

Figure **49** is a tabular representation of a reseller global mark-up table record;

Figure **50** is a tabular representation of a reseller global mark-up table record for the reseller Klondike;

Figure **51** is a tabular representation of a SIP bye message transmitted from either of the telephones shown in Figure **1** to the call controller;

Figure **52** is a tabular representation of a SIP bye message sent to the controller from the Calgary callee;

Figure **53** is a flowchart of a process executed by the call controller for producing a RC stop message in response to receipt of a SIP bye message;

Figure **54** is a tabular representation of an exemplary RC call stop message;

Figure **55** is a tabular representation of an RC call stop message for the Calgary callee;

Figures **56**A and **56**B are respective portions of a flowchart of a RC call stop message handling routine executed by the RC shown in Figure **1**;

Figure **57** is a tabular representation of a reseller accounts table record;

Figure **58** is a tabular representation of a reseller accounts table record for the reseller Klondike;

Figure **59** is a tabular representation of a system operator accounts table record; and

Figure **60** is a tabular representation of a system operator accounts record for the system operator described herein.

DETAILED DESCRIPTION

Referring to Figure **1**, a system for making voice over IP telephone/videophone calls is shown generally at **10**. The system includes a first super node shown generally at **11** and a second super node shown generally at **21**. The first super node **11** is located in geographical area, such as Vancouver, B.C., Canada for example and the second super node **21** is located in London, England, for example. Different super nodes may be located in different geographical regions throughout the world to provide telephone/videophone service to subscribers in respective regions. These super nodes may be in communication with each other by high speed/ high data throughput links including optical fiber, satellite and/or cable links, forming a backbone to the system. These super nodes may alternatively or, in addition, be in communication with each other through conventional internet services.

In the embodiment shown, the Vancouver supernode **11** provides telephone/videophone service to western Canadian customers from Vancouver Island to Ontario. Another node (not shown) may be located in Eastern Canada to provide services to subscribers in that area.

Other nodes of the type shown may also be employed within the geographical area serviced by a supernode, to provide for call load sharing, for example within a region of the geographical area serviced by the supernode. However, in general, all nodes are similar and have the properties described below in connection with the Vancouver supernode **11**.

In this embodiment, the Vancouver supernode includes a call controller (C) **14**, a routing controller (RC) **16,** a database **18** and a voicemail server **19** and a media relay **9**. Each of these may be implemented as separate modules on a common computer system or by separate computers, for example. The voicemail server **19** need not be included in the node and can be provided by an outside service provider.

Subscribers such as a subscriber in Vancouver and a subscriber in Calgary communicate with the Vancouver supernode using their own internet service providers which route internet traffic from these subscribers over the internet shown generally at **13** in Figure **1**. To these subscribers the Vancouver supernode is accessible at a pre-determined internet protocol (IP) address or a fully qualified domain name that can be accessed in the usual way through a subscriber's internet service provider. The subscriber in Vancouver uses a telephone **12** that is capable of communicating with the Vancouver supernode **11** using Session Initiation Protocol (SIP) messages and the Calgary subscriber uses a similar telephone **15**, in Calgary AB.

It should be noted that throughout this description, the IP/UDP addresses of all elements such as the caller and callee telephones, call controller, media relay, and any others, will be assumed to be valid IP/UDP addresses directly accessible via the Internet or a private IP network, for example, depending on the specific implementation of the system. As such, it will be assumed, for example, that the caller and callee telephones will have IP/UDP addresses directly accessible by the call controllers and the media relays on their respective supernodes, and those addresses will not be obscured by Network Address Translation (NAT) or similar mechanisms. In other words, the IP/UDP information contained in SIP messages (for example the SIP Invite message or the RC Request message which will be described below) will match the IP/UDP addresses of the IP packets carrying these SIP messages.

It will be appreciated that in many situations, the IP addresses assigned to various elements of the system may be in a private IP address space, and thus not directly accessible from other elements. Furthermore, it will also be appreciated that NAT is commonly used to share a "public" IP address between multiple devices, for example between home PCs and IP telephones sharing a single Internet connection. For example, a home PC may be assigned an IP address such as **192.168.0.101** and a Voice over IP telephone may be assigned an IP address of **192.168.0.103**. These addresses are located in so called "non-routable" (IP) address space and cannot be accessed directly from the Internet. In order for these devices to communicate with other computers located on the Internet, these IP addresses have to be converted into a "public" IP address, for example **24.10.10.123** assigned by the Internet Service Provider to the subscriber, by a device performing NAT, typically a home router. In addition to translating the IP addresses, NAT typically also translates UDP port numbers, for example an audio path originating at a VoIP telephone and using a UDP port **12378** at its private IP address, may have be translated to a UDP port **23465** associated with the public IP address of the NAT device. In other words, when a packet originating from the above VoIP telephone arrives at an Internet-based supernode, the source IP/UDP address contained in the IP packet header will be **24.10.10.1:23465**, whereas the source IP/UDP address information contained in the SIP message inside this IP packet will be **192.168.0.103:12378**. The mismatch in the IP/UDP addresses may cause a problem for SIP-based VoIP systems because, for example, a supernode will attempt to send messages to a private address of a telephone but the messages will never get there.

Referring to Figure **1**, in an attempt to make a call by the Vancouver telephone/videophone **12** to the Calgary telephone/videophone **15**, the Vancouver telephone/videophone sends a SIP invite message to the Vancouver supernode **11** and in response, the call controller **14** sends an RC request message to the RC **16** which makes various enquiries of the database **18** to produce a routing message which is sent back to the call controller **14**. The call controller **14** then communicates with the media relay **9** to cause a communications link including an audio path and a videophone (if a videopath call) to be established through the media relay to the same node, a different node or to a communications supplier gateway as shown generally at **20** to carry audio, and where applicable, video traffic to the call recipient or callee.

Generally, the RC **16** executes a process to facilitate communication between callers and callees. The process involves, in response to initiation of a call by a calling subscriber, receiving a callee identifier from the calling subscriber, using call classification criteria associated with the calling subscriber to classify the call as a public network call or a private network call and producing a routing message identifying an address on the private network, associated with the callee when the call is classified as a private network call and producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

<u>Subscriber Telephone</u>

In greater detail, referring to Figure **2**, in this embodiment, the telephone/videophone **12** includes a processor circuit shown generally at **30** comprising a microprocessor **32**, program memory **34**, an input/output (I/O) port **36**, parameter memory **38** and temporary memory **40**. The program memory **34**, I/O port **36**, parameter memory **38** and temporary memory **40** are all in communication with the microprocessor **32**. The I/O port **36** has a dial input **42** for receiving a dialled telephone/videophone number from a keypad, for example, or from a voice recognition unit or from pre-stored telephone/videophone numbers stored in the parameter memory **38**, for example. For simplicity, in Figure **2** a box labelled dialing functions **44** represents any device capable of informing the microprocessor **32** of a callee identifier, e.g., a callee telephone/videophone number.

The processor **32** stores the callee identifier in a dialled number buffer **45**. In this case, assume the dialled number is **2001 1050 2222** and that it is a number associated with the Calgary subscriber. The I/O port **36** also has a handset interface **46** for receiving and producing signals from and to a handset that the user may place to his ear. This interface **46** may include a BLUETOOTH™ wireless interface, a wired interface or speaker phone, for example. The handset acts as a termination point for an audio path (not shown) which will be appreciated later. The I/O port **36** also has an internet connection **48** which is preferably a high speed internet connection and is operable to connect the telephone/videophone to an internet service provider. The internet connection **48** also acts as a part of the voice path, as will be appreciated later. It will be appreciated that where the subscriber device is a videophone, a separate video path is established in the same way an audio path is established. For simplicity, the following description refers to a telephone call, but it is to be understood that a videophone call is handled similarly, with the call controller causing the media relay to facilitate both an audio path and a video path instead of only an audio path.

The parameter memory **38** has a username field **50**, a password field **52** an IP address field **53** and a SIP proxy address field **54**, for example. The user name field **50** is operable to hold a user name, which in this case is **2001 1050 8667**. The user name is assigned upon subscription or registration into the system and, in this embodiment, includes a twelve digit number having a continent code **61**, a country code **63**, a dealer code **70** and a unique number code **74**. The continent code **61** is comprised of the first or left-most digit of the user name in this embodiment. The country code **63** is comprised of the next three digits. The dealer code **70** is comprised of the next four digits and the unique number code **74** is comprised of the last four digits. The password field **52** holds a password of up to **512** characters, in this example. The IP address field **53** stores an IP address of the telephone, which for this explanation is **192.168.0.20**. The SIP proxy address field **54** holds an IP protocol compatible proxy address which may be provided to the telephone through the internet connection **48** as part of a registration procedure.

The program memory **34** stores blocks of codes for directing the processor **32** to carry out the functions of the telephone, one of which includes a firewall block **56** which provides firewall functions to the telephone, to prevent access by unauthorized persons to the microprocessor **32** and memories **34**, **38** and **40** through the internet connection **48**. The program memory **34** also stores codes **57** for establishing a call ID. The call ID codes **57** direct the processor **32** to produce a call identifier having a format comprising a hexadecimal string at an IP address, the IP address being the IP address of the telephone. Thus, an exemplary call identifier might be FF**10@192.168.0.20**.

Generally, in response to picking up the handset interface **46** and activating a dialing function **44**, the microprocessor **32** produces and sends a SIP invite message as shown in Figure **3**, to the routing controller **16** shown in Figure **1**. This SIP invite message is essentially to initiate a call by a calling subscriber.

Referring to Figure **3**, the SIP invite message includes a caller ID field **60**, a callee identifier field **62**, a digest parameters field **64**, a call ID field **65** an IP address field **67** and a caller UDP port field **69**. In this embodiment, the caller ID field **60** includes the user name **2001 1050 8667** that is the Vancouver user name stored in the user name field **50** of the parameter memory **38** in the telephone **12** shown in Figure **2**. In addition, referring back to Figure **3**, the callee identifier field **62** includes a callee identifier which in this embodiment is the user name **2001 1050 2222** that is the dialled number of the Calgary subscriber stored in the dialled number buffer **45** shown in Figure **2**. The digest parameters field **64** includes digest parameters and the call ID field **65** includes a code comprising a generated prefix code (FF**10**) and a suffix which is the Internet Protocol (IP) address of the telephone **12** stored in the IP address field **53** of the telephone. The IP address field **67** holds the IP address assigned to the telephone, in this embodiment **192.168.0.20**, and the caller UDP port field **69** includes a UDP port identifier identifying a UDP port at which the audio path will be terminated at the caller's telephone.

<u>Call Controller</u>

Referring to Figure **4**, a call controller circuit of the call controller **14** (Figure **1**) is shown in greater detail at **100**. The call controller circuit **100** includes a microprocessor **102**, program memory **104** and an I/O port **106**. The circuit **100** may include a plurality of microprocessors, a plurality of program memories and a plurality of I/O ports to be able to handle a large volume of calls. However, for simplicity, the call controller circuit **100** will be described as having only one microprocessor **102**, program memory **104** and I/O port **106**, it being understood that there may be more.

Generally, the I/O port **106** includes an input **108** for receiving messages such as the SIP invite message shown in Figure **3**, from the telephone shown in Figure **2**. The I/O port **106** also has an RC request message output **110** for transmitting an RC request message to the RC **16** of Figure **1**, an RC message input **112** for receiving routing messages from the RC **16**, a gateway output **114** for transmitting messages to one of the gateways **20** shown in Figure **1** to advise the gateway to establish an audio path, for example, and a gateway input **116** for receiving messages from the gateway. The I/O port **106** further includes a SIP output **118** for transmitting messages to the telephone **12** to advise the telephone of the IP addresses of the gateways which will establish the audio path. The I/O port **106** further includes a voicemail server input and output **117**, **119** respectively for communicating with the voicemail server **19** shown in Figure **1**.

While certain inputs and outputs have been shown as separate, it will be appreciated that some may be a single IP address and IP port. For example, the messages sent to the RC **16** and received from the RC **16** may be transmitted and received on the same single IP port.

The program memory **104** includes blocks of code for directing the microprocessor **102** to carry out various functions of the call controller **14**. For example, these blocks of code include a first block **120** for causing the call controller circuit **100** to execute a SIP invite to RC request process to produce an RC request message in response to a received SIP invite message. In addition, there is a routing message to gateway message block **122** which causes the call controller circuit **100** to produce a gateway query message in response to a received routing message from the RC **16**.

Referring to Figure **5**, the SIP invite to RC request process is shown in more detail at **120**. On receipt of a SIP invite message of the type shown in Figure **3**, block **122** of Figure **5** directs the call controller circuit **100** of Figure **4** to authenticate the user. This may be done, for example, by prompting the user for a password, by sending a message back to the telephone **12** which is interpreted at the telephone as a request for a password entry or the password may automatically be sent to the call controller **14** from the telephone, in response to the message. The call controller **14** may then make enquiries of databases to which it has access, to determine whether or not the user's password matches a password stored in the database. Various functions may be used to pass encryption keys or hash codes back and forth to ensure that the transmittal of passwords is secure.

Should the authentication process fail, the call controller circuit **100** is directed to an error handling routine **124** which causes messages to be displayed at the telephone **12** to indicate there was an authentication problem. If the authentication procedure is passed, block **121** directs the call controller circuit **100** to determine whether or not the contents of the caller ID field **60** of the SIP invite message received from the telephone is an IP address. If it is an IP address, then block **123** directs the call controller circuit **100** to set the contents of a type field variable maintained by the microprocessor **102** to a code representing that the call type is a third party invite. If at block **121** the caller ID field contents do not identify an IP address, then block **125** directs the microprocessor to set the contents of the type field to a code indicating that the call is being made by a system subscriber. Then, block **126** directs the call controller circuit to read the call identifier **65** provided in the SIP invite message from the telephone **12**, and at block **128** the processor is directed to produce an RC request message that includes that call ID. Block **129** then directs the call controller circuit **100** to send the RC request to the RC **16**.

Referring to Figure **6**, an RC request message is shown generally at **150** and includes a caller field **152**, a callee field **154**, a digest field **156**, a call ID field **158** and a type field **160**. The caller, callee, digest call ID fields **152**, **154**, **156** and **158** contain copies of the caller, callee, digest parameters and call ID fields **60**, **62**, **64** and **65** of the SIP invite message shown in Figure **3**. The type field **160** contains the type code established at blocks **123** or **125** of Figure **5** to indicate whether the call is from a third party or system subscriber, respectively. The caller identifier field may include a PSTN number or a system subscriber username as shown, for example.

Routing Controller (RC)

Referring to Figure **7**, the RC **16** is shown in greater detail and includes an RC processor circuit shown generally at **200**. The RC processor circuit **200** includes a processor **202**, program memory **204**, a table memory **206**, buffer memory **207**, and an I/O port **208**, all in communication with the processor **202**. (As earlier indicated, there may be a plurality of processor circuits (**202**), memories (**204**), etc.)

The buffer memory **207** includes a caller id buffer **209** and a callee id buffer **211**.

The I/O port **208** includes a database request port **210** through which a request to the database (**18** shown in Figure **1**) can be made and includes a database response port **212** for receiving a reply from the database **18**. The I/O port **208** further includes an RC request message input **214** for receiving the RC request message from the call controller (**14** shown in Figure **1**) and includes a routing message output **216** for sending a routing message back to the call controller **14**. The I/O port **208** thus acts to receive caller identifier and a callee identifier contained in the RC request message from the call controller, the RC request message being received in response to initiation of a call by a calling subscriber.

The program memory **204** includes blocks of codes for directing the processor **202** to carry out various functions of the RC (**16**). One of these blocks includes an RC request message handler **250** which directs the RC to produce a routing message in response to a received RC request message. The RC request message handler process is shown in greater detail at **250** in Figures **8**A through **8**D.

<u>RC Request Message Handler</u>

Referring to Figure **8**A, the RC request message handler begins with a first block **252** that directs the RC processor circuit (**200**) to store the contents of the RC request message (**150**) in buffers in the buffer memory **207** of Figure **7**, one of which includes the caller ID buffer **209** of Figure **7** for separately storing the contents of the callee field **154** of the RC request message. Block **254** then directs the RC processor circuit to use the contents of the caller field **152** in the RC request message shown in Figure **6**, to locate and retrieve from the database **18** a record associating calling attributes with the calling subscriber. The located record may be referred to as a dialing profile for the caller. The retrieved dialing profile may then be stored in the buffer memory **207**, for example.

Referring to Figure **9**, an exemplary data structure for a dialing profile is shown generally at **253** and includes a user name field **258**, a domain field **260**, and calling attributes comprising a national dialing digits (NDD) field **262**, an international dialing digits (IDD) field **264**, a country code field **266**, a local area codes field **267**, a caller minimum local length field **268**, a caller maximum local length field **270**, a reseller field **273**, a maximum number of concurrent calls field **275** and a current number of concurrent calls field **277**. Effectively the dialing profile is a record identifying calling attributes of the caller identified by the caller identifier. More generally, dialing profiles represent calling attributes of respective subscribers.

An exemplary caller profile for the Vancouver subscriber is shown generally at **276** in Figure **10** and indicates that the user name field **258** includes the user name (**2001 1050 8667**) that has been assigned to the subscriber and is stored in the user name field **50** in the telephone as shown in Figure **2**.

Referring back to Figure **10**, the domain field **260** includes a domain name as shown at **282**, including a node type identifier **284**, a location code identifier **286**, a system provider identifier **288** and a domain portion **290**. The domain field **260** effectively identifies a domain or node associated with the user identified by the contents of the user name field **258**.

In this embodiment, the node type identifier **284** includes the code “sp” identifying a supernode and the location identifier **286** identifies the supernode as being in

Vancouver (YVR). The system provider identifier **288** identifies the company supplying the service and the domain portion **290** identifies the "com" domain.

The national dialled digit field **262** in this embodiment includes the digit "**1**" and, in general, includes a number specified by the International Telecommunications Union (ITU) Telecommunications Standardization Sector (ITU-T) E. **164** Recommendation which assigns national dialing digits to countries.

The international dialing digit field **264** includes a code also assigned according to the ITU-T according to the country or location of the user.

The country code field **266** also includes the digit "**1**" and, in general, includes a number assigned according to the ITU-T to represent the country in which the user is located.

The local area codes field **267** includes a list of area codes that have been assigned by the ITU-T to the geographical area in which the subscriber is located. The caller minimum and maximum local number length fields **268** and **270** hold numbers representing minimum and maximum local number lengths permitted in the area code(s) specified by the contents of the local area codes field **267**. The reseller field **273** is optional and holds a code identifying a retailer of the services, in this embodiment "Klondike". The maximum number of concurrent calls field **275** holds a code identifying the maximum number of concurrent calls that the user is entitled to cause to concurrently exist. This permits more than one call to occur concurrently while all calls for the user are billed to the same account. The current number of concurrent calls field **277** is initially **0** and is incremented each time a concurrent call associated with the user is initiated and is decremented when a concurrent call is terminated.

The area codes associated with the user are the area codes associated with the location code identifier **286** of the contents of the domain field **260**.

A dialing profile of the type shown in Figure **9** is produced whenever a user registers with the system or agrees to become a subscriber to the system. Thus, for example, a user wishing to subscribe to the system may contact an office maintained by a system operator and personnel in the office may ask the user certain questions about his location and service preferences, whereupon tables can be used to provide office personnel with appropriate information to be entered into the user name **258**, domain **260**, NDD **262**, IDD **264**, country code **266**, local area codes **267**, caller minimum and maximum local length fields **268** and **270** reseller field **273** and concurrent call fields **275** and **277** to establish a dialing profile for the user.

Referring to Figures **11** and **12**, callee dialing profiles for users in Calgary and London, respectively for example, are shown.

In addition to creating dialing profiles when a user registers with the system, a direct-in-dial (DID) record of the type shown at **278** in Figure **13** is added to a direct-in-dial bank table in the database (**18** in Figure **1**) to associate the username and a host name of the supernode with which the user is associated, with an E.**164** number associated with the user on the PSTN network.

An exemplary DID table record entry for the Calgary callee is shown generally at **300** in Figure **14**. The user name field **281** and user domain field **272** are analogous to the user name and user domain fields **258** and **260** of the caller dialing profile shown in Figure **10**. The contents of the DID field **274** include a E.**164** public telephone number including a country code **283**, an area code **285**, an exchange code **287** and a number **289**. If the user has multiple telephone numbers, then multiple records of the type shown at **300** would be included in the DID bank table, each having the same user name and user domain, but different DID field **274** contents reflecting the different telephone numbers associated with that user.

In addition to creating dialing profiles as shown in Figure **9** and DID records as shown in Figure **13** when a user registers with the system, call blocking records of the type shown in Figure **26**, call forwarding records of the type shown in Figure **28** and voicemail records of the type shown in Figure **30** may be added to the database **18** when a new subscriber is added to the system.

Referring back to Figure **8**A, after retrieving a dialing profile for the caller, such as shown at **276** in Figure **10**, the RC processor circuit **200** is directed to block **256** which directs the processor circuit (**200**) to determine whether the contents of the concurrent call field **277** are less then the contents of the maximum concurrent call field **275** of the dialing profile for the caller and, if so, block **271** directs the processor circuit to increment the contents of the concurrent call field **277**. If the contents of concurrent call field **277** are equal to or greater than the contents of the maximum concurrent call field **275**, block **259** directs the processor circuit **200** to send an error message back to the call controller (**14**) to cause the call controller to notify the caller that the maximum number of concurrent calls has been reached and no further calls can exist concurrently, including the presently requested call.

Assuming block **256** allows the call to proceed, the RC processor circuit **200** is directed to perform certain checks on the callee identifier provided by the contents of the callee field **154** in Figure **6**, of the RC request message **150**. These checks are shown in greater detail in Figure **8**B.

Referring to Figure **8**B, the processor (**202** in Figure **7**) is directed to a first block **257** that causes it to determine whether a digit pattern of the callee identifier (**154**) provided in the RC request message (**150**) includes a pattern that matches the contents of the international dialing digits (IDD) field **264** in the caller profile shown in

Figure **10**. If so, then block **259** directs the processor (**202**) to set a call type code identifier variable maintained by the processor to indicate that the call is an international call and block **261** directs the processor to produce a reformatted callee identifier by reformatting the callee identifier into a predefined digit format. In this embodiment, this is done by removing the pattern of digits matching the IDD field contents **264** of the caller dialing profile to effectively shorten the callee identifier. Then, block **263** directs the processor **202** to determine whether or not the callee identifier has a length which meets criteria establishing it as a number compliant with the E.**164** Standard set by the ITU. If the length does not meet this criteria, block **265** directs the processor **202** to send back to the call controller (**14**) a message indicating the length is not correct. The process is then ended. At the call controller **14**, routines (not shown) stored in the program memory **104** may direct the processor (**102** of Figure **4**) to respond to the incorrect length message by transmitting a message back to the telephone (**12** shown in Figure **1**) to indicate that an invalid number has been dialled.

Still referring to Figure **8**B, if the length of the amended callee identifier meets the criteria set forth at block **263**, block **269** directs the processor (**202** of Figure **7**) to make a database request to determine whether or not the amended callee identifier is found in a record in the direct-in-dial bank (DID) table. Referring back to Figure **8**B, at block **269**, if the processor **202** receives a response from the database indicating that the reformatted callee identifier produced at block **261** is found in a record in the DID bank table, then the callee is a subscriber to the system and the call is classified as a private network call by directing the processor to block **279** which directs the processor to copy the contents of the corresponding user name field (**281** in Figure **14**) from the callee DID bank table record (**300** in Figure **14**) into the callee ID buffer (**211** in Figure **7**). Thus, the processor **202** locates a subscriber user name associated with the reformatted callee identifier. The processor **202** is then directed to point B in Figure **8**A.

Subscriber to Subscriber Calls Between Different Nodes

Referring to Figure **8**A, block **280** directs the processor (**202** of Figure **7**) to execute a process to determine whether or not the node associated with the reformatted callee identifier is the same node that is associated with the caller identifier. To do this, the processor **202** determines whether or not a prefix (e.g., continent code **61**) of the callee name held in the callee ID buffer (**211** in Figure **7**), is the same as the corresponding prefix of the caller name held in the username field **258** of the caller dialing profile shown in Figure **10**. If the corresponding prefixes are not the same, block **302** in Figure **8**A directs the processor (**202** in Figure **7**) to set a call type flag in the buffer memory (**207** in Figure **7**) to indicate the call is a cross-domain call. Then, block **350** of Figure **8**A directs the processor (**202** of Figure **7**) to produce a routing message identifying an address on the private network with which the callee identified by the contents of the callee ID buffer is associated and to set a time to live for the call at a maximum value of **99999**, for example.

Thus the routing message includes a caller identifier, a call identifier set according to a username associated with the located DID bank table record and includes an identifier of a node on the private network with which the callee is associated.

The node in the system with which the callee is associated is determined by using the callee identifier to address a supernode table having records of the type as shown at **370** in Figure **17**. Each record **370** has a prefix field **372** and a supernode address field **374**. The prefix field **372** includes the first n digits of the callee identifier. In this embodiment n=**2**. The supernode address field **374** holds a code representing the IP address or a fully qualified domain name of the node associated with the code stored in the callee identifier prefix field **372**. Referring to Figure **18**, for example, if the prefix is **20**, the supernode address associated with that prefix is sp.yvr.digifonica.com.

Referring to Figure **15**, a generic routing message is shown generally at **352** and includes an optional supplier prefix field **354**, and optional delimiter field **356**, a callee user name field **358**, at least one route field **360**, a time to live field **362** and other fields **364**. The optional supplier prefix field **354** holds a code for identifying supplier traffic. The optional delimiter field **356** holds a symbol that delimits the supplier prefix code from the callee user name field **358**. In this embodiment, the symbol is a number sign (#). The route field **360** holds a domain name or IP address of a gateway or node that is to carry the call, and the time to live field **362** holds a value representing the number of seconds the call is permitted to be active, based on subscriber available minutes and other billing parameters.

Referring to Figure **8**A and Figure **16**, an example of a routing message produced by the processor at block **350** for a caller associated with a different node than the caller is shown generally at **366** and includes only a callee field **359**, a route field **361** and a time to live field **362**.

Referring to Figure **8**A, having produced a routing message as shown in Figure **16**, block **381** directs the processor (**202** of Figure **7**) to send the routing message shown in Figure **16** to the call controller **14** shown in Figure **1**.

Referring back to Figure **8**B, if at block **257**, the callee identifier stored in the callee id buffer (**211** in Figure **7**) does not begin with an international dialing digit, block **380** directs the processor (**202**) to determine whether or not the callee identifier begins with the same national dial digit code as assigned to the caller. To do this, the processor (**202**) is directed to refer to the retrieved caller dialing profile as shown in Figure **10**. In Figure **10**, the national dialing digit code **262** is the number **1**. Thus, if the callee identifier begins with the number **1**, then the processor (**202**) is directed to block **382** in Figure **8**B.

Block **382** directs the processor (**202** of Figure **7**) to examine the callee identifier to determine whether or not the digits following the NDD digit identify an area code that is the same as any of the area codes identified in the local area codes field **267** of the caller dialing profile **276** shown in Figure **10**. If not, block **384** of Figure **8**B directs the processor **202** to set the call type flag to indicate that the call is a national call. If the digits following the NDD digit identify an area code that is the same as a local area code associated with the caller as indicated by the caller dialing profile, block **386** directs the processor **202** to set the call type flag to indicate a local call, national style. After executing blocks **384** or **386**, block **388** directs the processor **202** to format the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier by removing the national dialled digit and prepending a caller country code identified by the country code field **266** of the caller dialing profile shown in Figure **10**. The processor (**202**) is then directed to block **263** of Figure **8**B to perform other processing as already described above.

If at block **380**, the callee identifier does not begin with a national dialled digit, block **390** directs the processor (**202**) to determine whether the callee identifier begins with digits that identify the same area code as the caller. Again, the reference for this is the retrieved caller dialing profile shown in Figure **10**. The processor (**202**) determines whether or not the first few digits of the callee identifier identify an area code corresponding to the local area code field **267** of the retrieved caller dialing profile. If so, then block **392** directs the processor **202** to set the call type flag to indicate that the call is a local call and block **394** directs the processor (**202**) to format the callee identifier into a pre-defined digit format to produce a reformatted callee identifier by prepending the caller country code to the callee identifier, the caller country code being determined from the country code field **266** of the retrieved caller dialing profile shown in Figure **10**. The processor (**202**) is then directed to block **263** for further processing as described above.

Referring back to Figure **8**B, at block **390**, the callee identifier does not start with the same area code as the caller, block **396** directs the processor (**202** of Figure **7**) to determine whether the number of digits in the callee identifier, i.e. the length of the callee identifier, is within the range of digits indicated by the caller minimum local number length field **268** and the caller maximum local number length field **270** of the retrieved caller dialing profile shown in Figure **10**. If so, then block **398** directs the processor (**202**) to set the call type flag to indicate a local call and block **400** directs the processor (**202**) to format the callee identifier into a pre-defined digit format to produce a reformatted callee identifier by prepending to the callee identifier the caller country code (as indicated by the country code field **266** of the retrieved caller dialing profile shown in Figure **10)** followed by the caller area code (as indicated by the local area code field **267** of the caller profile shown in Figure **10**). The processor (**202**) is then directed to block **263** of Figure **8**B for further processing as described above.

Referring back to Figure **8**B, if at block **396**, the callee identifier has a length that does not fall within the range specified by the caller minimum local number length field (**268** in Figure **10**) and the caller maximum local number length field (**270** in Figure **10**), block **402** directs the processor **202** of Figure **7** to determine whether or not the callee identifier identifies a valid user name. To do this, the processor **202** searches through the database (**18** of Figure **10** of dialing profiles to find a dialing profile having user name field contents (**258** in Figure **10**) that match the callee identifier. If no match is found, block **404** directs the processor (**202**) to send an error message back to the call controller (**14**). If at block **402**, a dialing profile having a user name field **258** that matches the callee identifier is found, block **406** directs the processor **202** to set the call type flag to indicate that the call is a private network call and then the processor is directed to block **280** of Figure **8**A. Thus, the call is classified as a private network call when the callee identifier identifies a subscriber to the private network.

From Figure **8**B, it will be appreciated that there are certain groups of blocks of codes that direct the processor **202** in Figure **7** to determine whether the callee identifier has certain features such as an international dialing digit, a national dialing digit, an area code and a length that meet certain criteria, and cause the processor **202** to reformat the callee identifier stored in the callee id buffer **211**, as necessary into a predetermined target format including only a country code, area code, and a normal telephone number, for example, to cause the callee identifier to be compatible with the E.**164** number plan standard in this embodiment. This enables block **269** in Figure **8**B to have a consistent format of callee identifiers for use in searching through the DID bank table records of the type shown in Figure **13** to determine how to route calls for subscriber to subscriber calls on the same system. Effectively, therefore blocks **257**, **380**, **390**, **396** and **402** establish call classification criteria for classifying the call as a public network call or a private network call. Block **269** classifies the call, depending on whether or not the formatted callee identifier has a DID bank table record and this depends on how the call classification criteria are met and block **402** directs the processor **202** of Figure **7** to classify the call as a private network call when the callee identifier complies with a pre-defined format, i.e. is a valid user name and identifies a subscriber to the private network, after the callee identifier has been subjected to the classification criteria of blocks **257**, **380**, **390** and **396**.

Subscriber to Non-Subscriber Calls

Not all calls will be subscriber to subscriber calls and this will be detected by the processor **202** of Figure **7** when it executes block **269** in Figure **8**B, and does not find a DID bank table record that is associated with the callee, in the DID bank table. When this occurs, the call is classified as a public network call by directing the processor **202** to block **408** of Figure **8**B which causes it to set the contents of the callee id buffer **211** of Figure **7** equal to the newly formatted callee identifier, i.e., a number compatible with the E.**164** standard. Then, block **410** of Figure **8**B directs the processor (**202**) to search a database of route or master list records associating route identifiers with dialing codes shown in Figure **19** to locate a router having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

Referring to Figure **19**, a data structure for a master list or route list record is shown. Each master list record includes a master list ID field **500**, a dialing code field **502**, a country code field **504**, a national sign number field **506**, a minimum length field **508**, a maximum length field **510**, a national dialled digit field **512**, an international dialled digit field **514** and a buffer rate field **516**.

The master list ID field **500** holds a unique code such as **1019**, for example, identifying the record. The dialing code field **502** holds a predetermined number pattern that the processor **202** of Figure **7** uses at block **410** in Figure **8**B to find the master list record having a dialing code matching the first few digits of the amended callee identifier stored in the callee id buffer **211**. The country code field **504** holds a number representing the country code associated with the record and the national sign number field **506** holds a number representing the area code associated with the record. (It will be observed that the dialing code is a combination of the contents of the country code field **504** and the national sign number field **506**.) The minimum length field **508** holds a number representing the minimum length of digits associated with the record and the maximum length field **51** holds a number representing the maximum number of digits in a number with which the record may be compared. The national dialled digit (NDD) field **512** holds a number representing an access code used to make a call within the country specified by the country code, and the international dialled digit (IDD) field **514** holds a number representing the international prefix needed to dial a call from the country indicated by the country code.

Thus, for example, a master list record may have a format as shown in Figure **20** with exemplary field contents as shown.

Referring back to Figure **8**B, using the country code and area code portions of the reformatted callee identifier stored in the callee id buffer **211**, block **410** directs the processor **202** of Figure **7** to find a master list record such as the one shown in Figure **20** having a dialing code that matches the country code (**1**) and area code (**604**) of the callee identifier. Thus, in this example, the processor (**202**) would find a master list record having an ID field containing the number **1019**. This number may be referred to as a route ID. Thus, a route ID number is found in the master list record associated with a predetermined number pattern in the reformatted callee identifier.

After executing block **410** in Figure **8**B, the process continues as shown in Figure **8**D. Referring to Figure **8**D, block **412** directs the processor **202** of Figure **7** to use the route ID number to search a database of supplier records associating supplier identifiers with route identifiers to locate at least one supplier record associated with the route identifier to identify at least one supplier operable to supply a communications link for the route.

Referring to Figure **21**, a data structure for a supplier list record is shown. Supplier list records include a supplier ID field **540**, a master list ID field **542**, an optional prefix field **544**, a specific route identifier field **546**, a NDD/IDD rewrite field **548**, a rate field **550**, and a timeout field **551**. The supplier ID field **540** holds a code identifying the name of the supplier and the master list ID field **542** holds a code for associating the supplier record with a master list record. The prefix field **544** holds a string used to identify the supplier traffic and the specific route identifier field **546** holds an IP address of a gateway operated by the supplier indicated by the supplier ID field **540**. The NDD/IDD rewrite field **548** holds a code representing a rewritten value of the NDD/IDD associated with this route for this supplier, and the rate field

550 holds a code indicating the cost per second to the system operator to use the route provided by the gateway specified by the contents of the route identifier field **546**. The timeout field **551** holds a code indicating a time that the call controller should wait for a response from the associated gateway before giving up and trying the next gateway. This time value may be in seconds, for example. Exemplary supplier records are shown in Figures **22**, **23** and **24** for the exemplary suppliers shown at **20** in Figure **1**, namely Telus, Shaw and Sprint.

Referring back to Figure **8**D, at block **412** the processor **202** finds all supplier records that identify the master list ID found at block **410** of Figure **8**B.

Referring back to Figure **8**D, block **560** directs the processor **202** of Figure **7** to begin to produce a routing message of the type shown in Figure **15**. To do this, the processor **202** loads a routing message buffer as shown in Figure **25** with a supplier prefix of the least costly supplier where the least costly supplier is determined from the rate fields **550** of Figure **21** of the records associated with respective suppliers.

Referring to Figures **22-24**, in the embodiment shown, the supplier "Telus" has the lowest number in the rate field **550** and therefore the prefix **4973** associated with that supplier is loaded into the routing message buffer shown in Figure **25** first.

Block **562** in Figure **8**D directs the processor to delimit the prefix **4973** by the number sign (#) and to next load the reformatted callee identifier into the routing message buffer shown in Figure **25**. At block **563** of Figure **8**D, the contents of the route identifier field **546** of Figure **21** of the record associated with the supplier "Telus" are added by the processor **202** of Figure **7** to the routing message buffer shown in Figure **25** after an @ sign delimiter, and then block **564** in Figure **8**D directs the processor to get a time to live value, which in one embodiment may be **3600** seconds, for example. Block **566** then directs the processor **202** to load this time to live value and the timeout value (**551**) in Figure **21** in the routing message buffer of

Figure **25**. Accordingly, a first part of the routing message for the Telus gateway is shown generally at **570** in Figure **25**.

Referring back to Figure **8**D, block **571** directs the processor **202** back to block **560** and causes it to repeat blocks **560**, **562**, **563**, **564** and **566** for each successive supplier until the routing message buffer is loaded with information pertaining to each supplier identified by the processor at block **412**. Thus, a second portion of the routing message as shown at **572** in Figure **25** relates to the second supplier identified by the record shown in Figure **23**. Referring back to Figure **25**, a third portion of the routing message as shown at **574** and is associated with a third supplier as indicated by the supplier record shown in Figure **24**.

Consequently, referring to Figure **25**, the routing message buffer holds a routing message identifying a plurality of different suppliers able to provide gateways to the public telephone network (i.e. specific routes) to establish at least part of a communication link through which the caller may contact the callee. In this embodiment, each of the suppliers is identified, in succession, according to rate. Other criteria for determining the order in which suppliers are listed in the routing message may include preferred supplier priorities which may be established based on service agreements, for example.

Referring back to Figure **8**D, block **568** directs the processor **202** of Figure **7** to send the routing message shown in Figure **25** to the call controller **14** in Figure **1**.

<u>Subscriber to Subscriber Calls Within the Same Node</u>

Referring back to Figure **8**A, if at block **280**, the callee identifier received in the RC request message has a prefix that identifies the same node as that associated with the caller, block **600** directs the processor **202** to use the callee identifier in the callee id buffer **211** to locate and retrieve a dialing profile for the callee. The dialing profile may be of the type shown in Figure **11** or **12**, for example. Block **602** of Figure

8A then directs the processor **202** of Figure **7** to get call block, call forward and voicemail records from the database **18** of Figure **1** based on the user name identified in the callee dialing profile retrieved by the processor at block **600**. Call block, call forward and voicemail records may be as shown in Figures **26**, **27**, **28** and **30** for example.

Referring to Figure **26**, the call block records include a user name field **604** and a block pattern field **606**. The user name field holds a user name corresponding to the user name in the user name field (**258** in Figure **10**) of the callee profile and the block pattern field **606** holds one or more E.**164**-compatible numbers or user names identifying PSTN numbers or system subscribers from whom the subscriber identified in the user name field **604** does not wish to receive calls.

Referring to Figure **8**A and Figure **27**, block **608** directs the processor **202** of Figure **7** to determine whether or not the caller identifier received in the RC request message matches a block pattern stored in the block pattern field **606** of the call block record associated with the callee identified by the contents of the user name field **604** in Figure **26**. If the caller identifier matches a block pattern, block **610** directs the processor to send a drop call or non-completion message to the call controller (**14**) and the process is ended. If the caller identifier does not match a block pattern associated with the callee, block **609** directs the processor to store the username and domain of the callee, as determined from the callee dialing profile, and a time to live value in the routing message buffer as shown at **650** in Figure **32**. Referring back to Figure **8**A, block **612** then directs the processor **202** to determine whether or not call forwarding is required.

Referring to Figure **28**, the call forwarding records include a user name field **614**, a destination number field **616**, and a sequence number field **618**. The user name field **614** stores a code representing a user with which the record is associated. The destination number field **616** holds a user name representing a number to which the current call should be forwarded, and the sequence number field **618** holds an integer number indicating the order in which the user name associated with the corresponding destination number field **616** should be attempted for call forwarding. The call forwarding table may have a plurality of records for a given user. The processor **202** of Figure **7** uses the contents of the sequence number field **618** to place the records for a given user in order. As will be appreciated below, this enables the call forwarding numbers to be tried in an ordered sequence.

Referring to Figure **8**A and Figure **29**, if at block **612**, the call forwarding record for the callee identified by the callee identifier contains no contents in the destination number field **616** and accordingly no contents in the sequence number field **618**, there are no call forwarding entries for this callee, and the processor **202** is directed to block **620** in Figure **8**C. If there are entries in the call forwarding table **27**, block **622** in Figure **8**A directs the processor **202** to search the dialing profile table to find a dialing profile record as shown in Figure **9**, for the user identified by the destination number field **616** of the call forward record shown in Figure **28**. The processor **202** of Figure **7** is further directed to store the username and domain for that user and a time to live value in the routing message buffer as shown at **652** in Figure **32**, to produce a routing message as illustrated. This process is repeated for each call forwarding record associated with the callee identified by the callee id buffer **211** in Figure **7** to add to the routing message buffer all call forwarding usernames and domains associated with the callee.

Referring back to Figure **8**A, if at block **612** there are no call forwarding records, then at block **620** in Figure **8**C the processor **202** is directed to determine whether or not the user identified by the callee identifier has paid for voicemail service. This is done by checking to see whether or not a flag is set in a voicemail record of the type shown in Figure **30** in a voicemail table stored in the database **18** shown in Figure **1**.

Referring to Figure **30**, voicemail records in this embodiment may include a user name field **624**, a voicemail server field **626**, a seconds to voicemail field **628** and an enable field **630**. The user name field **624** stores the user name of the callee. The voicemail server field **626** holds a code identifying a domain name of a voicemail server associated with the user identified by the user name field **624**. The seconds to voicemail field **628** holds a code identifying the time to wait before engaging voicemail, and the enable field **630** holds a code representing whether or not voicemail is enabled for the user. Referring back to Figure **8**C, at block **620** if the processor **202** of Figure **7** finds a voicemail record as shown in Figure **30** having user name field **624** contents matching the callee identifier, the processor is directed to examine the contents of the enabled field **630** to determine whether or not voicemail is enabled. If voicemail is enabled, then block **640** in Figure **8**C directs the processor **202** to Figure **7** to store the contents of the voicemail server field **626** and the contents of the seconds to voicemail field **628** in the routing message buffer, as shown at **654** in Figure **32**. Block **642** then directs the processor **202** to get time to live values for each path specified by the routing message according to the cost of routing and the user's balance. These time to live values are then appended to corresponding paths already stored in the routing message buffer.

Referring back to Figure **8**C, block **644** then directs the processor **202** of Figure **7** to store the IP address of the current node in the routing message buffer as shown at **656** in Figure **32**. Block **646** then directs the processor **202** to send the routing message shown in Figure **32** to the call controller **14** in Figure **1**. Thus in the embodiment described the routing controller will produce a routing message that will cause at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server.

Referring back to Figure **1**, the routing message whether of the type shown in Figures **16**, **25** or **32**, is received at the call controller **14** and the call controller interprets the receipt of the routing message as a request to establish a call.

Referring to Figure **4**, the program memory **104** of the call controller **14** includes a routing to gateway routine depicted generally at **122**.

Where a routing message of the type shown in Figure **32** is received by the call controller **14**, the routing to gateway routine **122** shown in Figure **4** may direct the processor **102** cause a message to be sent back through the internet **13** shown in Figure **1** to the callee telephone **15**, knowing the IP address of the callee telephone **15** from the user name.

Alternatively, if the routing message is of the type shown in Figure **16**, which identifies a domain associated with another node in the system, the call controller may send a SIP invite message along the high speed backbone **17** connected to the other node. The other node functions as explained above, in response to receipt of a SIP invite message.

If the routing message is of the type shown in Figure **25** where there are a plurality of gateway suppliers available, the call controller sends a SIP invite message to the first supplier, in this case Telus, using a dedicated line or an internet connection to determine whether or not Telus is able to handle the call. If the Telus gateway returns a message indicating it is not able to handle the call, the call controller **14** then proceeds to send a SIP invite message to the next supplier, in this case Shaw. The process is repeated until one of the suppliers responds indicating that it is available to carry the call. Once a supplier responds indicating that it is able to carry the call, the supplier sends back to the call controller **14** an IP address for a gateway provided by the supplier through which the call or audio path of the call will be carried. This IP address is sent in a message from the call controller **14** to the media relay **9** which responds with a message indicating an IP address to which the caller telephone should send its audio/video, traffic and an IP address to which the gateway should send its audio/video for the call. The call controller conveys the IP address at which the media relay expects to receive audio/video from the caller telephone, to the caller telephone **12** in a message. The caller telephone replies to the call controller with an IP address at which it would like to receive audio/video and the call controller conveys that IP address to the media relay. The call may then be conducted between the caller and callee through the media relay and gateway.

Referring back to Figure **1**, if the call controller **14** receives a routing message of the type shown in Figure **32**, and which has at least one call forwarding number and/or a voicemail number, the call controller attempts to establish a call to the callee telephone **15** by seeking from the callee telephone a message indicating an IP address to which the media relay should send audio/video. If no such message is received from the callee telephone, no call is established. If no call is established within a pre-determined time, the call controller **14** attempts to establish a call with the next user identified in the call routing message in the same manner. This process is repeated until all call forwarding possibilities have been exhausted, in which case the call controller communicates with the voicemail server **19** identified in the routing message to obtain an IP address to which the media relay should send audio/video and the remainder of the process mentioned above for establishing IP addresses at the media relay **9** and the caller telephone is carried out to establish audio/video paths to allowing the caller to leave a voicemail message with the voicemail server.

When an audio/video path through the media relay is established, a call timer maintained by the call controller **14** logs the start date and time of the call and logs the call ID and an identification of the route (i.e., audio/video path IP address) for later use in billing.

Time to Live

Referring to Figures **33**A and **33**B, a process for determining a time to live value for any of blocks **642** in Figure **8**C, **350** in Figure **8**A or **564** in Figure **8**D above is described. The process is executed by the processor **202** shown in Figure **7**. Generally, the process involves calculating a cost per unit time, calculating a first time value as a sum of a free time attributed to a participant in the communication session and the quotient of a funds balance held by the participant to the cost per unit time value and producing a second time value in response to the first time value and a billing pattern associated with the participant, the billing pattern including first and second billing intervals and the second time value being the time to permit a communication session to be conducted.

Referring to Figure **33**A, in this embodiment, the process begins with a first block **700** that directs the RC processor to determine whether or not the call type set at block **302** in Figure **8**A indicates the call is a network or cross-domain call. If the call is a network or cross-domain call, block **702** of Figure **33**A directs the RC processor to set the time to live equal to **99999** and the process is ended. Thus, the network or cross-domain call type has a long time to live. If at block **700** the call type is determined not to be a network or cross-domain type, block **704** directs the RC processor to get a subscriber bundle table record from the database **18** in Figure **1** and store it locally in the subscriber bundle record buffer at the RC **14**.

Referring to Figure **34**, a subscriber bundle table record is shown generally at **706**. The record includes a user name field **708** and a services field **710**. The user name field **708** holds a code identifying the subscriber user name and the services field **710** holds codes identifying service features assigned to the subscriber, such as free local calling, call blocking and voicemail, for example.

Figure **35** shows an exemplary subscriber bundle record for the Vancouver caller. In this record the user name field **708** is loaded with the user name **2001 1050 8667** and the services field **710** is loaded with codes **10**, **14** and **16** corresponding to free local calling, call blocking and voicemail, respectively. Thus, user **2001 1050 8667** has free local calling, call blocking and voicemail features.

Referring back to Figure **33**A, after having loaded a subscriber bundle record into the subscriber bundle record buffer, block **712** directs the RC processor to search the database (**18**) determine whether or not there is a bundle override table record for the master list ID value that was determined at block **410** in Figure **8**B. An exemplary bundle override table record is shown at **714** in Figure **36**. The bundle table record includes a master list ID field **716**, an override type field **718**, an override value field **720** a first interval field **722** and a second interval field **724**. The master list ID field **716** holds a master list ID code. The override type field **718** holds an override type code indicating a fixed, percent or cent amount to indicate the amount by which a fee will be increased. The override value field **720** holds a real number representing the value of the override type. The first interval field **722** holds a value indicating the minimum number of seconds for a first level of charging and the second interval field **724** holds a number representing a second level of charging.

Referring to Figure **37**, a bundle override record for the located master list ID code is shown generally at **726** and includes a master list ID field **716** holding the code **1019** which was the code located in block **410** of Figure **8**B. The override type field **718** includes a code indicating the override type is a percentage value and the override value field **720** holds the value **10.0** indicating that the override will be **10.0**% of the charged value. The first interval field **722** holds a value representing **30** seconds and the second interval field **724** holds a value representing **6** seconds. The **30** second value in the first interval field **722** indicates that charges for the route will be made at a first rate for **30** seconds and thereafter the charges will be made at a different rate in increments of **6** seconds, as indicated by the contents of the second interval field **724**.

Referring back to Figure **33**A, if at block **712** the processor finds a bundle override record of the type shown in Figure **37**, block **728** directs the processor to store the bundle override record in local memory. In the embodiment shown, the bundle override record shown in Figure **37** is stored in the bundle override record buffer at the RC as shown in Figure **7**. Still referring to Figure **33**A, block **730** then directs the RC processor to determine whether or not the subscriber bundle table record **706** in Figure **35** has a services field including a code identifying that the user is entitled to free local calling and also directs the processor to determine whether or not the call type is not a cross domain cell, i.e. it is a local or local/national style. If both of these conditions are satisfied, block **732** directs the processor to set the time to live equal to **99999**, giving the user a long period of time for the call. The process is then ended. If the conditions associated with block **730** are not satisfied, block **734** of Figure **33**B directs the RC processor to retrieve a subscriber account record associated with a participant in the call. This is done by copying and storing in the subscriber account record buffer a subscriber account record for the caller.

Referring to Figure **38**, an exemplary subscriber account table record is shown generally at **736**. The record includes a user name field **738**, a funds balance field **740** and a free time field **742**. The user name field **738** holds a subscriber user name, the funds balance field **740** holds a real number representing the dollar value of credit available to the subscriber and the free time field **742** holds an integer representing the number of free seconds that the user is entitled to.

An exemplary subscriber account record for the Vancouver caller is shown generally at **744** in Figure **39**, wherein the user name field **738** holds the user name **2001 1050 8667**, the funds balance field **740** holds the value $**10.00**, and the free time field **742** holds the value **100**. The funds balance field holding the value of $**10.00** indicates the user has $**10.00** worth of credit and the free time field having the value of **100** indicates that the user has a balance of **100** free seconds of call time.

Referring back to Figure **33**B, after copying and storing the subscriber account record shown in Figure **39** from the database to the subscriber account record buffer RC, block **746** directs the processor to determine whether or not the subscriber account record funds balance field **740** or free time field **742** are greater than zero. If they are not greater than zero, block **748** directs the processor to set the time to live equal to zero and the process is ended. The RC then sends a message back to the call controller to cause the call controller to deny the call to the caller. If the conditions associated with block **746** are satisfied, block **750** directs the processor to calculate the call cost per unit time. A procedure for calculating the call cost per unit time is described below in connection with Figure **41**.

Assuming the procedure for calculating the cost per second returns a number representing the call cost per second, block **752** directs the processor **202** in Figure **7** to determine whether or not the cost per second is equal to zero. If so, block **754** directs the processor to set the time to live to **99999** to give the caller a very long length of call and the process is ended.

If at block **752** the call cost per second is not equal to zero, block **756** directs the processor **202** in Figure **7** to calculate a first time to live value as a sum of a free time attributed to the participant in the communication session and the quotient of the funds balance held by the participant to the cost per unit time value. To do this, the processor **202** of Figure **7** is directed to set a first time value or temporary time to live value equal to the sum of the free time provided in the free time field **742** of the subscriber account record shown in Figure **39** and the quotient of the contents of the funds balance field **740** in the subscriber account record for the call shown in Figure **39** and the cost per second determined at block **750** of Figure **33**B. Thus, for example, if at block **750** the cost per second is determined to be three cents per second and the funds balance field holds the value $10.00, the quotient of the funds balance and cost per second is **333** seconds and this is added to the contents of the free time field **742**, which is **100**, resulting in a time to live of **433** seconds.

Block **758** then directs the RC processor to produce a second time value in response to the first time value and the billing pattern associated with the participant as established by the bundle override record shown in Figure **37**. This process is shown in greater detail at **760** in Figure **40** and generally involves producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between the first time value and the first billing interval.

Referring to Figure **40**, the process for producing the second time value begins with a first block **762** that directs the processor **202** in Figure **7** to set a remainder value equal to the difference between the time to live value calculated at block **756** in Figure **33**B and the contents of the first interval field **722** of the record shown in Figure **37**, multiplied by the modulus of the contents of the second interval field **724** of Figure **37**. Thus, in the example given, the difference between the time to live field and the first interval field is **433** minus **30**, which is **403** and therefore the remainder produced by the mod of **403** divided by **6** is **0**.**17**. Block **764** then directs the processor to determine whether or not this remainder value is greater than zero and, if so, block **766** directs the processor to subtract the remainder from the first time value and set the difference as the second time value. To do this the processor is directed to set the time to live value equal to the current time to live of **403** minus the remainder of **1**, i.e., **402** seconds. The processor is then returned back to block **758** of Figure **33**B.

Referring back to Figure **40**, if at block **764** the remainder is not greater than zero, block **768** directs the processor **202** of Figure **7** to determine whether or not the time to live is less than the contents of the first interval field **722** in the record shown in Figure **37**. If so, then block **770** of Figure **40** directs the processor to set the time to live equal to zero. Thus, the second time value is set to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant in the call. If at block **768** the conditions of that block are not satisfied, the processor returns the first time to live value as the second time to live value.

Thus, referring to Figure **33**B, after having produced a second time to live value, block **772** directs the processor to set the time to live value for use in blocks **342**, **350** or **564**.

<u>Cost per Second</u>

Referring back to Figure **33**B, at block **750** it was explained that a call cost per unit time is calculated. The following explains how that call cost per unit time value is calculated.

Referring to Figure **41**, a process for calculating a cost per unit time is shown generally at **780**. The process is executed by the processor **202** in Figure **7** and generally involves locating a record in a database, the record comprising a markup type indicator, a markup value and a billing pattern and setting a reseller rate equal to the sum of the markup value and the buffer rate, locating at least one of an override record specifying a route cost per unit time amount associated with a route associated with the communication session, a reseller record associated with a reseller of the communications session, the reseller record specifying a reseller cost per unit time associated with the reseller for the communication session and a default operator markup record specifying a default cost per unit time and setting as the cost per unit time the sum of the reseller rate and at least one of the route cost per unit time, the reseller cost per unit time and the default cost per unit time.

The process begins with a first set of blocks **782**, **802** and **820** which direct the processor **202** in Figure **7** to locate at least one of a record associated with a reseller and a route associated with the reseller, a record associated with the reseller, and a default reseller mark-up record. Block **782**, in particular, directs the processor to address the database **18** to look for a record associated with a reseller and a route with the reseller by looking for a special rate record based on the master list ID established at block **410** in Figure **8**C.

Referring to Figure **42**, a system operator special rate table record is shown generally at **784**. The record includes a reseller field **786**, a master list ID field **788**, a mark-up type field **790**, a mark-up value field **792**, a first interval field **794** and a second interval field **796**. The reseller field **786** holds a reseller ID code and the master list ID field **788** holds a master list ID code. The mark-up type field **790** holds a mark-up type such as fixed percent or cents and the mark-up value field **792** holds a real number representing the value corresponding to the mark-up type. The first interval field **794** holds a number representing a first level of charging and the second interval field **796** holds a number representing a second level of charging.

An exemplary system operator special rate table for a reseller known as “Klondike” is shown at **798** in Figure **43**. In this record, the reseller field **786** holds a code indicating the retailer ID is Klondike, the master list ID field **788** holds the code **1019** to associate the record with the master list ID code **1019**. The mark-up type field **790** holds a code indicating the mark-up type is cents and the mark-up value field **792** holds a mark-up value indicating **1/10** of one cent. The first interval field **794** holds the value **30** and the second interval field **796** holds the value **6**, these two fields indicating that the operator allows **30** seconds for free and then billing is done in increments of **6** seconds after that.

Referring back to Figure **41**, if at block **782** a record such as the one shown in Figure **43** is located in the system operator special rates table, the processor is directed to block **800** in Figure **41**. If such a record is not found in the system operator special rates table, block **802** directs the processor to address the database **18** to look in a system operator mark-up table for a mark-up record associated with the reseller.

Referring to Figure **44**, an exemplary system operator mark-up table record is shown generally at **804**. The record includes a reseller field **806**, a mark-up type field **808**, a mark-up value field **810**, a first interval field **812** and a second interval field **814**. The reseller mark-up type, mark-up value, first interval and second interval fields are as described in connection with the fields by the same names in the system operator special rates table shown in Figure **42**.

Figure **45** provides an exemplary system operator mark-up table record for the reseller known as Klondike and therefore the reseller field **806** holds the value "Klondike", the mark-up type field **808** holds the value cents, the mark-up value field holds the value **0.01**, the first interval field **812** holds the value **30** and the second interval field **814** holds the value **6**. This indicates that the reseller "Klondike" charges by the cent at a rate of one cent per minute. The first **30** seconds of the call are free and billing is charged at the rate of one cent per minute in increments of **6** seconds.

Figure **46** provides an exemplary system operator mark-up table record for cases where no specific system operator mark-up table record exists for a particular reseller, i.e., a default reseller mark-up record. This record is similar to the record shown in Figure **45** and the reseller field **806** holds the value "all", the mark-up type field **808** is loaded with a code indicating mark-up is based on a percentage, the mark-up value field **810** holds the percentage by which the cost is marked up, and the first and second interval fields **812** and **814** identify first and second billing levels.

Referring back to Figure **41**, if at block **802** a specific mark-up record for the reseller identified at block **782** is not located, block **820** directs the processor to get the mark-up record shown in Figure **46**, having the "all" code in the reseller field **806**. The processor is then directed to block **800**.

Referring back to Figure **41**, at block **800**, the processor **202** of Figure **7** is directed to set a reseller rate equal to the sum of the mark-up value of the record located by blocks **782**, **802** or **820** and the buffer rate specified by the contents of the buffer rate field **516** of the master list record shown in Figure **20**. To do this, the RC processor sets a variable entitled "reseller cost per second" to a value equal to the sum of the contents of the mark-up value field (**792**, **810**) of the associated record, plus the contents of the buffer rate field (**516**) from the master list record associated with the master list ID. Then, block **822** directs the processor to set a system operator cost per second variable equal to the contents of the buffer rate field (**516**) from the master list record. Block **824** then directs the processor to determine whether the call type flag indicates the call is local or national/local style and whether the caller has free local calling. If both these conditions are met, then block **826** sets the user cost per second variable equal to zero and sets two increment variables equal to one, for use in later processing. The cost per second has thus be calculated and the process shown in Figure **41** is ended.

If at block **824** the conditions of that block are not met, the processor **202** of Figure **7** is directed to locate at least one of a bundle override table record specifying a route cost per unit time associated with a route associated with the communication session, a reseller special destinations table record associated with a reseller of the communications session, the reseller record specifying a reseller cost per unit time associated with the reseller for the communication session and a default reseller global markup record specifying a default cost per unit time.

To do this block **828** directs the processor **202** of Figure **7** to determine whether or not the bundle override record **726** in Figure **37** located at block **712** in Figure **33**A has a master list ID equal to the stored master list ID that was determined at block **410** in Figure **8**B. If not, block **830** directs the processor to find a reseller special destinations table record in a reseller special destinations table in the database (**18**), having a master list ID code equal to the master list ID code of the master list ID that was determined at block **410** in Figure **8**B. An exemplary reseller special destinations table record is shown in Figure **47** at **832**. The reseller special destinations table record includes a reseller field **834**, a master list ID field **836**, a mark-up type field **838**, a mark-up value field **840**, a first interval field **842** and a second interval field **844**. This record has the same format as the system operator special rates table record shown in Figure **42**, but is stored in a different table to allow for different mark-up types and values and time intervals to be set according to resellers' preferences. Thus, for example, an exemplary reseller special destinations table record for the reseller "Klondike" is shown at **846** in Figure **48**. The reseller field **834** holds a value indicating the reseller as the reseller "Klondike" and the master list ID field holds the code **1019**. The mark-up type field **838** holds a code indicating the mark-up type is percent and the mark-up value field **840** holds a number representing the mark-up value as **5**%. The first and second interval fields identify different billing levels used as described earlier.

Referring back to Figure **41**, the record shown in Figure **48** may be located at block **830**, for example. If at block **830** such a record is not found, then block **832** directs the processor to get a default operator global mark-up record based on the reseller ID.

Referring to Figure **49**, an exemplary default reseller global mark-up table record is shown generally at **848**. This record includes a reseller field **850**, a mark-up type field **852**, a mark-up value field **854**, a first interval field **856** and a second interval field **858**. The reseller field **850** holds a code identifying the reseller. The mark-up type field **852**, the mark-up value field **854** and the first and second interval fields **856** and **858** are of the same type as described in connection with fields of the same name in Figure **47**, for example. The contents of the fields of this record **860** may be set according to system operator preferences, for example.

Referring to Figure **50**, an exemplary reseller global mark-up table record is shown generally at **860**. In this record, the reseller field **850** holds a code indicating the reseller is "Klondike", the mark-up type field **852** holds a code indicating the mark-up type is percent, the mark-up value field **854** holds a value representing **10**% as the mark-up value, the first interval field **856** holds the value **30** and the second interval field **858** holds the values **30** and **6** respectively to indicate the first **30** seconds are free and billing is to be done in **6** second increments after that.

Referring back to Figure **41**, should the processor get to block **832**, the reseller global mark-up table record as shown in Figure **50** is retrieved from the database and stored locally at the RC. As seen in Figure **41**, it will be appreciated that if the conditions are met in blocks **828** or **830**, or if the processor executes block **832**, the processor is then directed to block **862** which causes it to set an override value equal to the contents of the mark-up value field of the located record, to set the first increment variable equal to the contents of the first interval field of the located record and to set the second increment variable equal to the contents of the second interval field of the located record. (The increment variables were alternatively set to specific values at block **826** in Figure **41**.)

It will be appreciated that the located record could be a bundle override record of the type shown in Figure **37** or the located record could be a reseller special destination record of the type shown in Figure **48** or the record could be a reseller global mark-up table record of the type shown in Figure **50**. After the override and first and second increment variables have been set at block **862**, the processor **202** if Figure **7** is directed to set as the cost per unit time the sum of the reseller rate and at least one of the route cost per unit time, the reseller cost per unit time and the default cost per unit time, depending on which record was located. To do this, block **864** directs the processor to set the cost per unit time equal to the sum of the reseller cost set at block **800** in Figure **41**, plus the contents of the override variable calculated in block **862** in Figure **41**. The cost per unit time has thus been calculated and it is this cost per unit time that is used in block **752** of Figure **33**B, for example.

<u>Terminating the Call</u>

In the event that either the caller or the callee terminates a call, the telephone of the terminating party sends a SIP bye message to the controller **14**. An exemplary SIP bye message is shown at **900** in Figure **51** and includes a caller field **902**, a callee field **904** and a call ID field **906**. The caller field **902** holds a twelve digit user name, the callee field **904** holds a PSTN compatible number or user name, and the call ID field **906** holds a unique call identifier field of the type shown in the call ID field **65** of the SIP invite message shown in Figure **3**.

Thus, for example, referring to Figure **52**, a SIP bye message for the Calgary callee is shown generally at **908** and the caller field **902** holds a user name identifying the caller, in this case **2001 1050 8667**, the callee field **904** holds a user name identifying the Calgary callee, in this case **2001 1050 2222**, and the call ID field **906** holds the code FA**10** @ **192**.**168**.**0**.**20**, which is the call ID for the call.

The SIP bye message shown in Figure **52** is received at the call controller **14** and the call controller executes a process as shown generally at **910** in Figure **53**. The process includes a first block **912** that directs the call controller processor **202** of Figure **7** to copy the caller, callee and call ID field contents from the SIP bye message received from the terminating party to corresponding fields of an RC stop message buffer (not shown). Block **914** then directs the processor to copy the call start time from the call timer and to obtain a call stop time from the call timer. Block **916** then directs the call controller to calculate a communication session time by determining the difference in time between the call start time and the call stop time. This session time is then stored in a corresponding field of the RC call stop message buffer. Block **917** then directs the processor to decrement the contents of the current concurrent call field **277** of the dialing profile for the caller as shown in Figure **10**, to indicate that there is one less concurrent call in progress. A copy of the amended dialing profile for the caller is then stored in the database **18** of Figure **1**. Block **918** then directs the processor to copy the route from the call log. An RC call stop message produced as described above is shown generally at **1000** in Figure **54**. An RC call stop message specifically associated with the call made to the Calgary callee is shown generally at **1020** in Figure **55**.

Referring to Figure **54**, the RC stop call message includes a caller field **1002**, callee field **1004**, a call ID field **1006**, an account start time field **1008**, an account stop time field **1010**, a communication session time **1012** and a route field **1014**. The caller field **1002** holds a username, the callee field **1004** holds a PSTN-compatible number or system number, the call ID field **1006** hold the unique call identifier received from the SIP invite message shown in Figure **3**, the account start time field **1008** holds the date and start time of the call, the account stop time field **1010** holds the date and time the call ended, the communication session time field **1012** holds a value representing the difference between the start time and the stop time, in seconds, and the route field **1014** holds the IP address for the communications link that was established.

Referring to Figure **55**, an exemplary RC stop call message for the Calgary callee is shown generally at **1020**. In this example the caller field **1002** holds the user name **2001 1050 8667** identifying the Vancouver-based caller and the callee field **1004** holds the user name **2001 1050 2222** identifying the Calgary callee. The contents of the call ID field **1006** are FA**10 @ 192.168.0.20**. The contents of the account start time field **1008** are **2006-12-30 12:12:12** and the contents of the account stop time field are **2006-12-30 12:12:14**. The contents of the communication session time field **1012** are **2** to indicate **2** seconds call duration and the contents of the route field are **72.64.39.58**.

Referring back to Figure **53**, after having produced an RC call stop message, block **920** directs the processor **202** in Figure **7** to send the RC stop message compiled in the RC call stop message buffer to the RC **16** of Figure **1**. Block **922** directs the call controller **14** to send a "bye" message back to the party that did not terminate the call.

The RC **16** of Figure **1** receives the call stop message and an RC call stop message process is invoked at the RC, the process being shown at **950** in Figures **56**A, **56**B and **56**C. Referring to Figure **56**A, the RC stop message process **950** begins with a first block **952** that directs the processor **202** in Figure **7** to determine whether or not the communication session time is less than or equal to the first increment value set by the cost calculation routine shown in Figure **41**, specifically blocks **826** or **862** thereof. If this condition is met, then block **954** of Figure **56**A directs the RC processor to set a chargeable time variable equal to the first increment value set at block **826** or **862** of Figure **41**. If at block **952** of Figure **56**A the condition is not met, block **956** directs the RC processor to set a remainder variable equal to the difference between the communication session time and the first increment value mod the second increment value produced at block **826** or **862** of Figure **41**. Then, the processor is directed to block **958** of Figure **56**A which directs it to determine whether or not the remainder is greater than zero. If so, block **960** directs the RC processor to set the chargeable time variable equal to the difference between the communication session time and the remainder value. If at block **958** the remainder is not greater than zero, block **962** directs the RC processor to set the chargeable time variable equal to the contents of the communication session time from the RC stop message. The processor is then directed to block **964**. In addition, after executing block **954** or block **960**, the processor is directed to block **964**.

Block **964** directs the processor **202** of Figure **7** to determine whether or not the chargeable time variable is greater than or equal to the free time balance as determined from the free time field **742** of the subscriber account record shown in Figure **39**. If this condition is satisfied, block **966** of Figure **56**A directs the processor to set the free time field **742** in the record shown in Figure **39**, to zero. If the chargeable time variable is not greater than or equal to the free time balance, block **968** directs the RC processor to set a user cost variable to zero and Block **970** then decrements the free time field **742** of the subscriber account record for the caller by the chargeable time amount determined by block **954**, **960** or **962**.

If at Block **964** the processor **202** of Figure **7** was directed to Block **966** which causes the free time field (**742** of Figure **39**) to be set to zero, referring to Figure **56**B, Block **972** directs the processor to set a remaining chargeable time variable equal to the difference between the chargeable time and the contents of the free time field (**742** of Figure **39**). Block **974** then directs the processor to set the user cost variable equal to the product of the remaining chargeable time and the cost per second calculated at Block **750** in Figure **33**B. Block **976** then directs the processor to decrement the funds balance field (**740**) of the subscriber account record shown in Figure **39** by the contents of the user cost variable calculated at Block **974**.

After completing Block **976** or after completing Block **970** in Figure **56**A, block **978** of Figure **56**B directs the processor **202** of Figure **7** to calculate a reseller cost variable as the product of the reseller rate as indicated in the mark-up value field **810** of the system operator mark-up table record shown in Figure **45** and the communication session time determined at Block **916** in Figure **53**. Then, Block **980** of Figure **56**B directs the processor to add the reseller cost to the reseller balance field **986** of a reseller account record of the type shown in Figure **57** at **982**.

The reseller account record includes a reseller ID field **984** and the aforementioned reseller balance field **986**. The reseller ID field **984** holds a reseller ID code, and the reseller balance field **986** holds an accumulated balance of charges.

Referring to Figure **58**, a specific reseller accounts record for the reseller "Klondike" is shown generally at **988**. In this record the reseller ID field **984** holds a code representing the reseller "Klondike" and the reseller balance field **986** holds a balance of $**100.02**. Thus, the contents of the reseller balance field **986** in Figure **58** are incremented by the reseller cost calculated at block **978** of Figure **56**B.

Still referring to Figure **56**B, after adding the reseller cost to the reseller balance field as indicated by Block **980**, Block **990** directs the processor to **202** of Figure **7** calculate a system operator cost as the product of the system operator cost per second, as set at block **822** in Figure **41**, and the communication session time as determined at Block **916** in Figure **53**. Block **992** then directs the processor to add the system operator cost value calculated at Block **990** to a system operator accounts table record of the type shown at **994** in Figure **59**. This record includes a system operator balance field **996** holding an accumulated charges balance. Referring to Figure **60** in the embodiment described, the system operator balance field **996** may hold the value $**1,000**.**02** for example, and to this value the system operator cost calculated at Block **990** is added when the processor executes Block **992** of Figure **56**B.

Ultimately, the final reseller balance **986** in Figure **58** holds a number representing an amount owed to the reseller by the system operator and the system operator balance **996** of Figure **59** holds a number representing an amount of profit for the system operator.

While specific embodiments have been described and illustrated, such embodiments should be considered illustrative only and not as limiting the accompanying claims.

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

1. A method for routing a communication in a communication system between an Internet-connected first participant device associated with a first participant and a second participant device associated with a second participant, the method comprising:

    in response to initiation of the communication by the first participant device, receiving, by a controller comprising at least one processor, over an Internet protocol (IP) network a first participant identifier and a second participant identifier;

    causing the at least one processor to access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes;

    comparing at least a portion of the second participant identifier, using the at least one processor, with at least one of the plurality of first participant attributes obtained from the user profile for the first participant;

    causing the at least one processor to access the at least one database to search for a user profile for the second participant;

    classifying the communication, based on the comparing, as a system communication or an external network communication, using the at least one processor;

when the communication is classified as a system communication, producing a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant, using the at least one processor, wherein the system routing message causes the communication to be established to the second participant device; and

when the communication is classified as an external network communication, producing an external network routing message identifying an Internet address associated with a gateway to an external network, using the at least one processor, wherein the external network routing message causes the communication to the second participant device to be established using the gateway to the external network.

2. The method of claim **1**,

wherein producing the system routing message causes the communication to be established over an Internet protocol (IP) network;

and wherein producing the external network routing message causes a portion of a path taken by the communication to be established over a circuit switched network.

3. The method of claim **1** or **2**,

wherein the Internet address associated with the second participant device comprises an IP address or domain name of the communication system node associated with the second participant device, the communication system node being one of a plurality of communication system nodes each operably configured to provide communications services to a plurality of communication system subscribers.

4. The method of any one of claims **1** to **3**, wherein:

(a) the causing the at least one processor to access the at least one database to search for the user profile for the second participant is based on the comparing at least a portion of the second participant identifier with the at least one of the plurality of first participant attributes; and

(b) the classifying the communication is based on the causing the at least one processor to access the at least one database to search for the user profile for the second participant.

5. The method of any one of claims **1** to **4**, further comprising:

accessing the at least one database to locate communication blocking information for the second participant, using the at least one processor; and blocking the communication when the communication blocking information identifies the first participant identifier.

6. The method of any one of claims **1** to **5**, further comprising:

accessing the at least one database to locate communication forwarding information for the second participant, using the at least one processor; and

wherein classifying the communication is based on the communication forwarding information for the second participant.

7. The method of claim **6**, wherein the communication forwarding information for the second participant comprises a plurality of destination identifiers.

8. The method of any one of claims **1** to **7**, further comprising:

processing a plurality of communications from the first participant device to a plurality of communication recipient devices to classify each of the plurality of communications as a system communication or an external network communication, wherein the plurality of communications are concurrent; and

producing a respective plurality of routing messages, based on the classifying of each respective one of the plurality of communications, each respective routing message identifying an Internet address associated with a recipient device or identifying an Internet address associated with a gateway to an external network.

9. The method of any one of claims **1** to **8**, further comprising updating the first participant profile, via the at least one processor, to cause at least one of the plurality of first participant attributes to be modified.

10. The method of any one of claims **1** to **9**, wherein the external network routing message comprises a code identifying a communication supplier associated with the gateway to the external network.

11. The method of any one of claims **1** to **5**,

wherein the Internet address of the communication system node comprises a first Internet address and wherein the second participant device uses a second Internet address distinct from the first Internet address;

wherein the user profile for the second participant is associated with communication forwarding information identifying at least one other destination device for the communication; and

wherein the at least one processor is further operably configured to use the communication forwarding information associated with the second participant to cause the communication system node to establish the communication to the at least one other destination device using a third Internet address distinct from the first and second Internet addresses.

12. The method of any one of claims **1** to **11**, further comprising causing the at least one processor to:

determine whether the second participant device is operably configured to communicate via the Internet; and

if the second participant device is not operably configured to communicate via the Internet, classify the communication as the external network communication.

13. The method of any one of claims **1** to **12**, further comprising causing the at least one processor to:

determine whether the user profile for the second participant exists in the at least one database; and if the user profile for the second participant does not exist in the at least one database, classify the communication as the external network communication.

14. The method of any one of claims **1** to **13**, further comprising causing the at least one processor to:

if the user profile for the second participant exists in the at least one database, classify the communication as the system communication.

15. The method of any one of claims **1 – 14**, wherein the communication comprises a voice-over-IP (VoIP) communication.

16. The method of any one of claims **1 – 14**, wherein the communication comprises at least one of video data traffic and message traffic.

17. The method of any one of claims **1 – 16**, wherein at least one of the system routing message and the external network routing message is communicated to a call controller to effect routing of the communication.

18. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of any one of claims **1** to **17**.

19. An apparatus for routing communications in a communication system that includes an Internet-connected first participant device associated with a first participant, the first participant device operable to initiate a communication to a second participant device associated with a second participant, the apparatus comprising:

a controller comprising at least one processor in communication with at least one memory storing processor readable instructions, wherein the at least one processor is operably configured by the processor readable instructions to:

in response to initiation of the communication by the first participant device, receive over an Internet protocol (IP) network a first participant identifier and a second participant identifier;

access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes;

compare at least a portion of the second participant identifier with at least one of the plurality of first participant attributes obtained from the user profile for the first participant to generate a comparison result;

access the at least one database to search for a user profile for the second participant;

classify the communication, based on the comparison result, as a system communication or an external network communication;

when the communication is classified as a system communication, produce a system routing message identifying an Internet address of a communication system node associated with the second participant device based on the user profile for the second participant, wherein the system routing message causes the communication to be established to the second participant device; and

when the communication is classified as an external network communication, produce an external network routing message identifying an Internet address associated with a gateway to an external network, wherein the external network routing message causes the communication to the second participant device to be established using the gateway to the external network.

20. The apparatus of claim **19**,

wherein the at least one processor is operably configured to cause the communication to be established over an Internet protocol (IP) network when the communication is classified as a system communication; and

wherein the at least one processor is operably configured to cause a portion of a path taken by the communication to be established over a circuit switched network when the communication is classified as an external network communication.

21. The apparatus of claim **19** or **20**, wherein the at least one processor is further operably configured to:

access the at least one database to locate communication blocking information associated with the second participant; and

block the communication when the communication blocking information identifies the first participant identifier.

22. The apparatus of any one of claims **19** to **20**, wherein the at least one processor is further operably configured to:

access the at least one database to locate communication forwarding information, associated with the second participant, comprising a plurality of destination identifiers; and

use the communication forwarding information associated with the second participant to classify the communication.

23. The apparatus of any one of claims **19** to **22**, wherein the at least one processor is further operably configured to:

process a plurality of communications from the first participant device to a plurality of communication recipient devices to classify each of the plurality of communications as a system communication or an external network communication, wherein the plurality of communications are concurrent; and

produce a respective plurality of routing messages, based on the classifying of each respective one of the plurality of communications, each respective routing message identifying an Internet address associated with a recipient device or identifying an Internet address associated with a gateway to an external network.

24. An apparatus for routing communications in a communication system that includes an Internet-connected first participant device associated with a first participant, the first participant device operable to initiate a communication to a second participant device associated with a second participant, the apparatus comprising:

a controller comprising at least one processor in communication with at least one memory storing processor-readable instruction codes, wherein the at least one processor is operably configured by the processor-readable instruction codes to:

in response to initiation of the communication by the first participant device over the Internet, receive a first participant identifier and a second participant identifier;

access at least one database comprising user profiles using the first participant identifier, each user profile comprising a respective plurality of attributes for a respective user, to locate a user profile for the first participant including a plurality of first participant attributes;

compare at least a portion of the second participant identifier with at least one of the plurality of first participant attributes obtained from the user profile for the first participant to generate a comparison result;

access the at least one database to search for a user profile for the second participant and communication blocking information for the second participant;

classify the communication, based on at least one of the comparison result and the communication blocking information for the second participant, as a system communication, an external network communication or a blocked communication;

when the communication is classified as a system communication, produce a system routing message identifying a first Internet address associated with the second participant device, causing the communication to be established entirely over an Internet protocol (IP) network; and

when the communication is classified as an external network communication, produce an external routing message identifying an Internet address associated with a gateway to a network that is external to the communication system, causing a portion of a path taken by the communication to be established over a circuit switched network.

25. The apparatus of claim **24**,

wherein the first Internet address identifies a first communication system node operably configured to establish the communication to the second participant device, wherein the second participant device uses a second Internet address distinct from the first Internet address;

wherein the user profile for the second participant is associated with communication forwarding information identifying at least one other destination device for the communication; and

wherein the at least one processor is further operably configured to use the communication forwarding information for the second participant to cause the first communication system node to establish the communication to the at least one other destination device using a third Internet address distinct from the first and second Internet addresses.

26. The apparatus of claim **24** or **25**, wherein the at least one processor is further operably configured to update the first participant profile to cause at least one of the plurality of first participant attributes to be modified.

27. The apparatus of any one of claims **24** to **26**, wherein the first Internet address associated with the second participant device comprises an IP address or domain name of a communication system node associated with the second participant device, the communication system node being one of a plurality of communication system nodes each operably configured to provide communications services to a plurality of communication system subscribers.

28. The apparatus of any one of claims **24** to **27**, wherein the external routing message comprises a code identifying a communication supplier associated with the gateway to the network that is external to the communication system.

29. The apparatus of any one of claims **24** to **28**, wherein the at least one processor is further operably configured to:

access the at least one database to locate communication forwarding information, associated with the second participant, comprising a plurality of destination identifiers; and

use the communication forwarding information associated with the second participant to classify the communication.

30. The apparatus of any one of claims **24** to **29**, wherein the at least one processor is further operably configured to:

determine whether the second participant device is operably configured to communicate via the Internet; and

if the second participant device is not operably configured to communicate via the Internet, classify the communication as the external network communication.

31. The apparatus of any one of claims **24** to **30**, wherein the at least one processor is further operably configured to:

determine whether the user profile for the second participant exists in the at least one database; and

if the user profile for the second participant does not exist in the at least one database, classify the communication as the external network communication.

32. The apparatus of any one of claims **24** to **31**, wherein the at least one processor is further operably configured to:

if the user profile for the second participant exists in the at least one database, classify the communication as the system communication, wherein the first Internet address associated with the second participant device is determined based on the user profile for the second participant.

33. The apparatus of any one of claims **24** to **32**, wherein producing the external routing message comprises causing the at least one processor to select the Internet address associated with the gateway from among a plurality of Internet addresses associated with a respective plurality of gateways to the network that is external to the communication system, and wherein the external routing message comprises a code identifying a communication supplier associated with the gateway.

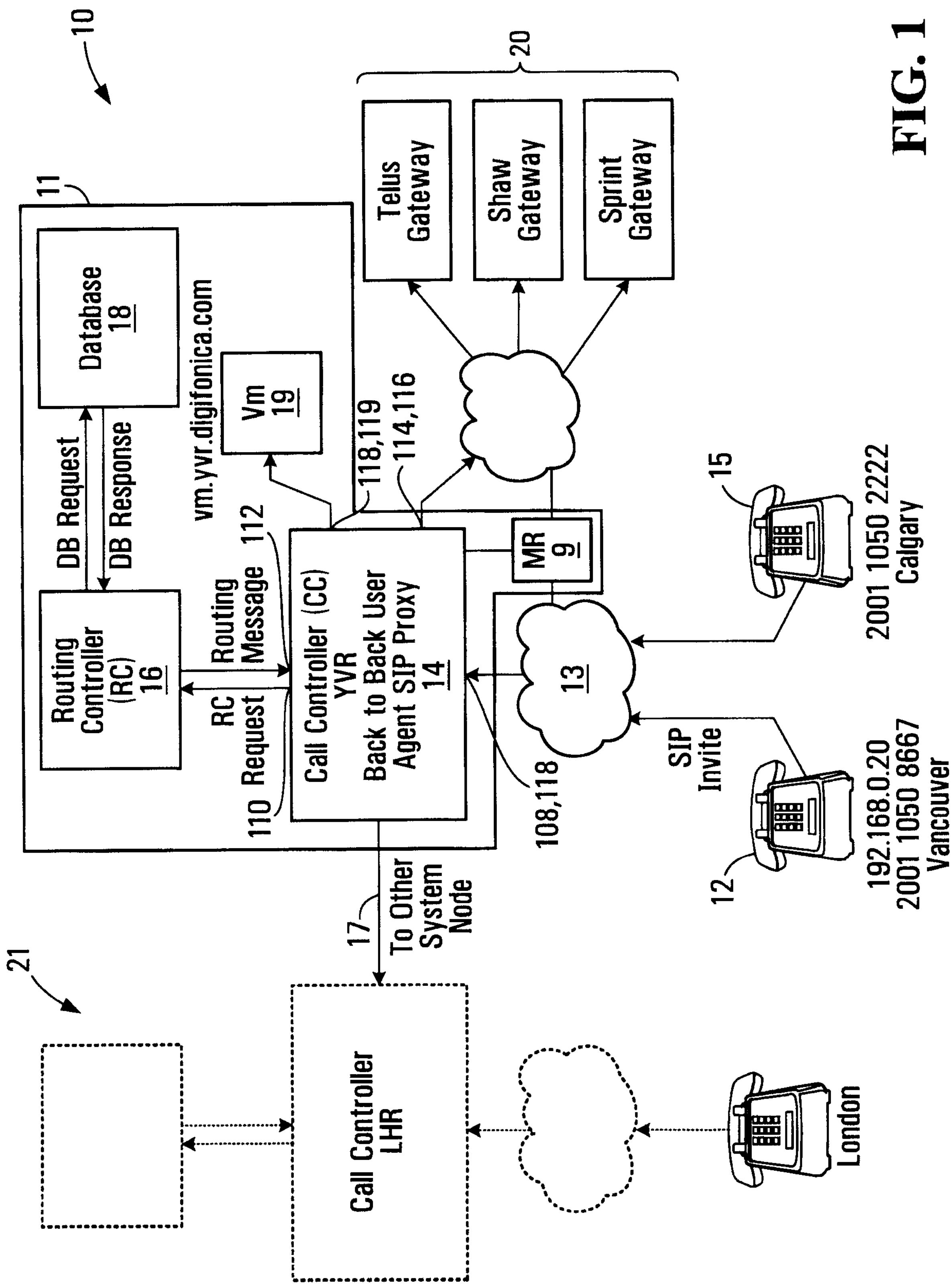

10
11
Database
18
DB Request
DB Response
vm.yvr.digifonica.com
Vm
19
Routing
Controller
(RC)
16
Routing
Message
112
RC
Request
110
Call Controller (CC)
YVR
Back to Back User
Agent SIP Proxy
14
118,119
114,116
108,118
MR
9
20
Telus
Gateway
Shaw
Gateway
Sprint
Gateway
13
SIP
Invite
15
2001 1050 2222
Calgary
12
192.168.0.20
2001 1050 8667
Vancouver
17
To Other
System
Node
21
Call Controller
LHR
London

FIG. 1

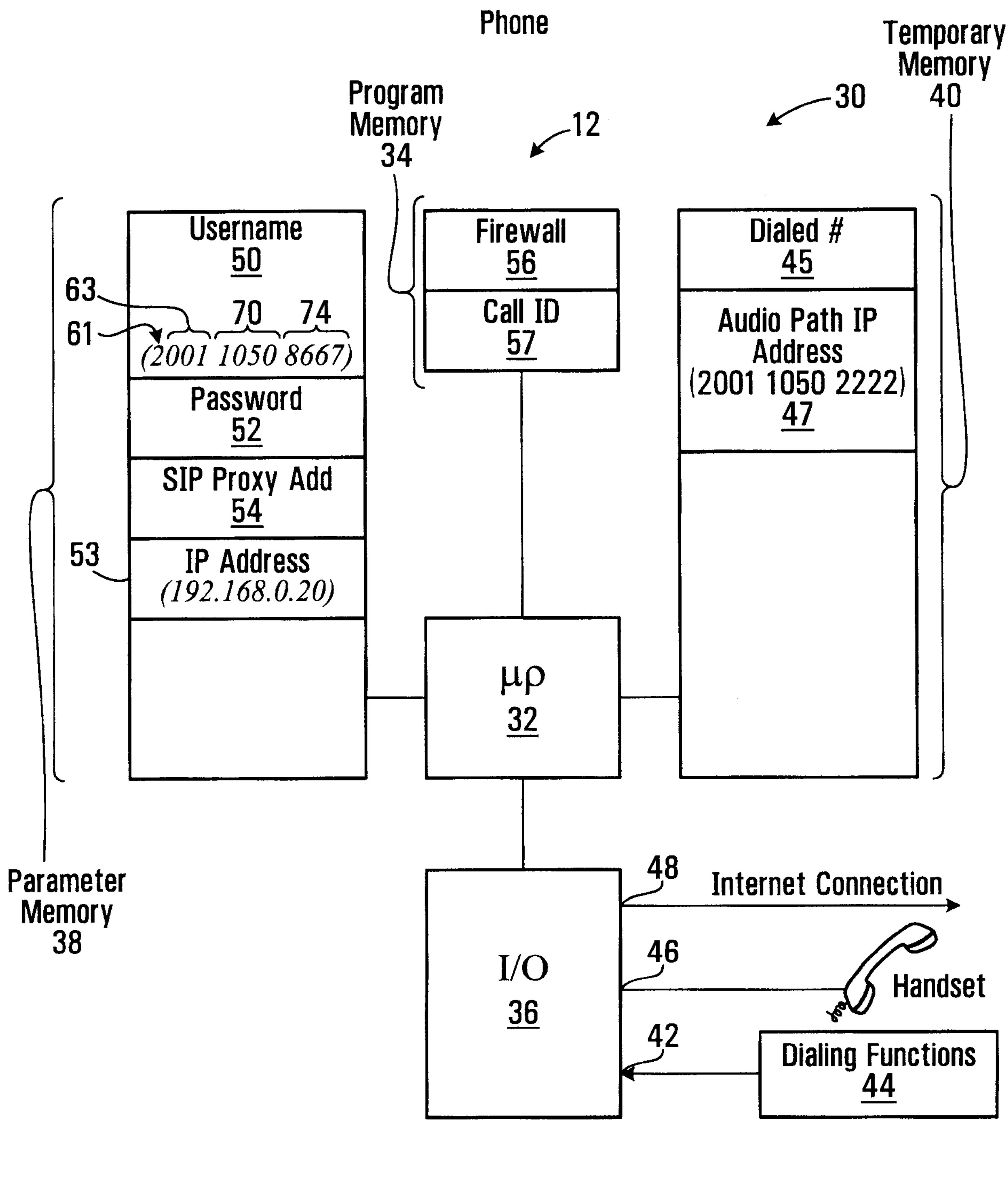

Phone
Program Memory 34
12
30
Temporary Memory 40
Username 50
63
61
70
74
(2001 1050 8667)
Password 52
SIP Proxy Add 54
53
IP Address (192.168.0.20)
Firewall 56
Call ID 57
Dialed # 45
Audio Path IP Address (2001 1050 2222) 47
μρ 32
Parameter Memory 38
I/O 36
48
Internet Connection
46
Handset
42
Dialing Functions 44

FIG. 2

SIP Invite Message

60	Caller	2001 1050 8667
62	Callee	2001 1050 2222
64	Digest Parameters	XXXXXXX
65	Call ID	FF10@ 192.168.0.20
67	IP Address	192.168.0.20
69	Caller UDP Port	1

FIG. 3

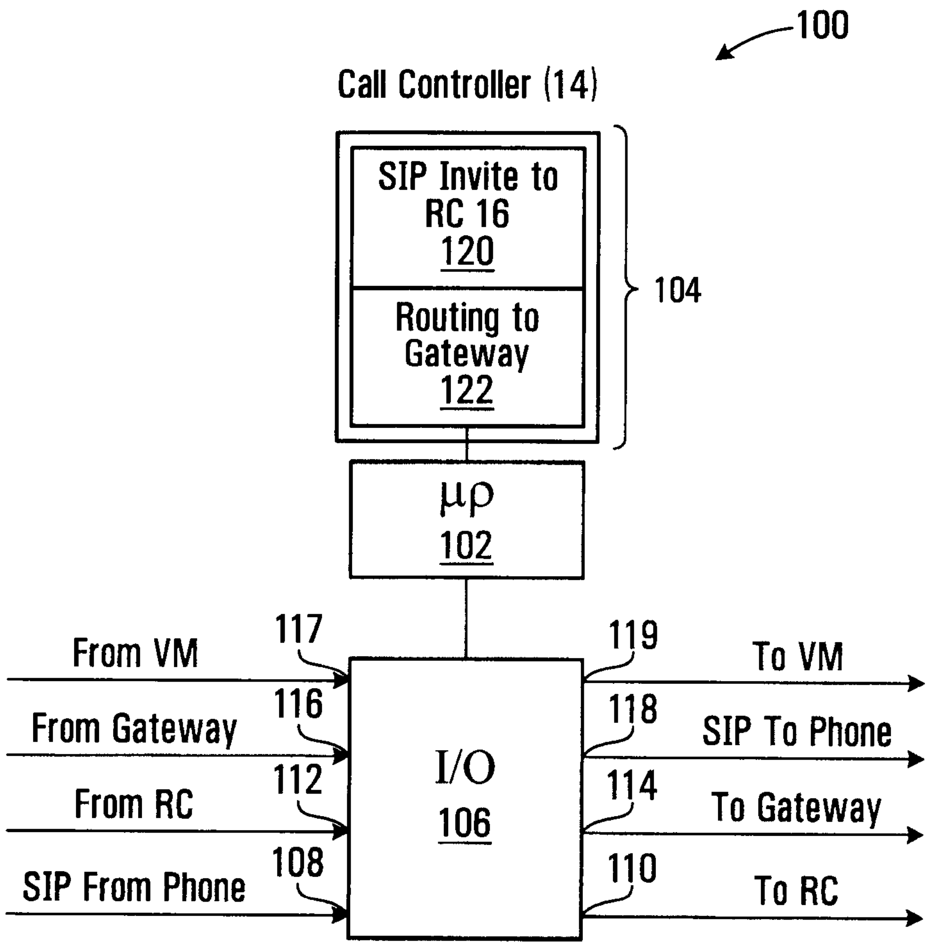


FIG. 4

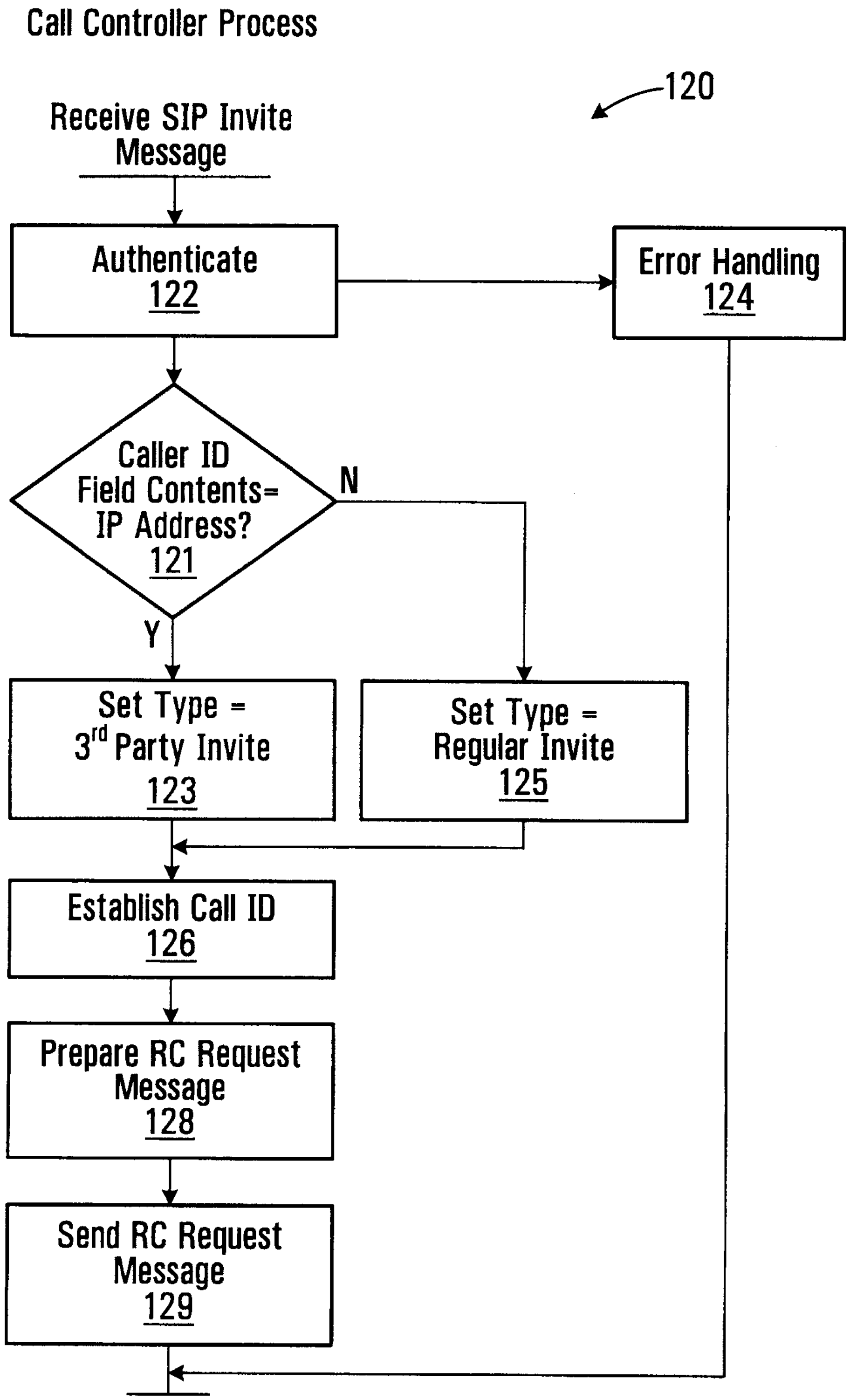

Call Controller Process
120
Receive SIP Invite Message
Authenticate 122
Error Handling 124
Caller ID Field Contents= IP Address? 121
N
Y
Set Type = 3rd Party Invite 123
Set Type = Regular Invite 125
Establish Call ID 126
Prepare RC Request Message 128
Send RC Request Message 129

FIG. 5

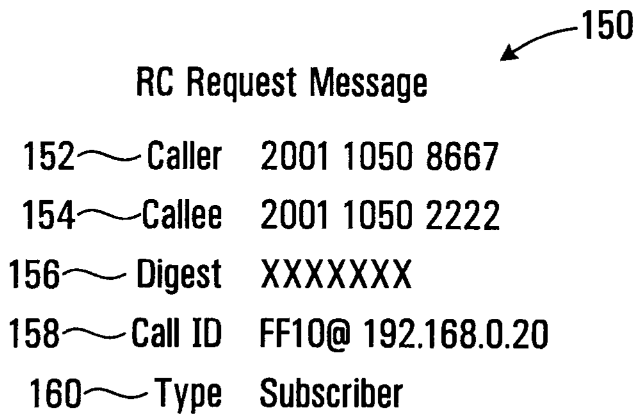

150
RC Request Message
152 Caller 2001 1050 8667
154 Callee 2001 1050 2222
156 Digest XXXXXXX
158 Call ID FF10@ 192.168.0.20
160 Type Subscriber

FIG. 6

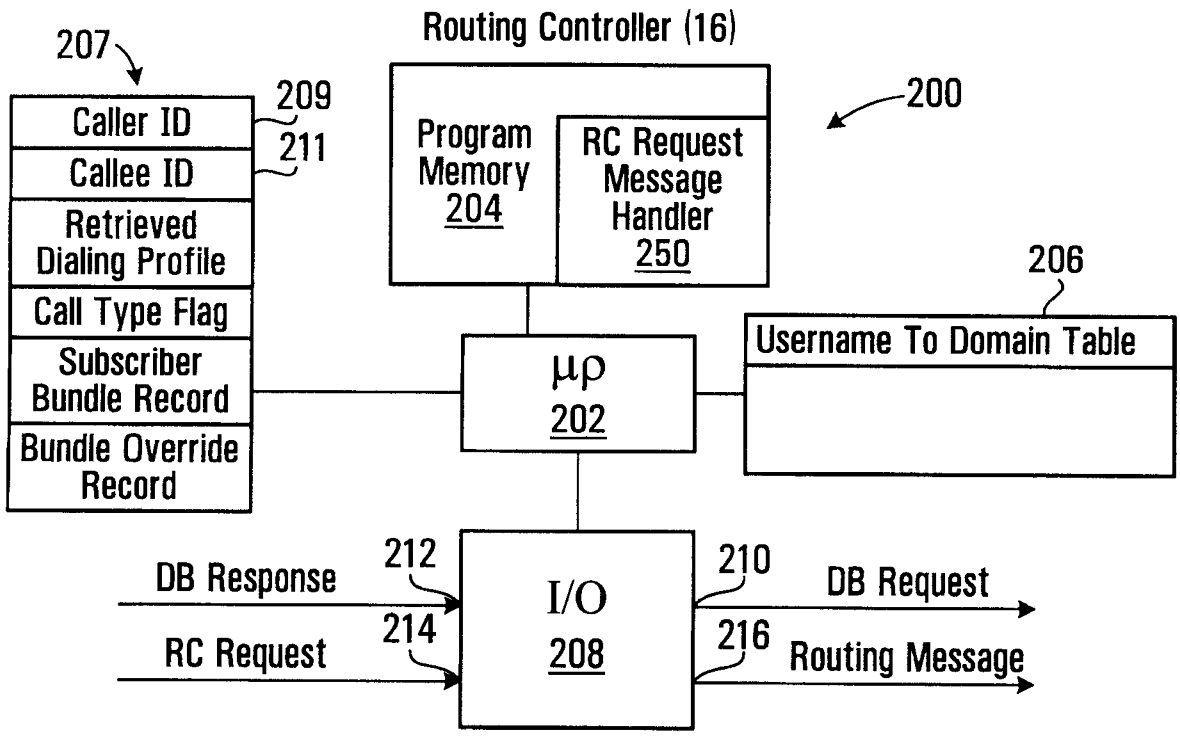

Routing Controller (16)
207
Caller ID
209
Callee ID
211
Retrieved Dialing Profile
Call Type Flag
Subscriber Bundle Record
Bundle Override Record
Program Memory 204
RC Request Message Handler 250
200
206
Username To Domain Table
μρ 202
I/O 208
DB Response
212
RC Request
214
210
DB Request
216
Routing Message

FIG. 7

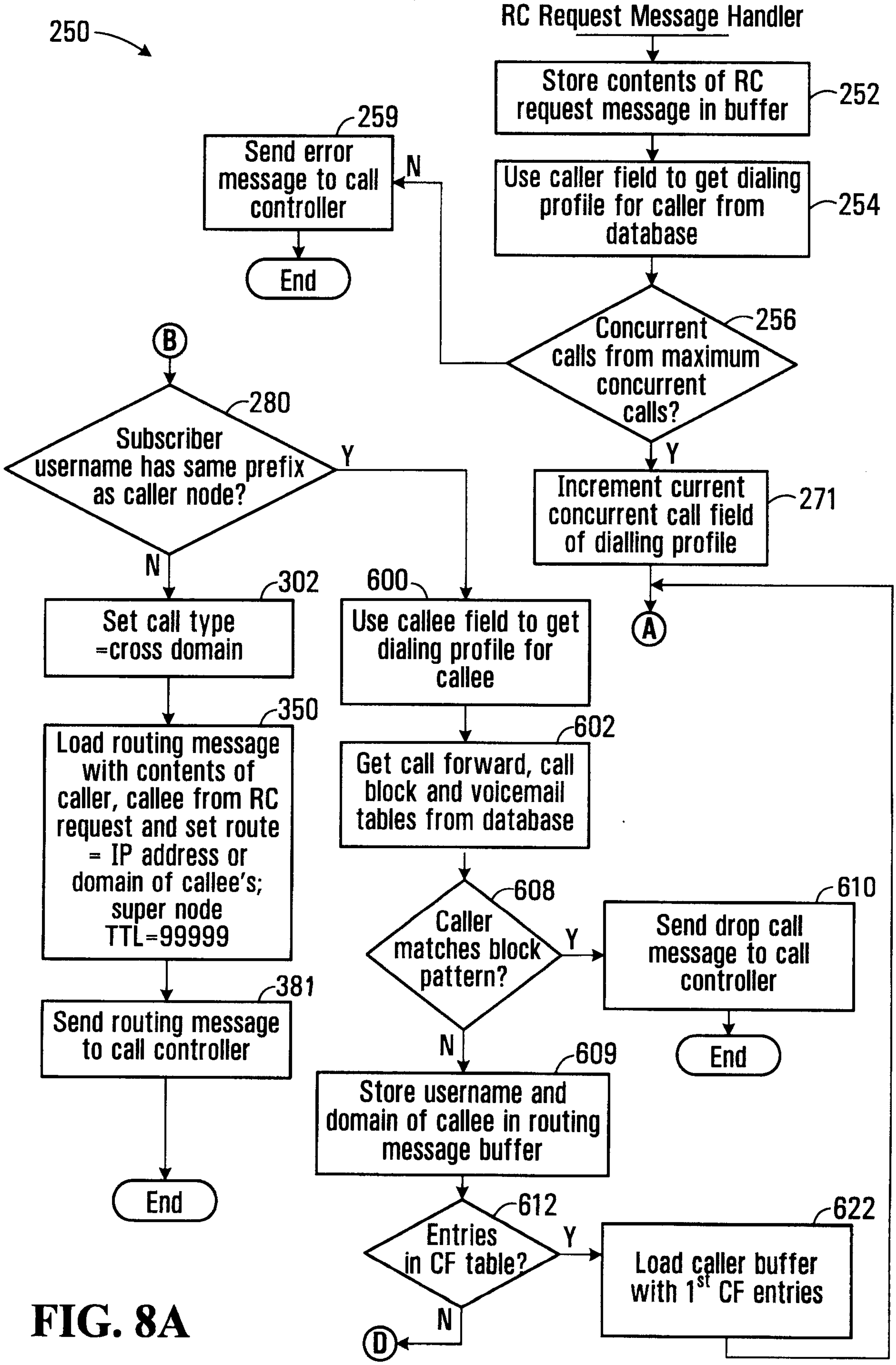

250
RC Request Message Handler
Store contents of RC request message in buffer
252
Use caller field to get dialing profile for caller from database
254
Concurrent calls from maximum concurrent calls?
256
N
Send error message to call controller
259
End
Y
Increment current concurrent call field of dialling profile
271
A
B
Subscriber username has same prefix as caller node?
280
Y
N
Set call type =cross domain
302
Load routing message with contents of caller, callee from RC request and set route = IP address or domain of callee's; super node TTL=99999
350
Send routing message to call controller
381
End
Use callee field to get dialing profile for callee
600
Get call forward, call block and voicemail tables from database
602
Caller matches block pattern?
608
Y
Send drop call message to call controller
610
End
N
Store username and domain of callee in routing message buffer
609
Entries in CF table?
612
Y
Load caller buffer with 1st CF entries
622
N
D

FIG. 8A

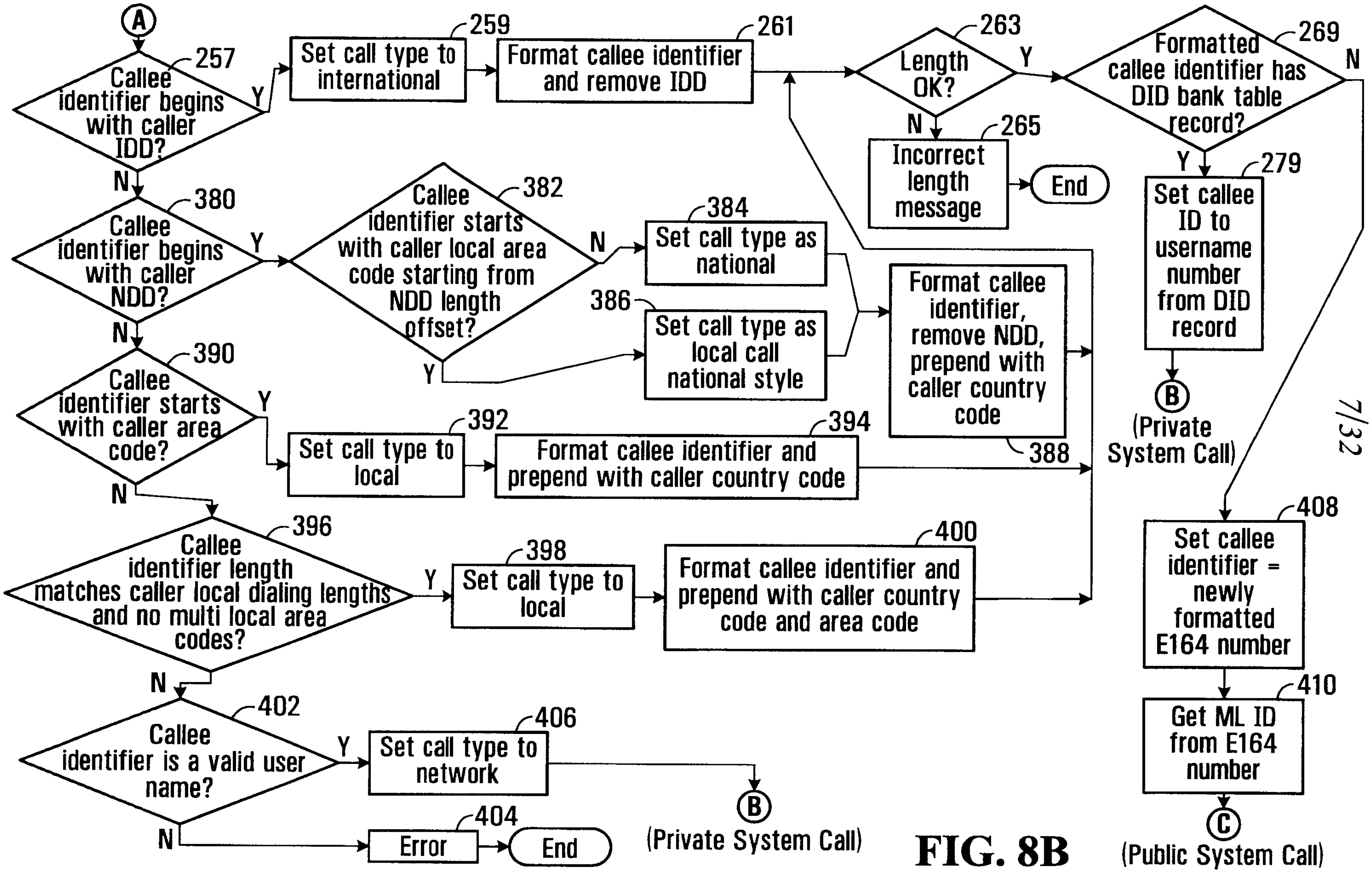

A
Callee identifier begins with caller IDD?
257
Y
N
Set call type to international
259
Format callee identifier and remove IDD
261
Length OK?
263
Y
N
Incorrect length message
265
End
Formatted callee identifier has DID bank table record?
269
Y
N
Set callee ID to username number from DID record
279
B
(Private System Call)
Callee identifier begins with caller NDD?
380
Y
N
Callee identifier starts with caller local area code starting from NDD length offset?
382
N
Y
Set call type as national
384
Set call type as local call national style
386
Format callee identifier, remove NDD, prepend with caller country code
388
Callee identifier starts with caller area code?
390
Y
N
Set call type to local
392
Format callee identifier and prepend with caller country code
394
Callee identifier length matches caller local dialing lengths and no multi local area codes?
396
Y
N
Set call type to local
398
Format callee identifier and prepend with caller country code and area code
400
Callee identifier is a valid user name?
402
Y
N
Set call type to network
406
B
(Private System Call)
Error
404
End
Set callee identifier = newly formatted E164 number
408
Get ML ID from E164 number
410
C
(Public System Call)

FIG. 8B

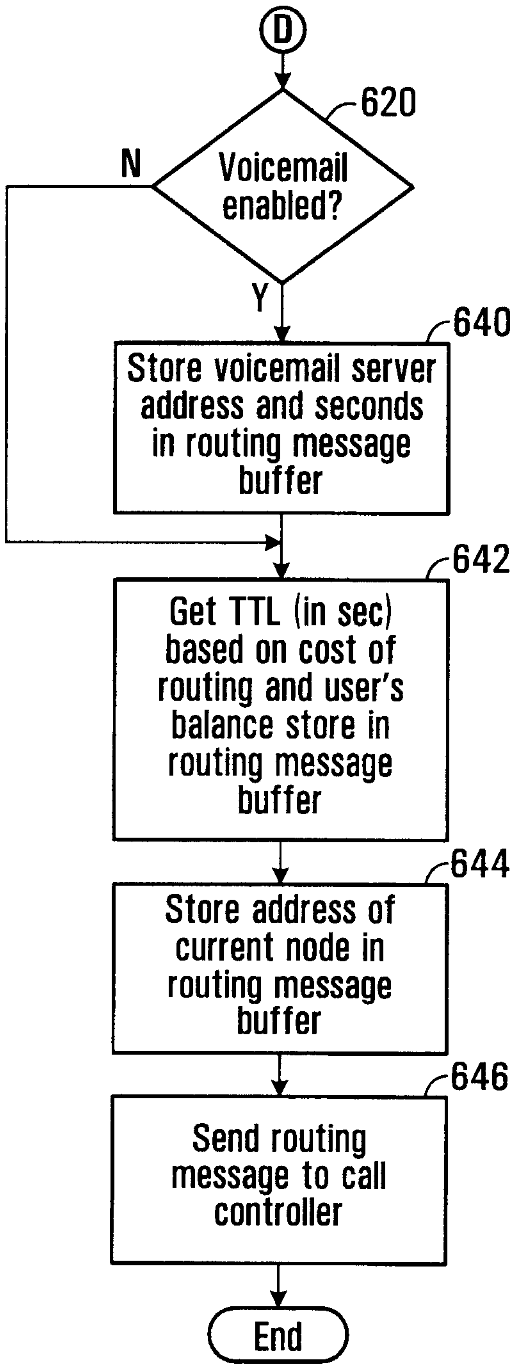

D
620
Voicemail enabled?
N
Y
640
Store voicemail server address and seconds in routing message buffer
642
Get TTL (in sec) based on cost of routing and user's balance store in routing message buffer
644
Store address of current node in routing message buffer
646
Send routing message to call controller
End

FIG. 8C

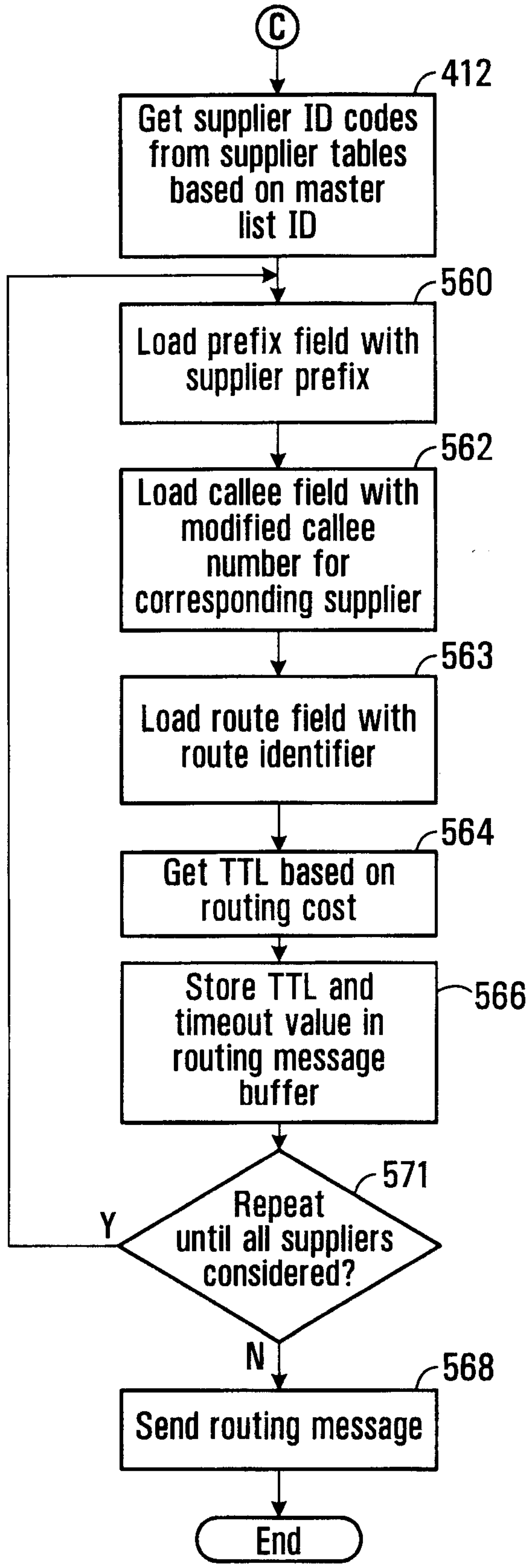

C
412
Get supplier ID codes from supplier tables based on master list ID
560
Load prefix field with supplier prefix
562
Load callee field with modified callee number for corresponding supplier
563
Load route field with route identifier
564
Get TTL based on routing cost
566
Store TTL and timeout value in routing message buffer
571
Repeat until all suppliers considered?
Y
N
568
Send routing message
End

FIG. 8D

253

Dialing Profile for a User

258 Username	Assigned on Subscription
260 Domain	Domain Associated with User
262 NDD	1
264 IDD	011
266 Country Code	1
267 Local Area Codes	604;778
268 Caller Minimum Local Length	10
270 Caller Maximum Local Length	10
273 Reseller	Retailer
275 Maximum # of concurrent calls	Assigned on Subscription
277 Current # of concurrent calls	Assigned on Subscription

FIG. 9

Dialing Profile for Caller (Vancouver Subscriber)

276

61 63 70 74

284

258 Username	2001 1050 8667
260 Domain	sp.yvr.digifonica.com ← 282
262 NDD	1
264 IDD	011 286 288 290
266 Country Code	1
267 Local Area Codes	604;778 (Vancouver)
268 Caller Minimum Local Length	10
270 Caller Maximum Local Length	10
273 Reseller	Klondike
275 Maximum # of concurrent calls	5
277 Current # of concurrent calls	0

FIG. 10

Callee Profile for Calgary Subscriber

Username	2001 1050 2222
Domain	sp.yvr.digifonica.com
NDD	1
IDD	011
Country Code	1
Local Area Codes	403 (Calgary)
Caller Minimum Local Length	7
Caller Maximum Local Length	10
Reseller	Deerfoot
Maximum # of concurrent calls	5
Current # of concurrent calls	0

FIG. 11

Callee Profile for London Subscriber

Username	4401 1062 4444
Domain	sp.lhr.digifonica.com
NDD	0
IDD	00
Country Code	44
Local Area Codes	20 (London)
Caller Minimum Local Length	10
Caller Maximum Local Length	11
Reseller	Marble Arch
Maximum # of concurrent calls	5
Current # of concurrent calls	0

FIG. 12

278

DID Bank Table Record Format

281	Username	System subscriber
272	User Domain	Host name of supernode
274	DID	E164#

FIG. 13

300

61

DID Bank Table Record for Calgary Subscriber

281	Username	2001 1050 2222
272	User Domain	Sp.yvr.digifonica.com
274	DID	1 604 867 5309

283 285 287 289

FIG. 14

352

Routing Message Format

354	Supplier Prefix (optional)	Code identifying supplier traffic
356	Delimiter (optional)	Symbol separating fields
358	Callee	PSTN compatible number or Digifonica number
360	Route	Domain name or IP address
362	Time to Live(TTL)	In seconds
364	Other	TBD

FIG. 15

366

Example of Routing Message - Different Node

$\underbrace{\text{440110624444}}_{359}\text{@}\underbrace{\text{sp.lhr.digifonica.com;}}_{361}\underbrace{\text{ttl=9999}}_{363}$

FIG. 16

370

Prefix to Supernode Table Record Format

372	Prefix	First n digits of callee identifier
374	Supernode Address	IP address or fully qualified domain name

FIG. 17

Prefix to Supernode Table Record for Calgary Subscriber

Prefix	20
Supernode Address	sp.yvr.digifonica.com

FIG. 18

Master List Record Format

500	ml_id	Alphanumeric
502	Dialing code	Number Sequence
504	Country code	The country code is the national prefix to be used when dialing TO a particular country FROM another country.
506	Nat Sign #(Area Code)	Number Sequence
508	Min Length	Numeric
510	Max Length	Numeric
512	NDD	The NDD prefix is the access code used to make a call **WITHIN** that country from one city to another (when calling another city in the same vicinity, this may not be necessary).
514	IDD	The **IDD prefix** is the international prefix needed to dial a call **FROM** the country listed **TO** another country.
516	Buffer rate	Safe change rate above the highest rate charged by suppliers

FIG. 19

Example: Master List Record with Populated Fields

ml_id	1019
Dialing code	1604
Country code	1
Nat Sign #(Area Code)	604
Min Length	7
Max Length	7
NDD	1
IDD	011
Buffer rate	$0.009/min

FIG. 20

Suppliers List Record Format

540	Sup_id	Name code
542	MI_id	Numeric code
544	Prefix (optional)	String identifying supplier's traffic #
546	Specific Route	IP address
548	NDD/IDD rewrite	
550	Rate	Cost per second to Digifonica to use this route
551	Timeout	Maximum time to wait for a response when requesting this gateway

FIG. 21

Telus Supplier Record

Sup_id	2010 (Telus)
MI_id	1019
Prefix (optional)	4973#
Specific Route	72.64.39.58
NDD/IDD rewrite	011
Rate	$0.02/min
Timeout	20

FIG. 22

Shaw Supplier Record

Sup_id	2011 (Shaw)
MI_id	1019
Prefix (optional)	4974#
Specific Route	73.65.40.59
NDD/IDD rewrite	011
Rate	$0.025/min
Timeout	30

FIG. 23

Sprint Supplier Record

Sup_id	2012 (Sprint)
MI_id	1019
Prefix (optional)	4975#
Specific Route	74.66.41.60
NDD/IDD rewrite	011
Rate	$0.03/min
Timeout	40

FIG. 24

Routing Message Buffer for Gateway Call

4973#0116048675309@72.64.39.58;ttl=3600;to=20 570
4974#0116048675309@73.65.40.59;ttl=3600;to=30 572
4975#0116048675309@74.66.41.60;ttl=3600;to=40 574

FIG. 25

Call Block Table Record Format

604	Username	Digifonica #
606	Block Pattern	PSTN compatible or Digifonica #

FIG. 26

Call Block Table Record for Calgary Callee

604	Username of Callee	2001 1050 2222
606	Block Pattern	2001 1050 8664

FIG. 27

Call Forwarding Table Record Format for Callee

614	Username of Callee	Digifonica #
616	Destination Number	Digifonica #
618	Sequence Number	Integer indicating order to try this

FIG. 28

Call Forwarding Table Record for Calgary Callee

614	Username of Callee	2001 1050 2222
616	Destination Number	2001 1055 2223
618	Sequence Number	1

FIG. 29

Voicemail Table Record Format

624	Username of Callee	Digifonica #
626	Vm Server	domain name
628	Seconds to Voicemail	time to wait before engaging voicemail
630	Enabled	yes/no

FIG. 30

Voicemail Table Record for Calgary Callee

Username of Callee	2001 1050 2222
Vm Server	vm.yvr.digifonica.com
Seconds to Voicemail	20
Enabled	1

FIG. 31

Routing Message Buffer - Same Node

650 200110502222@sp.yvr.digifonica.com;ttl=3600
652 200110552223@sp.yvr.digifonica.com;ttl=3600
654 vm.yvr.digifonica.com;20;ttl=60
656 sp.yvr.digifonica.com

FIG. 32

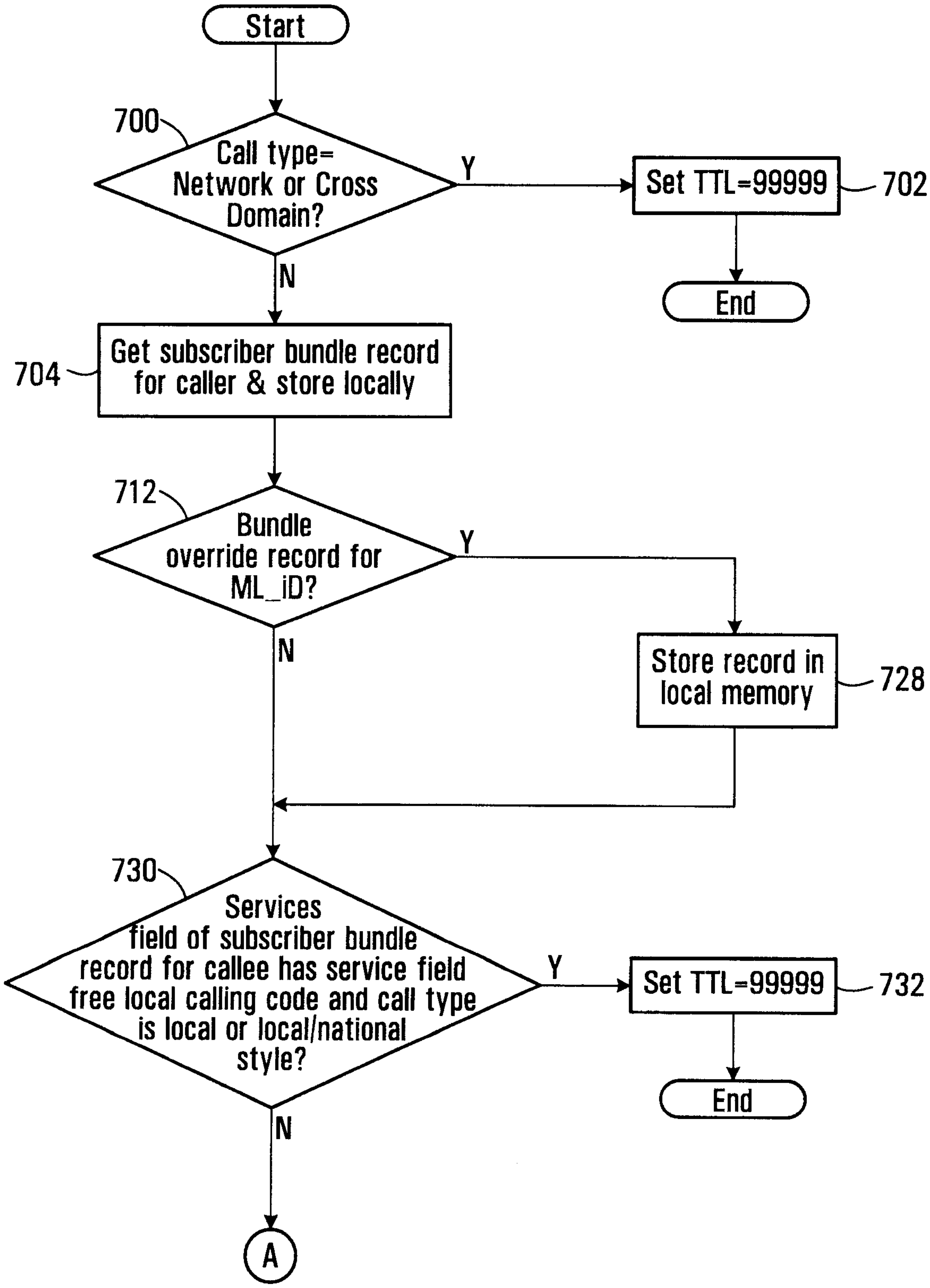

Start
700
Call type=
Network or Cross
Domain?
Y
Set TTL=99999
702
End
N
704
Get subscriber bundle record
for caller & store locally
712
Bundle
override record for
ML_iD?
Y
Store record in
local memory
728
N
730
Services
field of subscriber bundle
record for callee has service field
free local calling code and call type
is local or local/national
style?
Y
Set TTL=99999
732
End
N
A

FIG. 33A

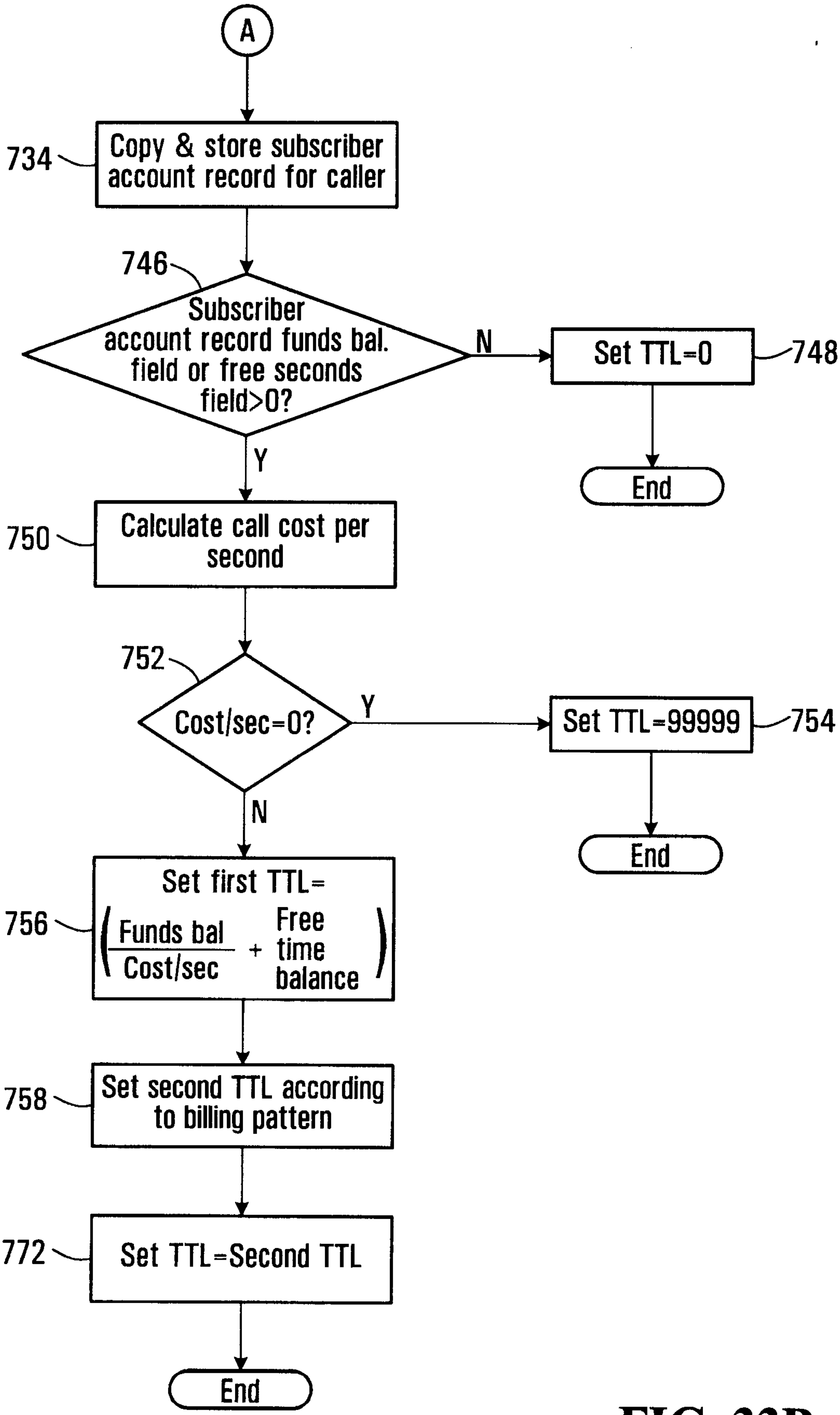

A
734
Copy & store subscriber account record for caller
746
Subscriber account record funds bal. field or free seconds field>0?
N
Set TTL=0
748
End
Y
750
Calculate call cost per second
752
Cost/sec=0?
Y
Set TTL=99999
754
End
N
756
Set first TTL= (Funds bal / Cost/sec + Free time balance)
758
Set second TTL according to billing pattern
772
Set TTL=Second TTL
End

FIG. 33B

706

Subscriber Bundle Table Record

708	Username	Subscriber username
710	Services	Codes identifying service features (e.g. Free local calling; call blocking, voicemail)

FIG. 34

Subscriber Bundle Record for Vancouver Caller

708	Username	2001 1050 8667
710	Services	10; 14; 16

FIG. 35

714

Bundle Override Table Record

716	ML_Id	Master list ID code
718	Override type	Fixed; percent; cents
720	Override value	real number representing value of override type
722	Inc1	first level of charging (minimum # of seconds) charge
724	Inc2	second level of charging

FIG. 36

726

Bundle Override Record for Located ML_iD

716	ML_Id	1019
718	Override type	percent
720	Override value	10.0
722	Inc1	30 seconds
724	Inc2	6 seconds

FIG. 37

736

Subscriber Account Table Record

738	Username	Subscriber username
740	Funds balance	real number representing $ value of credit
742	Free time balance	integer representing # of free seconds

FIG. 38

744

Subscriber Account Record for Vancouver Caller

738	Username	2001 1050 8667
740	Funds balance	$10.00
742	Free time balance	100

FIG. 39

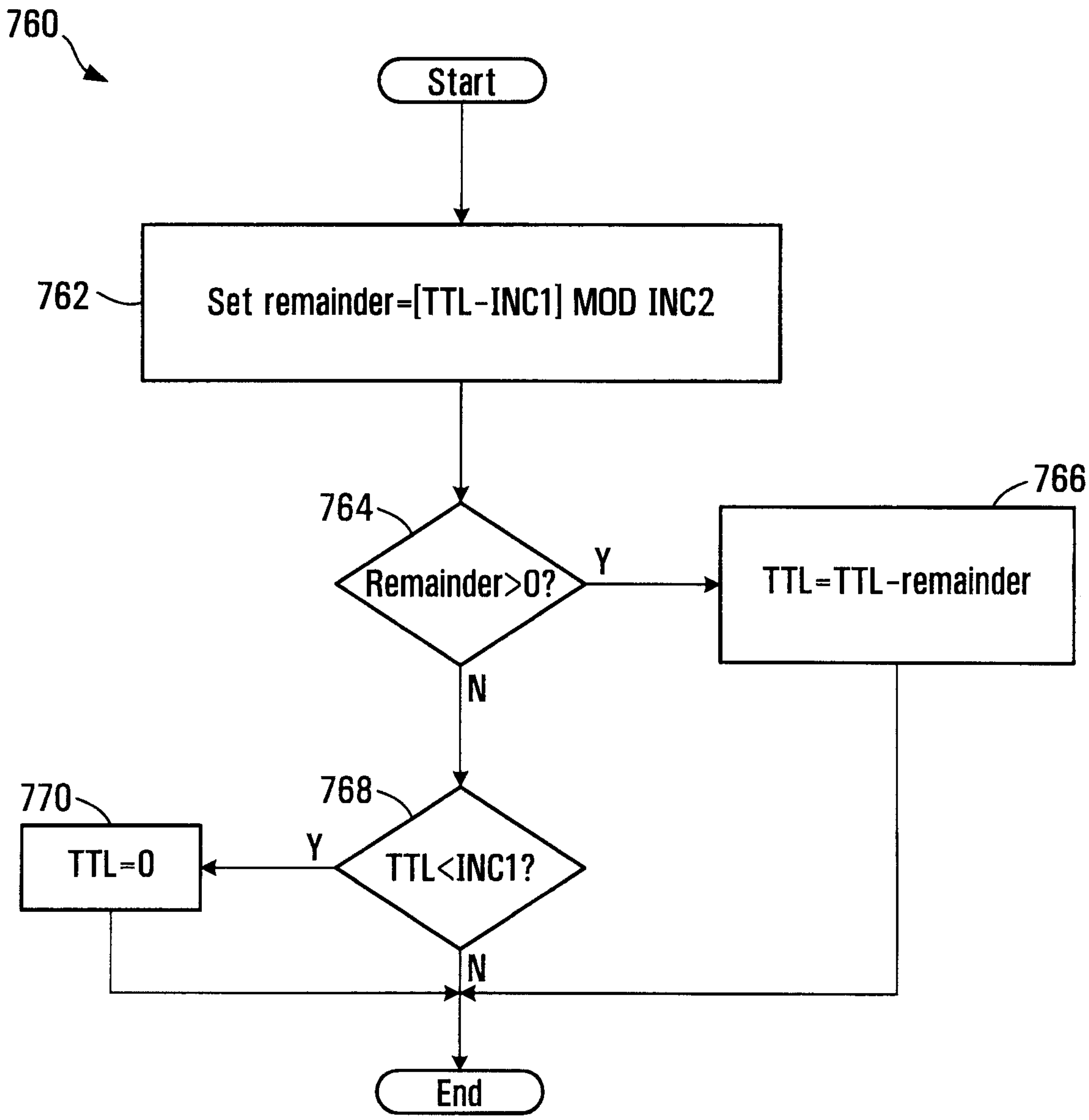

760
Start
762
Set remainder=[TTL-INC1] MOD INC2
764
Remainder>0?
Y
766
TTL=TTL-remainder
N
768
770
TTL=0
Y
TTL<INC1?
N
End

FIG. 40

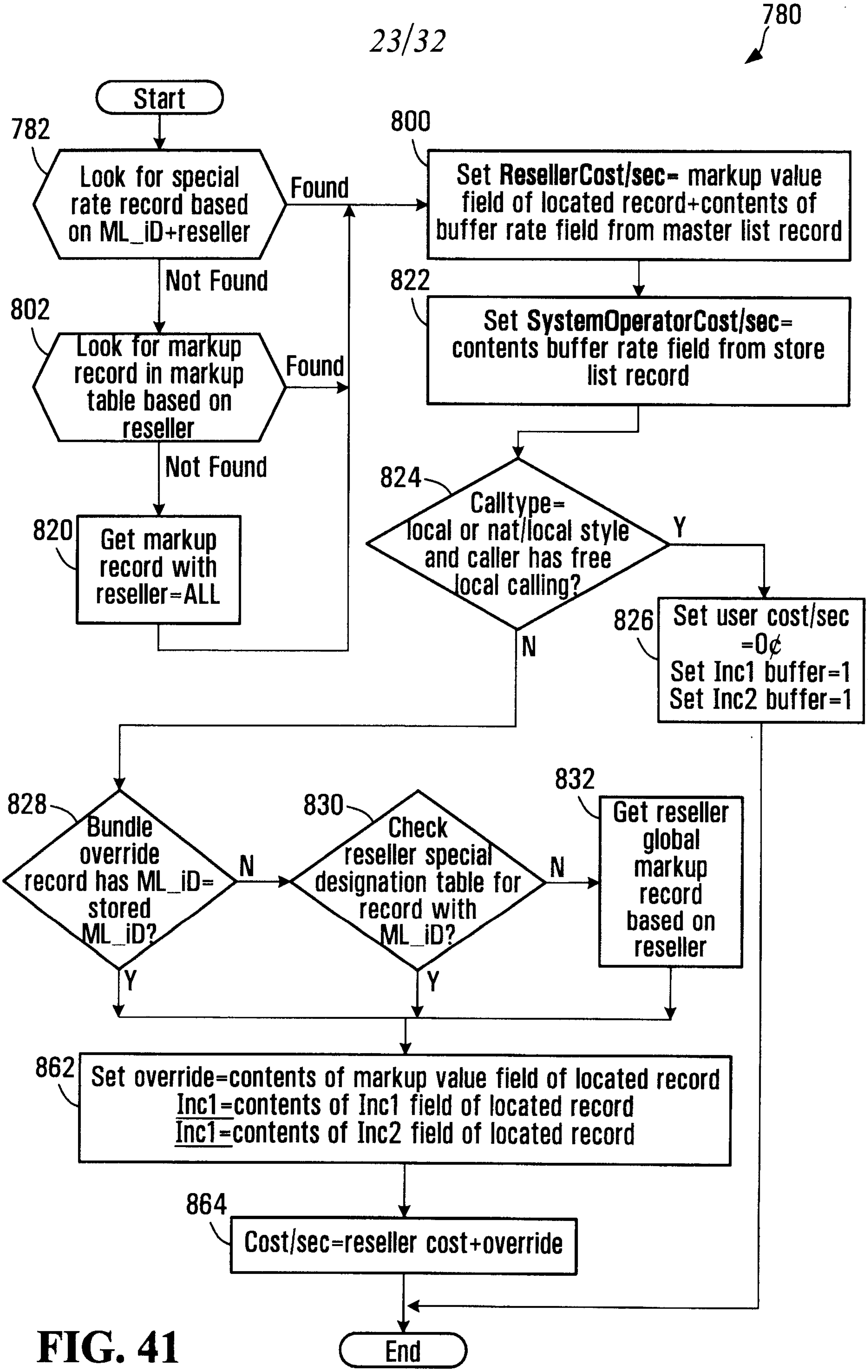

780
Start
782
Look for special rate record based on ML_iD+reseller
Found
800
Set ResellerCost/sec= markup value field of located record+contents of buffer rate field from master list record
Not Found
802
Look for markup record in markup table based on reseller
Found
822
Set SystemOperatorCost/sec= contents buffer rate field from store list record
Not Found
820
Get markup record with reseller=ALL
824
Calltype= local or nat/local style and caller has free local calling?
Y
N
826
Set user cost/sec =0¢
Set Inc1 buffer=1
Set Inc2 buffer=1
828
Bundle override record has ML_iD= stored ML_iD?
N
Y
830
Check reseller special designation table for record with ML_iD?
N
Y
832
Get reseller global markup record based on reseller
862
Set override=contents of markup value field of located record
Inc1=contents of Inc1 field of located record
Inc1=contents of Inc2 field of located record
864
Cost/sec=reseller cost+override
End

FIG. 41

784

System Operator Special Rates Table Record

786	**Reseller**	retailer id
788	**ML_Id**	master list id
790	**Markup Table**	fixed; percent; cents
792	**Markup Value**	real number representing value of markup type
794	**Inc1**	first level of charging (minimum # of seconds) charge
796	**Inc2**	second level of charging

FIG. 42

798

System Operator Special Rates Table Record for Klondike

786	**Reseller**	Klondike
788	**ML_Id**	1019
790	**Markup Table**	cents
792	**Markup Value**	$0.001
794	**Inc1**	30
796	**Inc2**	6

FIG. 43

804

System Operator Markup Table Record

806	Reseller	reseller id code
808	Markup Table	fixed; percent; cents
810	Markup Value	real number representing value of markup type
812	Inc1	first level of charging (minimum # of seconds) charge
814	Inc2	second level of charging

FIG. 44

System Operator Markup Table Record for the Reseller Klondike

806	Reseller	Klondike
808	Markup Table	cents
810	Markup Value	$0.01
812	Inc1	30
814	Inc2	6

FIG. 45

System Operator Markup Table Record

806	Reseller	all
808	Markup Table	percent
810	Markup Value	1.0
812	Inc1	30
814	Inc2	6

FIG. 46

832

Reseller Special Destinations Table Record

834	Reseller	reseller id code
836	ML_id	Master List ID code
838	Markup Table	fixed; percent; cents
840	Markup Value	real number representing value of markup type
842	Inc1	first level of charging (minimum # of seconds) charge
844	Inc2	second level of charging

FIG. 47

846

Reseller Special Destinations Table Record for the Reseller Klondike

834	Reseller	Klondike
836	ML_id	1019
838	Markup Table	percent
840	Markup Value	5%
842	Inc1	30
844	Inc2	6

FIG. 48

848

Reseller Global Markup Table Record

850	Reseller	reseller id code
852	Markup Table	fixed; percent; cents
854	Markup Value	real number representing value of markup type
856	Inc1	first level of charging (minimum # of seconds) charge
858	Inc2	second level of charging

FIG. 49

860

Reseller Global Markup Table Record for the Reseller Klondike

850	Reseller	Klondike
852	Markup Table	percent
854	Markup Value	10%
856	Inc1	30
858	Inc2	6

FIG. 50

900

SIP Bye Message

902	**Caller**	Username
904	**Callee**	PSTN compatible # or Username
906	**Call ID**	unique call identifier (hexadecimal string@IP))

FIG. 51

908

SIP Bye Message

902	**Caller**	2001 1050 8667
904	**Callee**	2001 1050 2222
906	**Call ID**	FA10@192.168.0.20

FIG. 52

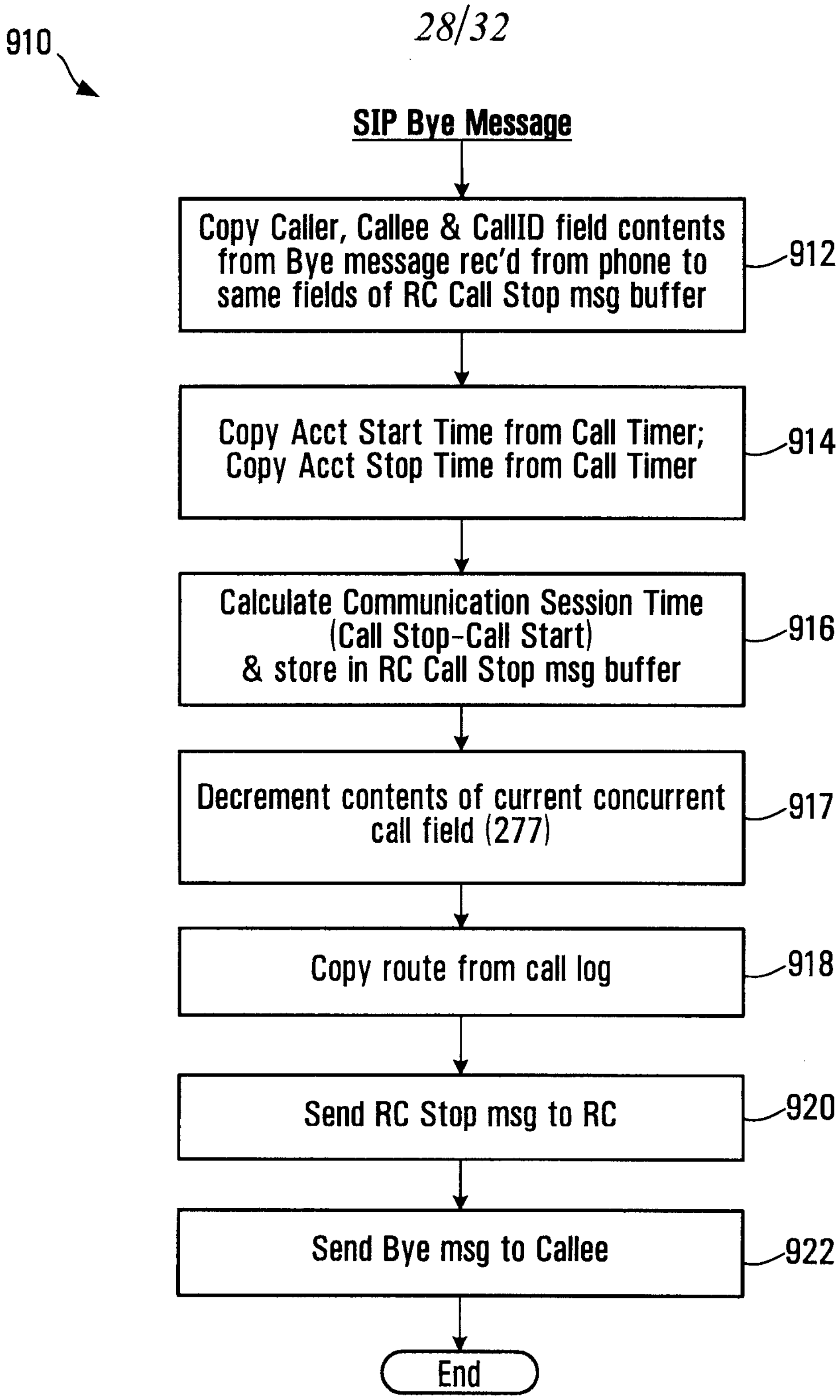

910
SIP Bye Message
Copy Caller, Callee & CallID field contents from Bye message rec'd from phone to same fields of RC Call Stop msg buffer
912
Copy Acct Start Time from Call Timer; Copy Acct Stop Time from Call Timer
914
Calculate Communication Session Time (Call Stop-Call Start) & store in RC Call Stop msg buffer
916
Decrement contents of current concurrent call field (277)
917
Copy route from call log
918
Send RC Stop msg to RC
920
Send Bye msg to Callee
922
End

FIG. 53

1000

RC Call Stop Message

1002	**Caller**	Username
1004	**Callee**	PSTN compatible # or Username
1006	**Call ID**	unique call identifier (hexadecimal string@IP)
1008	**Acct Start Time**	start time of call
1010	**Acct Stop Time**	time the call ended
1012	**Acct Session Time**	start time-stop time (in seconds)
1014	**Route**	IP address for the communications link that was established

FIG. 54

1020

RC Call Stop Message for Calgary Callee

1002	**Caller**	2001 1050 8667
1004	**Callee**	2001 1050 2222
1006	**Call ID**	FA10@192.168.0.20
1008	**Acct Start Time**	2006-12-30 12:12:12
1010	**Acct Stop Time**	2006-12-30 12:12:14
1012	**Acct Session Time**	2
1014	**Route**	72.64.39.58

FIG. 55

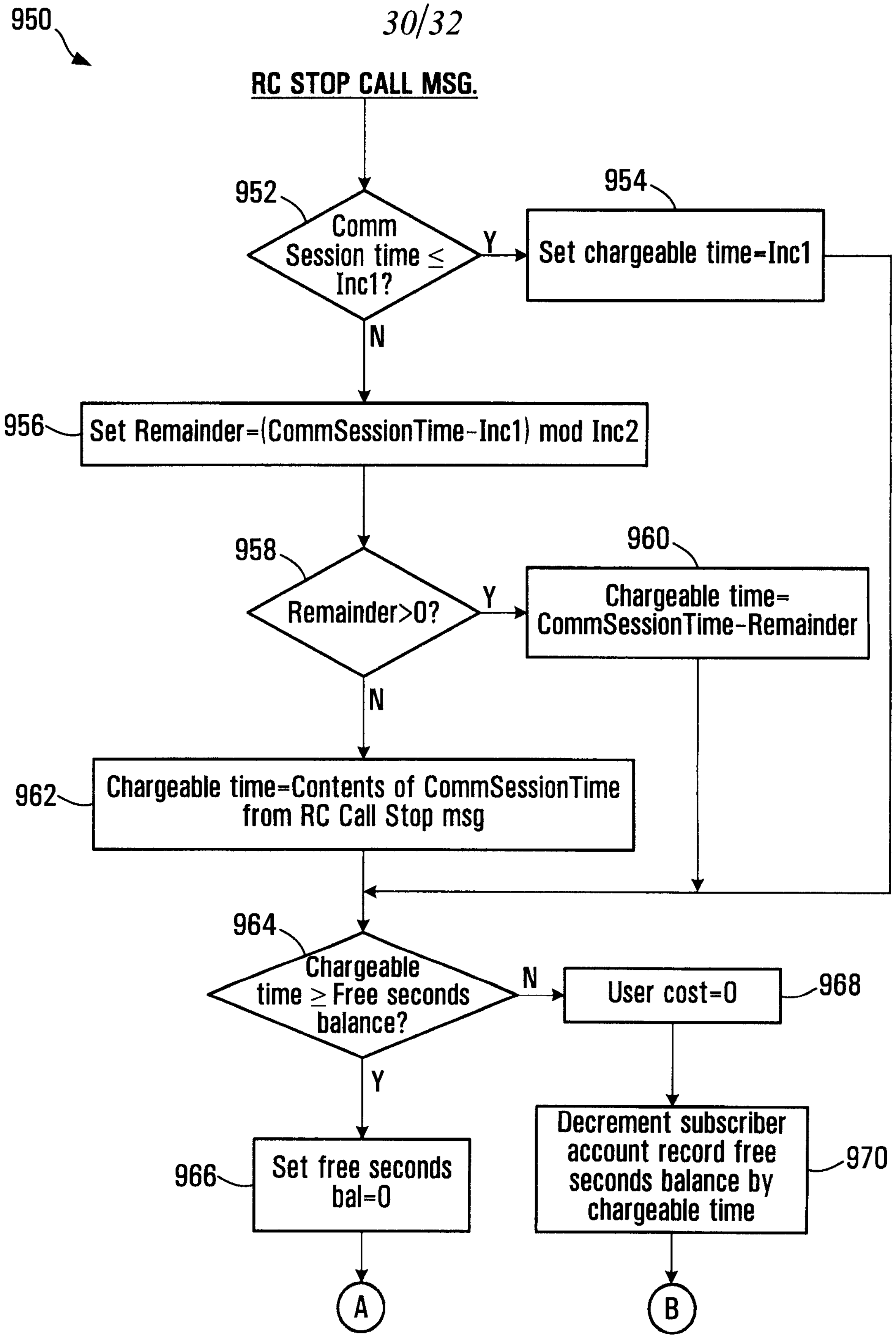

950
RC STOP CALL MSG.
952
Comm Session time ≤ Inc1?
Y
954
Set chargeable time=Inc1
N
956
Set Remainder=(CommSessionTime-Inc1) mod Inc2
958
Remainder>0?
Y
960
Chargeable time= CommSessionTime-Remainder
N
962
Chargeable time=Contents of CommSessionTime from RC Call Stop msg
964
Chargeable time ≥ Free seconds balance?
N
User cost=0
968
Y
966
Set free seconds bal=0
Decrement subscriber account record free seconds balance by chargeable time
970
A
B

FIG. 56A

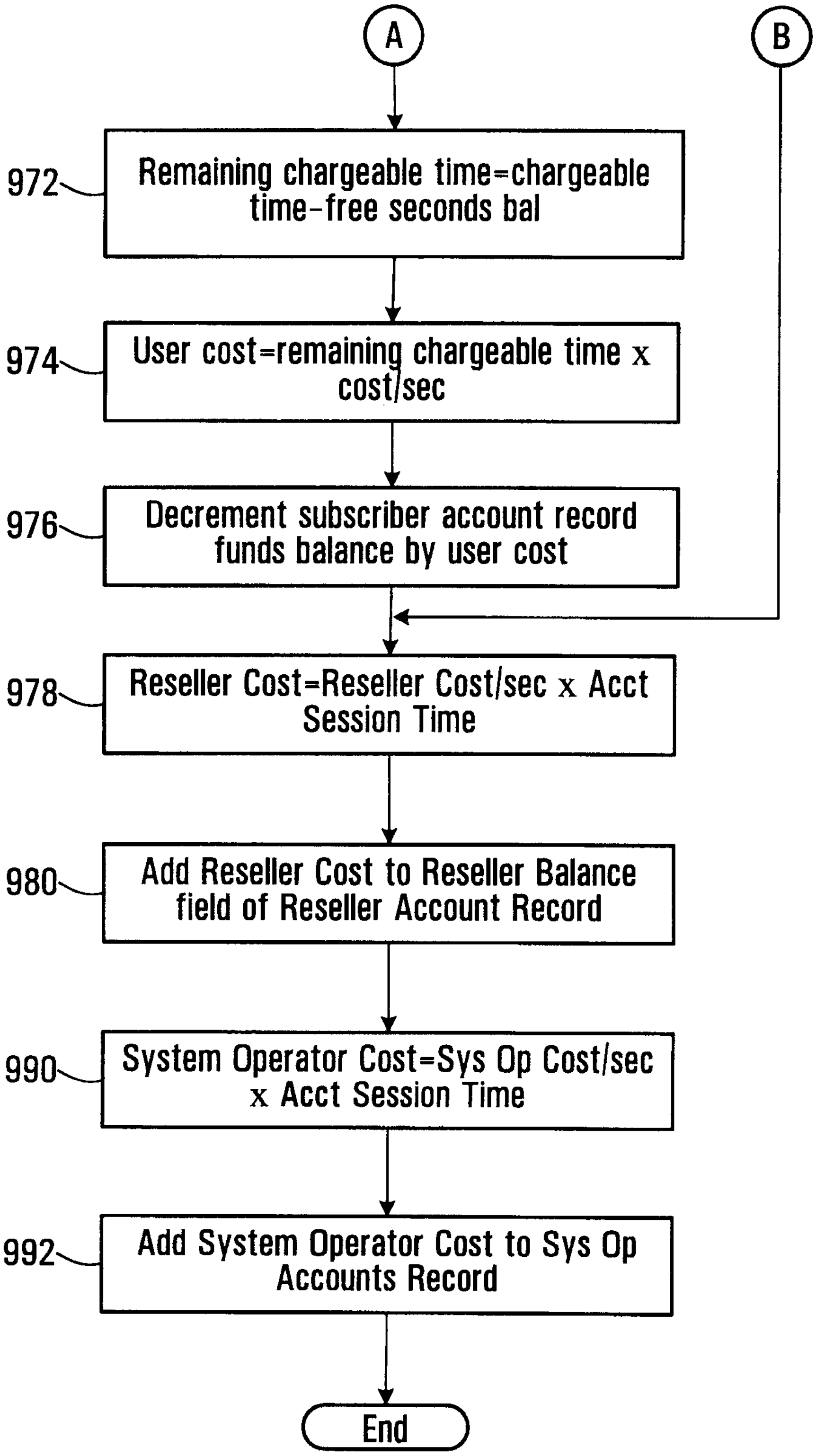

A
B
972
Remaining chargeable time=chargeable time-free seconds bal
974
User cost=remaining chargeable time x cost/sec
976
Decrement subscriber account record funds balance by user cost
978
Reseller Cost=Reseller Cost/sec x Acct Session Time
980
Add Reseller Cost to Reseller Balance field of Reseller Account Record
990
System Operator Cost=Sys Op Cost/sec x Acct Session Time
992
Add System Operator Cost to Sys Op Accounts Record
End

FIG. 56B

982

Reseller Accounts Table Record

984	Reseller ID	reseller id code
986	Reseller balance	accumulated balance of charges

FIG. 57

988

Reseller Accounts Table Record for Klondike

984	Reseller ID	Klondike
986	Reseller balance	$100.02

FIG. 58

994

System Operator Accounts Table Record

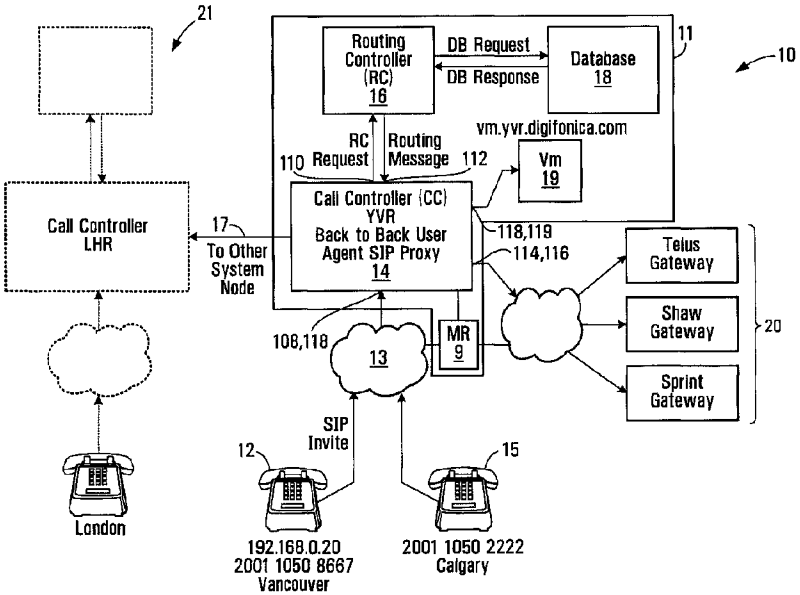
996	System Operator balance	accumulated balance of charges

FIG. 59

System Operator Accounts Record for this System Operator

996	System Operator balance	$1000.02

FIG. 60



21
Call Controller
LHR
London
Routing
Controller
(RC)
16
DB Request
DB Response
Database
18
11
10
vm.yvr.digifonica.com
RC
Request
Routing
Message
110
112
Vm
19
Call Controller (CC)
YVR
Back to Back User
Agent SIP Proxy
14
17
To Other
System
Node
118,119
114,116
Telus
Gateway
Shaw
Gateway
Sprint
Gateway
20
MR
9
108,118
13
SIP
Invite
12
15
192.168.0.20
2001 1050 8667
Vancouver
2001 1050 2222
Calgary