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UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
(SAN JOSE DIVISION)

VOIP-PAL.COM, INC., a Nevada corporation, *Plaintiff,* v. AMAZON.COM, INC., a Delaware corporation, AMAZON TECHNOLOGIES, INC., a Nevada corporation, *Defendants.*	Case No. 5:18-cv-07020-LHK **FIRST AMENDED COMPLAINT** **Jury Trial Demanded**

Pursuant to Fed. R. Civ. P. 15(a)(1)(b), Plaintiff VoIP-Pal.com, Inc. ("VoIP-Pal"), for its First Amended Complaint against Defendants Amazon.com, Inc. ("Amazon Inc."), Amazon Technologies, Inc. ("Amazon Technologies") (Amazon Inc. and Amazon Technologies collectively referred to as the "Defendants") hereby alleges as follows:

PARTIES

1. Plaintiff VoIP-Pal is a Nevada corporation with its principal place of business located at 10900 NE 4th Street, Suite 2300, Bellevue, Washington 98004.

2. Defendant Amazon.com, Inc. is a Delaware corporation with its principal place of business at 410 Terry Avenue N, Seattle, Washington 98109-5210. On information and belief, Amazon Inc. regularly conducts and transacts business in the District of Nevada and throughout the United States, and, as set forth below, has committed and continues to commit, tortious acts of patent infringement within the District of Nevada.

3. Defendant Amazon Technologies, Inc. is a Nevada corporation with its principal place of business at 410 Terry Avenue N, Seattle, Washington 98109-5210. On information and belief, Amazon Technologies regularly conducts and transacts business in the District of Nevada and throughout the United States, and, as set forth below, has committed and continues to commit, tortious acts of patent infringement within the District of Nevada.

NATURE OF THE ACTION

4. This is a civil action for infringement of United States Patent No. 9,537,762 (the " '762 Patent"), United States Patent No. 9,813,330 (the " '330 Patent"), United States Patent No. 9,826,002 (the " '002 Patent"), and United States Patent No. 9,948,549 (the " '549 Patent" and together with the '762 Patent, the '330 Patent and the '002 Patent, the "Patents-in-Suit") under the Patent Laws of the United States, 35 U.S.C. § 1 *et seq*.

JURISDICTION AND VENUE

5. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

6. This Court has personal jurisdiction over Defendants because, among other things, Defendants have committed, aided, abetted, contributed to, and/or participated in the commission of patent infringement in this judicial district and elsewhere that led to foreseeable harm and injury to VoIP-Pal.

7. This Court also has personal jurisdiction over Defendants because, among other things, Defendants have established minimum contacts within the forum such that the exercise of jurisdiction over Defendants will not offend traditional notions of fair play and substantial justice. Moreover, Defendants have placed products and provided services that practice the claimed inventions of the Patents-in-Suit into the stream of commerce with the reasonable expectation and/or knowledge that purchasers and users of such products and services were located within this District. Defendants have sold, advertised, marketed, distributed and made available products and services in this District that practice the claimed inventions of the Patents-in-Suit. Further, upon information and belief, Defendants have induced and/or are inducing third parties to make, use, sell, offer for sale, import and/or distribute products and services that practice the claimed inventions of the Patents-in-Suit.

8. Upon information and belief, Defendants have engaged in actions constituting patent infringement of the Patents-in-Suit collectively and jointly with respect to or arising out of the same transaction, occurrence, or series of transactions or occurrences relating to the making, using, importing into the United States, offering for sale, or selling of the same accused products, systems, processes and/or Accused Instrumentalities as described herein. Moreover, upon information and belief, there are questions of fact common to all Defendants that will arise in the action.

9. Venue is proper in this district pursuant to 28 U.S.C. § 1400(b).

BACKGROUND OF THE TECHNOLOGY AND THE PATENTS-IN-SUIT

10. United States Patent No. 9,537,762 (the "'762 Patent") entitled "Producing Routing Messages For Voice Over IP Communications" was duly and legally issued by the United States Patent and Trademark Office on January 3, 2017. A copy of the '762 Patent is attached hereto as Exhibit 1.

11. United States Patent No. 9,813,330 (the "'330 Patent") entitled "Producing Routing Messages For Voice Over IP Communications" was duly and legally issued by the United States Patent and Trademark Office on November 7, 2017. A copy of the '330 Patent is attached hereto as Exhibit 2.

12. United States Patent No. 9,826,002 (the "'002 Patent") entitled "Producing Routing Messages For Voice Over IP Communications" was duly and legally issued by the United States Patent and Trademark Office November 21, 2017. A copy of the '762 Patent is attached hereto as Exhibit 3.

13. United States Patent No. 9,948,549 (the "'549 Patent") entitled "Producing Routing Messages For Voice Over IP Communications" was duly and legally issued by the United States Patent and Trademark Office on April 17, 2008. A copy of the '549 Patent is attached hereto as Exhibit 4.

14. The '762 Patent, '330 Patent, '002 Patent and '549 Patent are collectively referred to herein as the "Patents-In-Suit".

15. The earliest telephone systems to receive public use within the United States involved a telephone directly connected to a human operator. A portion of the phone rested on a mechanical hook such that the operator was signaled when the portion was lifted from the hook. A caller would then say the name of the person they wished to call to the operator. If the callee was connected to the same telephone switch board the operator would physically pull out a cable associated with the caller's phone and plug the cable into a socket associated with the callee's

telephone. If the callee was associated with a different switchboard, and thus out of reach of the operator, a second operator would be involved to bridge the gap to the appropriate switchboard. While initially very effective compared to no telephone service, this structure quickly proved error prone (operators would connect the wrong party), and limiting the number of possible telephones because of the physical limits of switchboards and cable to be pulled. This basic system corresponds to the introduction of a Plain Old Telephone Service ("POTS") connection to the operator. In these configurations, there was a dedicated, point-to-point electrical connection between the caller and the callee.

16. Rotary dialing eventually was introduced, beginning at around the turn of the 20th century, where a rotary disk was marked with numbers from zero to nine. A caller would spin the wheel and a mechanical device in the telephone would cause a sequence of electrical pulses to be sent to the network corresponding to the digit dialed, for example, four pulses would be sent for the number four. Rather than speaking to a human operator, an electric device would count the pulses and begin to route a call once an appropriate and valid sequence of digits was dialed by the caller. This advancement improved reliability of call routing and reduced the time required to initiate a call. But, even so, there was a dedicated, point-to-point electrical connection between the caller and the callee. As multiple companies entered the market of telephone service and the number of customers increased, an issue emerged where a caller would be a customer of one telephone company and the callee would be a customer of another. The solution that emerged to this problem was to introduce trunk lines, which connect one company to another.

17. Eventually, as the number of companies continued to increase and telephone services spread over much larger geographic areas, the notion of a Public Switched Telephone Service ("PSTN") emerged. The term derives from the notion, at least in part, that the dedicated wires used to connect the caller and callee were "circuit-switched" to connect the two. The PSTN developed gradually into the middle of the 20th century, still built around the notion of rotary

dialing and POTS connections to the individual telephones. These calls involved analog communications over circuit-switched electrical connections. A circuit-switched network involves assigning dedicated resources, such as switch settings and specific wires, to establish a link from the caller to the callee. While the call is ongoing these resources cannot be used for any other communications.

18. The next important advancement for consumer telephone service, introduced broadly during the second half of the 20th century, was the introduction of push-button telephones. With such telephones the rotary dial was replaced by a matrix of buttons, each labeled with a digit from zero through nine along with the additions of ‘*’ and ‘#’. The underlying signaling technology was called dual-tone multiple-frequency (“DTMF”) and involves two different audible tones being sent simultaneously from the telephone into the telephone network. A receiver within the network decoded these tones and formed them into a sequence of digits indicating the number of the callee.

19. Around this same time a scheme for international telephone addressing was introduced, with a numeric protocol for identifying one country from another and providing country-specific routing within the destination country. The E.164 standard now documents how a caller anywhere in the world, for example in Ann Arbor, Michigan, can cause a telephone call to be routed to any other location, such as Avignon, France. While many of these advances, such as DTMF dialing and automated international routing, may have been originally introduced via *ad hoc* methods, eventually they required multiple parties (companies and governments) to agree on protocols to enable wide-spread reliable use and inter-operability among different physical communications networks. Even with all these advances, the systems still relied on circuit-switched technology that dedicated resources between the caller and the callee during the duration of a call. The move to take human operators out of the loop, with the introduction of rotary dialing, combined with the fast increase in demand for telephone services throughout the 20th

century, resulted in the development of automated telephone switches. These devices comprise a set of input ports, each dedicated to, and associated with a specific caller, and output ports, each associated with a callee. A small local telephone system may have had a single switch while a larger service would use a large number of switches that were connected to each other. Eventually a switch from a local service provider would be connected to a trunk line which then connected to an input switch of another service provider. These switches originally supported analog voice calls initiated via rotary dialing and dedicating input and output ports as well as physical wires for each circuit-switched call.

20. Eventually analog voice services were replaced within the network with digital voice. Digital voice is communicated using a sequence of chunks (or packets) of data. This advancement allowed the physical resources to be shared among multiple calls over short bursts of time. For example, a physical wire can move a packet for one call at a specific instance in time and then move a packet for a totally different call subsequently, only to later return to transfer a new packet for the original call. This advance is called packet-switched communications and provided an important increase in network reliability and efficiency while driving down the cost. However, in most situations throughout the 20th century (and often still today), the connection to the end user’s physical telephone is analog. While network switches operate via digital circuitry, and often comprises programmable processors executing software, they tend to be dedicated special-purpose devices. The conversion between analog and digital encoding is typically done at the point where the PSTN network switch connects to the POTS handset, for example, at a device called a Class-5 telephone switch, which connects the customer POTS handset to the PSTN network of a service provider’s central office.

21. The Internet became important to consumers, via broad deployment, during the late 1980’s and early 1990’s. Eventually available bandwidth and reliability increased to the point where pioneers began to experiment with techniques to carry voice communications over the

Internet. These early efforts then began to focus on techniques called Voice Over Internet Protocol (VOIP) and session initiation protocol (SIP). VOIP provided a consistent set of protocols and mechanisms for moving digital voice packets between two callers using the Internet rather than existing PSTN networks. SIP provided a mechanism for establishing and terminating these calls between users of a VOIP service. For example, a callee could register with a VOIP service so that an identifier (such as their name, email address or a nickname) could be associated with the computer to which they are logged in. Eventually VOIP services increased to provide interoperability with the existing PSTN services. For example, the company Skype began to allow a user to call a PSTN number using a feature marketed as “Skype out”. However, the user was required to explicitly classify the call as a PSTN call by specifying a real physical telephone number. In this case the VOIP system must include a gateway to bridge from the VOIP network to the PSTN network in order to route to the physical telephone. Calls that use a proprietary non-PSTN user identifier such as an email or nickname remain within the VOIP network and are not routed to the PSTN network and do not connect to a POTS telephone.

22. The advent of VOIP technology allowed customers to physically move their telephones from one location to another, even from one continent to another, with no fundamental change in its operation from the point of view of a caller once a connection to the Internet was established. However, the integration of network gateways to route between different types of networks using VOIP, for example from a VOIP caller in Europe to a PSTN callee in the United States, introduced a number of new complications. The VOIP service needed to be able to distinguish between callees that were within the VOIP network and those that were outside of it and thus required different methods for identifying callees and routing to them depending on whether the callees were within or outside the VOIP network. One way to identify callees on the VOIP network was to use a predefined proprietary user identifier such as an email or nickname. The VOIP service provider also needed to interpret dialed PSTN numbers in order to correctly

route calls to a PSTN callee. A VOIP caller had to use different types of callee identifier depending on whether or not the destination (callee) they were calling was within the VOIP network or not. The caller's choice of the type of callee identifier thus specified the network of the destination to be called. However, the asserted patents disclose and claim a distinct manner of call routing.

23. Digifonica, a wholly owned subsidiary of Patent Owner VoIP-Pal, starting in 2004 eventually came to employ over a dozen top professionals (e.g., software developers, system administrators, QA/test analysts) including three Ph.D.'s with engineering backgrounds, to develop innovative software solutions for communications. Digifonica spent over $15,000,000 researching, developing, and testing a communication solution capable of seamlessly integrating a private voice-over-IP ("VoIP") communication network with an external network (i.e., the "public switched telephone network" or "PSTN"), by bridging the disparate protocols, destination identifiers and addressing schemes used in the two networks. By the mid-2000's, Digifonica had successfully tested intra- and inter-network communications (i.e., communications within the Digifonica system and between the Digifonica system and the PSTN) by implementing high-capacity communication nodes across three geographic regions, including actual working nodes in Vancouver (Canada) and London (UK). *See* '762 Patent at Fig. 1 (nodes 11, 21) and 13:19-35[1]. Digifonica's R&D efforts led to a number of patent grants, including U.S. Patent No. 8,542,815, to which the Patents-In-Suit claim priority.

24. Prior to the '815 Patent, private branch exchange (PBX) systems typically enabled users to call destinations internal to the PBX by dialing an extension (i.e., "private number") and destinations external to the PBX on the public switched telephone network (PSTN) by dialing a "public number." Such PBX systems relied on a user-specified classification of the dialed number

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[1] References to citations herein to the '762 Patent are made in the following format col:lines of the specification, e.g., column 6, lines 5 through 9 of the '762 Patent is cited as '762 Patent 6:5-9.

to interpret the number and route the call. For example, a user placing a call to the public network dialed a predefined prefix such as "9" to indicate that subsequent digits were to be interpreted as a public PSTN number. If no prefix was dialed, the dialed digits were to be interpreted as a private PBX extension. The number alone, as dialed, dictated how the call was routed. Thus, the user made an affirmative decision when placing a call as to whether the call would be public or private.

25. Digifonica's system employed an approach fundamentally different from traditional PBX's: it did not rely on a caller-specified classification (e.g., a prefix digit) to distinguish private calls from PSTN calls. Digifonica provided flexible, user-specific dialing features and could decouple the type of number being called from the manner in which the call would be handled. For example, even if a public PSTN number was dialed, Digifonica's system could determine that the call should be routed to the private network, thus allowing the advantages of private network calling even if callers were unaware that the call recipient ("callee") was a Digifonica system subscriber.

26. VoIP-Pal's/Digifonica's technology and patents represent fundamental advancements to Internet Protocol ("IP") based communication, including improved functioning, classification, routing and reliability of Voice-over-IP (VoIP) and IP-based transmission of video, photographs, messages and mixed media, as well as improved interoperability of IP-based private communication networks with external networks, such as the public switched telephone network (PSTN), interconnected with the private communication networks via one or more gateways.

27. The Patents-In-Suit provide, *inter alia*, improvements in routing controllers, processes, and networks. Several illustrative examples of such improvements are briefly described below, although the patented invention is not limited to these specific improvements or examples.

28. The public switched telephone network (PSTN) connected callers through nodes such as central offices or exchanges. Because these nodes were limited to providing services only to subscribers in a "local calling service area," they required callers to place calls in a specific

manner, e.g., by requiring the use of certain dialing patterns and conventions associated with that local area. *See* ‘762 Patent at 1:36-42. For example, PSTN nodes conventionally required PSTN callers to dial in a manner compatible with a local numbering plan (e.g., a plan consistent with the “North American Numbering Plan” or “National Numbering Plan,” in use by AT&T as early as about the 1940’s and further developed in later years) as well as to dial in a manner compatible with international standards such as those of the International Telecommunications Union (ITU) Telecommunications Standardization Sector (ITU-T). *See* ‘762 Patent at 19:5-17. For example, it is known in the field of telephony that early numbering plans assigned an “area code” of 312 for calling Illinois, and that this code (312) remains in use even today as an area code for Chicago. To take another example, the ITU designates “44” as a “country code” for calling the United Kingdom. *Id*. at Fig. 12 (“County Code” attribute for London user is “44”).

29. Large organizations were able to avoid PSTN dialing constraints, at least for internal calls, by using private branch exchanges (PBXs) and private numbering plans for their internal private telephone networks, but these PBXs also needed to provide caller access to the PSTN. *See* ‘762 Patent at 1:22-33. As Andy Valdar has explained in his textbook, “Businesses which have more than a few telephones use <u>a private branch exchange system, known as a PBX</u>, to provide call connections between each telephone (which become ‘extensions’) and links into the PSTN... The PBX is really a small version of the PSTN exchanges, typically ranging in sizes from 10 up to 5,000 extensions. <u>A private numbering scheme is required to enable extension to extension dialing</u>, <u>also ***special codes (e.g. ‘dial 9’)*** are required to enable calls to be made to the PSTN</u>. [...] In the case where a company extends over two or more sites (e.g. office or factory buildings) the PBXs on each site can be linked by private circuits, thus enabling calling between all the extensions. This is known as a ‘private corporate network’ (or just ‘private network’). In this case <u>the private numbering scheme extends across all the PBXs and usually each PBX is linked to the PSTN</u>.” (*See* Valdar, Andy, Understanding Telecommunications Networks, The

Institution of Engineering and Technology, London, UK, 2006, p. 38 (emphasis added)).

30. It was well-understood, routine and conventional for PBXs to require users to dial a special code (e.g., a prefix digit of "9") if they wanted to place a call on the PSTN, as noted by Valdar and numerous other sources. For example, one telecom dictionary distinguishes between dialing an "internal PBX station number" and an "external number," wherein in the latter case, "the user must dial an access code in order to gain access to an external trunk connected to the public switched telephone network (PSTN)... The ***conventional*** access code is nine (9) in the United States and Canada, and zero (0) in most other countries". (*See* Ray Horak, Webster's New World Telecom Dictionary, Wiley Publishing, Inc., Indianapolis, Indiana, 2008, p.133 [emphasis added]). To take another example, U.S. Patent No. 3,725,596 to Maxon et al. ("Maxon"), filed in 1971, discloses an discloses an early private branch exchange (PBX) having equipment for automatically generating and transmitting calling station and trunk number information to a central office on outgoing calls. Maxon indicates that "a calling party at station ST10... dials a prefix digit, such as the ***conventional*** prefix digit 9, to initiate an outgoing call to the central office. The digit 9 is... detected by the dial 9 detector 152. Upon the detection of this digit, the register control circuit 153 advises common control that the digit 9 has been dialed for a central office call." [emphasis added]. Maxon at 9:66-10:6; *see* also Fig. 1B (152), 8:58-68, 9:21, 9:38-40, 13:3-6, 14:6-7 and at 14:59. Webster's New World Telecom dictionary and Maxon both confirm that it was considered "conventional" to use a prefix digit such as "9" to place a PSTN call from a PBX. The Patents-In-Suit eschewed such well-understood, routine and conventional approaches to integrating these two networks.

31. A person of skill in the art (POSITA), upon review of the Patents-in-Suit, would understand that the disclosed embodiments are inherently computer based. The POSITA would further appreciate that the asserted claims of the Patent-In-Suit are necessarily rooted in computer technology for the operation of communication networks, and provide technical improvements to

overcome certain technical limitations of prior art routing processes, systems and networks, *viz*., that the asserted claims provide technology solutions for one or more of: (1) user-specific call handling, (2) transparent routing, and (3) network resiliency and (4) communication blocking.

32. ***User-Specific Call Handling***: Many prior art communication systems required users to place a call by using a specific callee identifier format or by following certain dialing conventions with no opportunity for defining a user-specific manner of placing calls. For example, as discussed above, PSTN nodes were typically limited to supporting only the dialing conventions of their local calling service area and processed calls locally (*See* '762 Patent at 1:36-42) and did not support user-specific calling. The technology disclosed in the Patents-in-Suit and recited in the asserted claims overcomes such technical limitations and supports user-specific calling styles, e.g., calling styles from any continent or country based on the application of user-specific attributes to callee identifiers and network classification criteria to route a call. It is unnecessary for the user to do anything special to "trigger" such user-specific call processing. *See, e.g.*, '762 Patent at 15:50-58 (storing user-specific parameters including a "continent code" and "country code" in association with each subscriber), 18:40-58 (disclosing a user-specific "dialing profile" capable of supporting numerous global styles of dialing), and Figs. 8A-8D (disclosing steps for processing a routing request). By evaluating a called party identifier based on profile settings ("attributes") associated with the calling party, the technology provides an individually customizable manner of initiating a communication to a destination party. To be clear, it is not a calling party's identifier (i.e., "caller ID" or "caller identifier") that is used as the basis for evaluating the called party's identifier (e.g., "callee identifier"); rather, the calling party's identifier is used to locate a caller-specific *profile* identifying calling party attributes to be used to evaluate the called party's identifier and to determine the routing destination, as between two networks, and to engage infrastructure for effecting the communication. This approach is capable of fulfilling the individual service preferences of users (e.g., any desired PSTN dialing style) (*id*. at 19:38-50); it

also supports unconventional dialing styles and special callee identifiers such as usernames (*id*. at 17:61-63). All of the asserted claims of the Patents-In-Suit enable user-specific handling of communications; *viz*., every claim recites user-specific attributes that are used for determining and establishing routing.

33. ***Routing Transparency***: Some prior art communication systems required a user to explicitly signal how a call should be processed or to manually "trigger" special call handling. For example, as discussed above, it was well-understood, routine and conventional for PBX systems in large organizations to rely on a user-specified classification of the dialed number to interpret the number and route the call—e.g., a user placing a call to the PSTN would dial a predefined prefix such as "9" to indicate that subsequent digits were to be interpreted as a PSTN number. If no prefix was dialed, the dialed digits were interpreted as a private PBX extension. The dialed digits alone dictated how the call was routed, and thus the user made an affirmative decision when placing a call as to how the call's routing would take place. In the foregoing example, the PBX fails not only to provide user-specific call handling, but also *routing transparency*. In contrast, the asserted claims of the Patents-In-Suit use a caller's attributes to evaluate a callee identifier against network routing criteria to cause a call to automatically be routed over a system network or another network (e.g., such as the PSTN) interconnected to the system network through a gateway, *transparently* to the user, without the user manually specifying which network to use for routing by the user's manner of placing the call (e.g., by dialing a prefix of "9" to make a PSTN call).

34. To illustrate this with one embodiment disclosed in the '762 Patent, if a Vancouver user (user profile in Fig. 10) dialed the PSTN phone number of the London user (user profile in Fig. 12), the system would evaluate the dialed digits based on the caller's attributes, determine that the London user is a subscriber to the system, and classify the call as a system network call, identifying a subscriber username such as "44011062444" (*See* '762 Patent at Fig. 8B, Fig. 12, 20:61-22:15). A routing controller (*Id*. at 16 in Fig. 1) determines that the London user is

associated with a different node than the Vancouver user, and produces a routing message (*Id*. at Fig. 16; *see also id*. at 21:12-36; Fig. 8A at 280, 302, 350, 381) for receipt by a call controller (*id*. at 14 in Fig. 1), thereby causing the call controller to establish the call (*id*. at 27:44-47). The caller in this illustrative embodiment need not be aware that the London user is a subscriber and need not know whether or not the call is being placed over the PSTN. Thus, the identification of the destination network is transparent to the user; the same manner of initiating a communication can reach destinations on either network. All the claims of the Patents-In-Suit recite features which enable such transparent routing.

35. Furthermore, in some claimed embodiments of the invention, a node associated with the callee is identified (e.g., from a call*ee* profile stored in the communication system) and the communication is automatically forwarded to that node for handling. *See* '762 Patent at Fig. 8A (302, 350, 381). This, too, is transparent to the originator of the communication, who does not have to take any action to "trigger" the identification of, or routing to, a node with which the callee is associated. In this manner, the system architecture can distribute the load of very large numbers of subscribers from a large geographic area without imposing any requirement users to know how to route to the node at which the callee is currently registered. *See* '762 Patent at 13:20-44. If the system operator should reassign subscribers or adds nodes to the system, as needed, for better performance or to maintain quality of service, the caller need not know this—the node can be identified dynamically. In contrast, in the PSTN, when a new "area code" is overlaid to handle larger number of customers, callers are inconvenienced by having to learn new phone numbers or styles of dialing. Digifonica's system architecture and operation not only provided improved transparency in routing via multiple nodes of the system (as well as via gateways), it also gave rise to improved system resiliency, aspects of which are described below in greater detail with reference to the patent specification.

36. Yet another benefit was that Digifonica's technology enabled automatic network

selection based on determination of a callee’s registration status. Because Digifonica’s system supported the use of PSTN numbers both for subscribers on its own private network as well as for non-subscribers on a public network (e.g., the PSTN), a caller might know the PSTN number of a destination without knowing whether the destination was reachable via Digifonica’s IP-based network. Digifonica’s technology automatically determined whether the destination was a subscriber and, if so, routed over Digifonica’s network notwithstanding that a PSTN number had been dialed. This enabled callers to receive the advantages of IP-based private network calling even when callers were unaware that the callee was a Digifonica system subscriber; such calls could be transparently placed over Digifonica’s IP-based network at lower cost, with better quality and/or higher reliability than if the call had been sent over the PSTN network. In comparison to the prior art examples described above, Digifonica’s approach was unconventional in that it decoupled the type of number being dialed from the classification and routing of the call. As a further aspect, Digifonica’s network was designed to support multiple resellers of its communication services: *See, e.g.*, ‘762 Patent at 19:23-25, 31:48-32:57 and Figs. 9-12 (field 273), 41, 43, 45, 47-50, disclosing support for different resellers (e.g., phone companies retailing communication services based on Digifonica’s network under their own brand). Using the aforesaid technology, calls by callers to callees who were affiliated with a different reseller of communication services based on Digifonica’s network, would automatically and transparently be routed over Digifonica’s IP-based network even without the caller or callee knowing that both parties were Digifonica subscribers. Such network selection was especially helpful to overcome the costs and limitations of public networks when the calls were international, e.g., from callers using Digifonica’s node in North America (Vancouver) to callees associated with the node in Europe (London). *Id.* at Fig. 1.

37. ***Resiliency***: Some prior art provided service to a limited area (*See* ‘762 Patent at 1:50-53: “such as one location, or a small number of branch offices”) but was incapable of

providing reliable service to a large number of subscribers dispersed over a geographically dispersed area such as a continent (*id.* at 1:47-50). For example, PSTN exchanges and nodes were limited to serving a "local calling service area" (*id.* at 1:36-38), whereas the PBX systems described above in the Valdar textbook were "really a small version of the PSTN exchanges, typically ranging in sizes from 10 up to 5,000 extensions" (see Valdar, *supra*; cf. '762 Patent at 1:50-53). Furthermore, at a system-level, such networks did not always have "other nodes... able to take up the load" if a particular node failed, e.g., due to a natural disaster (*See* '762 Patent at 1:42-46). In contrast, the patented inventions can provide reliable service to large areas including countries and continents. This gave rise to technical challenges regarding how to handle issues such as a very large number of subscribers, bursts of excessive demand and/or communication node failure, all of which affected system reliability. The patented inventions describe a technology for flexibly assigning nodes to particular geographical areas, including the option of adding redundant nodes with overlapping responsibility for load sharing. *See* '762 Patent at 13:20-40 (disclosing a network of super nodes providing communication services to large geographical regions) and 13:41-44 (disclosing special nodes for "call load sharing"). The technology performed call routing by identifying a suitable system network "node" or a gateway (e.g., a gateway to the PSTN) in response to evaluation of the caller's attributes, the callee identifier, and available routing resources. This design made it simple to allocate or add new nodes and gateways to particular regions (*See* '762 Patent at 13:20-44; 25:51-64, 27:44-47; 27:64-28:7). The use of caller attributes, callee identifier and dynamic routing criteria to produce the routing message, as described in the Patents-in-Suit, allowed such new nodes and gateways to be identified in the routing message, to increase service availability to subscribers as needed without redesigning the routing apparatus and process, to create an improved, resilient and reliable global routing system. Unlike some prior art systems, the Digifonica technology did not require access to PSTN databases (cf. '762 Patent at 1:33-35), eliminating such dependence as a possible point of failure.

Digifonica's technology also supported routing through an *available* gateway selected from among many supplier gateways, which also improved overall system resilience. *See* '762 Patent at 27:64-28:23. At least some of these improvements are recited by certain claims that have been asserted from the Patents-In-Suit.

38. ***Communication Blocking***: Digifonica's inventions, among other important advances, enabled various methods of communication blocking. Callers can have caller-specific attributes associated with their profile for determining, in a caller-specific manner, whether or not they are permitted to initiate a communication. *See* '762 Patent at 20:14-32. Furthermore, the caller-specific attributes associated with the caller's profile can provide a basis for establishing whether an attempted communication is valid, e.g., by checking the validity of the called party identifier. *See* '762 Patent at 20:30-34 and Fig. 8B. Notably, what constitutes a valid initiation of a communication was a user-specific determination because it depended on user-specific profile attributes. Digifonica's approach in this regard was *unconventional* compared to the prior art, which imposed a manner of call placement (e.g., dialing style) on all users that was not configurable in a user-specific manner: e.g., conventionally, all PBX users had to dial a *particular* predefined digit to dial PSTN calls, or all PSTN users in a local area could dial only according to the local numbering plan. Finally, callee-specific information was supported in Digifonica's technology for identifying how an incoming communication to each particular subscriber was to be handled, to enable the communication system to implement selective call blocking, selective call forwarding, and/or selectively routing communications to voice mail without interrupting the callee or the caller making an explicit choice. *See* '762 Patent at Fig. 8A (e.g., steps 602, 608, 610), Fig. 8B, Figs. 26-32 and 26:2-27:43. At least some of these improvements are recited in asserted claims of the Patents-In-Suit.

39. The '815 Patent and the '005 Patent, to which the Patents-In-Suit claim priority, have survived eight *inter partes* reviews ("IPR's") by the U.S. Patent Office based on prior art

disclosing making routing decisions. *See* IPR2016-01201 and IPR2016-01198, filed by Apple (final written decisions upholding validity of all challenged claims); IPR2017-01383, IPR2017-01384 and IPR2017-01385, filed by AT&T (all denied institution); and IPR2016-01082, filed by Unified Patents (denied institution). The U.S. Patent and Trademark Office rejected all of the cited communication routing art as not rendering the ‘815 Patent and the ‘005 Patent invalid. On information and belief, the asserted claims are inventive over the art cited against the parent patents.

40. As described above, Digifonica eschewed the conventional approaches for bridging the requirements of disparate networks (different communication-initiation methods, identifiers, protocols and/or addressing schemes). Instead, one “inventive concept” embodied in the Patents-in-Suit—and *not* well-understood, routine or conventional for persons of skill in the art at the time of the invention—was an improved routing process, apparatus and system, in which user-specific “attributes” (e.g., “attributes” associated with a first participant in a communication) are utilized to evaluate a “second participant identifier” to identify, in a “routing message,” an appropriate routing “address” (e.g., an address in the system associated with the second participant or of a “gateway” to an external network), the routing message causing routing of the communication to the destination, as between the two networks, using the address in the system or of the gateway.

41. For example, claim 1 of the ‘762 Patent recites:

> A method of routing communications in a system in which a first participant identifier is associated with a first participant registered with the system and wherein a second participant identifier is associated with a second participant, the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising at least one processor operably configured to execute program code stored in at least one memory, the method comprising:
>
> in response to the first participant device initiating the communication to the second participant device, receiving the first participant identifier and the second participant identifier from the first participant device;
>
> using the first participant identifier to locate, via the at least one processor, a first participant profile from among a plurality of participant profiles that are

stored in a database, the first participant profile comprising one or more attributes associated with the first participant;

processing the second participant identifier, via the at least one processor, based on at least one of the one or more attributes from the first participant profile, to produce a new second participant identifier;

classifying the communication, via the at least one processor, using the new second participant identifier, as a first network communication if a first network classification criterion is met and as a second network communication if a second network classification criterion is met;

when the first network classification criterion is met, producing, via the at least one processor, a first network routing message, the first network routing message identifying an address in the system, the address being associated with the second participant device;

and when the second network classification criterion is met, producing, via the at least one processor, a second network routing message, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system.

42. For example, claim 1 of the '330 Patent recites:

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.

43. For example, claim 1 of the ‘002 Patent recites:

> A method of 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, the second participant identifier being associated with the second participant device;
>
> causing the at least one processor to access a database comprising user profiles, using the first participant identifier, each user profile associating a respective plurality of attributes with a respective user, to locate a plurality of first participant attributes;
>
> processing the second participant identifier, using the at least one processor, based on at least one of the plurality of first participant attributes obtained from a user profile for the first participant, to produce a new second participant identifier;
>
> classifying the communication, based on the new second participant identifier, 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 associated with the second participant device, 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.

44. For example, claim 1of the ‘549 Patent recites:

> A method of 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:

> causing at least one processor to access at least one memory storing a first participant profile identifying at least one first participant attribute;
>
> receiving, by the at least one processor, a second participant identifier inputted by the first participant using the first participant device to initiate a communication, the second participant identifier being associated with the second participant device;
>
> processing the second participant identifier, based on the at least one first participant attribute obtained from the first participant profile, to produce a new second participant identifier;
>
> classifying the communication as a system communication or an external network communication;
>
> when the communication is classified as a system communication, producing a system routing message, based on the new second participant identifier, that identifies an Internet Protocol (IP) address of a network element through which the communication is to be routed thereby causing 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, based on the new second participant identifier, that identifies an address associated with a gateway to an external network thereby causing the communication to the second participant device to be established by use of the gateway to the external network.

45. VoIP-Pal is the sole owner and assignee of the entire right, title and interest in the ‘762 Patent, the ‘330 Patent, the ‘002 Patent and the ‘549 Patent and has the right to sue and recover damages for any current or past infringement of the ‘762 Patent, the ‘330 Patent, the ‘002 Patent and the ‘549 Patent.

OVERVIEW OF THE ACCUSED INSTRUMENTALITIES

46. Each of the instrumentalities described herein made, used, sold and/or offered for sale by Defendants comprises systems and devices relating to and supporting communications, including calling and messaging, using devices, computers, servers, systems and methods used by, operated by and performed by Defendants (the “Amazon Alexa Calling and Messaging System”). *See*, e.g., Amazon product description entitled “Alexa Calling & Messaging” (https://www.amazon.com/b?node=16713667011).

47. Amazon Alexa and Alexa For Business devices that support the Amazon Alexa Calling and Messaging System include at least the Amazon Echo, Echo Plus, Echo Dot, Echo

Spot, Echo Show, Echo Connect, Amazon Tap, 4th Generation and later Amazon Fire devices with Alexa support, Android mobile phones and tablets with the Alexa app and software version 5.0 or higher, and Apple iOS mobile phones and tablets with the Alexa app and software version 9.0 or higher (collectively, "Amazon Alexa Calling Devices").

48. The Amazon Alexa Calling and Messaging System allows Amazon Alexa Calling Devices to initiate a call or a voice message between a first participant, and a second participant, using its system. The second participant may be an Amazon Alexa Calling and Messaging System subscriber or a non-subscriber. A profile that includes attributes is used as part of the process that classifies a call or message. On information and belief, Defendants also provide third parties with software development kits (SDK), application programming interface (API), code samples, hardware reference designs and/or other technical information to facilitate the third parties using the Amazon Alexa Calling and Messaging System or integrating Alexa-related technologies into their own network products (e.g., *see* "Alexa Voice Service" and "Alexa-Enabled Product" documentation at https://developer.amazon.com/alexa-voice-service). On information and belief, Defendants promote and license the Amazon Alexa Platform to third parties for use in the third parties' products on terms which support and enhance the Amazon Alexa Calling and Messaging System (e.g., *see* https://developer.amazon.com/support/legal/alexa/alexa-voice-service/terms-and-agreements), leading some third parties to integrate or apply Alexa communication features in their products (e.g., *see* article dated April 21, 2018 entitled "Voice Calls Are Coming to Third-Party Alexa Gadgets" at https://www.tomsguide.com/us/-alexa-gadgets-voice-calls,news-27036.html).

COUNT I

Infringement Of The '762 Patent

(against all Defendants)

49. Paragraphs 1 through 48 are incorporated by reference as if fully stated herein.

50. Defendants, either alone or in conjunction with others, have infringed and continue to infringe, both directly and indirectly, one or more claims of the ‘762 Patent, including at least exemplary claim 1, under 35 U.S.C. § 271, either literally and/or under the doctrine of equivalents, by making, using, offering to sell, selling and/or importing into the United States at least certain methods, apparatuses, products and services used for communication, including, without limitation, the Amazon Alexa Calling and Messaging System, the Amazon Alexa Calling Devices, Amazon Alexa software and/or methods employed thereby (collectively, “the ‘762 Accused Instrumentalities”).

51. For example, Defendants infringe exemplary claim 1 of the ‘762 Patent by making, using, offering to sell, selling and/or importing into the United States at least the ‘762 Accused Instrumentalities, which ‘762 Accused Instrumentalities provide, use and/or comprise a method for routing communications in a system:

- in which a first participant identifier is associated with a first participant registered with the system and wherein a second participant identifier is associated with a second participant (e.g., The Amazon Alexa Calling and Messaging System is a system that allows Amazon Alexa Calling Devices to place calls and send voice and text messages to other users. In order to send communications, the Amazon Alexa Calling Device must be registered), the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising at least one processor operably configured to execute program code stored in at least one memory, the method comprising (e.g., Amazon Alexa Calling and Messaging allows calling and messaging to registered devices anywhere in the world, and to devices on the PSTN within the

United States, Canada and Mexico for voice calls and over SMS to any destination with an associated cellular device. The Amazon Alexa Calling and Messaging system performs a method of routing communications in a system comprising an Amazon Server network. The first participant has a registered and subscribed Amazon Alexa Calling Device. A second participant device may be a registered and subscribed Amazon Alexa Calling Device, or it may be a telephone accessible over the PSTN including cellular devices. Amazon Alexa Calling and Messaging allows Amazon Alexa Calling Devices to make calls and send messages including text, audio, video and images to other users (i.e., second participants). The Amazon Alexa Calling and Messaging System comprises at least one processor, for example, in one or more Amazon Servers, that, on information and belief, are operably configured to execute program code stored in a memory):

- in response to the first participant device initiating the communication to the second participant device, receiving the first participant identifier and the second participant identifier from the first participant device (e.g., a call or message is initiated by the user of the Amazon Alexa Calling Device (i.e., the first participant) entering information identifying the receiver/recipient (i.e., the second participant identifier), which may include an Amazon Alexa Calling Device identifier (ID) or other ID of the second participant, such as a phone number. The Amazon Alexa Calling and Messaging System receives a first participant ID and a second participant ID in response to initiation of a call or message by the first participant device, which is an Amazon Alexa Calling and Messaging subscriber device. The Amazon Alexa Calling and Messaging System may include one or more Amazon Servers, which comprise at least one processor.);

- using the first participant identifier to locate, via the at least one processor, a first participant profile from among a plurality of participant profiles that are stored in a database, the first participant profile comprising one or more attributes associated with the first participant (e.g., one or more Amazon Servers locate(s) a first participant profile using the first participant ID from a database storing a plurality of participant profiles. The first participant profile contains a plurality of attributes associated with the first participant. A profile including attributes includes information used in the classification of a call or message, such as settings stored within the Amazon Alexa Calling and Messaging System, and/or information obtained regarding the connection of the caller device to the network, such as the specific user's Amazon Alexa Calling Device. Other attributes associated with the caller may include the caller's contact list obtained from the caller's Amazon Alexa Calling Device app that is used to initially enable Alexa Calling and Messaging, or the caller's address book as set up by an administrator.);
- processing the second participant identifier, via the at least one processor, based on at least one of the one or more attributes from the first participant profile, to produce a new second participant identifier (e.g., the Amazon Alexa Calling and Messaging System processes the receiver ID via the at least one processor based on at least one of the one or more attributes from the sender profile, to produce a new receiver ID. For example, if the

second participant identifier is the name of the second participant, and the first participant's attributes do not indicate that the second participant is an Amazon Alexa Calling and Messaging System subscriber, then, the new second participant identifier may be a phone number associated with the second participant. Alternatively, if the second participant identifier identifies an Amazon Alexa Calling and Messaging System subscriber, then the new second participant identifier may be the user's internal Amazon Alexa Calling Device identifier. Also, the processing of a new second participant identifier may be based on the second participant's device not being blocked. Another example of the first participant's attributes being used to determine a new second participant identifier may involve the use of the first participant's attributes to interpret the second participant's identifier. For example, if the first participant's attributes indicate that the second participant has an international phone number outside of the US, Canada or Mexico, the new second participant identifier may be processed as a "Blocked Number".);

- classifying the communication, via the at least one processor, using the new second participant identifier, as a first network communication if a first network classification criterion is met and as a second network communication if a second network classification criterion is met (e.g., the Amazon Alexa Calling and Messaging System allows calls to be made and voice and text messages to be sent either within the Amazon Alexa Calling and Messaging System or as a second network communication, for example, using an external network such as the PSTN. The Amazon Alexa Calling and Messaging System classifies the communication with the at least one processor using the new second participant identifier as either an Amazon Alexa Calling and Messaging System call or a second network communication, based on a first network classification criterion or a second network classification criterion. For example, the Amazon Alexa Calling and Messaging System classifies the call using the Amazon Server(s) as a first network communication when the processing to produce the new second participant identifier indicates that at least the second participant device is an Amazon Alexa Calling Device, and classifies it as a PSTN call (i.e., a “second network communication”) when the receiver device is not an Amazon Alexa Calling Device.);

- when the first network classification criterion is met, producing, via the at least one processor, a first network routing message, the first network routing message identifying an address in the system, the address being associated with the second participant device (e.g., when the communication is classified as a first network or system communication, a network routing message is produced, using the at least one processor in the Amazon Alexa Calling and Messaging System, identifying an address in the Amazon Alexa Calling and Messaging System associated with the second participant device.);
- and when the second network classification criterion is met, producing, via the at least one processor, a second network routing message, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system (e.g., when the communication is classified as an second

network or external communication, a second network routing message is produced using the at least one processor in the Amazon Alexa Calling and Messaging System, identifying an address outside of the Amazon Alexa Calling and Messaging System (e.g., a telephone number for the second participant device, or alternatively, an address of a gateway to the PSTN). The identified address outside of the Amazon Alexa Calling and Messaging System is an address associated with a gateway to a network outside of the Amazon Alexa Calling and Messaging System, e.g., the PSTN telephone network. In the case of a voice message to an external device, a cellular phone associated with the first participant is used to send an SMS message containing the transcribed message and a link to the audio message over a cellular network.).

52. On information and belief, Defendants have had knowledge of the ‘762 Patent since at least April 12, 2018 when VoIP-Pal issued a press release announcing the issuance of the ‘762 Patent, and also by written correspondence dated June 11, 2018, identifying and enclosing the Patents-in-Suit.

53. Despite knowledge and notice of the ‘762 Patent and their infringement of that patent, Defendants have continued to make, use, sell and offer to sell the ‘762 Accused Instrumentalities in the United States. Accordingly, Defendants’ infringement has been and continues to be willful.

54. Defendants have induced infringement, and continue to induce infringement, of one or more claims of the ‘762 Patent under 35 U.S.C. § 271(b). Defendants actively, knowingly, and intentionally induced, and continue to actively, knowingly and intentionally induce infringement of the ‘762 Patent by selling or otherwise making available and/or supplying the ‘762 Accused Instrumentalities; with the knowledge and intent that third parties will use the ‘762 Accused

Instrumentalities supplied by Defendants to infringe the ‘762 Patent; and with the knowledge and intent to encourage and facilitate third party infringement through the dissemination or application of the ‘762 Accused Instrumentalities and/or the creation and dissemination of promotional and marketing materials, supporting materials, instructions, product manuals, and/or technical information related to the ‘762 Accused Instrumentalities.

55. Defendants specifically intended and were aware that the ordinary and customary use of the ‘762 Accused Instrumentalities would infringe the ‘762 Patent. For example, Defendants sell, use, make available and provide the ‘762 Accused Instrumentalities, which when used in their ordinary and customary manner intended by Defendants, infringe one or more claims of the ‘762 Patent, including at least exemplary claim 1. Upon information and belief, Defendants further provide product manuals, software development kits (SDK), application programming interfaces (API), code samples, hardware reference designs and other technical information that cause Defendants’ customers and other third parties to use and to operate the ‘762 Accused Instrumentalities for their ordinary and customary use. Defendants’ customers and other third parties have directly infringed the ‘762 Patent, including at least exemplary claim 1, through the normal and customary use of the ‘762 Accused Instrumentalities. By providing instruction and training to customers and other third parties on how to use the ‘762 Accused Instrumentalities in an infringing manner, Defendants specifically intended to induce infringement of the ‘762 Patent, including at least exemplary claim 1. Defendants accordingly have induced and continue to induce Defendants’ customers, third parties and other users of the ‘762 Accused Instrumentalities in their ordinary and customary way to infringe the ‘762 Patent, knowing, or at least being willfully blind to the fact, that such use constitutes infringement of the ‘762 Patent.

56. VoIP-Pal has been and continues to be damaged by Defendants’ infringement of the ‘762 Patent.

57. Defendants’ conduct in infringing the ‘762 Patent renders this case exceptional

within the meaning of 35 U.S.C. § 285.

COUNT II

Infringement Of The '330 Patent

(against all Defendants)

58. Paragraphs 1 through 57 are incorporated by reference as if fully stated herein.

59. Defendants, either alone or in conjunction with others, have infringed and continue to infringe, both directly and indirectly, one or more claims of the '330 Patent, including at least exemplary claim 1, under 35 U.S.C. § 271, either literally and/or under the doctrine of equivalents, by making, using, offering to sell, selling and/or importing into the United States at least certain methods, apparatuses, products and services used for communication, including, without limitation, the Amazon Alexa Calling and Messaging System, the Amazon Alexa Calling Devices, Amazon Alexa software and/or methods employed thereby (collectively, "the '330 Accused Instrumentalities").

60. For example, Defendants infringe exemplary claim 1 of the '330 Patent by making, using, offering to sell, selling and/or importing into the United States at least the '330 Accused Instrumentalities, which '330 Accused Instrumentalities comprise a method for routing a communication in a 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 (e.g., The Amazon Alexa Calling and Messaging System comprises at least one or more Amazon Servers. The Amazon Alexa Calling and Messaging System allows Amazon Alexa Calling Devices to place audio and video calls and to send voice and text messages to other Amazon Alexa Calling Devices and to other users. The Amazon Alexa Calling and Messaging System performs a method of routing communications in a communication system comprising the Amazon Server(s). A first participant device is connected to the Internet and associated with a first participant. A second participant device is associated with a second participant.):

- 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 (e.g., a call or message is initiated by the user of the Amazon Alexa Calling Device (i.e., the first participant) entering information identifying the receiver (i.e., the second participant identifier), which may include an Amazon Alexa Calling Device identifier (ID) or other ID of the second participant, such as the phone number. The Amazon Alexa Calling and Messaging System receives a first participant ID and a second participant ID over an IP network in response to initiation of the call or message by the first participant device, which is an Amazon Alexa Calling and Messaging subscriber device. The Amazon Alexa Calling and Messaging System comprises one or more Amazon Servers, constituting a controller, which comprise at least one processor.);
- 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 (e.g., one or more Amazon Servers locate(s) a first participant profile using the first participant ID from a database storing user profiles. The first participant profile contains a plurality of attributes

associated with the first participant. A profile including attributes includes information used in the classification of a call or message, such as settings stored within the Amazon Alexa Calling and Messaging System, and/or information obtained regarding the connection of the caller device to the network, such as the specific user's Amazon Alexa Calling Device. Other attributes associated with the caller may include the caller's contact list obtained from the caller's Amazon Alexa Calling Device app that is used to initially enable Alexa Calling and Messaging, or the caller's address book as set up by an administrator.);

- 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 (e.g., the Amazon Alexa Calling and Messaging System compares at least one of the attributes of the sender profile, for example, the first participant's contact list contents (which it has access to) or the first participant's address book, to at least a portion of the second participant identifier, for example, a name that represents the second participant identifier.);
- causing the at least one processor to access the at least one database to search for a user profile for the second participant (e.g., a database of Amazon Alexa Calling and Messaging System subscribers is searched to determine whether or not the second participant is a subscriber having a user profile in the system.);
- classifying the communication, based on the comparing, as a system communication or an external network communication, using the at least one processor (e.g., the Amazon Alexa Calling and Messaging System

classifies the communication using the at least one processor, based on the comparing step, as either an Amazon Alexa Calling and Messaging System communication or a PSTN communication.);

- 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 (e.g., if the communication is classified as a system communication, a network routing message is produced, using the at least one processor, identifying an address in the Amazon Alexa Calling and Messaging System associated with the second participant's device. Unless otherwise blocked, the system routing message causes the Amazon Alexa Calling and Messaging System to establish a communication to the second participant device. In the case of a call, the second participant device is notified of an incoming call. In the case of a voice message, the second participant device is notified of a message.); 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 (e.g., if the communication is classified as an external communication, an external

> network routing message is produced that identifies an Internet address associated with a gateway to the PSTN. Unless otherwise blocked, the system routing message causes the Amazon Alexa Calling and Messaging System to determine a gateway to the PSTN and to establish a communication to the second participant device. In the case of a voice message to an external device, a cellular phone associated with the first participant is used to send an SMS message containing the transcribed message and a link to the audio message over a cellular network.).

61. On information and belief, Defendants have had knowledge of the ‘330 Patent since at least April 12, 2018 when VoIP-Pal issued a press release announcing the issuance of the ‘330 Patent, and also by written correspondence dated June 11, 2018, identifying and enclosing the Patents-in-Suit.

62. Despite its knowledge and notice of the ‘330 Patent and its infringement of that patent, Defendants have continued to make, use, sell and offer to sell the ‘330 Accused Instrumentalities in the United States. Accordingly, Defendants’ infringement has been and continues to be willful.

63. Defendants have induced infringement, and continue to induce infringement, of one or more claims of the ‘330 Patent under 35 U.S.C. § 271(b). Defendants actively, knowingly, and intentionally induced, and continue to actively, knowingly and intentionally induce infringement of the ‘330 Patent by selling or otherwise making available and/or supplying the ‘330 Accused Instrumentalities; with the knowledge and intent that third parties will use the ‘330 Accused Instrumentalities supplied by Defendants to infringe the ‘330 Patent; and with the knowledge and intent to encourage and facilitate third party infringement through the dissemination or application of the ‘330 Accused Instrumentalities and/or the creation and dissemination of promotional and marketing materials, supporting materials, instructions, product manuals, and/or technical

information related to the ‘330 Accused Instrumentalities.

64. Defendants specifically intended and were aware that the ordinary and customary use of the ‘330 Accused Instrumentalities would infringe the ‘330 Patent. For example, Defendants sell, use, make available and provide the ‘330 Accused Instrumentalities, which when used in their ordinary and customary manner intended by Defendants, infringe one or more claims of the ‘330 Patent, including at least exemplary claim 1. Upon information and belief, Defendants further provide product manuals, software development kits (SDK), application programming interfaces (API), code samples, hardware reference designs and other technical information that cause Defendants’ customers and other third parties to use and to operate the ‘330 Accused Instrumentalities for their ordinary and customary use. Defendants’ customers and other third parties have directly infringed the ‘330 Patent, including at least exemplary claim 1, through the normal and customary use of the ‘330 Accused Instrumentalities. By providing instruction and training to customers and other third parties on how to use the ‘330 Accused Instrumentalities in an infringing manner, Defendants specifically intended to induce infringement of the ‘330 Patent, including at least exemplary claim 1. Defendants accordingly have induced and continue to induce Defendants’ customers, third parties and other users of the ‘330 Accused Instrumentalities in their ordinary and customary way to infringe the ‘330 Patent, knowing, or at least being willfully blind to the fact, that such use constitutes infringement of the ‘330 Patent.

65. VoIP-Pal has been and continues to be damaged by Defendants’ infringement of the ‘330 Patent.

66. Defendants’ conduct in infringing the ‘330 Patent renders this case exceptional within the meaning of 35 U.S.C. § 285.

COUNT III

Infringement Of The ‘002 Patent

(against all Defendants)

67. Paragraphs 1 through 66 are incorporated by reference as if fully stated herein.

68. Defendants, either alone or in conjunction with others, have infringed and continue to infringe, both directly and indirectly, one or more claims of the ‘002 Patent, including at least exemplary claim 1, under 35 U.S.C. § 271, either literally and/or under the doctrine of equivalents, by making, using, offering to sell, selling and/or importing into the United States at least certain methods, apparatuses, products and services used for communication, including, without limitation, the Amazon Alexa Calling and Messaging System, Amazon Alexa Calling Devices, Amazon Alexa software and/or methods employed thereby (collectively, “the ‘002 Accused Instrumentalities”).

69. For example, Defendants infringe exemplary claim 1 of the ‘002 Patent by making, using, offering to sell, selling and/or importing into the United States at least the ‘002 Accused Instrumentalities, which ‘002 Accused Instrumentalities comprise a method for routing a communication in a 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 (e.g., The Amazon Alexa Calling and Messaging System is a system that allows Amazon Alexa Calling Devices to place calls and send voice and text messages to other users. Amazon Alexa Calling and Messaging allows calling and messaging to registered devices anywhere in the world, and to devices on the PSTN within the United States, Canada and Mexico for voice calls and over SMS to any destination with an associated cellular device. The Amazon Alexa Calling and Messaging system performs a method of routing communications in a system comprising an Amazon Server network. The first participant has a registered and subscribed Amazon Alexa Calling Device. A second participant device may be a registered and subscribed Amazon Alexa Calling Device, or it may be a telephone accessible over the PSTN including cellular devices. Amazon Alexa Calling and Messaging allows Amazon Alexa Calling Devices to make calls and send messages including text, audio, video and images to other users (i.e., second participants).):

- 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 second participant identifier being associated with the second participant device (e.g., A call or message is initiated by the user of the Amazon Alexa Calling Device (i.e., the first participant) entering information identifying the receiver (i.e., the second participant identifier), which may include an Amazon Alexa Calling Device identifier (ID) or other ID of the second participant, such as a phone number. The Amazon Alexa Calling and Messaging System receives a first participant ID and a second participant ID over an IP network in response to initiation of a call or message by the first participant device, which is an Amazon Alexa Calling and Messaging subscriber device. The Amazon Alexa Calling and Messaging System may include one or more Amazon Servers, constituting a controller comprising at least one processor.);
- causing the at least one processor to access a database comprising user profiles, using the first participant identifier, each user profile associating a respective plurality of attributes with a respective user, to locate a plurality of first participant attributes (e.g., One or more Amazon Servers locate(s) a first participant profile, using the first participant ID, from a database

storing user profiles. The first participant profile associates a plurality of attributes with the first participant. The profile includes information used in the classification of a call or message, such as settings stored within the Amazon Alexa Calling and Messaging System, and/or information obtained regarding the connection of the caller device to the network, such as the specific user's Amazon Alexa Calling Device. Other attributes associated with the caller may include the caller's contact list obtained from the caller's Amazon Alexa Calling Device app that is used to initially enable Alexa Calling and Messaging, or the caller's address book as set up by an administrator.);

- processing the second participant identifier, using the at least one processor, based on at least one of the plurality of first participant attributes obtained from a user profile for the first participant, to produce a new second participant identifier (e.g., The Amazon Alexa Calling and Messaging System processes the receiver ID, using the at least one processor, based on at least one of the one or more attributes from the caller/sender profile, to produce a new receiver ID. For example, if the second participant identifier is the name of the second participant, and the first participant's attributes do not indicate that the second participant is an Amazon Alexa Calling and Messaging System subscriber, then, the new second participant identifier may be the second participant's phone number. Alternatively, if the second participant identifier identifies an Amazon Alexa Calling and Messaging System subscriber, then the new second participant identifier may be the user's internal Amazon Alexa Calling Device identifier. Also, the processing of a new second participant identifier may be based on access to the second participant's device not being blocked. Another example of the first participant's attributes being used to determine a new second participant identifier may involve the use of the first participant's attributes to interpret the second participant's identifier. For example, if the first participant's attributes indicate that the second participant has an international phone number outside of the US, Canada or Mexico, the new second participant identifier may be processed as a "Blocked Number". Additionally, in the case of a voice message to the PSTN, if there is no associated cellular device configured to send SMS messages, the sending of the message will fail.);

- classifying the communication, based on the new second participant identifier, as a system communication or an external network communication, using the at least one processor (e.g., The Amazon Alexa Calling and Messaging System allows calls to be made and voice messages to be sent either within the Amazon Alexa Calling and Messaging System or as an external network communication. The Amazon Alexa Calling and Messaging System classifies the communication, using the at least one processor, based on the new second participant identifier as either an Amazon Alexa Calling and Messaging System call or an external network communication. The Amazon Alexa Calling and Messaging System classifies the call using the Amazon Server(s) as a system communication, such as when the processing to produce the new second participant identifier indicates that at least the second participant device is an Amazon Alexa Calling Device, or classifies it as an external network communication (e.g., PSTN call), such as when the processing to produce the new second participant identifier indicates that the second participant device is not an Amazon Alexa Calling Device.);

- when the communication is classified as a system communication, producing a system routing message identifying an Internet address associated with the second participant device, using the at least one processor, wherein the system routing message causes the communication to be established to the second participant device (e.g., when the communication is classified as a system communication, a network routing message is produced, using at least one processor in one or more Amazon Server(s) of the Amazon Alexa Calling and Messaging System, identifying an address in the Amazon Alexa Calling and Messaging System associated with the second participant device. In the case of a call, the second participant device is notified of an incoming call. In the case of a voice message, the second participant device is notified of a message.); 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 (e.g., when the communication is classified as an external communication, an external network routing message is produced, using the at least one processor in the Amazon Alexa Calling and Messaging System, identifying an address outside of the Amazon Alexa Calling and Messaging System (e.g., a telephone number for the second participant device, or alternatively, an

address of a gateway to the PSTN). The identified address outside of the Amazon Alexa Calling and Messaging System is an address associated with a gateway to a network outside of the Amazon Alexa Calling and Messaging System, e.g., the PSTN telephone network. In the case of a voice or audio message to an external device, a cellular phone associated with the first participant is used to send an SMS message containing the transcribed message and a link to the voice or audio message, over a cellular network.).

70. On information and belief, Defendants have had knowledge of the ‘002 Patent since at least April 12, 2018 when VoIP-Pal issued a press release announcing the issuance of the ‘002 Patent, and also by written correspondence dated June 11, 2018, identifying and enclosing the Patents-in-Suit.

71. Despite its knowledge and notice of the ‘002 Patent and its infringement of that patent, Defendants have continued to make, use, sell and offer to sell the ‘002 Accused Instrumentalities in the United States. Accordingly, Defendants’ infringement has been and continues to be willful.

72. Defendants have induced infringement, and continue to induce infringement, of one or more claims of the ‘002 Patent under 35 U.S.C. § 271(b). Defendants actively, knowingly, and intentionally induced, and continue to actively, knowingly and intentionally induce infringement of the ‘002 Patent by selling or otherwise making available and/or supplying the ‘002 Accused Instrumentalities; with the knowledge and intent that third parties will use the ‘002 Accused Instrumentalities supplied by Defendants to infringe the ‘002 Patent; and with the knowledge and intent to encourage and facilitate third party infringement through the dissemination or application of the ‘002 Accused Instrumentalities and/or the creation and dissemination of promotional and marketing materials, supporting materials, instructions, product manuals, and/or technical

information related to the ‘002 Accused Instrumentalities.

73. Defendants specifically intended and were aware that the ordinary and customary use of the ‘002 Accused Instrumentalities would infringe the ‘002 Patent. For example, Defendants sell, use, make available and provide the ‘002 Accused Instrumentalities, which when used in their ordinary and customary manner intended by Defendants, infringe one or more claims of the ‘002 Patent, including at least exemplary claim 1. Upon information and belief, Defendants further provide product manuals, software development kits (SDK), application programming interfaces (API), code samples, hardware reference designs and other technical information that cause Defendants' customers and other third parties to use and to operate the ‘002 Accused Instrumentalities for their ordinary and customary use. Defendants' customers and other third parties have directly infringed the ‘002 Patent, including at least exemplary claim 1, through the normal and customary use of the ‘002 Accused Instrumentalities. By providing instruction and training to customers and other third parties on how to use the ‘002 Accused Instrumentalities in an infringing manner, Defendants specifically intended to induce infringement of the ‘002 Patent, including at least exemplary claim 1. Defendants accordingly have induced and continue to induce Defendants' customers, third parties and other users of the ‘002 Accused Instrumentalities in their ordinary and customary way to infringe the ‘002 Patent, knowing, or at least being willfully blind to the fact, that such use constitutes infringement of the ‘002 Patent.

74. VoIP-Pal has been and continues to be damaged by Defendants' infringement of the ‘002 Patent.

75. Defendants' conduct in infringing the ‘002 Patent renders this case exceptional within the meaning of 35 U.S.C. § 285.

COUNT IV

Infringement Of The ‘549 Patent

(against all Defendants)

76. Paragraphs 1 through 75 are incorporated by reference as if fully stated herein.

77. Defendants, either alone or in conjunction with others, have infringed and continue to infringe, both directly and indirectly, one or more claims of the ‘549 Patent, including at least exemplary claim 1, under 35 U.S.C. § 271, either literally and/or under the doctrine of equivalents, by making, using, offering to sell, selling and/or importing into the United States at least certain methods, apparatuses, products and services used for communication, including, without limitation, the Amazon Alexa Calling and Messaging System, Amazon Alexa Calling Devices, Amazon Alexa software and/or methods employed thereby (collectively, “the ‘549 Accused Instrumentalities”).

78. For example, Defendants infringe exemplary claim 1 of the ‘549 Patent by making, using, offering to sell, selling and/or importing into the United States at least the ‘549 Accused Instrumentalities, which ‘549 Accused Instrumentalities comprise a method for routing a communication in a 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 (e.g., The Amazon Alexa Calling and Messaging System is a system that allows Amazon Alexa Calling Devices to place calls and send voice and text messages to other users. Amazon Alexa Calling and Messaging allows calling and messaging to registered devices anywhere in the world, and to devices on the PSTN within the United States, Canada and Mexico for voice calls and over SMS to any destination with an associated cellular device. The Amazon Alexa Calling and Messaging system performs a method of routing communications in a system comprising the Amazon Server network. The first participant may be a registered and subscribed Amazon Alexa Calling Device. A second participant device may be a registered and subscribed Amazon Alexa Calling Device, or it may be a telephone accessible over the PSTN including cellular devices. Amazon Alexa Calling and Messaging allows Amazon Alexa Calling Devices to make calls and send messages including text, audio, video and images to other users (i.e., second participants).):

- causing at least one processor to access at least one memory storing a first participant profile identifying at least one first participant attribute (e.g., one or more Amazon Servers access at least one memory storing a first participant profile. The first participant profile identifies at least one first participant attribute. A first participant profile or attribute includes information used in processing the second participant identifier or in the classification of a call or message, such as settings stored within the Amazon Alexa Calling and Messaging System, and/or information obtained regarding the connection of the caller device to the network, such as the specific user's Amazon Alexa Calling Device. Other attributes associated with the caller may include the caller's contact list obtained from the caller's Amazon Alexa Calling Device app that is used to initially enable Alexa Calling and Messaging, or the caller's address book as set up by an administrator.);
- receiving, by the at least one processor, a second participant identifier inputted by the first participant using the first participant device to initiate a communication, the second participant identifier being associated with the second participant device (e.g., The Amazon Alexa Calling and Messaging System receives a second participant ID upon initiation of a call or message by the first participant device, which is an Amazon Alexa Calling and

Messaging subscriber device. The second participant identifier is associated with the called party's device.);

- processing the second participant identifier, based on the at least one first participant attribute obtained from the first participant profile, to produce a new second participant identifier (e.g., The Amazon Alexa Calling and Messaging System processes the second participant ID based on at least one attribute from the caller/sender profile, to produce a new receiver/recipient ID. For example, if the second participant identifier is the name of the second participant, and processing of the second participant identifier based on the first participant's attributes indicates that the second participant is not an Amazon Alexa Calling and Messaging System subscriber, then, the new second participant identifier will be its phone number. Alternatively, if processing of the second participant identifier identifies an Amazon Alexa Calling and Messaging System subscriber, then the new second participant identifier may be the user's internal Amazon Alexa Calling Device identifier. Also, the processing of a new second participant identifier may be based on the second participant's device not being blocked. Another example of the first participant's attributes being used to determine a new second participant identifier may involve the use of the first participant's attributes to interpret the second participant's identifier. For example, if processing based on a first participant attribute indicates that the second participant has an international phone number outside of the US, Canada or Mexico, the new second participant identifier may be processed as a "Blocked Number". Additionally, in the case of a voice message to the PSTN, if there is no associated cellular device configured to send SMS messages, the sending of the message will fail.);

- classifying the communication as a system communication or an external network communication (e.g., The Amazon Alexa Calling and Messaging System allows calls to be made and voice messages to be sent within the Amazon Alexa Calling and Messaging System or as an external network communication. The Amazon Alexa Calling and Messaging System classifies the communication as an Amazon Alexa Calling and Messaging System call or an external network communication. For example, the Amazon Alexa Calling and Messaging System classifies the call using the Amazon Server(s) as a system communication when the second participant device is an Amazon Alexa Calling Device, and classifies it as a PSTN call (i.e., an "external network communication") when the receiver/recipient device is not an Amazon Alexa Calling Device.);
- when the communication is classified as a system communication, producing a system routing message, based on the new second participant identifier, that identifies an Internet Protocol (IP) address of a network element through which the communication is to be routed thereby causing the communication to be established to the second participant device (e.g., when the communication is classified as a system communication, a system routing message is produced identifying an IP address of a network element in the Amazon Alexa Calling and Messaging System through which routing occurs to the second participant device. In the case of a call, the second participant device is notified of an incoming call. In the case of a voice message, the second participant device is notified of a message.); and

- when the communication is classified as an external network communication, producing an external network routing message, based on the new second participant identifier, that identifies an address associated with a gateway to an external network thereby causing the communication to the second participant device to be established by use of the gateway to the external network (e.g., when the communication is classified as an external network communication, an external network routing message is produced identifying an address outside of the Amazon Alexa Calling and Messaging System (e.g., a telephone number for the second participant device, or alternatively, an address of a gateway to the PSTN). The identified address outside of the Amazon Alexa Calling and Messaging System is an address associated with a gateway to a network outside of the Amazon Alexa Calling and Messaging System, e.g., the PSTN telephone network. In the case of a voice message to an external device, a cellular phone associated with the first participant is used to send an SMS message containing the transcribed message and a link to the audio message over a cellular network.).

79. On information and belief, Defendants have had knowledge of the ‘549 Patent since at least April 12, 2018 when VoIP-Pal issued a press release announcing the forthcoming issuance of the ‘549 Patent, and also by written correspondence dated June 11, 2018, identifying and enclosing the Patents-in-Suit.

80. Despite its knowledge and notice of the ‘549 Patent and its infringement of that patent, Defendants have continued to make, use, sell and offer to sell the ‘549 Accused Instrumentalities in the United States. Accordingly, Defendants’ infringement has been and continues to be willful.

81. Defendants have induced infringement, and continue to induce infringement, of one or more claims of the ‘549 Patent under 35 U.S.C. § 271(b). Defendants actively, knowingly, and intentionally induced, and continue to actively, knowingly and intentionally induce infringement of the ‘549 Patent by selling or otherwise making available and/or supplying the ‘549 Accused Instrumentalities; with the knowledge and intent that third parties will use the ‘549 Accused Instrumentalities supplied by Defendants to infringe the ‘549 Patent; and with the knowledge and intent to encourage and facilitate third party infringement through the dissemination or application of the ‘549 Accused Instrumentalities and/or the creation and dissemination of promotional and marketing materials, supporting materials, instructions, product manuals, and/or technical information related to the ‘549 Accused Instrumentalities.

82. Defendants specifically intended and were aware that the ordinary and customary use of the ‘549 Accused Instrumentalities would infringe the ‘549 Patent. For example, Defendants sell, use, make available and provide the ‘549 Accused Instrumentalities, which when used in their ordinary and customary manner intended by Defendants, infringe one or more claims of the ‘549 Patent, including at least exemplary claim 1. Upon information and belief, Defendants further provide product manuals, software development kits (SDK), application programming interfaces (API), code samples, hardware reference designs and other technical information that cause Defendants’ customers and other third parties to use and to operate the ‘549 Accused Instrumentalities for their ordinary and customary use. Defendants’ customers and other third parties have directly infringed the ‘549 Patent, including at least exemplary claim 1, through the normal and customary use of the ‘549 Accused Instrumentalities. By providing instruction and training to customers and other third parties on how to use the ‘549 Accused Instrumentalities in an infringing manner, Defendants specifically intended to induce infringement of the ‘549 Patent, including at least exemplary claim 1. Defendants accordingly have induced and continue to induce Defendants’ customers, third parties and other users of the ‘549 Accused Instrumentalities in their

ordinary and customary way to infringe the ‘549 Patent, knowing, or at least being willfully blind to the fact, that such use constitutes infringement of the ‘549 Patent.

83. VoIP-Pal has been and continues to be damaged by Defendants’ infringement of the ‘549 Patent.

84. Defendants’ conduct in infringing the ‘549 Patent renders this case exceptional within the meaning of 35 U.S.C. § 285.

PRAYER FOR RELIEF

85. WHEREFORE, VoIP-Pal respectfully requests that this Court enter judgment against Defendants as follows:

A. That Defendants have infringed the Patents-In-Suit;

B. That VoIP-Pal be awarded damages adequate to compensate VoIP-Pal for Defendants’ past infringement and any continuing and future infringement up until the date such judgment is entered, including pre- and post-judgment interests, costs, disbursements as justified under 35 U.S.C. § 284;

C. That any award of damages be enhanced under 35 U.S.C. § 284 as a result of Defendants’ willful infringement;

D. That this case be declared an exceptional case within the meaning of 35 U.S.C. § 285 and that VoIP-Pal be awarded reasonable attorney fees;

E. A judgment requiring that VoIP-Pal be awarded a compulsory ongoing licensing fee or reasonable royalty; and

F. That VoIP-Pal be awarded such other and further relief at law or equity as this Court deems just and proper.

DEMAND FOR JURY TRIAL

Plaintiff VoIP-Pal demands a trial by jury on all claims and issues so triable.

[NO TEXT ON THIS PAGE]

New York, New York
May 17, 2019

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the above and foregoing PLAINTIFF VOIP-PAL'S FIRST AMENDED COMPLAINT has been served on May 17, 2019, to all counsel for Defendant through the Court's CM/ECF system.

/s/ Kevin N. Malek

EXHIBIT 1

US009537762B2

(12) **United States Patent**
Perreault et al.

(10) **Patent No.: US 9,537,762 B2**
(45) **Date of Patent: Jan. 3, 2017**

(54) **PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS**

(71) Applicant: **DIGIFONICA (INTERNATIONAL) LIMITED**, Vancouver (CA)

(72) Inventors: **Clay Perreault**, Panama (PA); **Steve Nicholson**, Hamilton (NZ); **Rod Thomson**, North Vancouver (CA); **Johan Emil Viktor Björsell**, Vancouver (CA); **Fuad Arafa**, Vancouver (CA)

(73) Assignee: **VOIP-PAL.COM, INC.**, Bellevue, WA (US)

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

(21) Appl. No.: **14/877,570**

(22) Filed: **Oct. 7, 2015**

(65) **Prior Publication Data**

US 2016/0028619 A1 Jan. 28, 2016

Related U.S. Application Data

(63) Continuation of application No. 13/966,096, filed on Aug. 13, 2013, now Pat. No. 9,179,005, which is a

(Continued)

(51) **Int. Cl.**

H04M 7/00	(2006.01)
H04L 12/725	(2013.01)

(Continued)

(52) **U.S. Cl.**
CPC ***H04L 45/3065*** (2013.01); ***A61K 39/39558*** (2013.01); ***A61K 45/06*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04L 45/3065; H04L 45/93226; H04L 12/14; H04L 12/1439; A61K 39/39558; A61K 45/06; C07K 16/18; H04M 3/4221; H04M 7/0075; H04M 15/51; H04M 15/56
See application file for complete search history.

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Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc., Petitioner* v. *VoIP-Pal.com Inc.*, Patent Owner; Case No. TBD, U.S. Pat. No. 9,179,005; Petition for Inter Partes Review of U.S. Pat. No. 9,179,005; Dated Jun. 15, 2016. 70 sheets.

(Continued)

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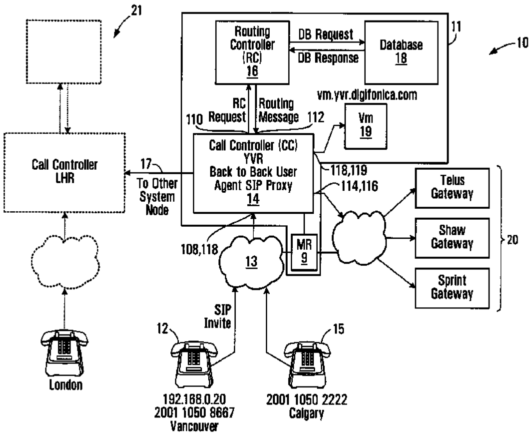
(57) **ABSTRACT**

A process and apparatus to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated is disclosed. In response to initiation of a call by a calling subscriber, a caller identifier and a callee identifier are received. Call classification criteria associated with the caller identifier are used to classify the call as a public network call or a private network call. A routing message identifying an address, on the private network, associated with the callee is produced when the call is classified as a private network call and a routing message identifying a

(Continued)



gateway to the public network is produced when the call is classified as a public network call.

45 Claims, 32 Drawing Sheets

Related U.S. Application Data

continuation of application No. 12/513,147, filed as application No. PCT/CA2007/001956 on Nov. 1, 2007, now Pat. No. 8,542,815.

(60) Provisional application No. 60/856,212, filed on Nov. 2, 2006.

(51) **Int. Cl.**

H04L 9/32	(2006.01)
H04L 12/14	(2006.01)
H04L 12/66	(2006.01)
H04Q 3/66	(2006.01)
H04Q 3/70	(2006.01)
H04M 15/00	(2006.01)
H04M 3/42	(2006.01)
A61K 39/395	(2006.01)
A61K 45/06	(2006.01)
C07K 16/18	(2006.01)

(52) **U.S. Cl.**

CPC ***C07K 16/18*** (2013.01); ***H04L 9/3226*** (2013.01); ***H04L 12/14*** (2013.01); ***H04L 12/1439*** (2013.01); ***H04L 12/1496*** (2013.01); ***H04L 12/66*** (2013.01); ***H04M 3/4211*** (2013.01); ***H04M 7/0075*** (2013.01); ***H04M 15/51*** (2013.01); ***H04M 15/56*** (2013.01); ***H04M 15/8083*** (2013.01); ***H04M 15/8228*** (2013.01); ***H04M 15/887*** (2013.01); ***H04M 15/888*** (2013.01); ***H04Q 3/66*** (2013.01); ***H04Q 3/70*** (2013.01); *H04Q 2213/1322* (2013.01); *H04Q 2213/13091* (2013.01); *H04Q 2213/13141* (2013.01); *H04Q 2213/13196* (2013.01); *H04Q 2213/13384* (2013.01)

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Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *VoIP-Pal.com, Inc., a Nevada corporation*, Plaintiff, v. *Apple, Inc., a California corporation*; Defendants; Case No: 2:16-CV-00260; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Chart 1 to Exhibit D; Chart 2 to Exhibit D; Chart 3 to Exhibit D; Chart 4 to Exhibit D; Exhibit E; Exhibit F; and Addendum 1 to Exhibit F.

Letter dated Nov. 30, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Apple Inc. in the U.S.

Letter dated Dec. 1, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Verizon Communications in the U.S.

Letters dated Dec. 18, 2015, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Airtel in India; Alcatel-Lucent in France; Avaya Inc. in the U.S.; AT&T in the U.S.; Blackberry in Canada; Cable One in the U.S.; CenturyLink in the U.S.; Charter Communications in the U.S.; Cisco Systems in the U.S.; Comcast in the U.S.; Cox Communications in the U.S.; Cricket Wireless in the U.S.; Facebook in the U.S.; Freedom Pop in the U.S.; Frontier Communications in the U.S.; Google Inc. in the U.S.; HP in the U.S.; Juniper Networks in the U.S.; LoopPay, Inc. in the U.S.; Magic Jack in the U.S.; MetroPCS in the U.S.; Ooma in the U.S.; PayPal in the U.S.; Republic Wireless in the U.S.; Rok Mobile in the U.S.; Samsung Electronics—America in the U.S.; ShoreTel, Inc. in the U.S.; Siemens in Germany; Skype USA in the U.S.; Sprint in the U.S.; Square Cash in the U.S.; Suddenlink Communications in the U.S.; Talktone in the U.S.; Tango in the U.S.; Time Warner Cable in the U.S.; T-Mobile in the U.S.; Twitter in the U.S.; US Cellular in the U.S.; Venmo in the U.S.; Virgin Mobile USA in the U.S.; Vodafone in the UK; and Vonage in the U.S.

Letters dated Jan. 4, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Rogers Communications Inc. in Canada; Shaw Cable in Canada; Walmart in Alaska; and WIND Mobile in Canada.

Letters dated Jan. 21, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Alibaba (China) Co., Ltd in China; Comwave Telecommunications in Canada; and Intel in the U.S.

Letters dated Feb. 2, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Netflix Inc. in the U.S.; Skype Technologies in the U.S.; and WhatsApp Inc. in the U.S.

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Indonesian Examination Report dated Feb. 8, 2013 for Indonesian Application No. W-00200901165.
Mexican Exam Report dated Jul. 11, 2011 for Mexican Application No. MX/a/2009/004811.
Mexican Notice of Allowance dated Sep. 2, 2011 for Mexican Application No. MX/a/2009/005751.
First Examination Report dated Dec. 9, 2015, India Patent Application No. 1047/MUMNP/2009.
Decision: Denying Institution of Inter Partes Review, 37 C.F.R. § 42.108, United States Patent and Trademark Office, Before the Patent Trial and Appeal Board, *Unified Patents Inc.*, Petitioner v. *Voip-Pal.Com Inc.*, Patent Owner, Case IPR2016-01082, U.S. Pat. No. 8,542,815 B2, Paper 8, Entered: Nov. 18, 2016.
Decision: Institution of Inter Partes Review, 37 C.F.R. § 42.108, United States Patent and Trademark Office, Before the Patent Trial and Appeal Board, *Apple Inc.*, Petitioner v. *Voip-Pal.Com Inc.*, Patent Owner, Case IPR2016-01201, U.S. Pat. No. 8,542,815 B2, Paper 6, Entered: Nov. 21, 2016.
Decision: Institution of Inter Partes Review, 37 C.F.R. § 42.108, United States Patent and Trademark Office, Before the Patent Trial and Appeal Board, *Apple Inc.*, Petitioner v. *Voip-Pal.Com Inc.*, Patent Owner, Case IPR2016-01198, U.S. Pat. No. 9,179,005 B2, Paper 6, Entered: Nov. 21, 2016.
Scheduling Order: United States Patent and Trademark Office, Before the Patent Trial and Appeal Board, *Apple Inc.*, Petitioner v. *Voip-Pal.Com Inc.*, Patent Owner, Cases IPR2016-01201, IPR2016-01198, U.S. Pat. No. 8,542,815 B2, U.S. Pat. No. 9,179,005 B2, Paper 7, Entered: Nov. 21, 2016.

* cited by examiner

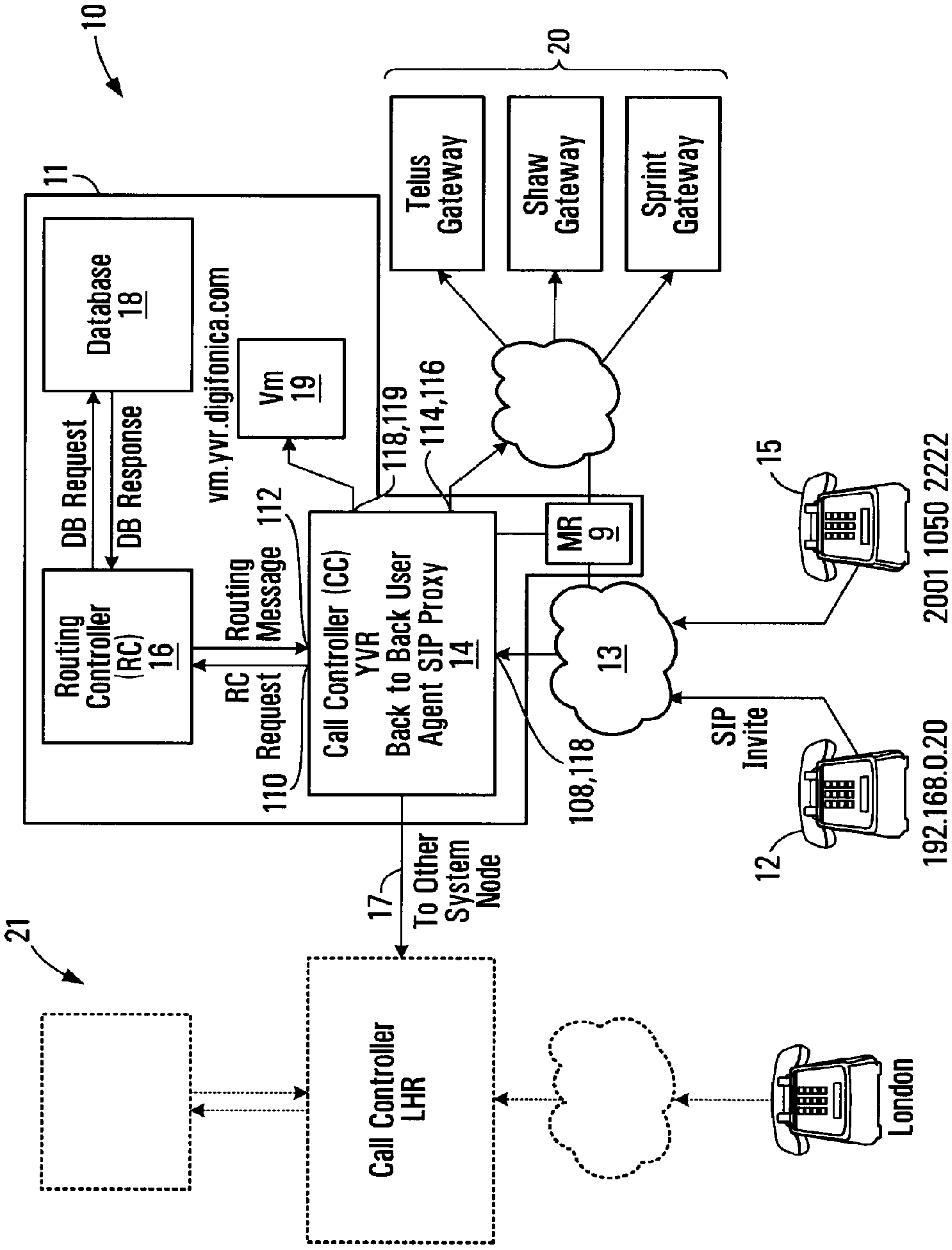

10
11
Database
18
DB Request
DB Response
Routing
Controller
(RC)
16
vm.yvr.digifonica.com
Vm
19
Routing
Message
112
RC
Request
110
Call Controller (CC)
YVR
Back to Back User
Agent SIP Proxy
14
118,119
114,116
MR
9
108,118
13
20
Telus
Gateway
Shaw
Gateway
Sprint
Gateway
15
2001 1050 2222
Calgary
SIP
Invite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

FIG. 1

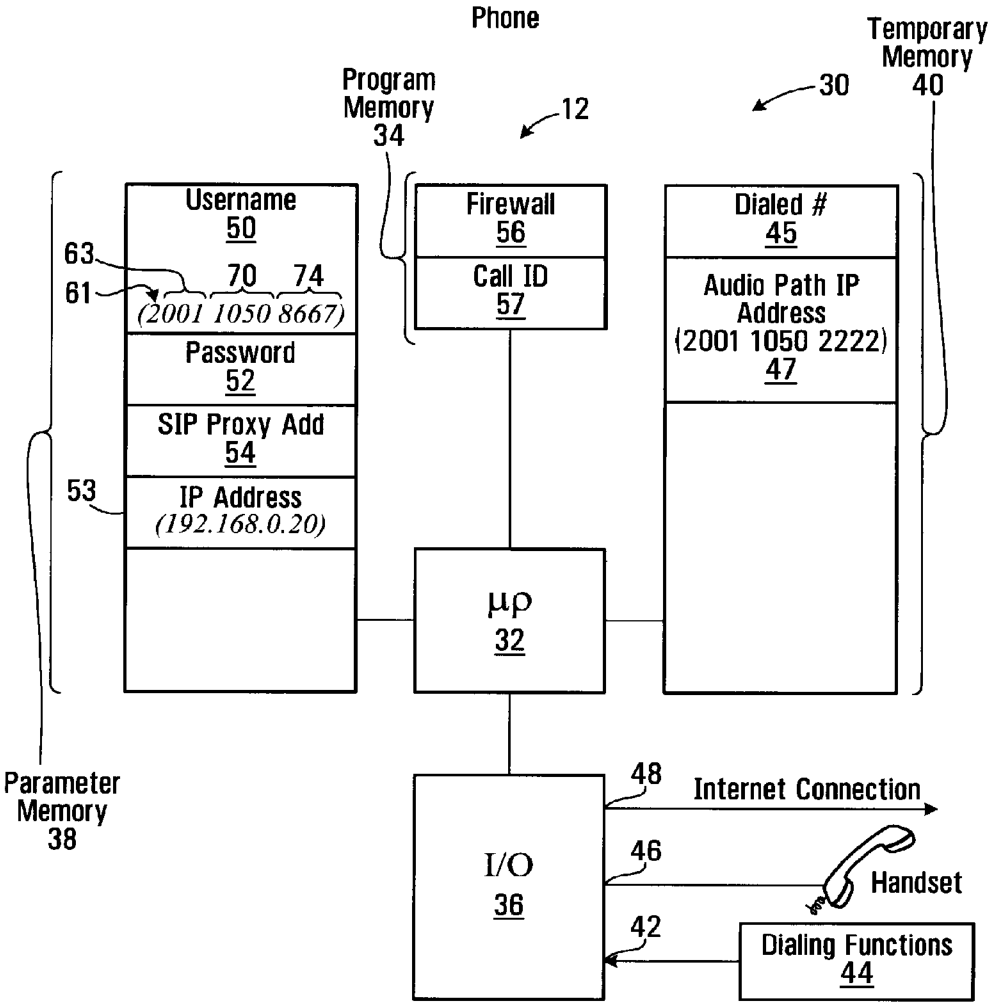

Phone
Program Memory 34
12
30
Temporary Memory 40
Username 50
63
61
70
74
(2001 1050 8667)
Password 52
SIP Proxy Add 54
53
IP Address (192.168.0.20)
Firewall 56
Call ID 57
Dialed # 45
Audio Path IP Address (2001 1050 2222) 47
μp 32
Parameter Memory 38
I/O 36
48
Internet Connection
46
Handset
42
Dialing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

FIG. 2

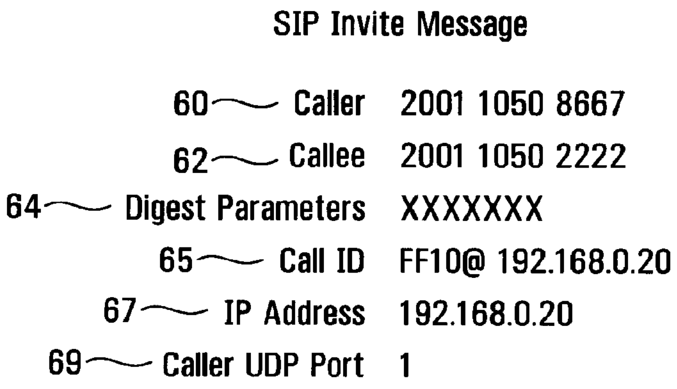

SIP Invite Message
60 Caller 2001 1050 8667
62 Callee 2001 1050 2222
64 Digest Parameters XXXXXXX
65 Call ID FF10@ 192.168.0.20
67 IP Address 192.168.0.20
69 Caller UDP Port 1

FIG. 3

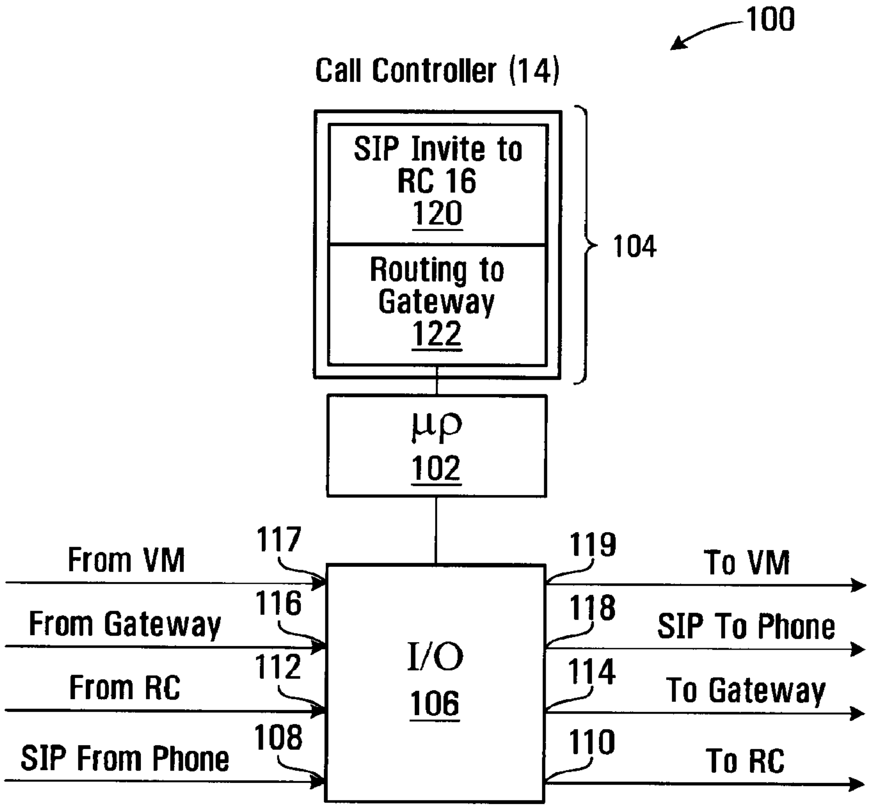

100
Call Controller (14)
SIP Invite to RC 16 120
Routing to Gateway 122
104
µp 102
I/O 106
From VM
117
From Gateway
116
From RC
112
SIP From Phone
108
119
To VM
118
SIP To Phone
114
To Gateway
110
To RC

FIG. 4

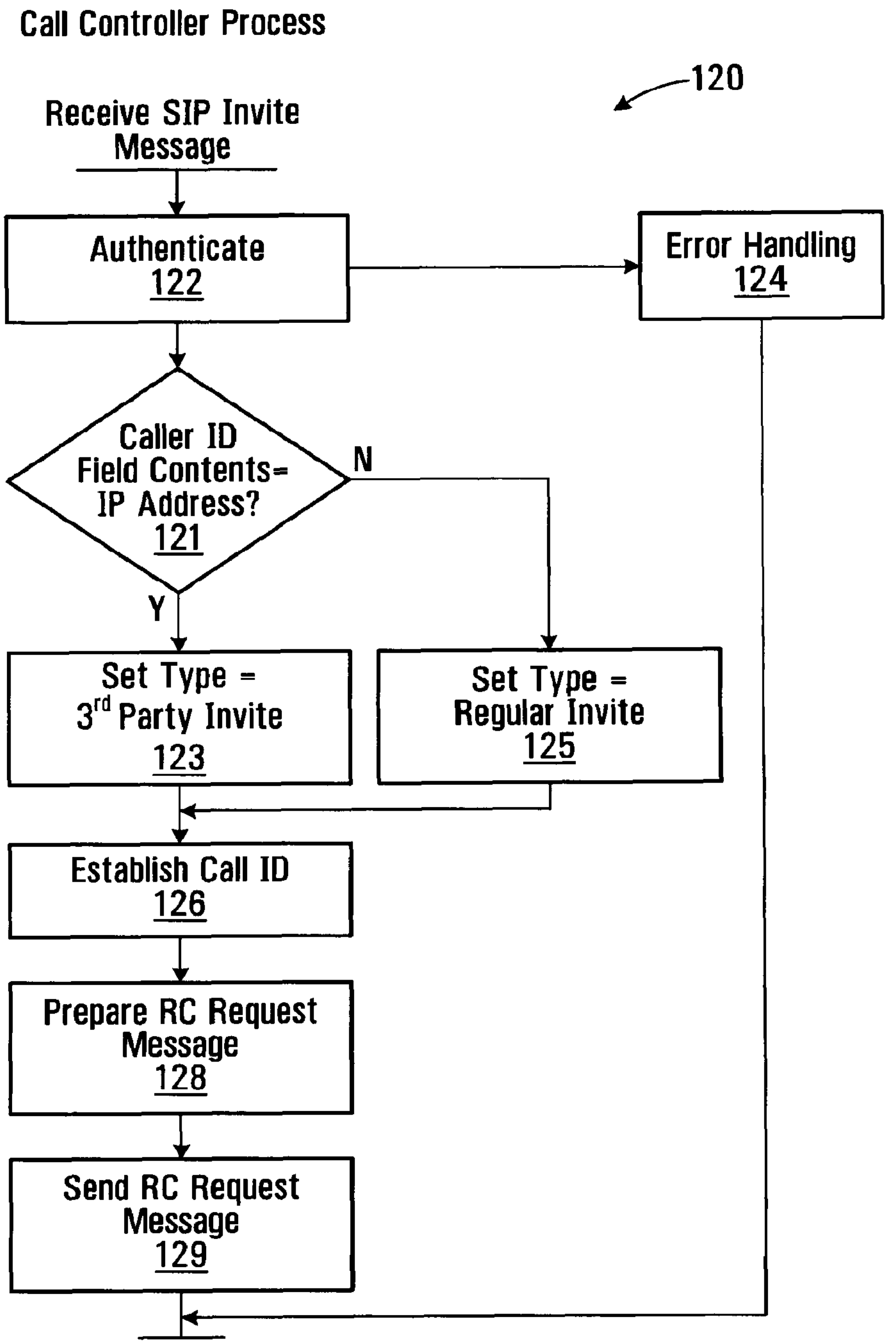

Call Controller Process
120
Receive SIP Invite Message
Authenticate 122
Error Handling 124
Caller ID Field Contents= IP Address? 121
N
Y
Set Type = 3rd Party Invite 123
Set Type = Regular Invite 125
Establish Call ID 126
Prepare RC Request Message 128
Send RC Request Message 129

FIG. 5

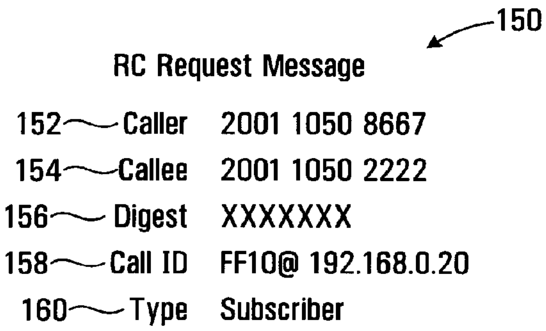

150
RC Request Message
152 Caller 2001 1050 8667
154 Callee 2001 1050 2222
156 Digest XXXXXXX
158 Call ID FF10@ 192.168.0.20
160 Type Subscriber

FIG. 6

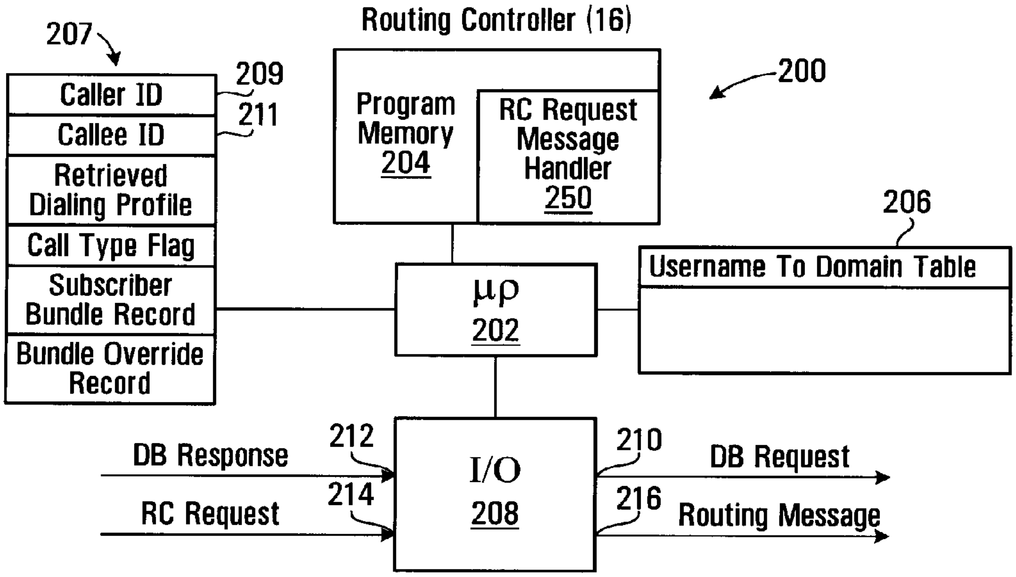

Routing Controller (16)
207
Caller ID
Callee ID
Retrieved Dialing Profile
Call Type Flag
Subscriber Bundle Record
Bundle Override Record
209
211
Program Memory 204
RC Request Message Handler 250
200
206
Username To Domain Table
μρ 202
I/O 208
DB Response
RC Request
212
214
210
216
DB Request
Routing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

FIG. 7

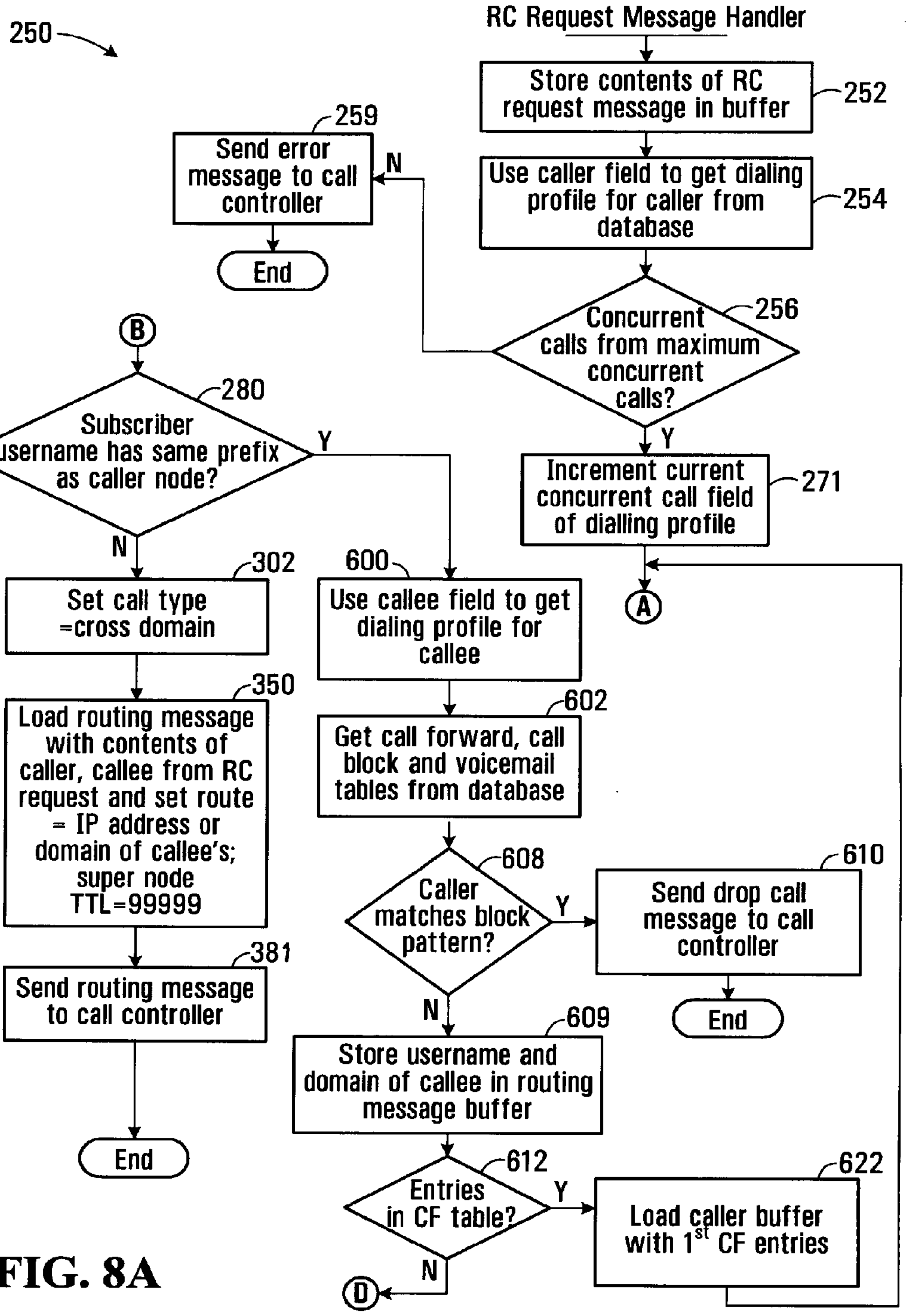

250
RC Request Message Handler
Store contents of RC request message in buffer
252
Use caller field to get dialing profile for caller from database
254
Concurrent calls from maximum concurrent calls?
256
N
Send error message to call controller
259
End
Y
Increment current concurrent call field of dialling profile
271
A
B
Subscriber username has same prefix as caller node?
280
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
Y
600
Use callee field to get dialing profile for callee
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

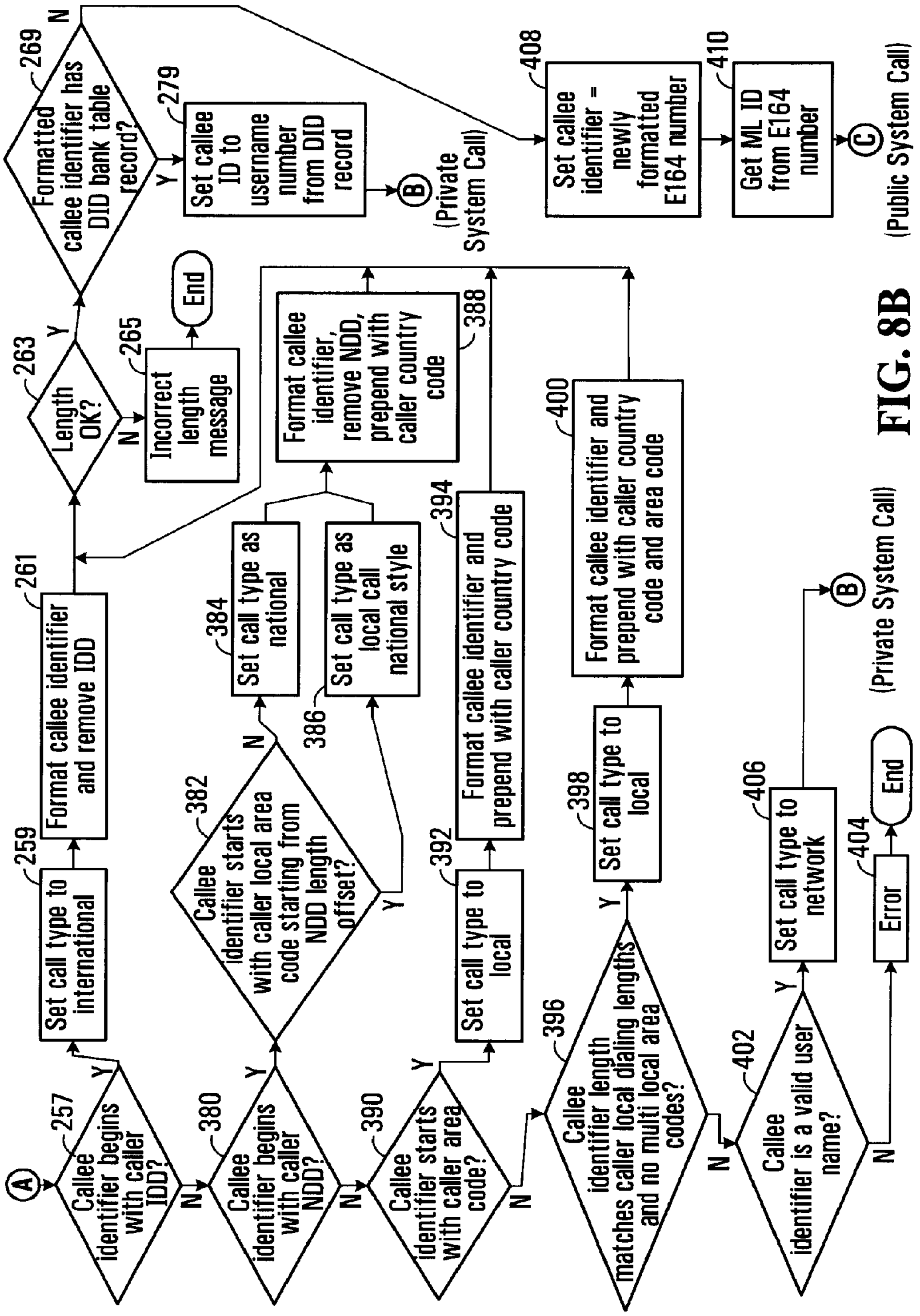

A
257
Callee identifier begins with caller IDD?
Y
N
259
Set call type to international
261
Format callee identifier and remove IDD
263
Length OK?
Y
N
265
Incorrect length message
End
269
Formatted callee identifier has DID bank table record?
Y
N
279
Set callee ID to username number from DID record
B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

FIG. 8B

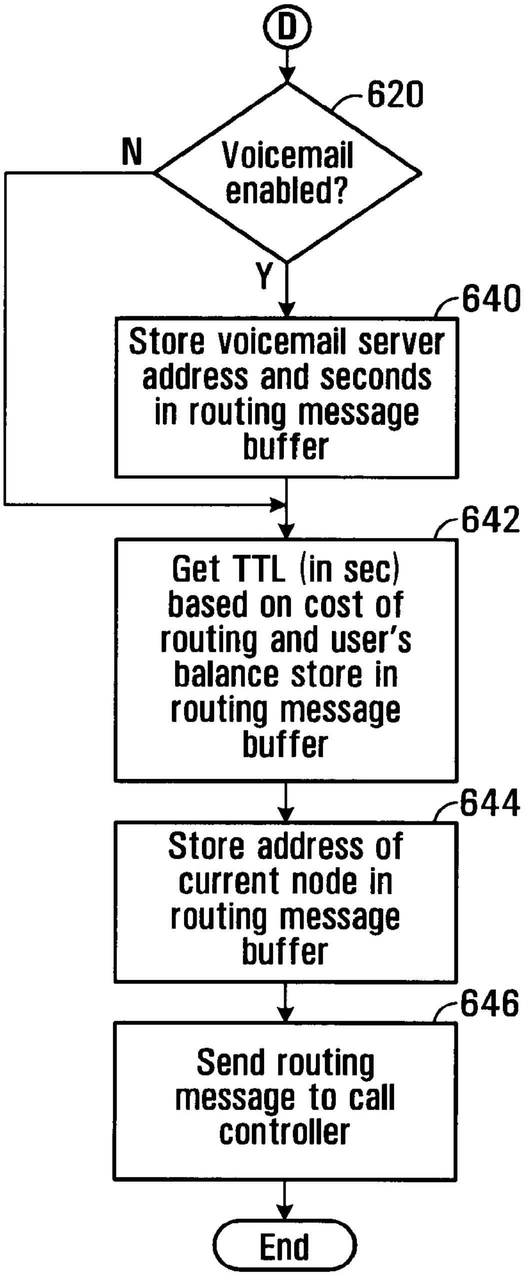

D
620
Voicemail enabled?
N
Y
640
Store voicemail server address and seconds in routing message buffer
642
Get TTL (in sec) based on cost of routing and user's balance store in routing message buffer
644
Store address of current node in routing message buffer
646
Send routing message to call controller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

FIG. 8C

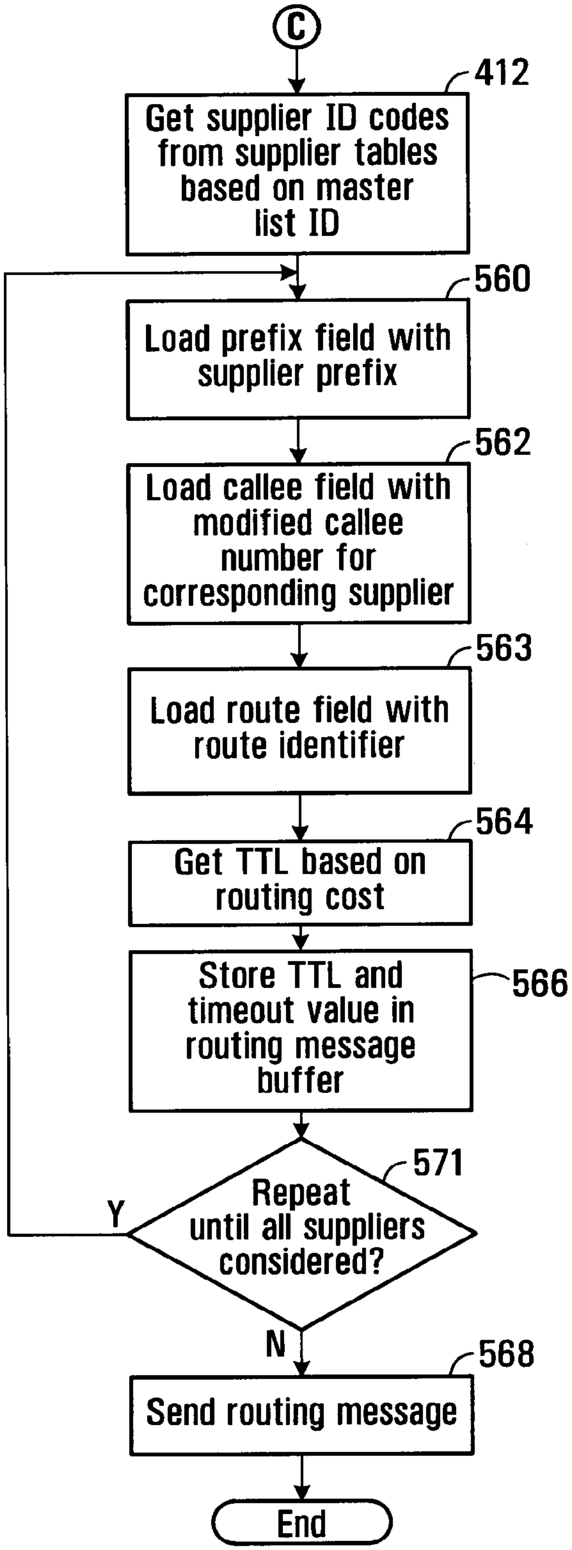
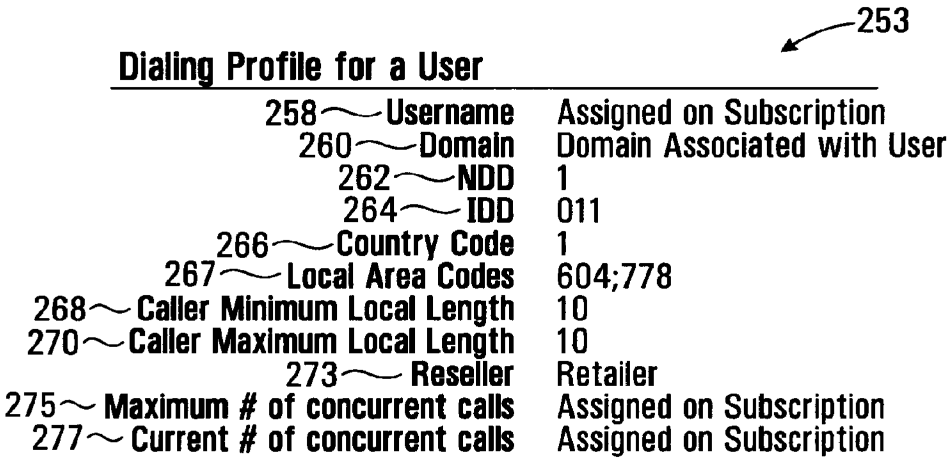

C
412
Get supplier ID codes from supplier tables based on master list ID
560
Load prefix field with supplier prefix
562
Load callee field with modified callee number for corresponding supplier
563
Load route field with route identifier
564
Get TTL based on routing cost
566
Store TTL and timeout value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

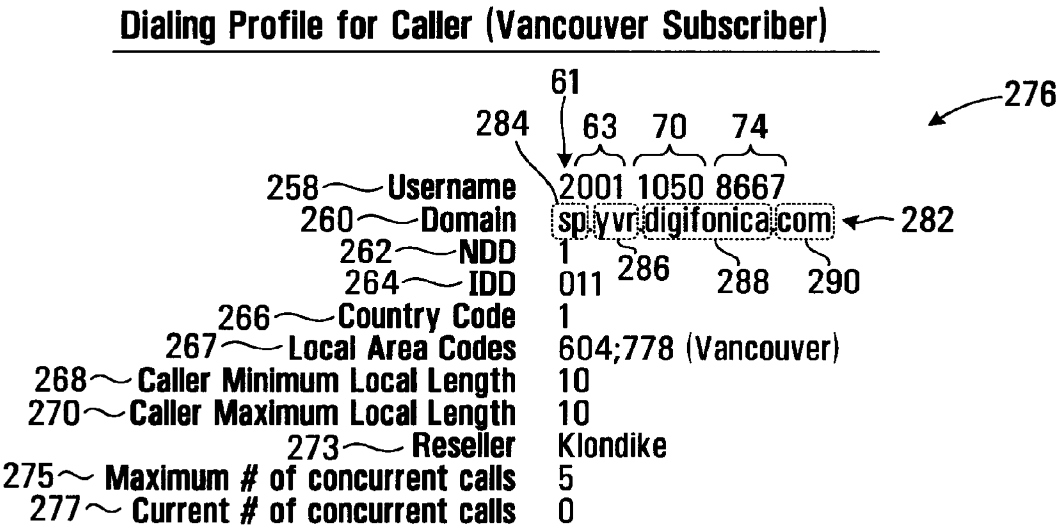
FIG. 8D



Dialing Profile for a User

Username	Assigned on Subscription
Domain	Domain Associated with User
NDD	1
IDD	011
Country Code	1
Local Area Codes	604;778
Caller Minimum Local Length	10
Caller Maximum Local Length	10
Reseller	Retailer
Maximum # of concurrent calls	Assigned on Subscription
Current # of concurrent calls	Assigned on Subscription

FIG. 9



Dialing Profile for Caller (Vancouver Subscriber)

Username	2001 1050 8667
Domain	sp.yvr.digifonica.com
NDD	1
IDD	011
Country Code	1
Local Area Codes	604;778 (Vancouver)
Caller Minimum Local Length	10
Caller Maximum Local Length	10
Reseller	Klondike
Maximum # of concurrent calls	5
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

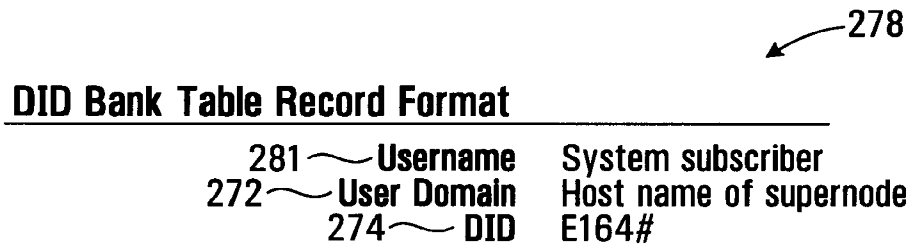

278
DID Bank Table Record Format
281 Username System subscriber
272 User Domain Host name of supernode
274 DID E164#

FIG. 13

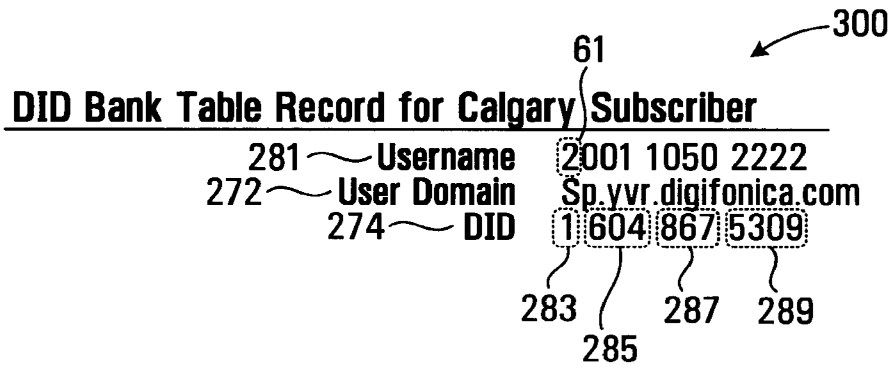

300
61
DID Bank Table Record for Calgary Subscriber
281 Username 2001 1050 2222
272 User Domain Sp.yvr.digifonica.com
274 DID 1 604 867 5309
283
285
287
289

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

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

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

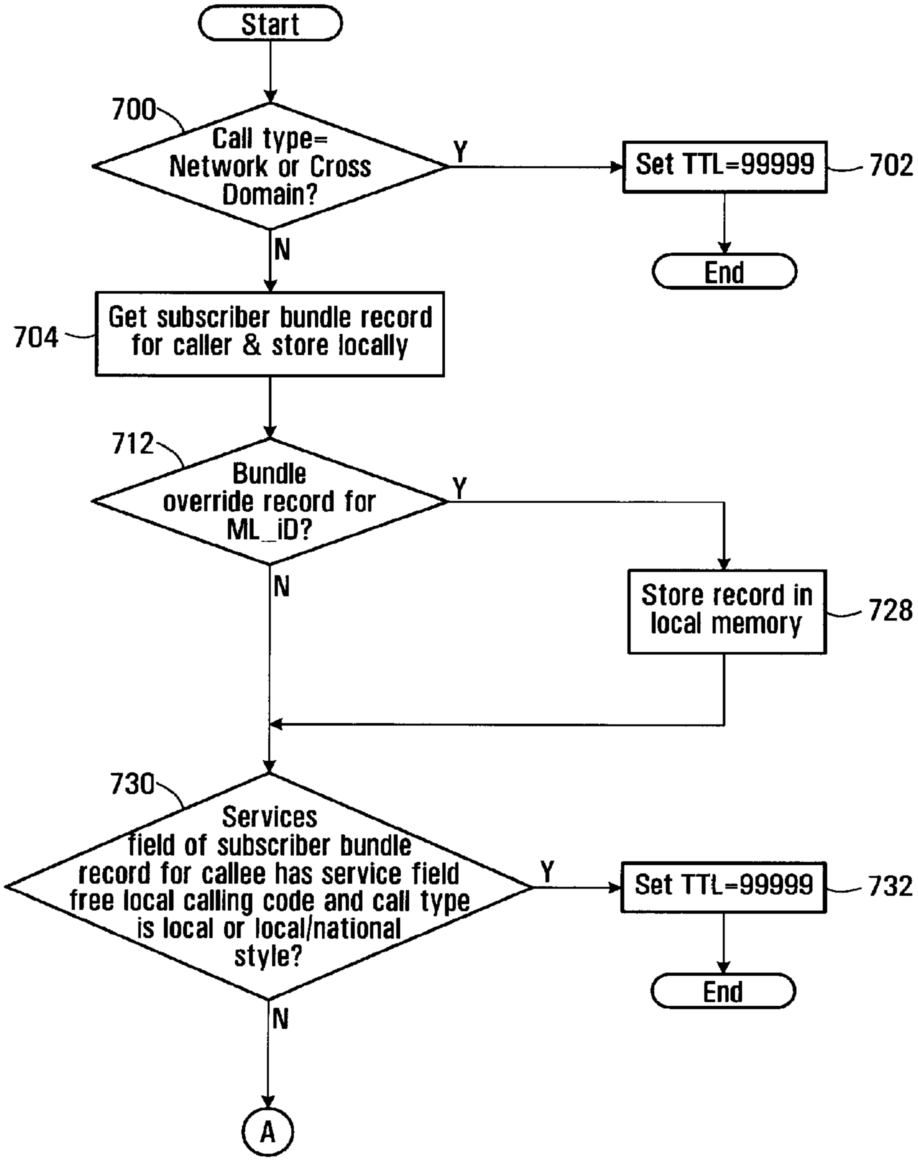

Start
700
Call type= Network or Cross Domain?
Y
N
Set TTL=99999
702
End
704
Get subscriber bundle record for caller & store locally
712
Bundle override record for ML_iD?
Y
N
Store record in local memory
728
730
Services field of subscriber bundle record for callee has service field free local calling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

FIG. 33A

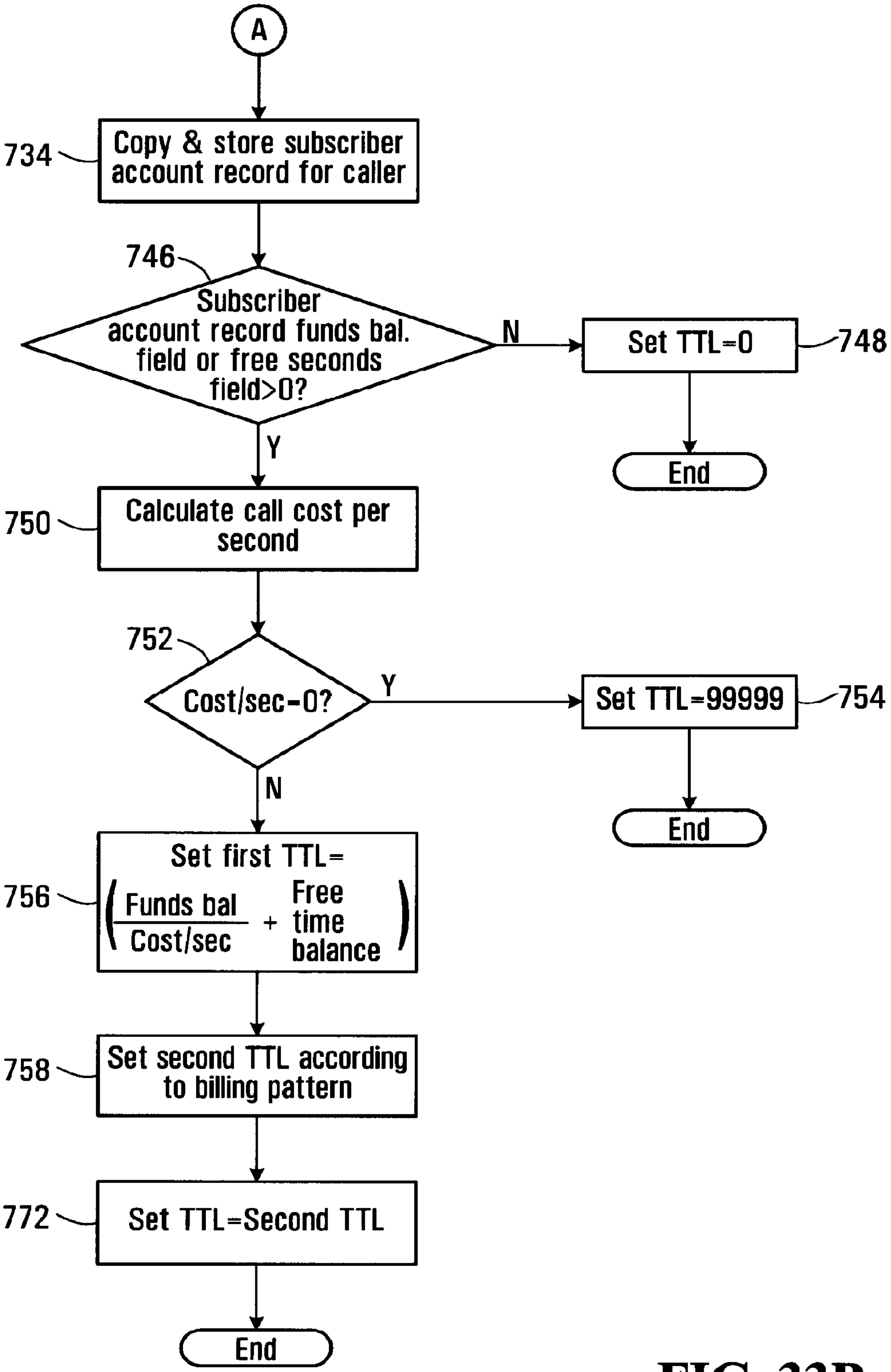

A
734
Copy & store subscriber account record for caller
746
Subscriber account record funds bal. field or free seconds field>0?
N
Set TTL=0
748
End
Y
750
Calculate call cost per second
752
Cost/sec=0?
Y
Set TTL=99999
754
End
N
756
Set first TTL=
Funds bal / Cost/sec + Free time balance
758
Set second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

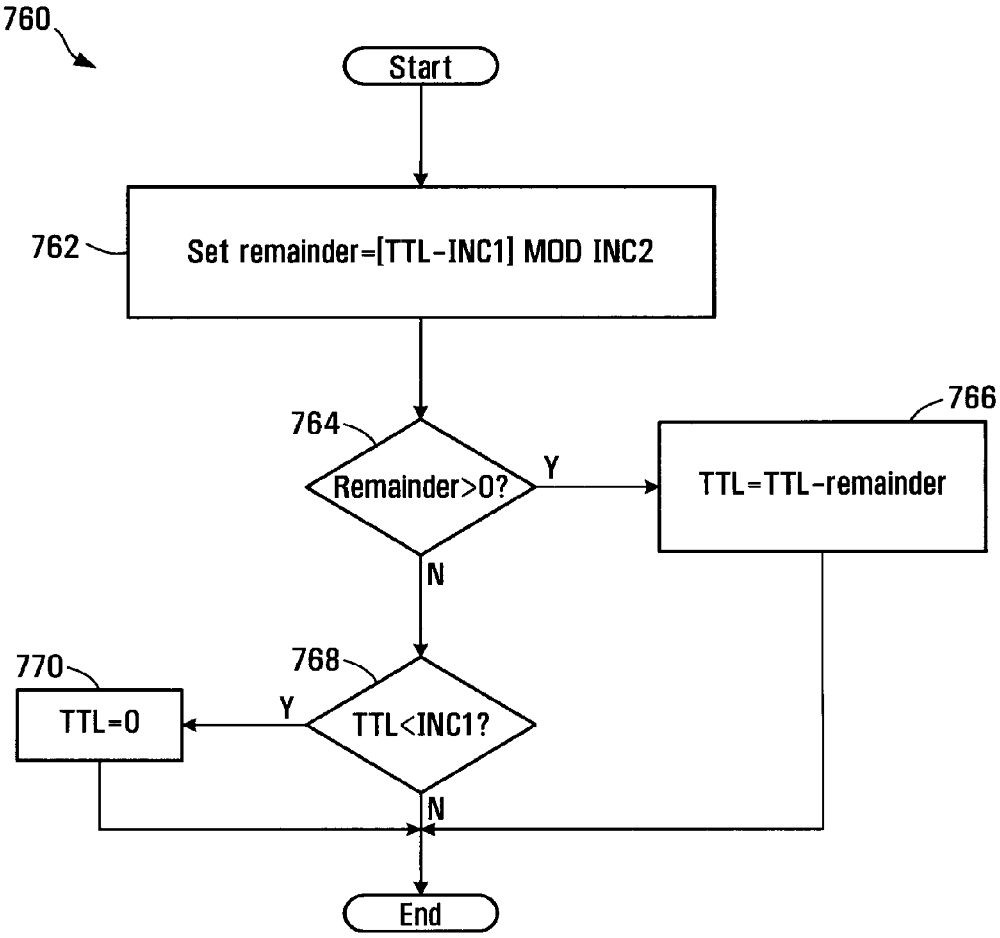

760
Start
762
Set remainder=[TTL-INC1] MOD INC2
764
Remainder>0?
Y
766
TTL=TTL-remainder
N
768
TTL<INC1?
Y
770
TTL=0
N
End

FIG. 40

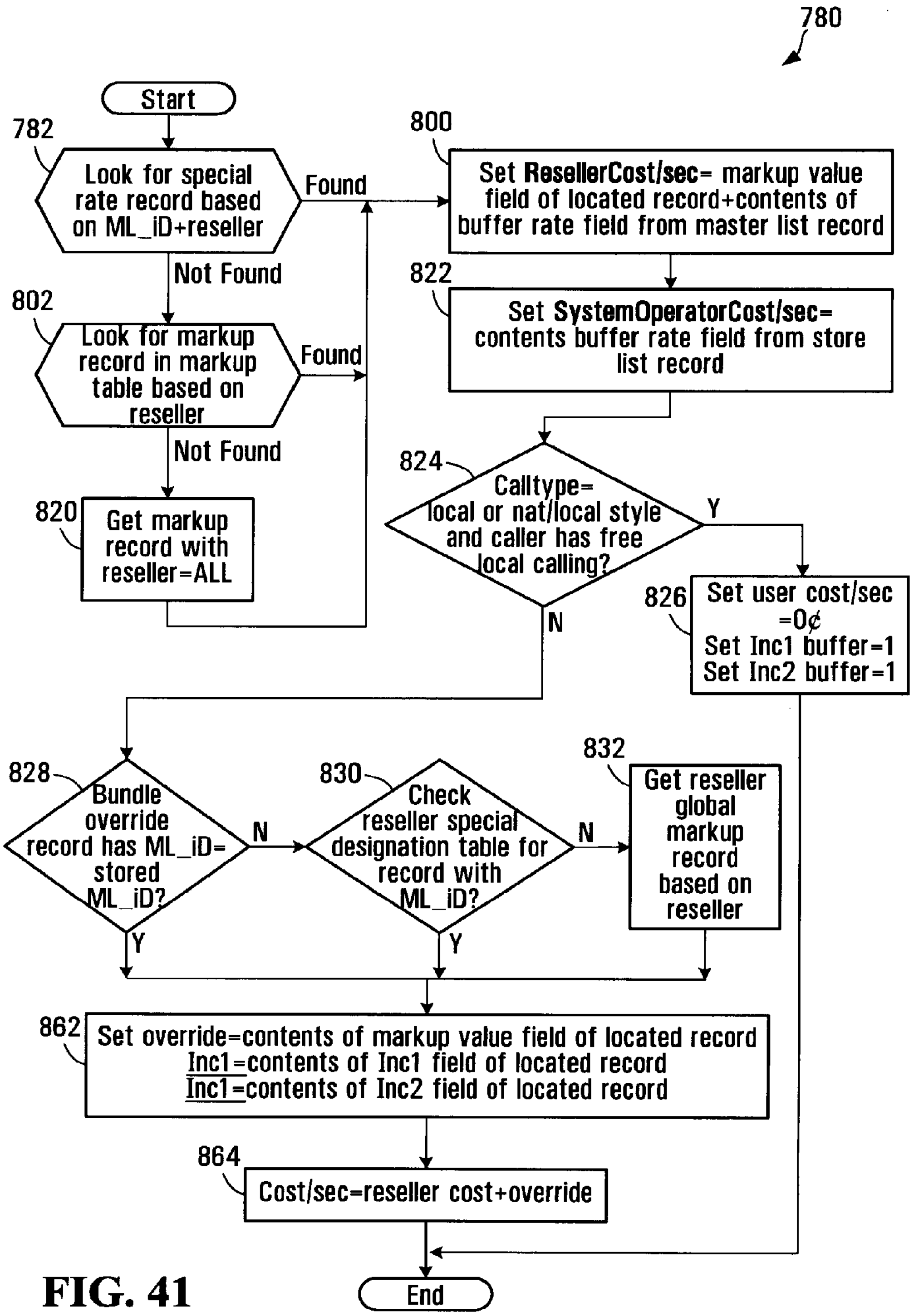

780
Start
782
Look for special rate record based on ML_iD+reseller
Found
Not Found
800
Set ResellerCost/sec= markup value field of located record+contents of buffer rate field from master list record
802
Look for markup record in markup table based on reseller
Found
Not Found
820
Get markup record with reseller=ALL
822
Set SystemOperatorCost/sec= contents buffer rate field from store list record
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

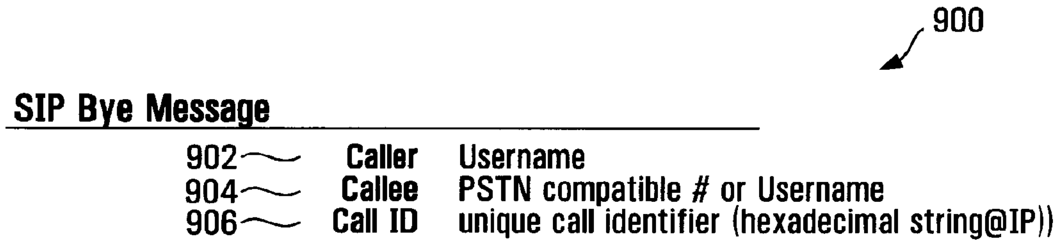
FIG. 49

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

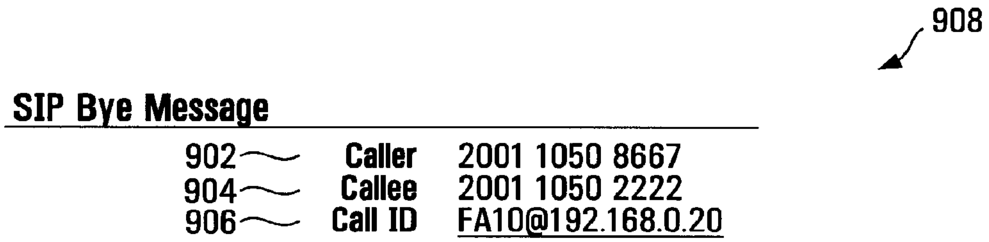
FIG. 50



SIP Bye Message

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

FIG. 51



SIP Bye Message

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

FIG. 52

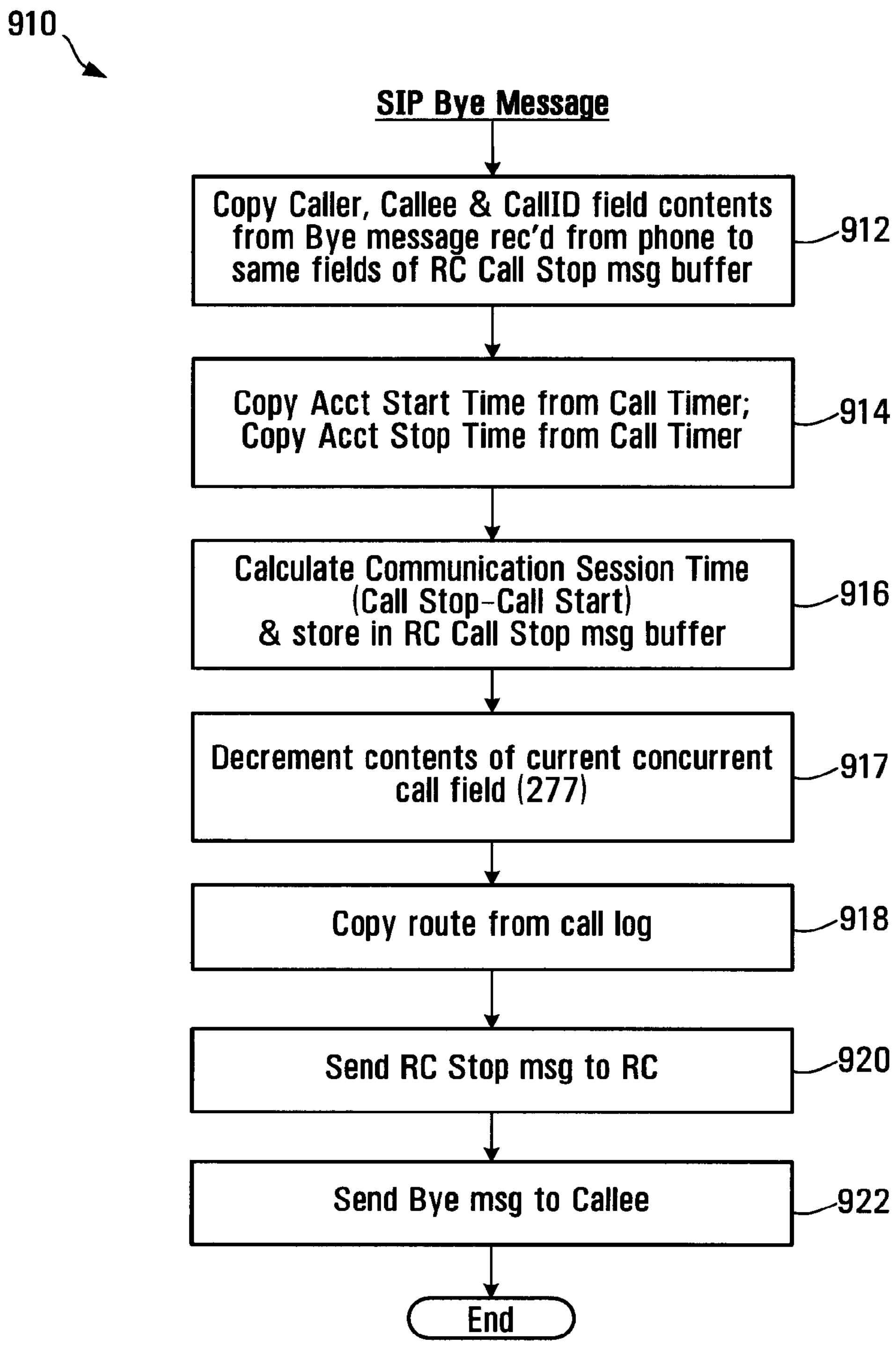

910
SIP Bye Message
Copy Caller, Callee & CallID field contents from Bye message rec'd from phone to same fields of RC Call Stop msg buffer
912
Copy Acct Start Time from Call Timer; Copy Acct Stop Time from Call Timer
914
Calculate Communication Session Time (Call Stop-Call Start) & store in RC Call 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

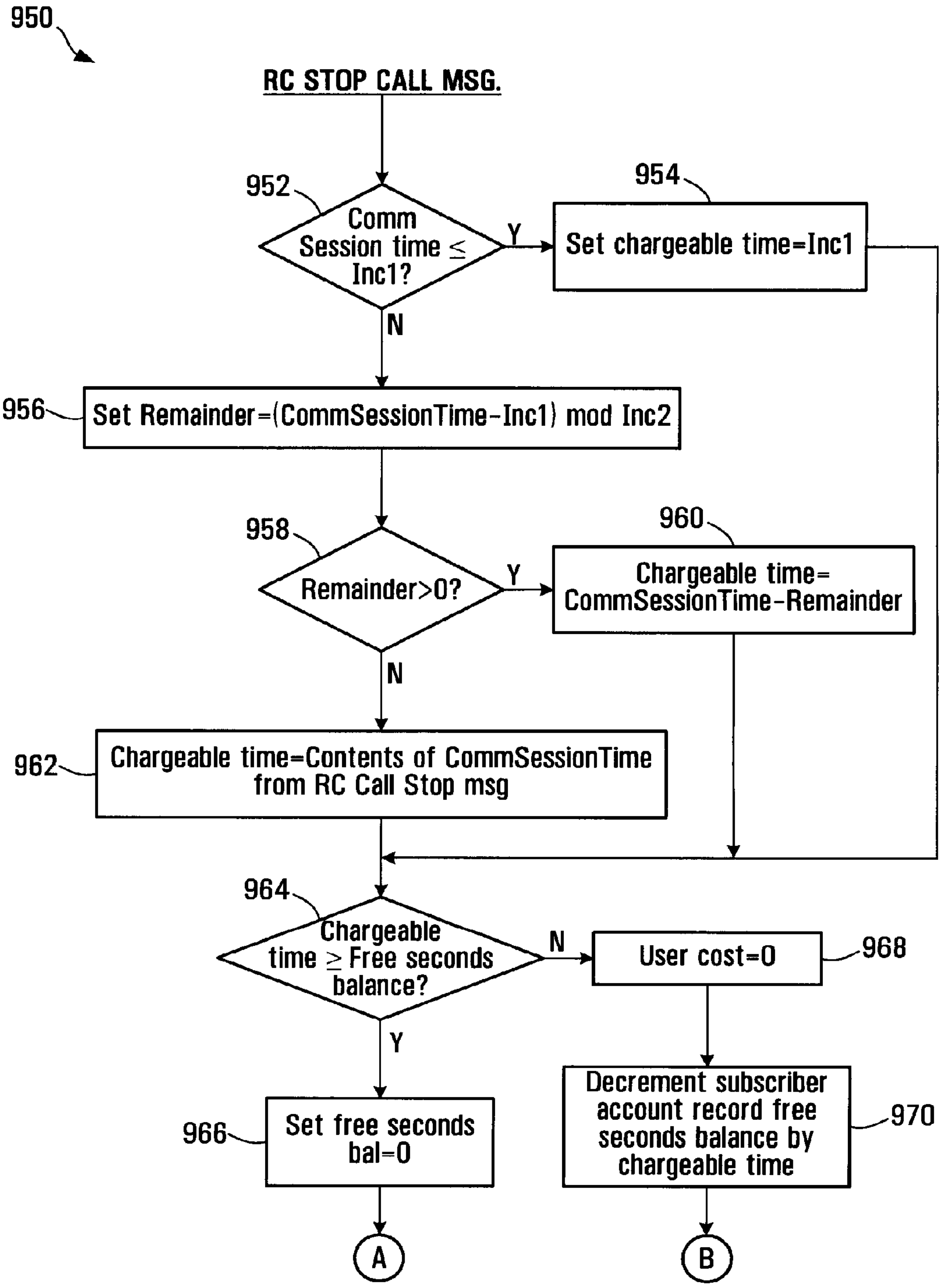

950
RC STOP CALL MSG.
952
Comm Session time ≤ Inc1?
Y
N
954
Set chargeable time=Inc1
956
Set Remainder=(CommSessionTime-Inc1) mod Inc2
958
Remainder>0?
Y
N
960
Chargeable time= CommSessionTime-Remainder
962
Chargeable time=Contents of CommSessionTime from RC Call Stop msg
964
Chargeable time ≥ Free seconds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

FIG. 56A

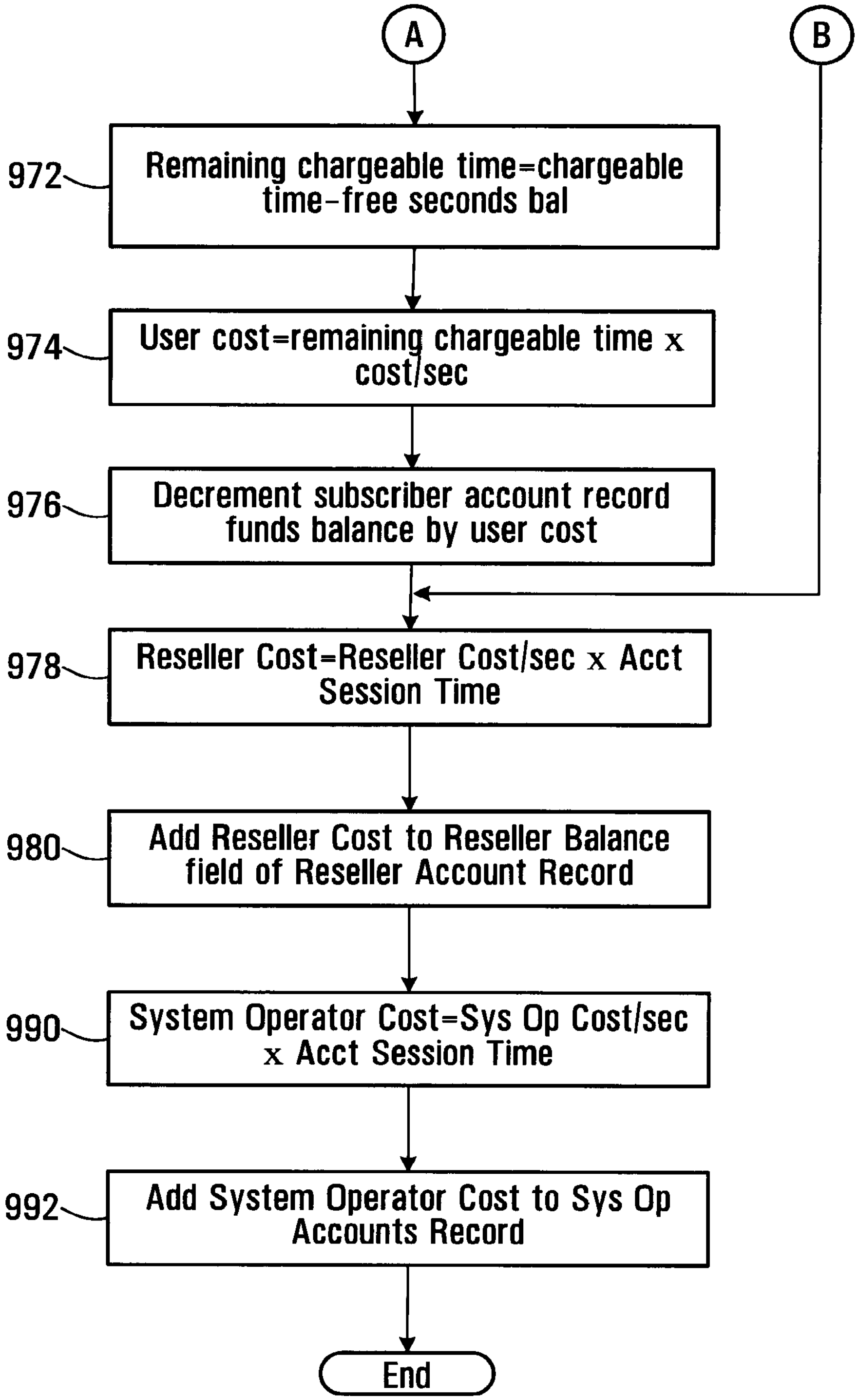

A
B
972
Remaining chargeable time=chargeable time-free seconds bal
974
User cost=remaining chargeable time x cost/sec
976
Decrement subscriber account record funds balance by user cost
978
Reseller Cost=Reseller Cost/sec x Acct Session Time
980
Add Reseller Cost to Reseller Balance field of Reseller 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

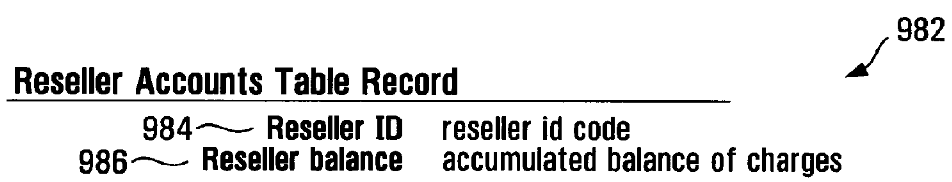


FIG. 57

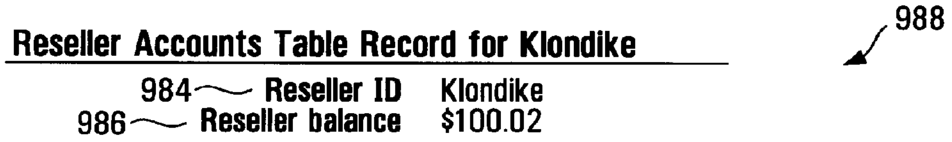


FIG. 58

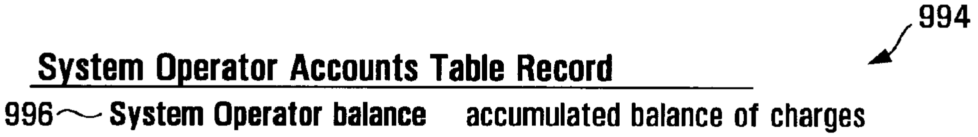


FIG. 59

FIG. 60

PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS

INCORPORATION BY REFERENCE TO ANY PRIORITY APPLICATIONS

This application is a continuation of U.S. application Ser. No. 13/966,096, filed Aug. 13, 2013, now U.S. Pat. No. 9,179,005, which is a continuation of U.S. application Ser. No. 12/513,147, filed Mar. 1, 2010, now U.S. Pat. No. 8,542,815, which is a national phase entry of PCT/CA2007/001956, filed Nov. 1, 2007, which claims priority to U.S. Provisional Application No. 60/856,212, filed Nov. 2, 2006, all of which are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of Invention

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 (SS7) 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 OF THE INVENTION

In accordance with one aspect of the invention, there is provided a process for operating a call routing controller to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The process involves, in response to initiation of a call by a calling subscriber, receiving a caller identifier and a callee identifier. The process also involves using call classification criteria associated with the caller identifier to classify the call as a public network call or a private network call. The process further involves 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. The process also involves producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The process may involve receiving a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

Using the call classification criteria may involve searching a database to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

Locating a record may involve locating a caller dialing profile comprising a user name associated with the caller, a domain associated with the caller, and at least one calling attribute.

Using the call classification criteria may involve comparing calling attributes associated with the caller dialing profile with aspects of the callee identifier.

Comparing may involve determining whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier has a length within a range specified in the caller dialing profile.

The process may involve formatting the callee identifier into a pre-defined digit format to produce a reformatted callee identifier.

Formatting may involve removing an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

Formatting may involve removing a national dialing digit from the callee identifier and prepending a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

Formatting may involve prepending a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

Formatting may involve prepending a caller country code and an area code to the callee identifier when the callee identifier has a length that matches a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The process may involve classifying the call as a private network call when the reformatted callee identifier identifies a subscriber to the private network.

The process may involve determining whether the callee identifier complies with a pre-defined user name format and if so, classifying the call as a private network call.

The process may involve causing a database of records to be searched to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and if the DID bank table record is found, classifying the call as a private network call and if a DID bank table record is not found, classifying the call as a public network call.

Producing the routing message identifying a node on the private network may involve setting a callee identifier in response to a user name associated with the DID bank table record.

Producing the routing message may involve determining whether a node associated with the reformatted callee identifier is the same as a node associated the caller identifier.

Determining whether a node associated with the reformatted callee identifier is the same as a node associated the caller identifier may involve determining whether a prefix of the reformatted callee identifier matches a corresponding prefix of a user name associated with the caller dialing profile.

When the node associated with the caller is not the same as the node associated with the callee, the process involves producing a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and communicating the routing message to a call controller.

When the node associated with the caller is the same as the node associated with the callee, the process involves determining whether to perform at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee.

Producing the routing message may involve producing a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The process may involve communicating the routing message to a call controller.

Producing a routing message identifying a gateway to the public network may involve searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve loading a routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The process may involve communicating a routing message involving the contents of the routing message buffer to a call controller.

The process may involve causing the dialing profile to include a maximum concurrent call value and a concurrent call count value and causing the concurrent call count value to be incremented when the user associated with the dialing profile initiates a call and causing the concurrent call count value to be decremented when a call with the user associated with the dialing profile is ended.

In accordance with another aspect of the invention, there is provided a call routing apparatus for facilitating communications between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The apparatus includes receiving provisions for receiving a caller identifier and a callee identifier, in response to initiation of a call by a calling subscriber. The apparatus also includes classifying provisions for classifying the call as a private network call or a public network call according to call classification criteria associated with the caller identifier. The apparatus further includes provisions for 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. The apparatus also includes provisions for producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The receiving provisions may be operably configured to receive a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

The apparatus may further include searching provisions for searching a database including records associating calling attributes with subscribers to the private network to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

The records may include dialing profiles each including a user name associated with the subscriber, an identification of a domain associated with the subscriber, and an identification of at least one calling attribute associated with the subscriber.

The call classification provisions may be operably configured to compare calling attributes associated with the caller dialing profile with aspects of the callee identifier.

The calling attributes may include an international dialing digit and call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

The calling attributes may include a national dialing digit and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

The calling attributes may include an area code and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

The calling attribute may include a number length range and the call classification provisions may be operably configured to determine whether the callee identifier has a length within a number length range specified in the caller dialing profile.

The apparatus may further include formatting provisions for formatting the callee identifier into a pre-defined digit format to produce a reformatted callee identifier.

The formatting provisions may be operably configured to remove an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

The formatting provisions may be operably configured to remove a national dialing digit from the callee identifier and prepend a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

The formatting provisions may be operably configured to prepend a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

The formatting provisions may be operably configured to prepend a caller country code and area code to the callee identifier when the callee identifier has a length that matches a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The classifying provisions may be operably configured to classify the call as a private network call when the reformatted callee identifier identifies a subscriber to the private network.

The classifying provisions may be operably configured to classify the call as a private network call when the callee identifier complies with a pre-defined user name format.

The apparatus may further include searching provisions for searching a database of records to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and the classifying provisions may be operably configured to classify the call as a private network call when the DID bank table record is found and to classify the call as a public network call when a DID bank table record is not found.

The private network routing message producing provisions may be operably configured to produce a routing message having a callee identifier set according to a user name associated with the DID bank table record.

The private network routing message producing provisions may be operably configured to determine whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

The private network routing provisions may include provisions for determining whether a prefix of the reformatted callee identifier matches a corresponding prefix of a user name associated with the caller dialing profile.

The private network routing message producing provisions may be operably configured to produce a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and to communicate the routing message to a call controller.

The private network routing message producing provisions may be operably configured to perform at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee, when the node associated with the caller is the same as the node associated with the callee.

The provisions for producing the private network routing message may be operably configured to produce a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The apparatus further includes provisions for communicating the routing message to a call controller.

The provisions for producing a public network routing message identifying a gateway to the public network may include provisions for searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes provisions for searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes a routing message buffer and provisions for loading the routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The apparatus further includes provisions for communicating a routing message including the contents of the routing message buffer to a call controller.

The apparatus further includes means for causing said dialing profile to include a maximum concurrent call value and a concurrent call count value and for causing said concurrent call count value to be incremented when the user associated with said dialing profile initiates a call and for causing said concurrent call count value to be decremented when a call with said user associated with said dialing profile is ended.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes dialing profile records comprising fields for associating with respective subscribers to the system, a subscriber user name, direct-in-dial records comprising fields for associating with respective subscriber user names, a user domain and a direct-in-dial number, prefix to node records comprising fields for associating with at least a portion of the respective subscriber user names, a node address of a node in the system, whereby a subscriber name can be used to find a user domain, at least a portion of the a subscriber name can be used to find a node with which the subscriber identified by the subscriber name is associated, and a user domain and subscriber name can be located in response to a direct-in-dial number.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes master list records comprising fields for associating a dialing code with respective master list identifiers and supplier list records linked to master list records by the master list identifiers, said supplier list records comprising fields for associating with a communications services supplier, a supplier ID, a master list ID, a route identifier and a billing rate code, whereby communications services suppliers are associated with dialing codes, such that dialing codes can be used to locate suppliers capable of providing a communications link associated with a given dialing code.

In accordance with another aspect of the invention, there is provided a method for determining a time to permit a communication session to be conducted. The method 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.

Calculating the first time value may involve retrieving a record associated with the participant and obtaining from the record at least one of the free time and the funds balance.

Producing the second time value may involve 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.

Producing the second time value may involve setting a difference between the first time value and the remainder as the second time value.

The method may further involve setting the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

Calculating the cost per unit time may involve locating a record in a database, the record comprising a mark-up type indicator, a mark-up value and a billing pattern and setting a reseller rate equal to the sum of the mark-up value and the buffer rate.

Locating the record in a database may involve locating 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.

Calculating the cost per unit time value further may involve 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, a default operator mark-up record specifying a default cost per unit time.

The method may further involve 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 method may further involve receiving a communication session time representing a duration of the communication session and incrementing a reseller balance by the product of the reseller rate and the communication session time.

The method may further involve receiving a communication session time representing a duration of the communication session and incrementing a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided an apparatus for determining a time to permit a communication session to be conducted. The apparatus includes a processor circuit, a computer readable medium coupled to the processor circuit and encoded with instructions for directing the processor circuit to calculate a cost per unit time for the communication session, calculate 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 produce 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.

The instructions may include instructions for directing the processor circuit to retrieve a record associated with the participant and obtain from the record at least one of the free time and the funds balance.

The instructions may include instructions for directing the processor circuit to produce the second time value by 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.

The instructions may include instructions for directing the processor circuit to produce the second time value comprises setting a difference between the first time value and the remainder as the second time value.

The instructions may include instructions for directing the processor circuit to set the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

The instructions for directing the processor circuit to calculate the cost per unit time may include instructions for directing the processor circuit to locate a record in a database, the record comprising a mark-up type indicator, a mark-up value and a billing pattern and set a reseller rate equal to the sum of the mark-up value and the buffer rate.

The instructions for directing the processor circuit to locate the record in a database may include instructions for directing the processor circuit 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. The instructions for directing the processor circuit to calculate the cost per unit time value may further include instructions for directing the processor circuit to locate 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, a default operator mark-up record specifying a default cost per unit time.

The instructions may include instructions for directing the processor circuit 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.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a reseller balance by the product of the reseller rate and the communication session time.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided a process for attributing charges for communications services. The process involves determining a first chargeable time in response to a communication session time and a pre-defined billing pattern, determining a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, changing an account balance associated with the user in response to a user cost per unit time. The process may further involve changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

Determining the first chargeable time may involve locating at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and setting as the pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may involve a first billing interval and a second billing interval.

Determining the first chargeable time may involve setting the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

Determining the first chargeable time may involve producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and setting the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and setting the first chargeable time to the communication session time when the remainder is not greater than zero.

The process may further involve determining a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Determining the second chargeable time may involve setting the second chargeable time to a difference between the first chargeable time.

The process may further involve resetting the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Changing an account balance associated with the user may involve calculating a user cost value in response to the second chargeable time and the user cost per unit time.

The process may further involve changing a user free cost balance in response to the user cost value.

The process may further involve setting the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The process may further involve changing a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided an apparatus for attributing charges for communications services. The apparatus includes a processor circuit, a computer readable medium in communication with the processor circuit and encoded with instructions for directing the processor circuit to determine a first chargeable time in response to a communication session time and a pre-defined billing pattern, determine a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, change an account balance associated with the user in response to a user cost per unit time.

The instructions may further include instructions for changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

The instructions for directing the processor circuit to determine the first chargeable time may further include instructions for causing the processor circuit to communicate with a database to locate at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and instructions for setting as the pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may include a first billing interval and a second billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for directing the processor circuit to set the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and instructions for causing the processor circuit to set the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and instructions for causing the processor circuit to set the first chargeable time to the communication session time when the remainder is not greater than zero.

The instructions may further include instructions for causing the processor circuit to determine a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to determine the second chargeable time may include instructions for causing the processor circuit to set the second chargeable time to a difference between the first chargeable time.

The instructions may further include instructions for causing the processor circuit to reset the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to change an account balance associated with the user may include instructions for causing the processor circuit to calculate a user cost value in response to the second chargeable time and the user cost per unit time.

The instructions may further include instructions for causing the processor circuit to change a user free cost balance in response to the user cost value.

The instructions may further include instructions for causing the processor circuit to set the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The instructions may further include instructions for causing the processor circuit to change a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided a computer readable medium encoded with codes for directing a processor circuit to execute one or more of the methods described above and/or variants thereof.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon

review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

FIG. **1** is a block diagram of a system according to a first embodiment of the invention;

FIG. **2** is a block diagram of a caller telephone according to the first embodiment of the invention;

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

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

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

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

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

FIGS. **8**A-**8**D is a flowchart of an RC request message handler executed by the RC processor circuit shown in FIG. **7**;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

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

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

FIG. **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;

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

FIG. **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;

FIGS. **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;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

DETAILED DESCRIPTION

Referring to FIG. **1**, a system for making voice over IP telephone/videophone calls is shown generally at **10**. The system includes a first supernode shown generally at **11** and a second supernode shown generally at **21**. The first supernode **11** is located in a geographical area, such as Vancouver, B.C., Canada for example and the second supernode **21** is located in London, England, for example. Different supernodes may be located in different geographical regions throughout the world to provide telephone/videophone service to subscribers in respective regions. These supernodes 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 supernodes 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 FIG. **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 the description of the embodiments of this invention, 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 been 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 FIG. **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.

Subscriber Telephone

In greater detail, referring to FIG. **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 FIG. **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 user name 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 FF10@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 FIG. **3**, to the routing controller **16** shown in FIG. **1**. This SIP invite message is essentially to initiate a call by a calling subscriber.

Referring to FIG. **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 FIG. **2**. In addition, referring back to FIG. **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 FIG. **2**. The digest parameters field **64** includes digest parameters and the call ID field **65** includes a code comprising a generated prefix code (FF10) 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.

Call Controller

Referring to FIG. **4**, a call controller circuit of the call controller **14** (FIG. **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 FIG. **3**, from the telephone shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **3**, block **122** of FIG. **5** directs the call controller circuit **100** of FIG. **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 FIG. **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 FIG. **3**. The type field **160** contains the type code established at blocks **123** or **125** of FIG. **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 user name as shown, for example.

Routing Controller (RC)

Referring to FIG. **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 FIG. **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 FIG. **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 FIGS. **8**A through **8**D.

RC Request Message Handler

Referring to FIG. **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 FIG. **7**, one of which includes the caller ID buffer **209** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **2**.

Referring back to FIG. **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 FIG. **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 FIGS. **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 FIG. **13** is added to a direct-in-dial bank table in the database (**18** in FIG. **1**) to associate the user name 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 FIG. **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 FIG. **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 FIG. **9** and DID records as shown in FIG. **13** when a user registers with the system, call blocking records of the type shown in FIG. **26**, call forwarding records of the type shown in FIG. **28** and voicemail records of the type shown in FIG. **30** may be added to the database **18** when a new subscriber is added to the system.

Referring back to FIG. **8**A, after retrieving a dialing profile for the caller, such as shown at **276** in FIG. **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 than 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 FIG. **6**, of the RC request message **150**. These checks are shown in greater detail in FIG. **8**B.

Referring to FIG. **8**B, the processor (**202** in FIG. **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 FIG. **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 FIG. **4**) to respond to the incorrect length message by transmitting a message back to the telephone (**12** shown in FIG. **1**) to indicate that an invalid number has been dialled.

Still referring to FIG. **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 FIG. **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 FIG. **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 FIG. **14**) from the callee DID bank table record (**300** in FIG. **14**) into the callee ID buffer (**211** in FIG. **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 FIG. **8**A.

Subscriber to Subscriber Calls Between Different Nodes

Referring to FIG. **8**A, block **280** directs the processor (**202** of FIG. **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 FIG. **7**), is the same as the corresponding prefix of the caller name held in the user name field **258** of the caller dialing profile shown in FIG. **10**. If the corresponding prefixes are not the same, block **302** in FIG. **8**A directs the processor (**202** in FIG. **7**) to set a call type flag in the buffer memory (**207** in FIG. **7**) to indicate the call is a cross-domain call. Then, block **350** of FIG. **8**A directs the processor (**202** of FIG. **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 user name 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 FIG. **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 FIG. **18**, for example, if the prefix is 20, the supernode address associated with that prefix is sp.yvr.digifonica.com.

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

Referring back to FIG. **8**B, if at block **257**, the callee identifier stored in the callee ID buffer (**211** in FIG. **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 FIG. **10**. In FIG. **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 FIG. **8**B.

Block **382** directs the processor (**202** of FIG. **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 FIG. **10**. If not, block **384** of FIG. **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 reformatted 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 FIG. **10**. The processor (**202**) is then directed to block **263** of FIG. **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 FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** for further processing as described above.

Referring back to FIG. **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 FIG. **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 FIG. **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 predefined 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 FIG. **10**) followed by the caller area code (as indicated by the local area code field **267** of the caller profile shown in FIG. **10**). The processor (**202**) is then directed to block **263** of FIG. **8**B for further processing as described above.

Referring back to FIG. **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 FIG. **10**) and the caller maximum local number length field (**270** in FIG. **10**), block **402** directs the processor **202** of FIG. **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 FIG. **10**) of dialing profiles to find a dialing profile having user name field contents (**258** in FIG. **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 FIG. **8**A. Thus, the call is classified as a private network call when the callee identifier identifies a subscriber to the private network.

From FIG. **8**B, it will be appreciated that there are certain groups of blocks of codes that direct the processor **202** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **7** when it executes block **269** in FIG. **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 FIG. **8**B which causes it to set the contents of the callee ID buffer **211** of FIG. **7** equal to the newly formatted callee identifier, i.e., a number compatible with the E.164 standard. Then, block **410** of FIG. **8**B directs the processor (**202**) to search a database of route or master list records associating route identifiers with dialing codes shown in FIG. **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 FIG. **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 FIG. **7** uses at block **410** in FIG. **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 FIG. **20** with exemplary field contents as shown.

Referring back to FIG. **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 FIG. **7** to find a master list record such as the one shown in FIG. **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 **411** in FIG. **8**B, the process continues as shown in FIG. **8**D. Referring to FIG. **8**D, block **412** directs the processor **202** of FIG. **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 FIG. **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 FIGS. **22**, **23** and **24** for the exemplary suppliers shown at **20** in FIG. **1**, namely Telus, Shaw and Sprint.

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

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

Referring to FIGS. **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 FIG. **25** first.

Block **562** in FIG. **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 FIG. **25**. At block **563** of FIG. **8**D, the contents of the route identifier field **546** of FIG. **21** of the record associated with the supplier "Telus" are added by the processor **202** of FIG. **7** to the routing message buffer shown in FIG. **25** after an @ sign delimiter, and then block **564** in FIG. **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 FIG. **21** in the routing message buffer of FIG. **25**. Accordingly, a first part of the routing message for the Telus gateway is shown generally at **570** in FIG. **25**.

Referring back to FIG. **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 FIG. **25** relates to the second supplier identified by the record shown in FIG. **23**. Referring back to FIG. **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 FIG. **24**.

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

Subscriber to Subscriber Calls Within the Same Node

Referring back to FIG. **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 FIG. **11** or **12**, for example. Block **602** of FIG. **8**A then directs the processor **202** of FIG. **7** to get call block, call forward and voicemail records from the database **18** of FIG. **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 FIGS. **26**, **27**, **28** and **30** for example.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **27**, block **608** directs the processor **202** of FIG. **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 FIG. **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 user name 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 FIG. **32**. Referring back to FIG. **8**A, block **612** then directs the processor **202** to determine whether or not call forwarding is required.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **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 FIG. **8**C. If there are entries in the call forwarding table **27**, block **622** in FIG. **8**A directs the processor **202** to search the dialing profile table to find a dialing profile record as shown in FIG. **9**, for the user identified by the destination number field **616** of the call forward record shown in FIG. **28**. The processor **202** of FIG. **7** is further directed to store the user name and domain for that user and a time to live value in the routing message buffer as shown at **652** in FIG. **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 FIG. **7** to add to the routing message buffer all call forwarding user names and domains associated with the callee.

Referring back to FIG. **8**A, if at block **612** there are no call forwarding records, then at block **620** in FIG. **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 FIG. **30** in a voicemail table stored in the database **18** shown in FIG. **1**.

Referring to FIG. **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 FIG. **8**C, at block **620** if the processor **202** of FIG. **7** finds a voicemail record as shown in FIG. **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 FIG. **8**C directs the processor **202** to FIG. **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 FIG. **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 FIG. **8**C, block **644** then directs the processor **202** of FIG. **7** to store the IP address of the current node in the routing message buffer as shown at **656** in FIG. **32**. Block **646** then directs the processor **202** to send the routing message shown in FIG. **32** to the call controller **14** in FIG. **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 FIG. **1**, the routing message whether of the type shown in FIG. **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 FIG. **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 FIG. **32** is received by the call controller **14**, the routing to gateway routine **122** shown in FIG. **4** may direct the processor **102** to cause a message to be sent back through the internet **13** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **1**, if the call controller **14** receives a routing message of the type shown in FIG. **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 FIGS. **33**A and **33**B, a process for determining a time to live value for any of blocks **642** in FIG. **8**C, **350** in FIG. **8**A or **564** in FIG. **8**D above is described. The process is executed by the processor **202** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **1** and store it locally in the subscriber bundle record buffer at the RC **14**.

Referring to FIG. **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.

FIG. **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 FIG. **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**) to determine whether or not there is a bundle override table record for the master list ID value that was determined at block **410** in FIG. **8**B. An exemplary bundle override table record is shown at **714** in FIG. **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 FIG. **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 FIG. **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 FIG. **33**A, if at block **712** the processor finds a bundle override record of the type shown in FIG. **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 FIG. **37** is stored in the bundle override record buffer at the RC as shown in FIG. **7**. Still referring to FIG. **33**A, block **730** then directs the RC processor to determine whether or not the subscriber bundle table record **706** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **33**B, after copying and storing the subscriber account record shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **39** and the quotient of the contents of the funds balance field **740** in the subscriber account record for the call shown in FIG. **39** and the cost per second determined at block **750** of FIG. **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 FIG. **37**. This process is shown in greater detail at **760** in FIG. **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 FIG. **40**, the process for producing the second time value begins with a first block **762** that directs the processor **202** in FIG. **7** to set a remainder value equal to the difference between the time to live value calculated at block **756** in FIG. **33**B and the contents of the first interval field **722** of the record shown in FIG. **37** modulus the contents of the second interval field **724** of FIG. **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 403 divided by 6 is 1. 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 433 minus the remainder of 1, i.e., 432 seconds. The processor is then returned back to block **758** of FIG. **33**B.

Referring back to FIG. **40**, if at block **764** the remainder is not greater than zero, block **768** directs the processor **202** of FIG. **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 FIG. **37**. If so, then block **770** of FIG. **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 not greater than zero and the first time value is less than the first billing interval. 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 FIG. **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**.

Cost Per Second

Referring back to FIG. **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 FIG. **41**, a process for calculating a cost per unit time is shown generally at **780**. The process is executed by the processor **202** in FIG. **7** and generally involves locating a record in a database, the record comprising a mark-up type indicator, a mark-up value and a billing pattern and setting a reseller rate equal to the sum of the mark-up 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 mark-up 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 FIG. **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 FIG. **8**C.

Referring to FIG. **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 FIG. **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 FIG. **41**, if at block **782** a record such as the one shown in FIG. **43** is located in the system operator special rates table, the processor is directed to block **800** in FIG. **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 FIG. **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 FIG. **42**.

FIG. **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.

FIG. **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 FIG. **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 FIG. **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 FIG. **46**, having the “all” code in the reseller field **806**. The processor is then directed to block **800**.

Referring back to FIG. **41**, at block **800**, the processor **202** of FIG. **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 FIG. **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 been calculated and the process shown in FIG. **41** is ended.

If at block **824** the conditions of that block are not met, the processor **202** of FIG. **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 mark-up record specifying a default cost per unit time.

To do this block **828** directs the processor **202** of FIG. **7** to determine whether or not the bundle override record **726** in FIG. **37** located at block **712** in FIG. **33**A has a master list ID equal to the stored master list ID that was determined at block **410** in FIG. **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 FIG. **8**B. An exemplary reseller special destinations table record is shown in FIG. **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 FIG. **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 FIG. **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 FIG. **41**, the record shown in FIG. **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 FIG. **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 FIG. **47**, for example. The contents of the fields of this record **860** may be set according to system operator preferences, for example.

Referring to FIG. **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 FIG. **41**, should the processor get to block **832**, the reseller global mark-up table record as shown in FIG. **50** is retrieved from the database and stored locally at the RC. As seen in FIG. **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 FIG. **41**.)

It will be appreciated that the located record could be a bundle override record of the type shown in FIG. **37** or the located record could be a reseller special destination record of the type shown in FIG. **48** or the record could be a reseller global mark-up table record of the type shown in FIG. **50**. After the override and first and second increment variables have been set at block **862**, the processor **202** of FIG. **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 FIG. **41**, plus the contents of the override variable calculated in block **862** in FIG. **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 FIG. **33**B, for example.

Terminating the Call

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 FIG. **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 FIG. **3**.

Thus, for example, referring to FIG. **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 FA10 @ 192.168.0.20, which is the call ID for the call.

The SIP bye message shown in FIG. **52** is received at the call controller **14** and the call controller executes a process as shown generally at **910** in FIG. **53**. The process includes a first block **912** that directs the call controller processor **202** of FIG. **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 FIG. **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 FIG. **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 FIG. **54**. An RC call stop message specifically associated with the call made to the Calgary callee is shown generally at **1020** in FIG. **55**.

Referring to FIG. **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 user name, the callee field **1004** holds a PSTN-compatible number or system number, the call ID field **1006** holds the unique call identifier received from the SIP invite message shown in FIG. **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 FIG. **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 FA10 @ 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 FIG. **53**, after having produced an RC call stop message, block **920** directs the processor **202** in FIG. **7** to send the RC stop message compiled in the RC call stop message buffer to the RC **16** of FIG. **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 FIG. **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 FIGS. **56**A, **56**B and **56**C. Referring to FIG. **56**A, the RC stop message process **950** begins with a first block **952** that directs the processor **202** in FIG. **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 FIG. **41**, specifically blocks **826** or **862** thereof. If this condition is met, then block **954** of FIG. **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 FIG. **41**. If at block **952** of FIG. **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 FIG. **41**. Then, the processor is directed to block **958** of FIG. **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 FIG. **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 FIG. **39**. If this condition is satisfied, block **966** of FIG. **56**A directs the processor to set the free time field **742** in the record shown in FIG. **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 FIG. **7** was directed to block **966** which causes the free time field (**742** of FIG. **39**) to be set to zero, referring to FIG. **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 FIG. **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 FIG. **33**B. Block **976** then directs the processor to decrement the funds balance field (**740**) of the subscriber account record shown in FIG. **39** by the contents of the user cost variable calculated at block **974**.

After completing block **976** or after completing block **970** in FIG. **56**A, block **978** of FIG. **56**B directs the processor **202** of FIG. **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 FIG. **45** and the communication session time determined at block **916** in FIG. **53**. Then, block **980** of FIG. **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 FIG. **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 FIG. **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 FIG. **58** are incremented by the reseller cost calculated at block **978** of FIG. **56**B.

Still referring to FIG. **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 FIG. **7** calculate a system operator cost as the product of the system operator cost per second, as set at block **822** in FIG. **41**, and the communication session time as determined at block **916** in FIG. **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 FIG. **59**. This record includes a system operator balance field **996** holding an accumulated charges balance. Referring to FIG. **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 FIG. **56**B.

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

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

What is claimed is:

1. A method of routing communications in a system in which a first participant identifier is associated with a first participant registered with the system and wherein a second participant identifier is associated with a second participant, the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising at least one processor operably configured to execute program code stored in at least one memory, the method comprising:

in response to the first participant device initiating the communication to the second participant device, receiving the first participant identifier and the second participant identifier from the first participant device;

using the first participant identifier to locate, via the at least one processor, a first participant profile from among a plurality of participant profiles that are stored in a database, the first participant profile comprising one or more attributes associated with the first participant;

processing the second participant identifier, via the at least one processor, based on at least one of the one or more attributes from the first participant profile, to produce a new second participant identifier;

classifying the communication, via the at least one processor, using the new second participant identifier, as a first network communication if a first network classification criterion is met and as a second network communication if a second network classification criterion is met;

when the first network classification criterion is met, producing, via the at least one processor, a first network routing message, the first network routing message identifying an address in the system, the address being associated with the second participant device; and

when the second network classification criterion is met, producing, via the at least one processor, a second network routing message, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system.

2. The method of claim **1**, further comprising determining, based on at least one of the one or more attributes, whether a third network classification criterion is met, and when the third network classification criterion is met, producing an error message that prevents the communication from being established.

3. The method of claim **2**, further comprising:

updating the first participant profile to cause at least one of the one or more attributes to be modified.

4. The method of claim **2**, wherein the classifying comprises:

causing a database of records to be searched with the new second participant identifier.

5. The method of claim **4**, wherein the classifying further comprises:

classifying the communication as the first network communication if a record is found in the database and classifying the communication as the second network communication if the record is not found in the database.

6. The method of claim **2**, wherein if the third network classification criterion is met, the error message is sent to a call controller.

7. The method of claim **1**, wherein the processing comprises:

comparing at least one of the one or more attributes from the first participant profile with at least a portion of the second participant identifier.

8. The method of claim **7**, wherein the comparing comprises at least one of:

determining whether the second participant identifier includes a portion that matches an international dialing digit (IDD) associated with the first participant profile;

determining whether the second participant identifier includes a portion that matches a national dialing digit (NDD) associated with the first participant profile;

determining whether the second participant identifier includes a portion that matches an area code associated with the first participant profile; and

determining whether the second participant identifier has a length within a range specified in the first participant profile.

9. The method of claim **1**, wherein the system comprises an IP network and the first participant device is in data communication with the IP network, wherein the first network routing message causes the communication to take place entirely over the IP network, and wherein the network external to the system is a circuit switched network.

10. The method of claim **9**, wherein the first network routing message identifies a first IP address, and wherein the second network routing message identifies a second IP address.

11. The method of claim **9**, further comprising:

updating the first participant profile to cause at least one of the one or more attributes to be modified.

12. The method of claim **1**, wherein the second participant identifier is a plurality of dialing digits.

13. The method of claim **1**, wherein the processing comprises at least one of:

removing an international dialing digit (IDD) from the second participant identifier;

removing a national dialing digit (NDD) from the second participant identifier and prepending a first participant country code to the second participant identifier;

prepending a first participant country code to the second participant identifier; and

prepending a first participant country code and area code to the second participant identifier.

14. The method of claim **1**, wherein the classifying comprises:

causing a database of records to be searched with the new second participant identifier and determining whether the second participant is registered with the system.

15. The method of claim **14**, wherein the classifying further comprises:

classifying the communication as the first network communication if a record is found in the database and classifying the communication as the second network communication if the record is not found in the database.

16. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **14**.

17. The method of claim **1**, wherein the new second participant identifier is in a pre-defined format.

18. The method of claim **17**, wherein the pre-defined format comprises a number compliant with an E.164 international standard.

19. The method of claim **1**, wherein if the first network classification criterion is met, the second participant is registered with the system.

20. The method of claim **1** further comprising registering the second participant with the system including storing a second participant profile comprising one or more attributes associated with the second participant in the plurality of participant profiles that are stored in the database.

21. A method of routing communications in a system in which a first participant identifier is associated with a first participant registered with the system and wherein a second participant identifier is associated with a second participant, the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising at least one processor operably configured to execute program code stored in at least one memory, the method comprising:

in response to the first participant device initiating the communication to the second participant device, receiving the first participant identifier and the second participant identifier from the first participant device;

using the first participant identifier to locate, via the at least one processor, a first participant profile from among a plurality of participant profiles that are stored in a database, the first participant profile comprising one or more attributes associated with the first participant;

when at least one of the one or more attributes and at least a portion of the second participant identifier meet a first network classification criterion, producing, via the at least one processor, a first network routing message, the first network routing message identifying an address in the system, the address being associated with the second participant device;

when at least one of the one or more attributes and at least a portion of the second participant identifier meet a second network classification criterion, producing, via the at least one processor, a second network routing message, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system; and

when at least one of the one or more attributes meets a third network classification criterion, producing, via the at least one processor, an error message and causing prevention of the communication from being established.

22. The method of claim **21**, wherein the system comprises an IP network and the first participant device is in data communication with the IP network, wherein the first network routing message identifies a first IP address, wherein the second network routing message identifies a second IP address, wherein the first network routing message causes the communication to take place entirely over the IP network, and wherein the network external to the system is a circuit switched network.

23. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **22**.

24. The method of claim **21**, further comprising:

updating the first participant profile to cause at least one of the one or more attributes to be modified.

25. A system for routing communications in which a first participant is registered with the system and has an associated first participant identifier and wherein a second participant has an associated second participant identifier, the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising:

a controller comprising:

at least one processor operably configured to access at least one memory, wherein the at least one processor is operably configured to:

in response to the first participant device initiating the communication, receive the first participant identifier and the second participant identifier from the first participant device;

locate, using the first participant identifier, a first participant profile from among a plurality of participant profiles that are stored in a database, the first participant profile comprising one or more attributes associated with the first participant;

process the second participant identifier, based on at least one of the one or more attributes, to produce a new second participant identifier;

classify the communication, using the new second participant identifier, as a first network communication if a first network classification criterion is met and as a second network communication if a second network classification criterion is met;

produce a first network routing message when a first network classification criterion is met, the first network routing message identifying an address in the system, the address being associated with the second participant device; and

produce a second network routing message when the second network classification criterion is met, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system.

26. The system of claim **25**, wherein the at least one processor is further operably configured to determine, based on at least one of the one or more attributes, if a third network classification criterion is met, and when the third network classification criterion is met, the at least one processor is further operably configured to produce an error message that causes prevention of the communication from being established.

27. The system of claim **26**, wherein the at least one processor is further operably configured to:

update the first participant profile to cause at least one of the one or more attributes to be modified.

28. The system of claim **26**, wherein the at least one processor is operably configured to:

cause a database of records to be searched using the new second participant identifier and determine whether the second participant is registered with the system.

29. The system of claim **28**, wherein the at least one processor is further operably configured to:

classify the communication as the first network communication if a record is found in the database and classify the communication as the second network communication if the record is not found in the database.

30. The system of claim **25**, wherein the at least one processor is operably configured to:

compare at least one of the one or more attributes with at least a portion of the second participant identifier.

31. The system of claim **30**, wherein the at least one processor is operably configured to perform at least one of:

determine whether the second participant identifier includes a portion that matches an international dialing digit (IDD) associated with the first participant profile;

determine whether the second participant identifier includes a portion that matches a national dialing digit (NDD) associated with the first participant profile;

determine whether the second participant identifier includes a portion that matches an area code associated with the first participant profile; and

determine whether the second participant identifier has a length within a range specified in the first participant profile.

32. The system of claim **25**, wherein the system comprises an IP network and the first participant device is in data communication with the IP network, wherein the first network routing message causes the communication to take place entirely over the IP network, and wherein the network external to the system is a circuit switched network.

33. The system of claim **32**, wherein the first network routing message identifies a first IP address, and wherein the second network routing message identifies a second IP address.

34. The system of claim **25**, wherein the second participant identifier is a plurality of dialing digits.

35. The system of claim **25**, wherein the at least one processor is further operably configured to:

update the first participant profile to cause at least one of the one or more attributes to be modified.

36. The system of claim **25**, wherein the at least one processor is operably configured to perform at least one of:

remove an international dialing digit (IDD) from the second participant identifier;

remove a national dialing digit (NDD) from the second participant identifier and prepend a first participant country code to the second participant identifier;

prepend a first participant country code to the second participant identifier; and

prepend a first participant country code and area code to the second participant identifier.

37. The system of claim **25**, wherein the at least one processor is operably configured to:

cause a database of records to be searched using the new second participant identifier.

38. The system of claim **37**, wherein the at least one processor is further operably configured to:

classify the communication as the first network communication if a record is found in the database and classify the communication as the second network communication if the record is not found in the database.

39. The system of claim **25**, wherein the new second participant identifier is in a pre-defined format.

40. The system of claim **39**, wherein the pre-defined format comprises a number compliant with an E.164 international standard.

41. The system of claim **25**, wherein if the first network classification criterion is met, the second participant is registered with the system.

42. The system of claim **25**, wherein the controller is further operably configured to register the second participant with the system including to store a second participant profile in the plurality of participant profiles that are stored in the database.

43. A system for routing communications in which a first participant is registered with the system and has an associated first participant identifier and wherein a second participant has an associated second participant identifier, the first participant being associated with a first participant device operable to establish a communication using the system to a second participant device associated with the second participant, the system comprising:

a controller having at least one processor operably configured to access at least one memory storing program code that, when executed, operably configures the controller to:

in response to the first participant device initiating the communication, receive the first participant identifier and the second participant identifier from the first participant device;

locate, using the first participant identifier, a first participant profile from among a plurality of participant profiles that are stored in a database, the first participant profile comprising one or more attributes associated with the first participant;

produce a first network routing message when at least one of the one or more attributes and at least a portion of the second participant identifier meet a first network classification criterion, the first network routing message identifying an address in the system, the address being associated with the second participant device;

produce a second network routing message when at least one of the one or more attributes and at least a portion of the second participant identifier meet a second network classification criterion, the second network routing message identifying an address associated with a gateway to a network external to the system, wherein the second network classification criterion is met if the second participant is not registered with the system; and

produce an error message when at least one of the one or more attributes meets a third network classification criterion, the error message preventing the communication from being established.

44. The system of claim **43**, wherein the system comprises an IP network and the first participant device is in data communication with the IP network, wherein the first network routing message identifies a first IP address, and wherein the second network routing message identifies a second IP address, wherein the first network routing message causes the communication to take place entirely over the IP network, and wherein the network external to the system is a circuit switched network.

45. The system of claim **43**, wherein the at least one processor is further operably configured to:

update the first participant profile to cause at least one of the one or more attributes to be modified.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,537,762 B2
APPLICATION NO. : 14/877570
DATED : January 3, 2017
INVENTOR(S) : Clay Perreault et al.

Page 1 of 2

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

On the Title Page

In Column 2 (page 6, item (56)) at Line 18, Under Other Publications, change “23,840” to --23.840--.

In Column 2 (page 7, item (56)) at Line 35, Under Other Publications, change “Talktone” to --Talkatone--.

In Column 1 (page 8, item (56)) at Line 27, Under Other Publications, change “ViOP” to --VoIP--.

In Column 1 (page 8, item (56)) at Line 29, Under Other Publications, change “Oct. 1, 2003, Oct. 1, 2003,” to --Oct. 1, 2003,--.

In Column 1 (page 8, item (56)) at Line 61, Under Other Publications, change “Feb. 1, 2002, No. 3, Feb. 1, 2002,” to --No. 3, Feb. 1, 2002,--.

In Column 2 (page 8, item (56)) at Line 28, Under Other Publications, change “subcriber” to --subscriber--.

In the Drawings

Sheet 6 of 32 (Reference Numeral 271, FIG. 8A) at Line 3, Change “dialling” to --dialing--.

Sheet 7 of 32 (Reference Numeral 408, FIG. 8B) at Line 5, Change “E164” to --E.164--.

Sheet 7 of 32 (Reference Numeral 410, FIG. 8A) at Line 2, Change “E164” to --E.164--.

Sheet 12 of 32 (Reference Numeral 274, FIG. 13) at Line 1, Change “E164#” to --E.164#--.

Sheet 13 of 32 (Reference Numeral 354, FIG. 15) at Line 1, Change “Suppller” to --Supplier--.

Signed and Sealed this
Sixth Day of June, 2017

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office

CERTIFICATE OF CORRECTION (continued)
U.S. Pat. No. 9,537,762 B2

In the Specification

In Column 6 at Line 28, Change “the a” to --the--.

In Column 18 at Line 4, After “etc.)” insert --.--.

In Column 24 at Line 45, Change “411” to --410--.

EXHIBIT 2

US009813330B2

(12) **United States Patent**
Perreault et al.

(10) **Patent No.: US 9,813,330 B2**
(45) **Date of Patent: *Nov. 7, 2017**

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(54) **PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS**

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

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/396,344**

(22) Filed: **Dec. 30, 2016**

(65) **Prior Publication Data**

US 2017/0111265 A1 Apr. 20, 2017

Related U.S. Application Data

(63) Continuation of application No. 14/877,570, filed on Oct. 7, 2015, now Pat. No. 9,537,762, which is a

(Continued)

(51) **Int. Cl.**

H04L 12/725	(2013.01)
H04Q 3/70	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04L 45/3065*** (2013.01); ***H04M 3/4211*** (2013.01); ***H04M 7/006*** (2013.01); ***H04M 7/0075*** (2013.01); ***H04Q 3/70*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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Primary Examiner — Kodzovi Acolatse

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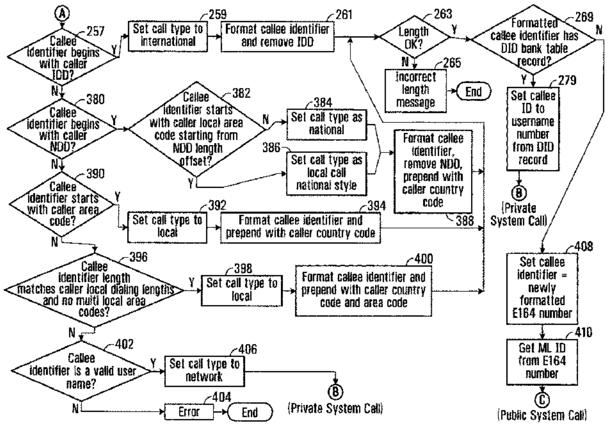
(57) **ABSTRACT**

A process and apparatus to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated is disclosed. In response to initiation of a call by a calling subscriber, a caller identifier and a callee identifier are received. Call classification criteria associated with the caller identifier are used to classify the call as a public network call or a private network call. A routing message identifying an address, on the private network, associated with the callee is produced when the call is classified as a private network call and a routing message identifying a

(Continued)



gateway to the public network is produced when the call is classified as a public network call.

40 Claims, 32 Drawing Sheets

Related U.S. Application Data

continuation of application No. 13/966,096, filed on Aug. 13, 2013, now Pat. No. 9,179,005, which is a continuation of application No. 12/513,147, filed as application No. PCT/CA2007/001956 on Nov. 1, 2007, now Pat. No. 8,542,815.

(60) Provisional application No. 60/856,212, filed on Nov. 2, 2006.

(51) **Int. Cl.**
H04M 3/42 (2006.01)
H04M 7/00 (2006.01)

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Document Title: Complaint for Patent Infringement [Jury Demand]; Case Title: *VoIP.Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Verizon Wireless Services, LLC*, a Delaware limited liability corporation; *Verizon Communications, Inc.*, a Delaware corporation; *AT&T, Inc.*, a Delaware corporation; *AT&T Corp.*, a Delaware corporation; and *DOES I through X*, inclusive, Defendants; Case No: 2:16-CV-00271; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Exhibit E; Chart 1 to Exhibit E; Chart 2 to Exhibit E; Chart 3 to Exhibit E; Chart 4 to Exhibit E; Chart 5 to Exhibit E; Chart 6 to Exhibit E; Exhibit F; Chart 1 to Exhibit F; Chart 2 to Exhibit F; Chart 3 to Exhibit F; Chart 4 to Exhibit F; Chart 5 to Exhibit F; Chart 6 to Exhibit F; Exhibit G; Exhibit H; and Addendum 1 to Exhibit H.

Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *VoIP.Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Apple, Inc.*, a California corporation; Defendants; Case No: 2:16-CV-00260; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Chart 1 to Exhibit D; Chart 2 to Exhibit D; Chart 3 to Exhibit D; Chart 4 to Exhibit D; Exhibit E; Exhibit F; and Addendum 1 to Exhibit F.

Letter dated Nov. 30, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Apple Inc. in the U.S.

Letter dated Dec. 1, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Verizon Communications in the U.S.

Letters dated Dec. 18, 2015, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Airtel in India; Alcatel-Lucent in France; Avaya Inc. in the U.S.; AT&T in the U.S.; Blackberry in Canada; Cable One in the U.S.; CenturyLink in the U.S.; Charter Communications in the U.S.; Cisco Systems in the U.S.; Comcast in the U.S.; Cox Communications in the U.S.; Cricket Wireless in the

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Letters dated Jan. 4, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Rogers Communications Inc. in Canada; Shaw Cable in Canada; Walmart in Alaska; and WIND Mobile in Canada.

Letters dated Jan. 21, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Alibaba (China) Co., Ltd in China; Comwave Telecommunications in Canada; and Intel in the U.S.

Letters dated Feb. 2, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. No. 9,179,005 and U.S. Pat. No. 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Netflix Inc. in the U.S.; Skype Technologies in the U.S.; and WhatsApp Inc. in the U.S.

Document Title: Petition for Inter Partes Review of U.S. Pat. No. 8,542,815; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc.*, Petitioner v. *VoIP-Pal.com Inc.*, Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Dated May 24, 2016. 64 sheets.

Document Title: Declaration of Michael Caloyannides; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc.*, Petitioner v. *VoIP-Pal.com Inc.*, Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Signed May 23, 2016; filed May 24, 2016. 84 sheets.

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Document Title: A Brief History of VoIP; Document One—The Past; Joe Hallock; joe@sitedifference.com; date on cover page: Nov. 26, 2004; Evolution and Trends in Digital Media Technologies—COM 538; Masters of Communication in Digital Media; University of Washington. 17 sheets.

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Document Title: VoIP-PAL, The World is Calling!, "Over $7 Billion in Lawsuits File by *Voip-Pal.com Inc.* vs *Apple, Verizon and AT&T* for Various Patent Infringements," *Business Wire®, A Berkshire Hathaway Company*, Feb. 11, 2016. 2 sheets.

Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *VoIP-Pal.com Inc.*, Patent Owner; Case No. TBD, U.S. Pat. No. 9,179,005; Petition for Inter Partes Review of U.S. Pat. No. 9,179,005; Dated Jun. 15, 2016. 70 sheets.

Document Title: In the United States Patent and Trademark Office; Petition for Inter Partes Review Pursuant to 37 C.F.R. §42.100 ET SEQ.; in re U.S. Pat. No. 9,179,005; Currently in Litigation Styled: *VoIP-Pal.com, Inc.* v. *Apple Inc.*, Case No: 2:16-cv-00260-RFB-VCF; Issued: Nov. 3, 2015; Application Filed: Aug. 13, 2013; Applicant: Clay Perreault, et al.; Title: Producing Routing Messages for Voice Over IP Communications; Declaration of Henry H. Houh, PhD; Signed Jun. 14, 2016. 143 sheets.

Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *VoIP-Pal.com Inc.*, Patent Owner; Case No. TBD, U.S. Pat. No. 8,542,815; Petition for Inter Partes Review of U.S. Pat. No. 8,542,815; Dated Jun. 15, 2016. 67 sheets.

Document Title: In the United States Patent and Trademark Office; Petition for Inter Partes Review Pursuant to 37 C.F.R. §42.100 ET SEQ.; In re U.S. Pat. No. 8,542,815; Currently in Litigation Styled: *VoIP-Pal.com, Inc.* v. *Apple Inc.*, Case No: 2:16-cv-00260-RFB-VCF; Issued: Sep. 24, 2013; Application Filed: Nov. 1, 2007; Applicant: Clay Perreault, et al.; Title: Producing Routing Messages for Voice Over IP Communications; Declaration of Henry H. Houh, PhD; Signed Jun. 14, 2016. 143 sheets.

Complaint for Patent Infringement, United States District Court, District of Nevada, Case No.: 2:16-cv-2338, *VoIP-Pal.com Inc.*, a Nevada corporation, Plaintiff v. *Twitter, Inc.*, a California corporation, Defendant, Filed Oct. 6, 2016, 8 pages.

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Exhibit B, Case 2:16-cv-02338-RFB-CWH, Filed Oct. 6, 2016, U.S. Pat. No. 9,179,005 B2, Issued Nov. 3, 2015, to Clay Perrault et al., 63 pages.

Exhibit C, Case 2:16-cv-02338-RFB-CWH, Filed Oct. 6, 2016, Letter dated Dec. 18, 2015 giving notice of U.S. Pat. No. 8,542,815 B2; U.S. Pat. No. 9,179,005 B2; and related Patents listed in Attachment A, 4 pages.

Exhibit D, Case 2:16-cv-02338-RFB-CWH, Filed Oct. 6, 2016, Asserted Claims and Infringement Conditions, United States District Court, District of Nevada, *VoIP-Pal.com Inc.*, a Nevada corporation, Plaintiff v. *Twitter, Inc.*, a California corporation, Defendants, 6 pages.

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Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *VoIP-*

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Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *VoIP-Pal.com Inc.*, Patent Owner, Case No. IPR2016-01198, U.S. Pat. No. 9,179,005; Patent Owner Objections to Apple Evidence Served With Petitioner's Reply, Filed on behalf of Patent Owner Voip-Pal.com Inc., Filed: May 24, 2017, 6 pages.

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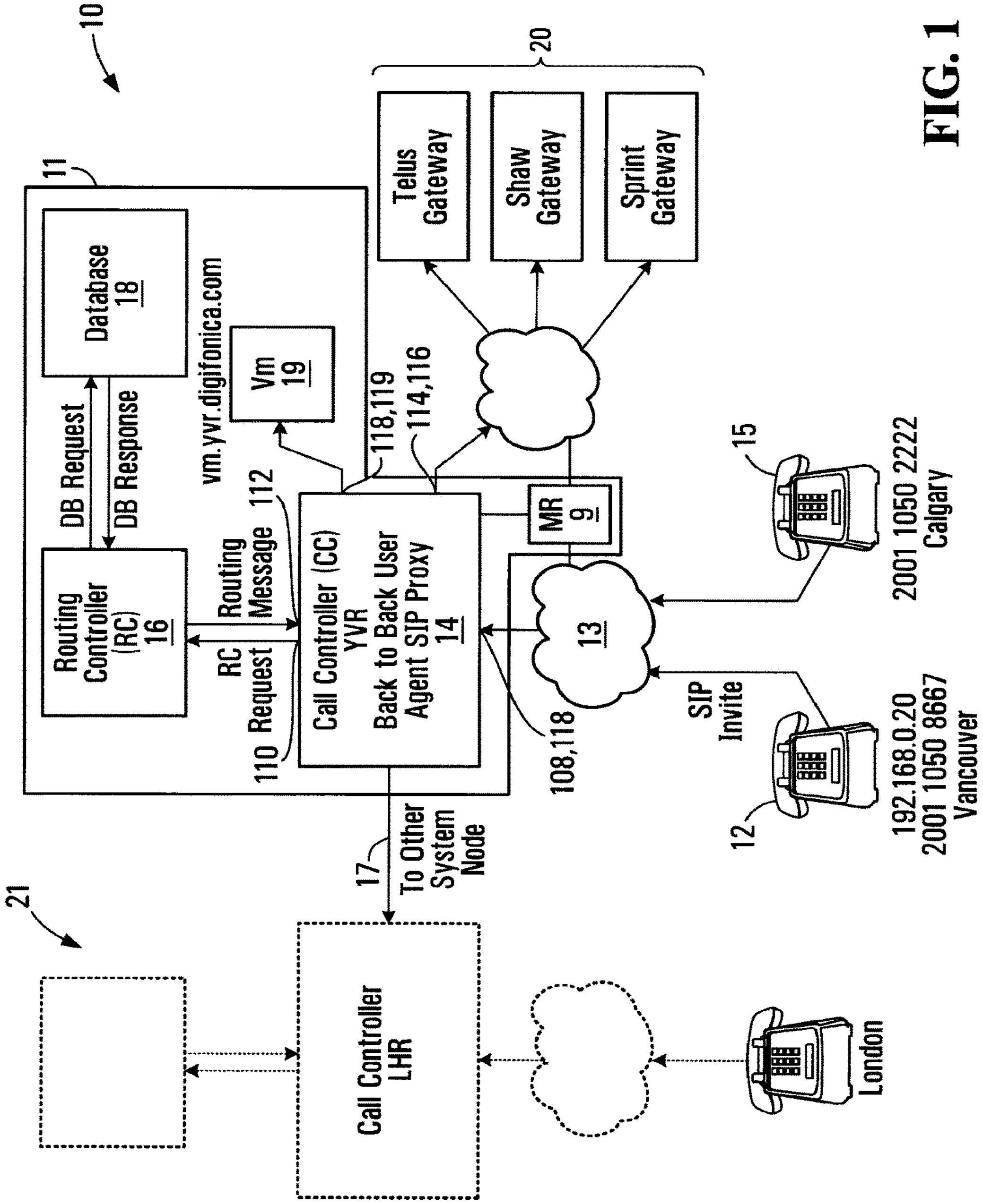

10
11
Database
18
DB Request
DB Response
Routing
Controller
(RC)
16
vm.yvr.digifonica.com
Vm
19
RC
Request
110
Routing
Message
112
Call Controller (CC)
YVR
Back to Back User
Agent SIP Proxy
14
118,119
114,116
MR
9
108,118
13
20
Telus
Gateway
Shaw
Gateway
Sprint
Gateway
15
2001 1050 2222
Calgary
SIP
Invite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

FIG. 1

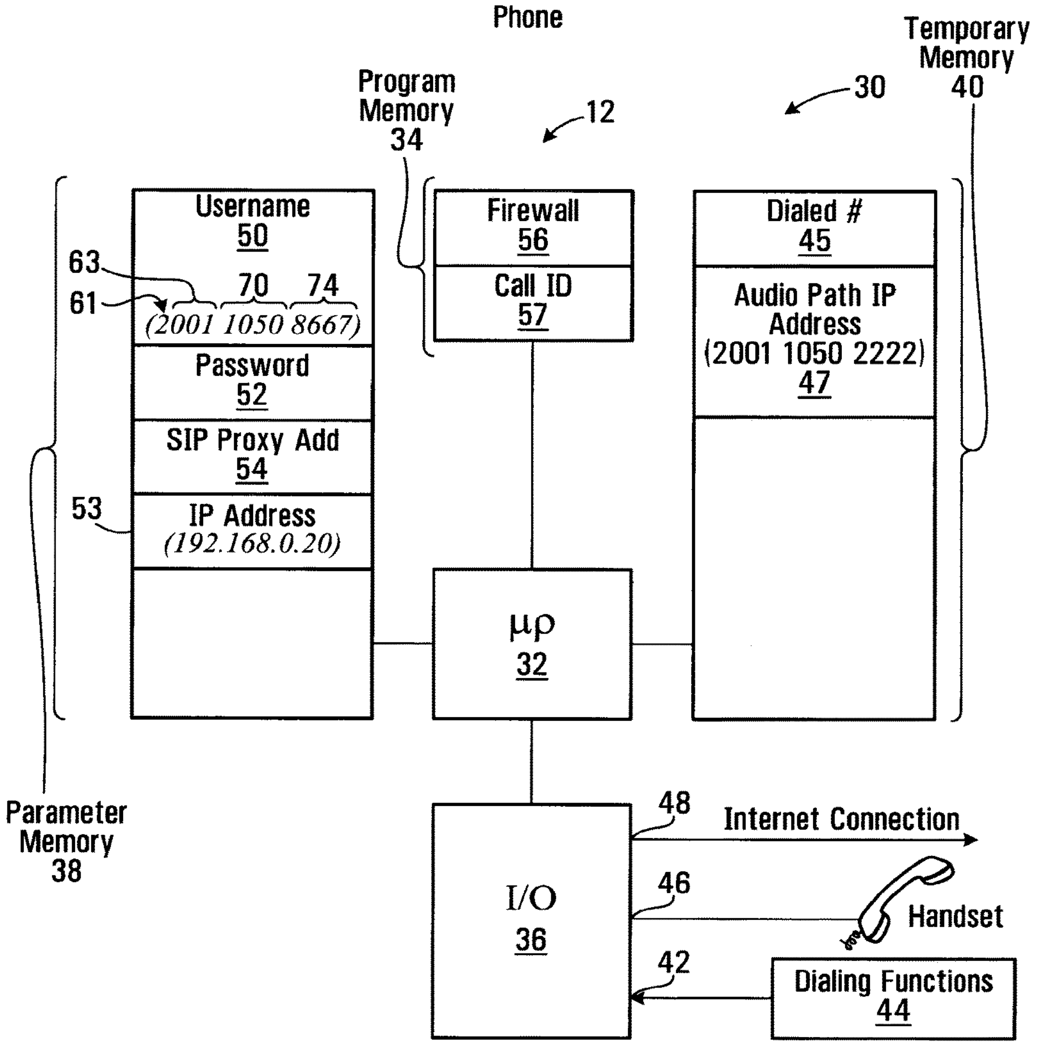

Phone
Program Memory 34
12
30
Temporary Memory 40
Username 50
63
61
70
74
(2001 1050 8667)
Password 52
SIP Proxy Add 54
53
IP Address (192.168.0.20)
Firewall 56
Call ID 57
Dialed # 45
Audio Path IP Address (2001 1050 2222) 47
μp 32
Parameter Memory 38
I/O 36
48
Internet Connection
46
Handset
42
Dialing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

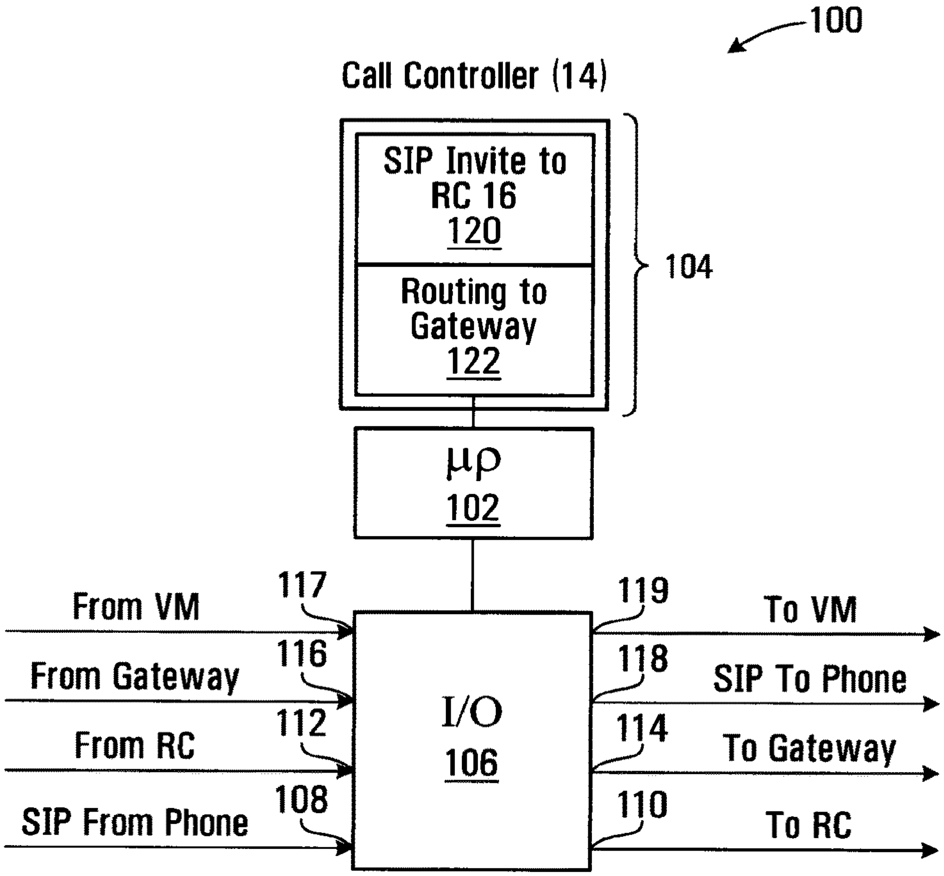


FIG. 4

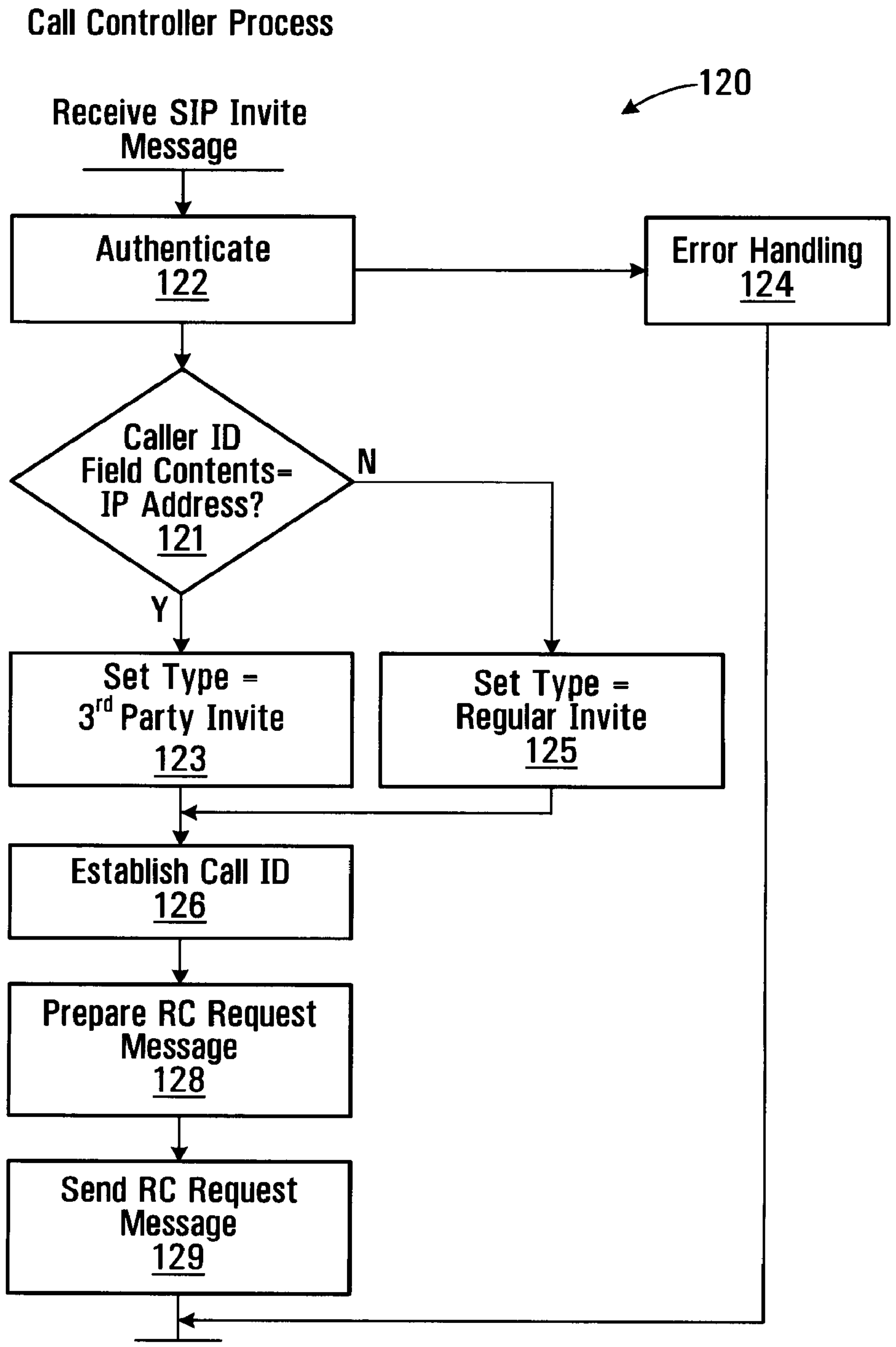

Call Controller Process
120
Receive SIP Invite Message
Authenticate 122
Error Handling 124
Caller ID Field Contents= IP Address? 121
N
Y
Set Type = 3rd Party Invite 123
Set Type = Regular Invite 125
Establish Call ID 126
Prepare RC Request Message 128
Send RC Request Message 129

FIG. 5

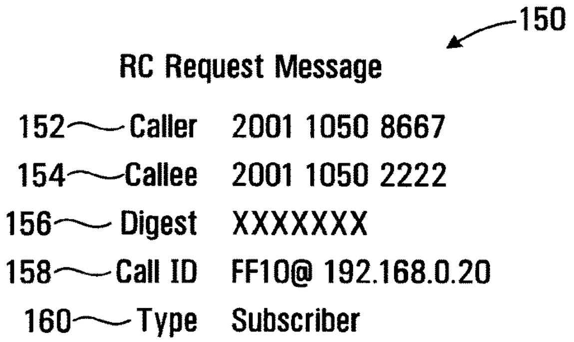

150
RC Request Message
152 Caller 2001 1050 8667
154 Callee 2001 1050 2222
156 Digest XXXXXXX
158 Call ID FF10@ 192.168.0.20
160 Type Subscriber

FIG. 6

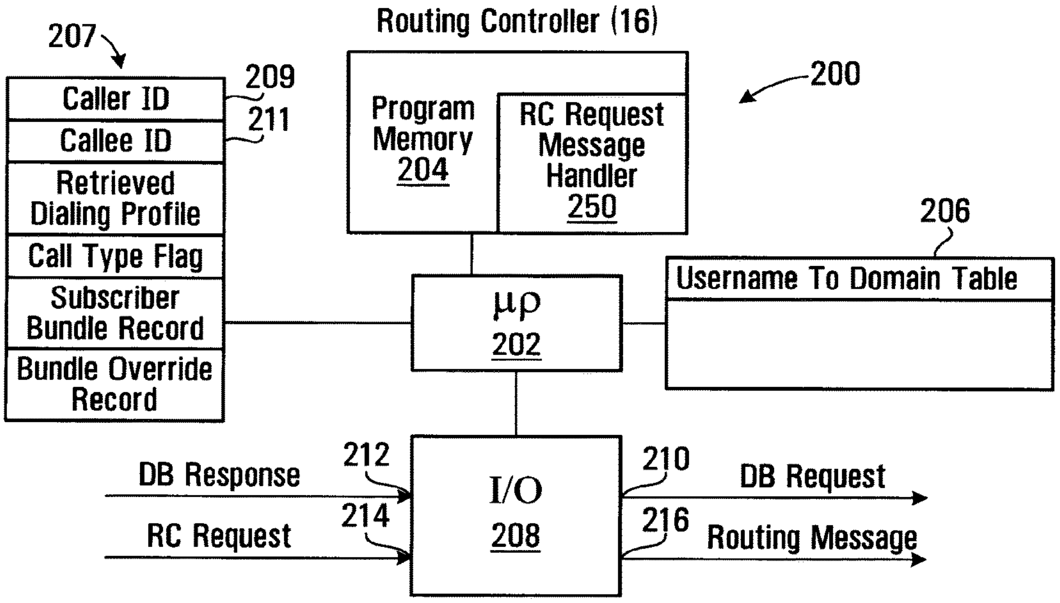

Routing Controller (16)
207
Caller ID
Callee ID
Retrieved Dialing Profile
Call Type Flag
Subscriber Bundle Record
Bundle Override Record
209
211
Program Memory 204
RC Request Message Handler 250
200
206
Username To Domain Table
μp 202
I/O 208
DB Response
212
RC Request
214
210
DB Request
216
Routing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

FIG. 7

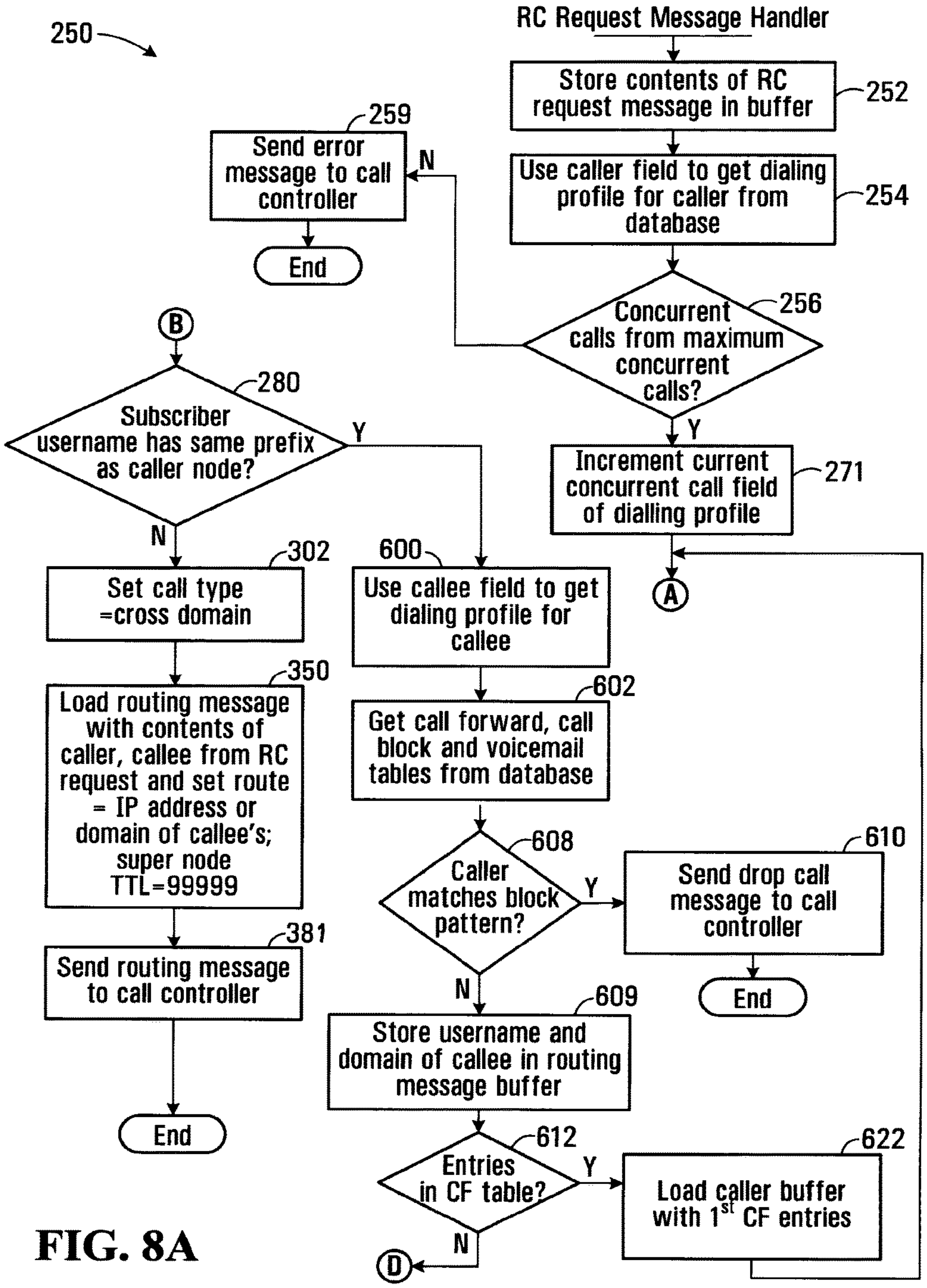

250
RC Request Message Handler
Store contents of RC request message in buffer
252
Use caller field to get dialing profile for caller from database
254
Concurrent calls from maximum concurrent calls?
256
N
Send error message to call controller
259
End
Y
Increment current concurrent call field of dialling 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
600
Use callee field to get dialing profile for callee
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

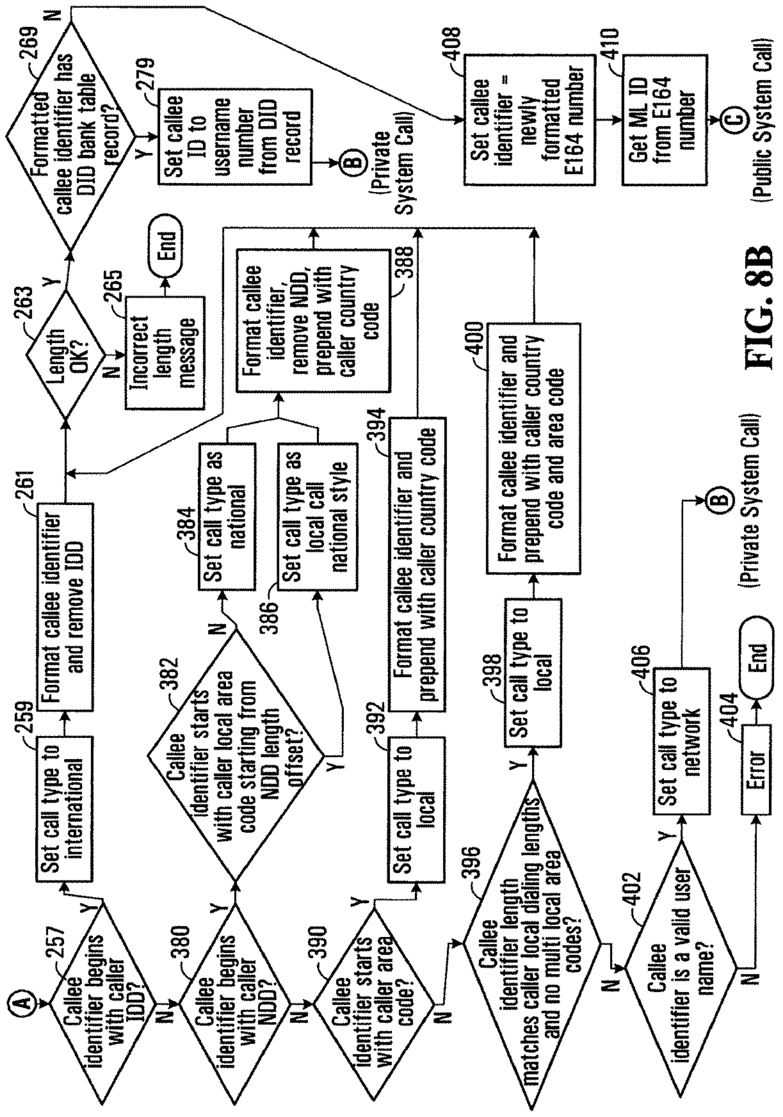

A
257
Callee identifier begins with caller IDD?
Y
N
259
Set call type to international
261
Format callee identifier and remove IDD
263
Length OK?
Y
N
265
Incorrect length message
End
269
Formatted callee identifier has DID bank table record?
Y
N
279
Set callee ID to username number from DID record
B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

FIG. 8B

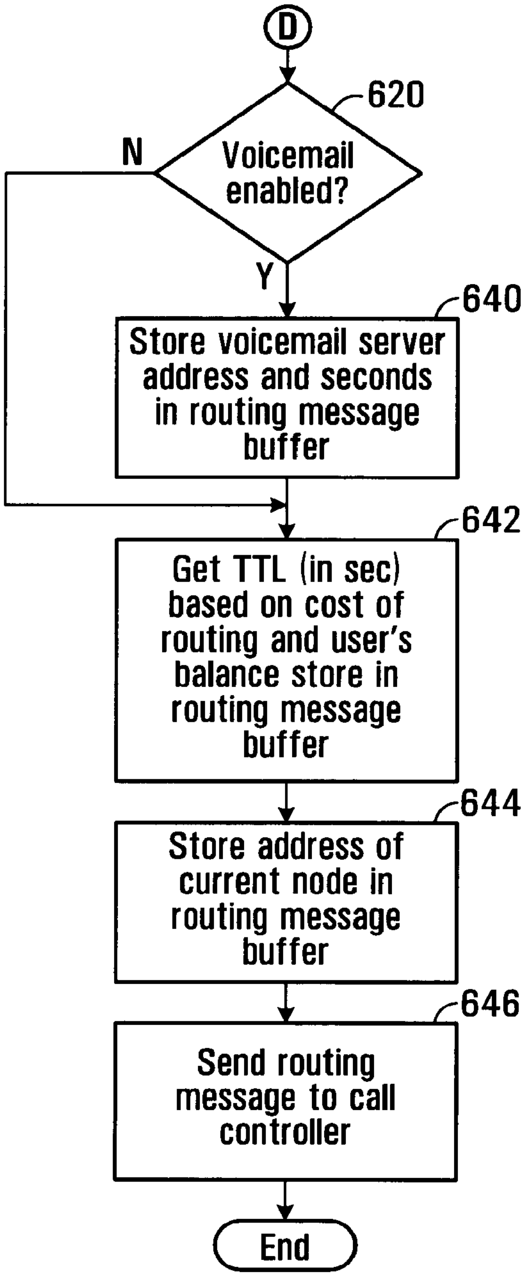

D
620
Voicemail enabled?
N
Y
640
Store voicemail server address and seconds in routing message buffer
642
Get TTL (in sec) based on cost of routing and user's balance store in routing message buffer
644
Store address of current node in routing message buffer
646
Send routing message to call controller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

FIG. 8C

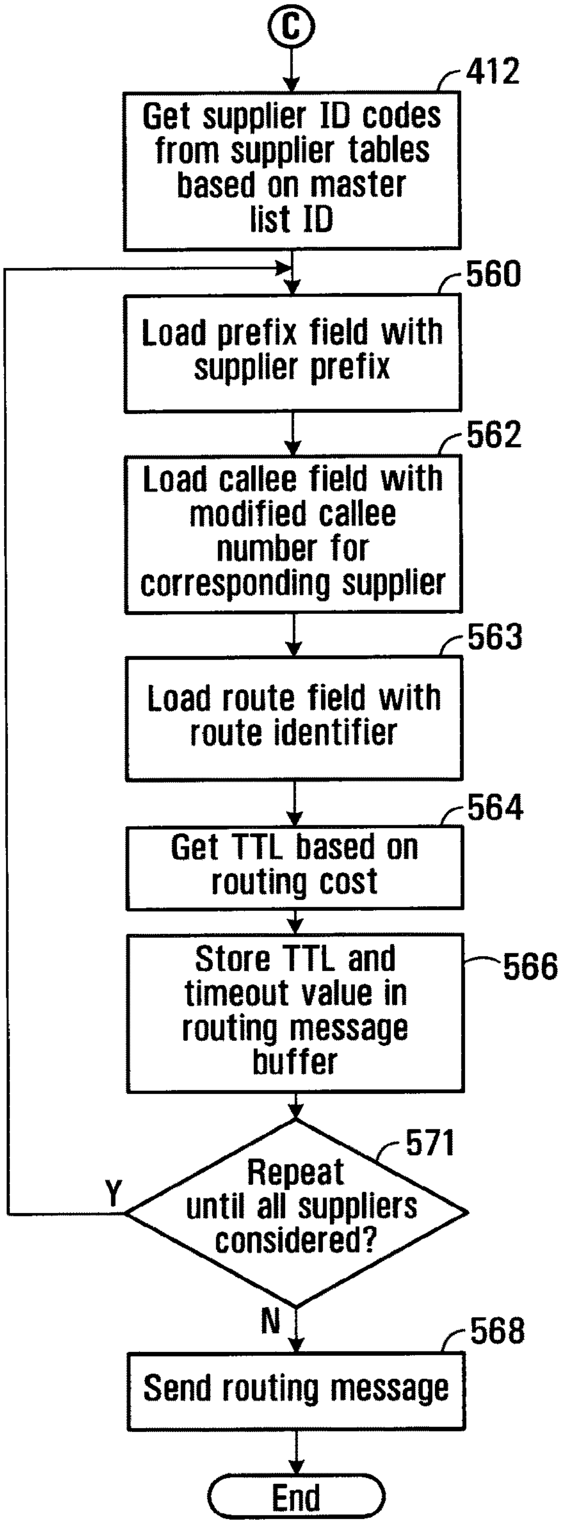

C
412
Get supplier ID codes from supplier tables based on master list ID
560
Load prefix field with supplier prefix
562
Load callee field with modified callee number for corresponding supplier
563
Load route field with route identifier
564
Get TTL based on routing cost
566
Store TTL and timeout value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

FIG. 8D

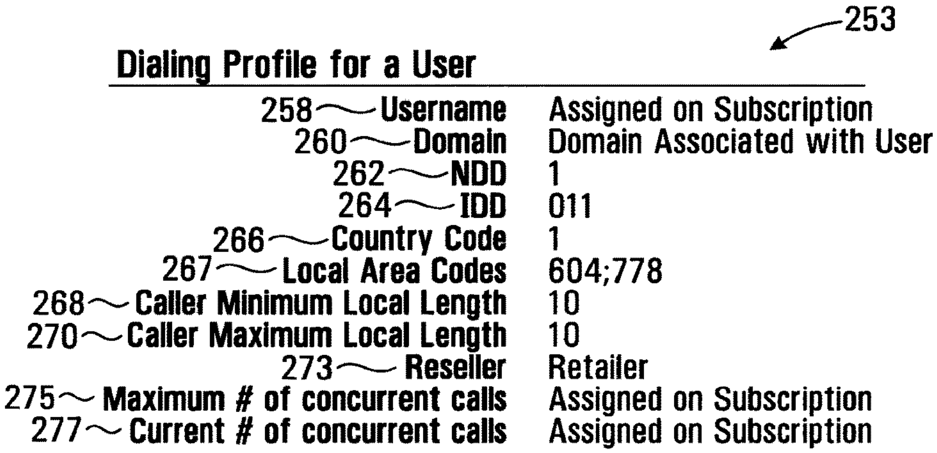

253
Dialing Profile for a User
258 Username Assigned on Subscription
260 Domain Domain Associated with User
262 NDD 1
264 IDD 011
266 Country Code 1
267 Local Area Codes 604;778
268 Caller Minimum Local Length 10
270 Caller Maximum Local Length 10
273 Reseller Retailer
275 Maximum # of concurrent calls Assigned on Subscription
277 Current # of concurrent calls Assigned on Subscription

FIG. 9

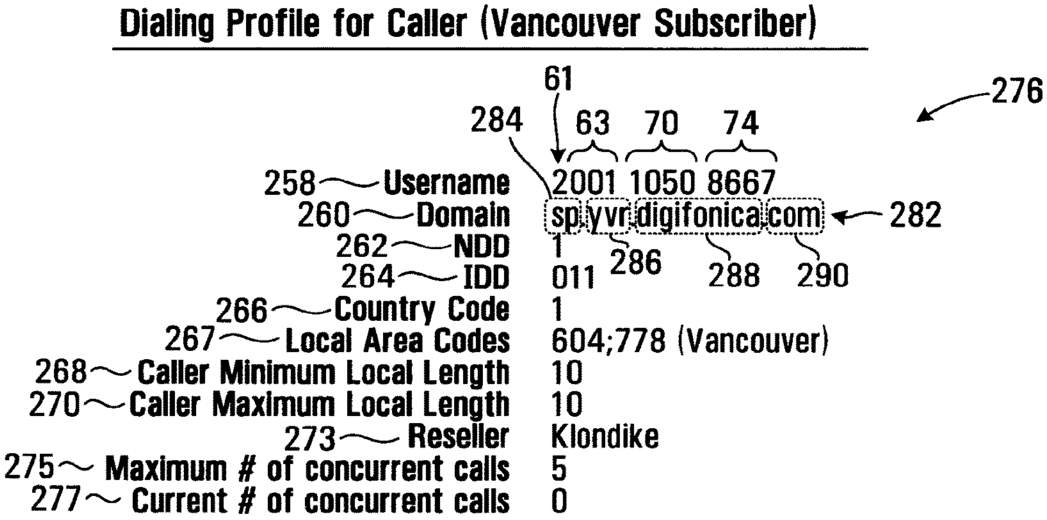

Dialing Profile for Caller (Vancouver Subscriber)
276
61
284
63
70
74
258 Username 2001 1050 8667
260 Domain sp.yvr.digifonica.com
282
262 NDD 1
286
288
290
264 IDD 011
266 Country Code 1
267 Local Area Codes 604;778 (Vancouver)
268 Caller Minimum Local Length 10
270 Caller Maximum Local Length 10
273 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

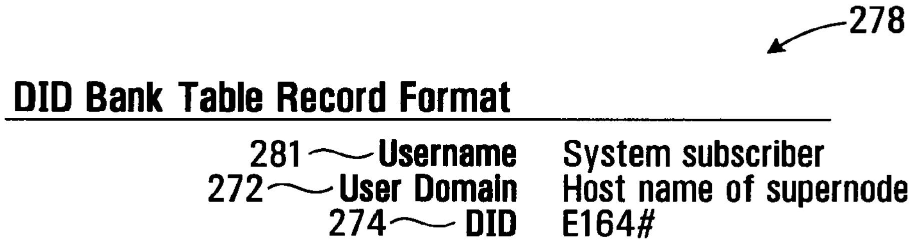

278
DID Bank Table Record Format
281 Username System subscriber
272 User Domain Host name of supernode
274 DID E164#

FIG. 13

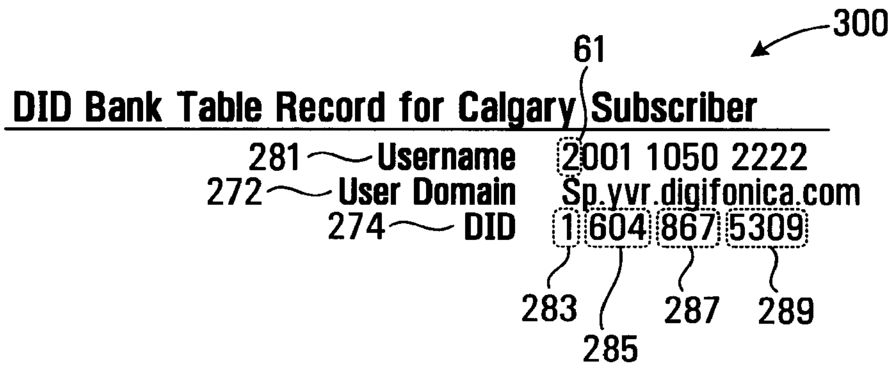

300
61
DID Bank Table Record for Calgary Subscriber
281 Username 2001 1050 2222
272 User Domain Sp.yvr.digifonica.com
274 DID 1 604 867 5309
283
285
287
289

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

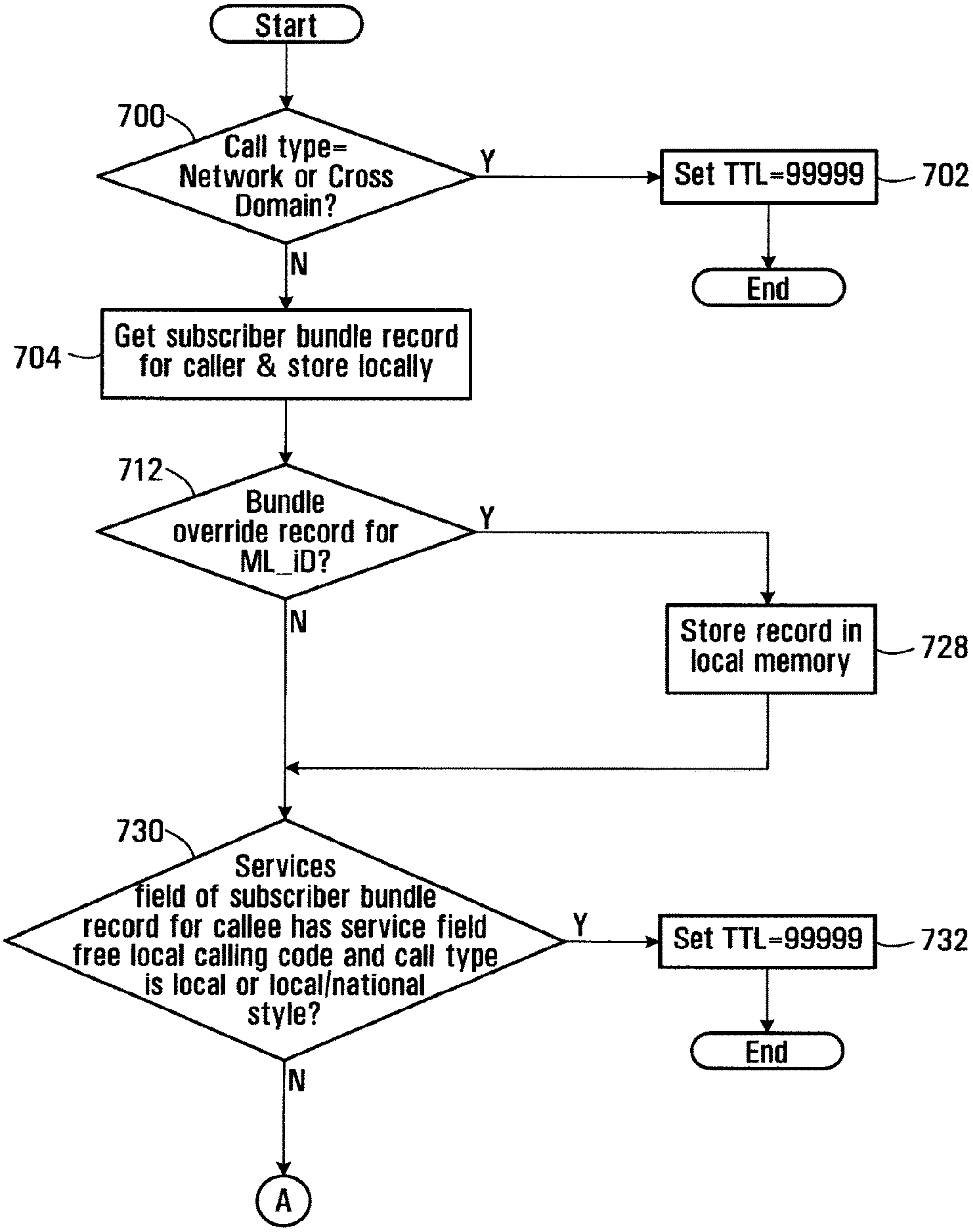

Start
700
Call type= Network or Cross Domain?
Y
Set TTL=99999
702
End
N
704
Get subscriber bundle record for caller & store locally
712
Bundle override record for ML_iD?
Y
Store record in local memory
728
N
730
Services field of subscriber bundle record for callee has service field free local calling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

FIG. 33A

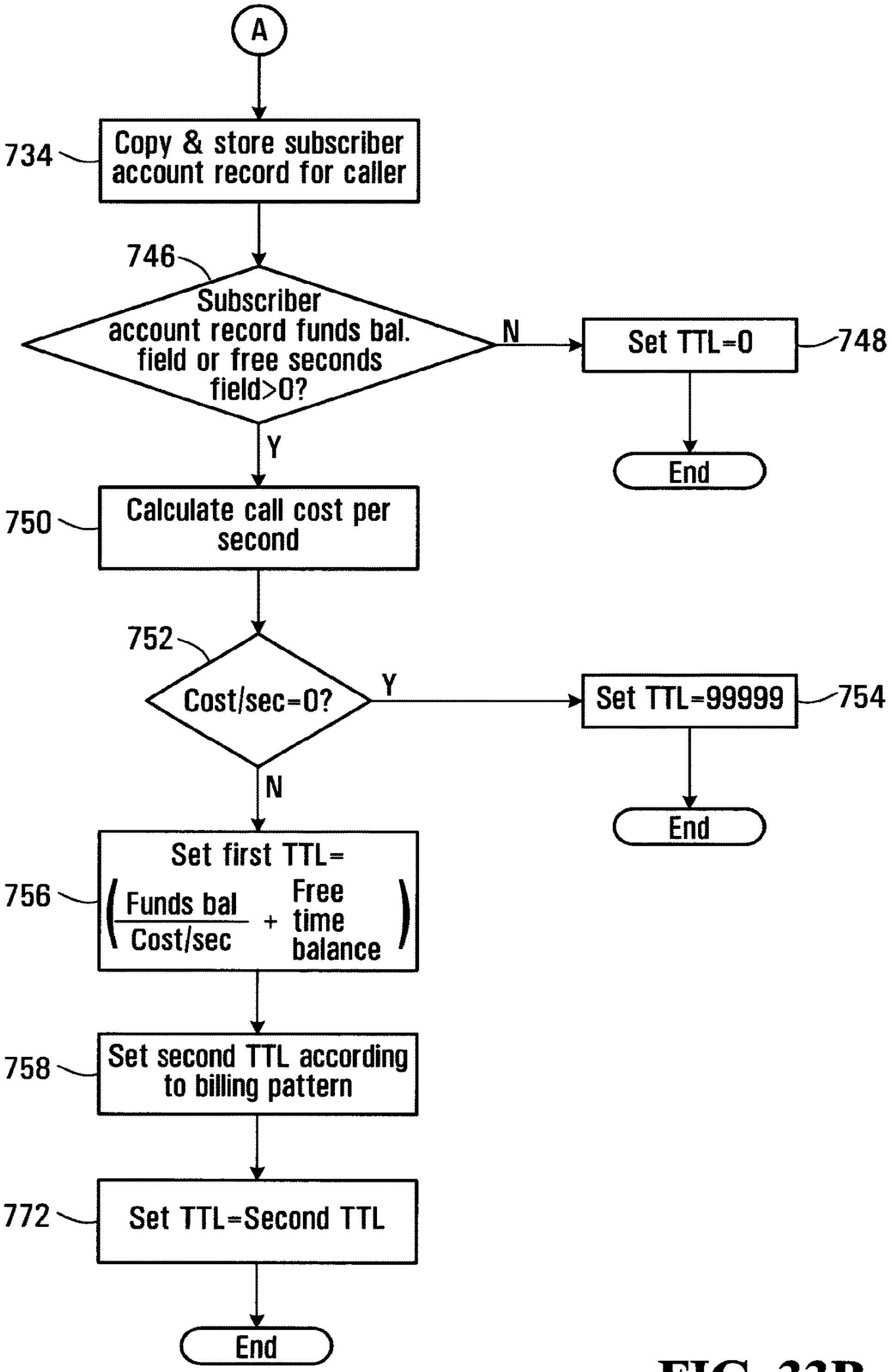
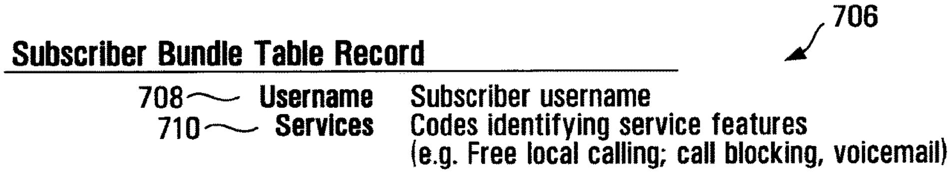

A
734
Copy & store subscriber account record for caller
746
Subscriber account record funds bal. field or free seconds field>0?
N
Set TTL=0
748
End
Y
750
Calculate call cost per second
752
Cost/sec=0?
Y
Set TTL=99999
754
End
N
756
Set first TTL= (Funds bal / Cost/sec + Free time balance)
758
Set second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

FIG. 33B



706

Subscriber Bundle Table Record

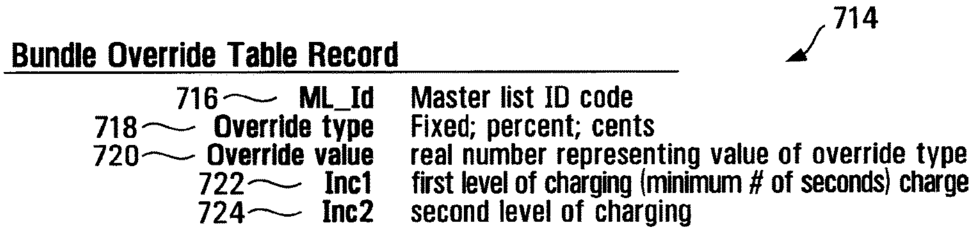
708	**Username**	Subscriber username
710	**Services**	Codes identifying service features (e.g. Free local calling; call blocking, voicemail)

FIG. 34

Subscriber Bundle Record for Vancouver Caller

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

FIG. 35

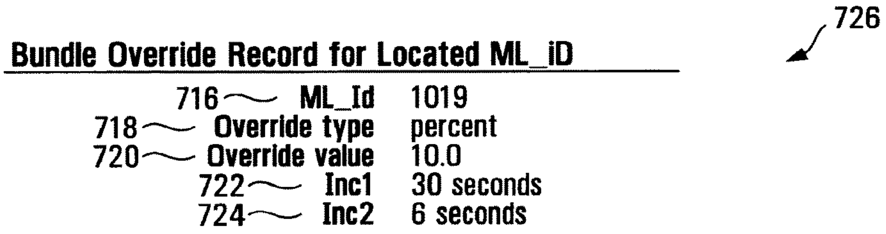


714

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

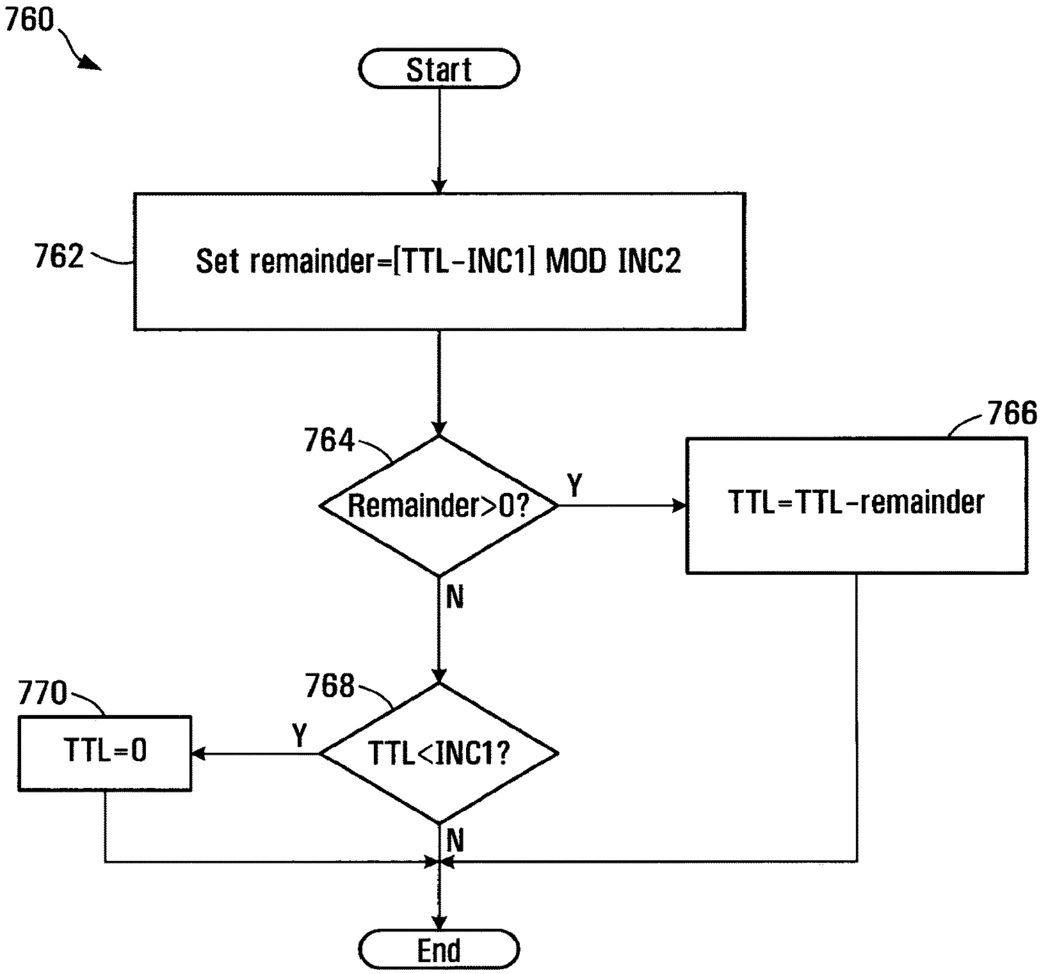

760
Start
762
Set remainder=[TTL-INC1] MOD INC2
764
Remainder>0?
Y
766
TTL=TTL-remainder
N
768
TTL<INC1?
Y
770
TTL=0
N
End

FIG. 40

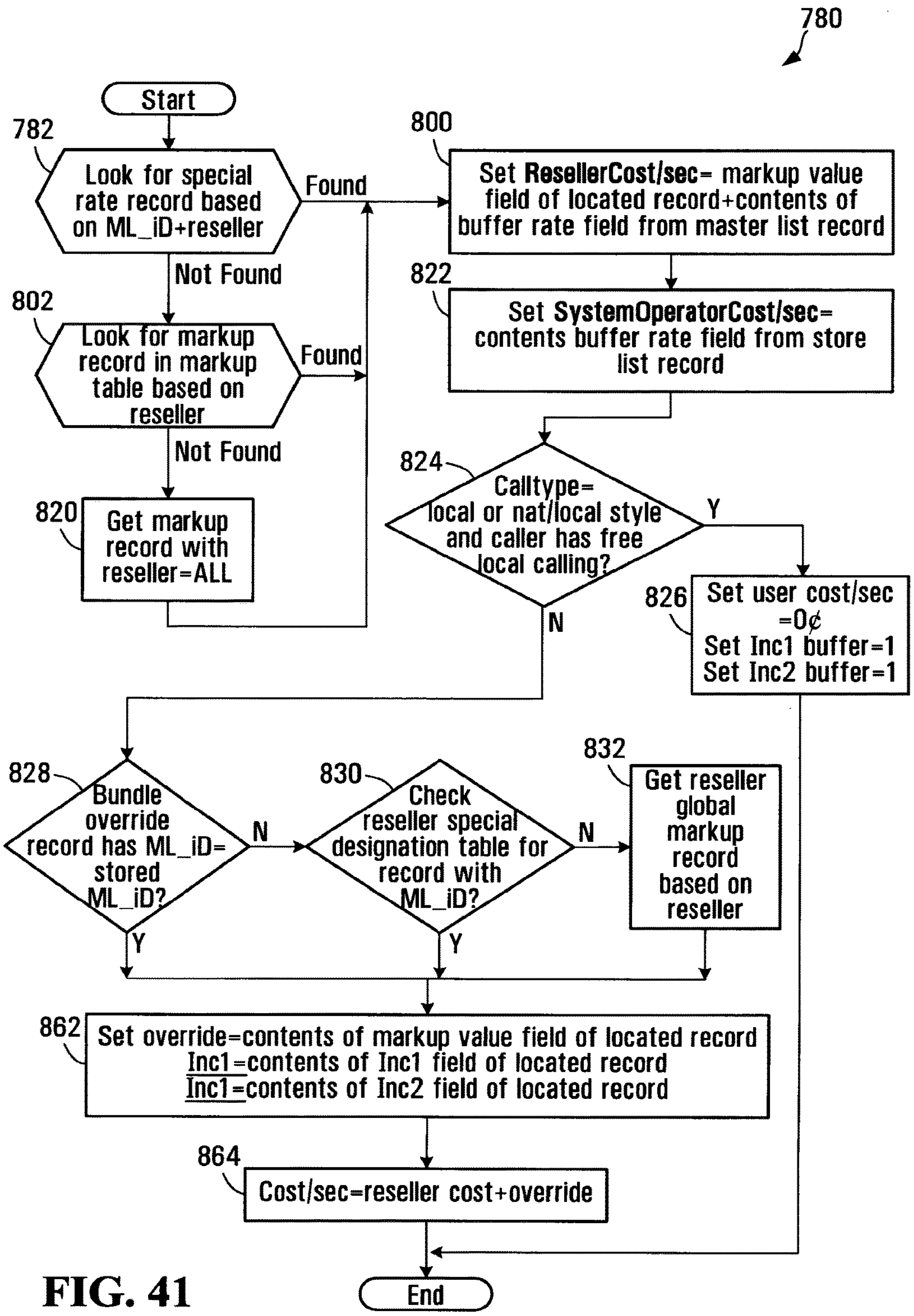

780
Start
782
Look for special rate record based on ML_iD+reseller
Found
Not Found
800
Set ResellerCost/sec= markup value field of located record+contents of buffer rate field from master list record
802
Look for markup record in markup table based on reseller
Found
Not Found
822
Set SystemOperatorCost/sec= contents buffer rate field from store list record
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

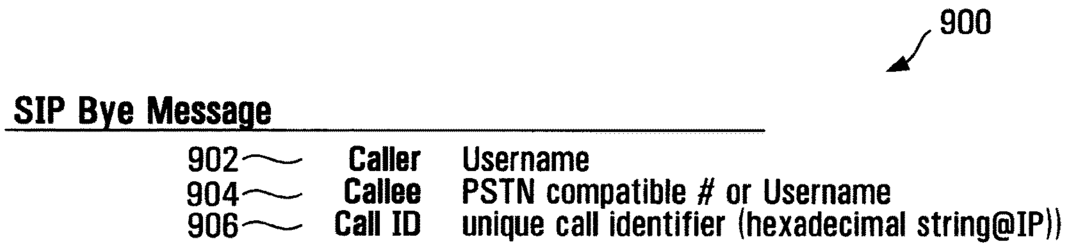

900
SIP Bye Message
902 Caller Username
904 Callee PSTN compatible # or Username
906 Call ID unique call identifier (hexadecimal string@IP))

FIG. 51

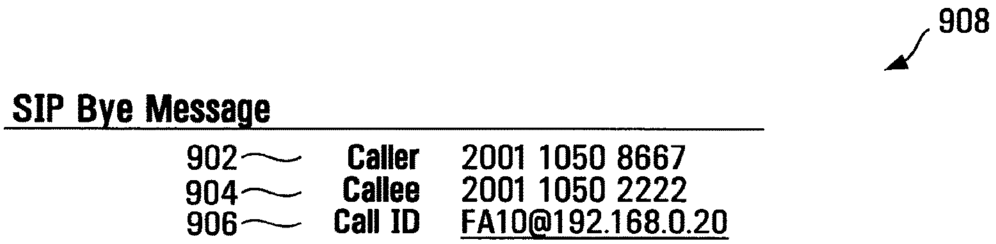

908
SIP Bye Message
902 Caller 2001 1050 8667
904 Callee 2001 1050 2222
906 Call ID FA10@192.168.0.20

FIG. 52

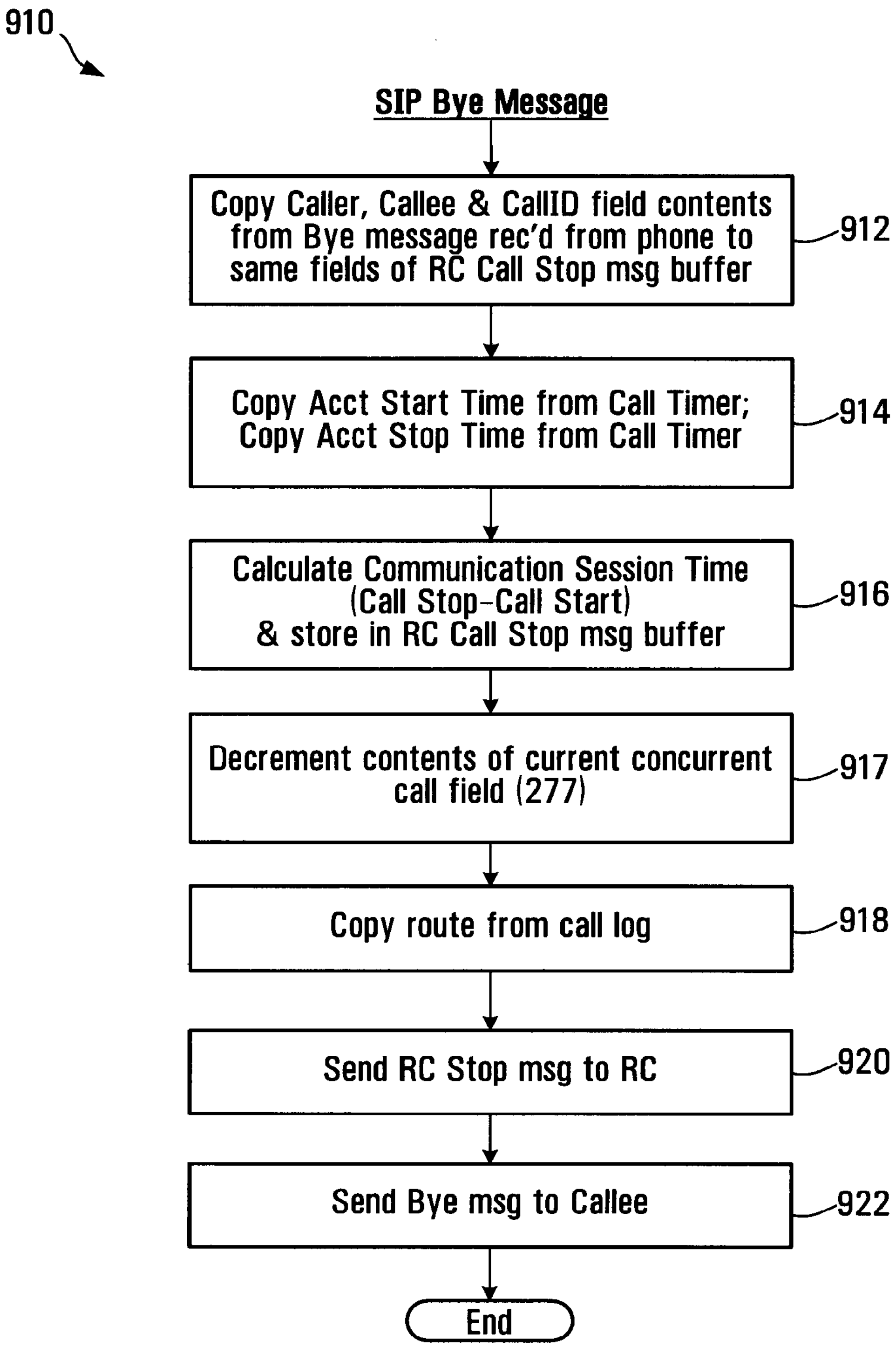

910
SIP Bye Message
Copy Caller, Callee & CallID field contents from Bye message rec'd from phone to same fields of RC Call Stop msg buffer
912
Copy Acct Start Time from Call Timer; Copy Acct Stop Time from Call Timer
914
Calculate Communication Session Time (Call Stop-Call Start) & store in RC Call 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

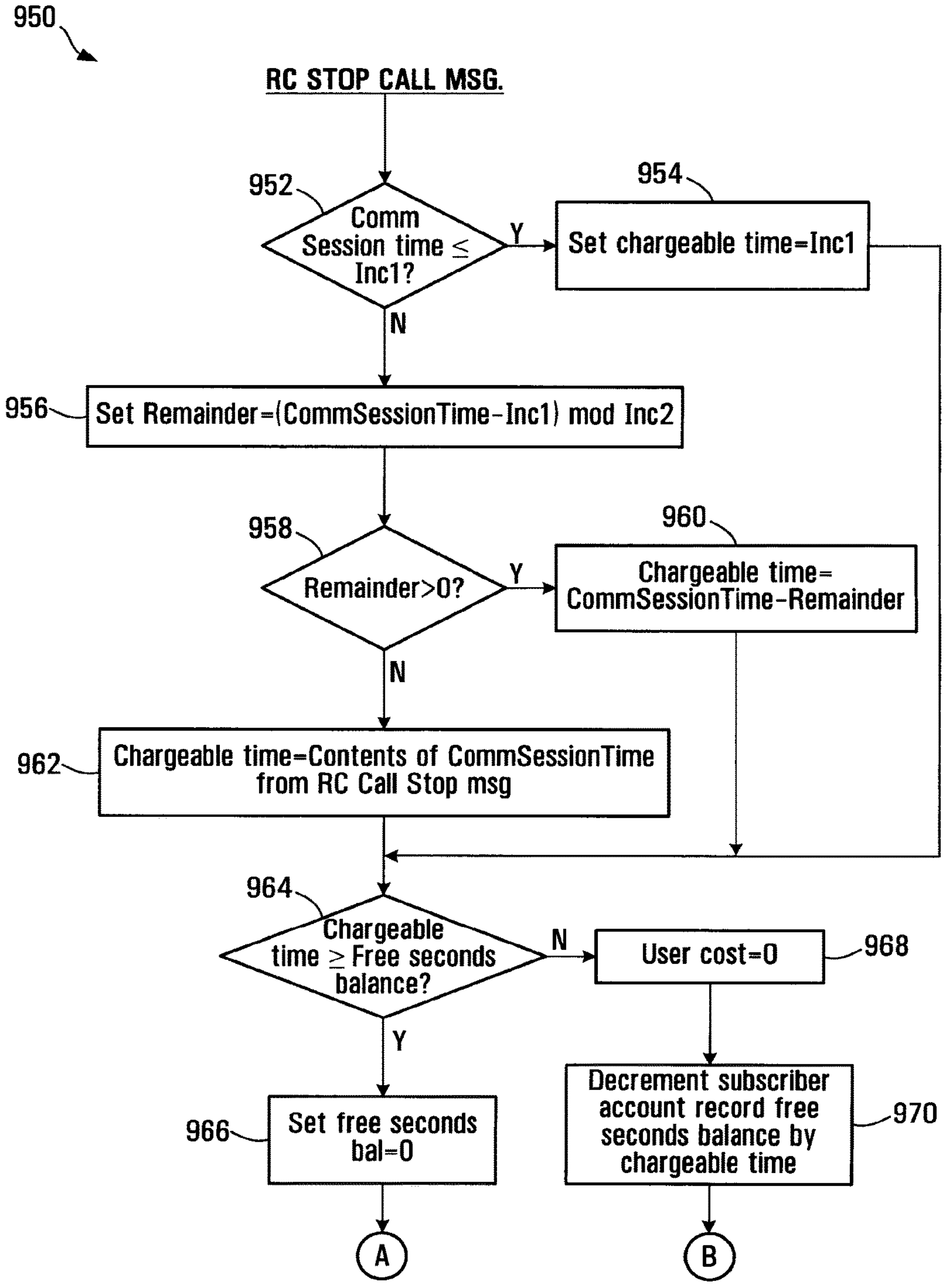

950
RC STOP CALL MSG.
952
Comm Session time ≤ Inc1?
Y
N
954
Set chargeable time=Inc1
956
Set Remainder=(CommSessionTime-Inc1) mod Inc2
958
Remainder>0?
Y
N
960
Chargeable time= CommSessionTime-Remainder
962
Chargeable time=Contents of CommSessionTime from RC Call Stop msg
964
Chargeable time ≥ Free seconds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

FIG. 56A

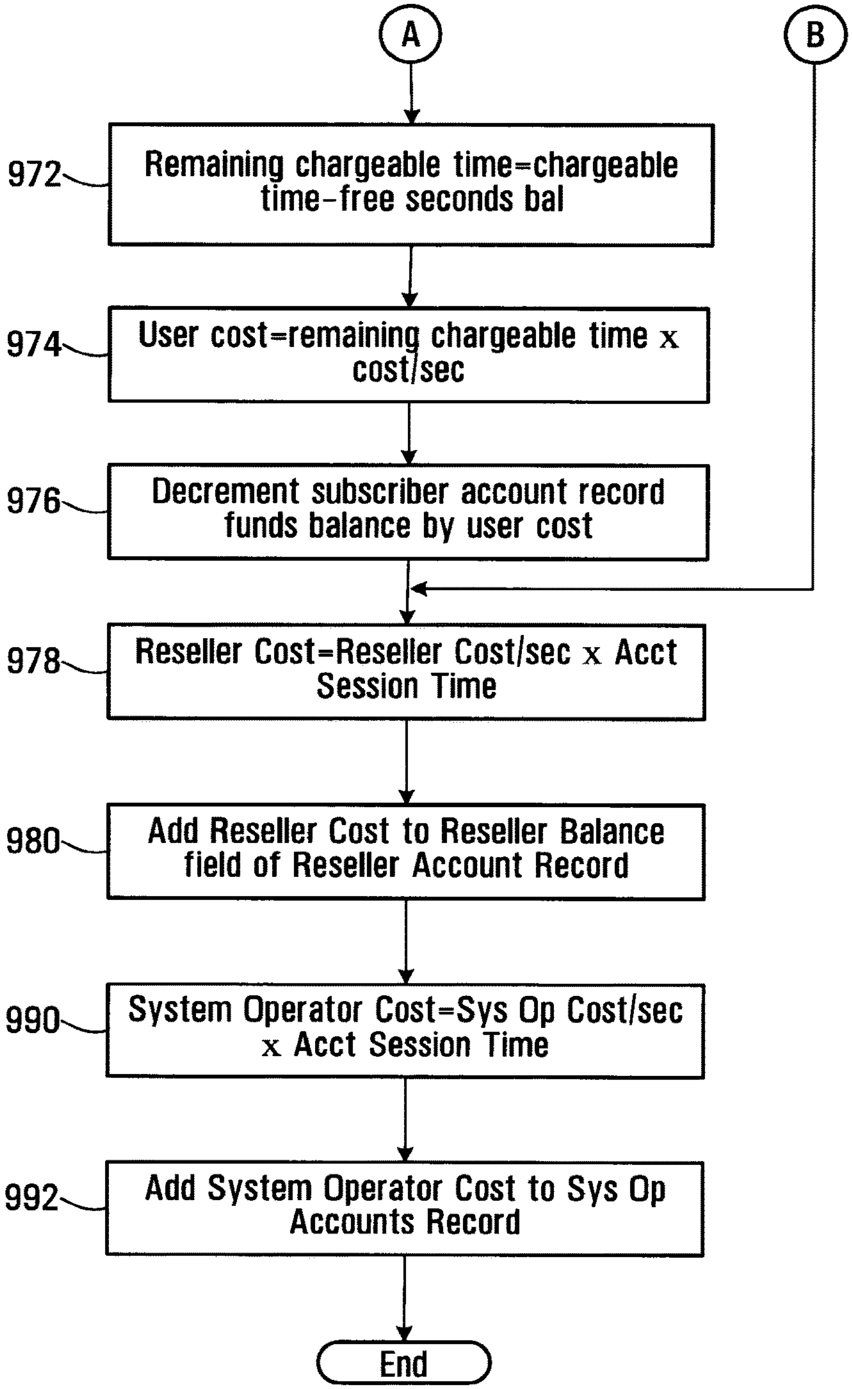

A
B
972
Remaining chargeable time=chargeable time-free seconds bal
974
User cost=remaining chargeable time x cost/sec
976
Decrement subscriber account record funds balance by user cost
978
Reseller Cost=Reseller Cost/sec x Acct Session Time
980
Add Reseller Cost to Reseller Balance field of Reseller 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

PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS

This application is a continuation of U.S. application Ser. No. 14/877,570, filed Oct. 7, 2015, now U.S. Pat. No. 9,537,762, which is a continuation of U.S. application Ser. No. 13/966,096, filed Aug. 13, 2013, now U.S. Pat. No. 9,179,005, which is a continuation of U.S. application Ser. No. 12/513,147, filed Mar. 1, 2010, now U.S. Pat. No. 8,542,815, which is a national phase entry of PCT/CA2007/001956, filed Nov. 1, 2007, which claims priority to U.S. Provisional Application No. 60/856,212, filed Nov. 2, 2006, all of which are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of Invention

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 (SS7) 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 OF THE INVENTION

In accordance with one aspect of the invention, there is provided a process for operating a call routing controller to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The process involves, in response to initiation of a call by a calling subscriber, receiving a caller identifier and a callee identifier. The process also involves using call classification criteria associated with the caller identifier to classify the call as a public network call or a private network call. The process further involves 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. The process also involves producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The process may involve receiving a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

Using the call classification criteria may involve searching a database to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

Locating a record may involve locating a caller dialing profile comprising a username associated with the caller, a domain associated with the caller, and at least one calling attribute.

Using the call classification criteria may involve comparing calling attributes associated with the caller dialing profile with aspects of the callee identifier.

Comparing may involve determining whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier has a length within a range specified in the caller dialing profile.

The process may involve formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

Formatting may involve removing an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

Formatting may involve removing a national dialing digit from the callee identifier and prepending a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

Formatting may involve prepending a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

Formatting may involve prepending a caller country code and an area code to the callee identifier when the callee identifier has a length that matches a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The process may involve classifying the call as a private network call when the re-formatted callee identifier identifies a subscriber to the private network.

The process may involve determining whether the callee identifier complies with a pre-defined username format and if so, classifying the call as a private network call.

The process may involve causing a database of records to be searched to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and if the DID bank table record is found, classifying the call as a private network call and if a DID bank table record is not found, classifying the call as a public network call.

Producing the routing message identifying a node on the private network may involve setting a callee identifier in response to a username associated with the DID bank table record.

Producing the routing message may involve determining whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

Determining whether a node associated with the reformatted callee identifier is the same as a node associated the caller identifier may involve determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

When the node associated with the caller is not the same as the node associated with the callee, the process involves producing a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and communicating the routing message to a call controller.

When the node associated with the caller is the same as the node associated with the callee, the process involves determining whether to perform at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee.

Producing the routing message may involve producing a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The process may involve communicating the routing message to a call controller.

Producing a routing message identifying a gateway to the public network may involve searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve loading a routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The process may involve communicating a routing message involving the contents of the routing message buffer to a call controller.

The process may involve causing the dialing profile to include a maximum concurrent call value and a concurrent call count value and causing the concurrent call count value to be incremented when the user associated with the dialing profile initiates a call and causing the concurrent call count value to be decremented when a call with the user associated with the dialing profile is ended.

In accordance with another aspect of the invention, there is provided a call routing apparatus for facilitating communications between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The apparatus includes receiving provisions for receiving a caller identifier and a callee identifier, in response to initiation of a call by a calling subscriber. The apparatus also includes classifying provisions for classifying the call as a private network call or a public network call according to call classification criteria associated with the caller identifier. The apparatus further includes provisions for 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. The apparatus also includes provisions for producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The receiving provisions may be operably configured to receive a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

The apparatus may further include searching provisions for searching a database including records associating calling attributes with subscribers to the private network to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

The records may include dialing profiles each including a username associated with the subscriber, an identification of a domain associated with the subscriber, and an identification of at least one calling attribute associated with the subscriber.

The call classification provisions may be operably configured to compare calling attributes associated with the caller dialing profile with aspects of the callee identifier.

The calling attributes may include an international dialing digit and call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

The calling attributes may include an national dialing digit and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

The calling attributes may include an area code and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

The calling attribute may include a number length range and the call classification provisions may be operably configured to determine whether the callee identifier has a length within a number length range specified in the caller dialing profile.

The apparatus may further include formatting provisions for formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

The formatting provisions may be operably configured to remove an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

The formatting provisions may be operably configured to remove a national dialing digit from the callee identifier and prepend a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

The formatting provisions may be operably configured to prepend a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

The formatting provisions may be operably configured to prepend a caller country code and area code to the callee identifier when the callee identifier has a length that matches

a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The classifying provisions may be operably configured to classify the call as a private network call when the reformatted callee identifier identifies a subscriber to the private network.

The classifying provisions may be operably configured to classify the call as a private network call when the callee identifier complies with a pre-defined username format.

The apparatus may further include searching provisions for searching a database of records to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and the classifying provisions may be operably configured to classify the call as a private network call when the DID bank table record is found and to classify the call as a public network call when a DID bank table record is not found

The private network routing message producing provisions may be operably configured to produce a routing message having a callee identifier set according to a username associated with the DID bank table record.

The private network routing message producing provisions may be operably configured to determine whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

The private network routing provisions may include provisions for determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

The private network routing message producing provisions may be operably configured to produce a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and to communicate the routing message to a call controller.

The private network routing message producing provisions may be operably configured to perform at least one of the following forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee, when the node associated with the caller is the same as the node associated with the callee.

The provisions for producing the private network routing message may be operably configured to produce a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The apparatus further includes provisions for communicating the routing message to a call controller.

The provisions for producing a public network routing message identifying a gateway to the public network may include provisions for searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes provisions for searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes a routing message buffer and provisions for loading the routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The apparatus further includes provisions for communicating a routing message including the contents of the routing message buffer to a call controller.

The apparatus further includes means for causing said dialing profile to include a maximum concurrent call value and a concurrent call count value and for causing said concurrent call count value to be incremented when the user associated with said dialing profile initiates a call and for causing said concurrent call count value to be decremented when a call with said user associated with said dialing profile is ended.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes dialing profile records comprising fields for associating with respective subscribers to the system, a subscriber user name, direct-in-dial records comprising fields for associating with respective subscriber usernames, a user domain and a direct-in-dial number, prefix to node records comprising fields for associating with at least a portion of the respective subscriber usernames, a node address of a node in the system, whereby a subscriber name can be used to find a user domain, at least a portion of the a subscriber name can be used to find a node with which the subscriber identified by the subscriber name is associated, and a user domain and subscriber name can be located in response to a direct-in-dial number.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes master list records comprising fields for associating a dialing code with respective master list identifiers and supplier list records linked to master list records by the master list identifiers, said supplier list records comprising fields for associating with a communications services supplier, a supplier id, a master list id, a route identifier and a billing rate code, whereby communications services suppliers are associated with dialing codes, such that dialing codes can be used to locate suppliers capable of providing a communications link associated with a given dialing code.

In accordance with another aspect of the invention, there is provided a method for determining a time to permit a communication session to be conducted. The method 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.

Calculating the first time value may involve retrieving a record associated with the participant and obtaining from the record at least one of the free time and the funds balance.

Producing the second time value may involve 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.

Producing the second time value may involve setting a difference between the first time value and the remainder as the second time value.

The method may further involve setting the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

Calculating the cost per unit time may involve 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 the record in a database may involve locating 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 markup record.

Calculating the cost per unit time value further may involve 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, a default operator markup record specifying a default cost per unit time.

The method may further involve 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 method may further involve receiving a communication session time representing a duration of the communication session and incrementing a reseller balance by the product of the reseller rate and the communication session time.

The method may further involve receiving a communication session time representing a duration of the communication session and incrementing a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided an apparatus for determining a time to permit a communication session to be conducted. The apparatus includes a processor circuit, a computer readable medium coupled to the processor circuit and encoded with instructions for directing the processor circuit to calculate a cost per unit time for the communication session, calculate 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 produce 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.

The instructions may include instructions for directing the processor circuit to retrieve a record associated with the participant and obtain from the record at least one of the free time and the funds balance.

The instructions may include instructions for directing the processor circuit to produce the second time value by 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.

The instructions may include instructions for directing the processor circuit to produce the second time value comprises setting a difference between the first time value and the remainder as the second time value. The instructions may include instructions for directing the processor circuit to set the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

The instructions for directing the processor circuit to calculate the cost per unit time may include instructions for directing the processor circuit to locate a record in a database, the record comprising a markup type indicator, a markup value and a billing pattern and set a reseller rate equal to the sum of the markup value and the buffer rate.

The instructions for directing the processor circuit to locate the record in a database may include instructions for directing the processor circuit 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 markup record. The instructions for directing the processor circuit to calculate the cost per unit time value may further include instructions for directing the processor circuit to locate 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, a default operator markup record specifying a default cost per unit time.

The instructions may include instructions for directing the processor circuit 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.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a reseller balance by the product of the reseller rate and the communication session time.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided a process for attributing charges for communications services. The process involves determining a first chargeable time in response to a communication session time and a pre-defined billing pattern, determining a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, changing an account balance associated with the user in response to a user cost per unit time. The process may further involve changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

Determining the first chargeable time may involve locating at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and setting as the

pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may involve a first billing interval and a second billing interval.

Determining the first chargeable time may involve setting the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

Determining the first chargeable time may involve producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and setting the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and setting the first chargeable time to the communication session time when the remainder is not greater than zero.

The process may further involve determining a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Determining the second chargeable time may involve setting the second chargeable time to a difference between the first chargeable time.

The process may further involve resetting the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Changing an account balance associated with the user may involve calculating a user cost value in response to the second chargeable time and the user cost per unit time.

The process may further involve changing a user free cost balance in response to the user cost value.

The process may further involve setting the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The process may further involve changing a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided an apparatus for attributing charges for communications services. The apparatus includes a processor circuit, a computer readable medium in communication with the processor circuit and encoded with instructions for directing the processor circuit to determine a first chargeable time in response to a communication session time and a pre-defined billing pattern, determine a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, change an account balance associated with the user in response to a user cost per unit time.

The instructions may further include instructions for changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

The instructions for directing the processor circuit to determine the first chargeable time may further include instructions for causing the processor circuit to communicate with a database to locate at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and instructions for setting as the pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may include a first billing interval and a second billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for directing the processor circuit to set the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and instructions for causing the processor circuit to set the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and instructions for causing the processor circuit to set the first chargeable time to the communication session time when the remainder is not greater than zero.

The instructions may further include instructions for causing the processor circuit to determine a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to determine the second chargeable time may include instructions for causing the processor circuit to set the second chargeable time to a difference between the first chargeable time.

The instructions may further include instructions for causing the processor circuit to reset the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to change an account balance associated with the user may include instructions for causing the processor circuit to calculate a user cost value in response to the second chargeable time and the user cost per unit time.

The instructions may further include instructions for causing the processor circuit to change a user free cost balance in response to the user cost value.

The instructions may further include instructions for causing the processor circuit to set the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The instructions may further include instructions for causing the processor circuit to change a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided a computer readable medium encoded with codes for directing a processor circuit to execute one or more of the methods described above and/or variants thereof.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon

review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

FIG. **1** is a block diagram of a system according to a first embodiment of the invention;

FIG. **2** is a block diagram of a caller telephone according to the first embodiment of the invention;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

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

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

FIG. **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;

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

FIG. **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;

FIGS. **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;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

FIGS. **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 FIG. **1**;

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

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

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

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

DETAILED DESCRIPTION

Referring to FIG. **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 FIG. **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 the description of the embodiments of this invention, 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 been 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 FIG. **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.

Subscriber Telephone

In greater detail, referring to FIG. **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 FIG. **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 FF10@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 FIG. **3**, to the routing controller **16** shown in FIG. **1**. This SIP invite message is essentially to initiate a call by a calling subscriber.

Referring to FIG. **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 FIG. **2**. In addition, referring back to FIG. **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 FIG. **2**. The digest parameters field **64** includes digest parameters and the call ID field **65** includes a code comprising a generated prefix code (FF10) 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.

Call Controller

Referring to FIG. **4**, a call controller circuit of the call controller **14** (FIG. **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 FIG. **3**, from the telephone shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **3**, block **122** of FIG. **5** directs the call controller circuit **100** of FIG. **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 FIG. **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 FIG. **3**. The type field **160** contains the type code established at blocks **123** or **125** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIGS. **8**A through **8**D.

RC Request Message Handler

Referring to FIG. **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 FIG. **7**, one of which includes the caller ID buffer **209** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **2**.

Referring back to FIG. **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 "corn" 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 FIG. **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 FIGS. **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 FIG. **13** is added to a direct-in-dial bank table in the database (**18** in FIG. **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 FIG. **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 FIG. **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 FIG. **9** and DID records as shown in FIG. **13** when a user registers with the system, call blocking records of the type shown in FIG. **26**, call forwarding records of the type shown in FIG. **28** and voicemail records of the type shown in FIG. **30** may be added to the database **18** when a new subscriber is added to the system.

Referring back to FIG. **8**A, after retrieving a dialing profile for the caller, such as shown at **276** in FIG. **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 than 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 FIG. **6**, of the RC request message **150**. These checks are shown in greater detail in FIG. **8**B.

Referring to FIG. **8**B, the processor (**202** in FIG. **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 FIG. **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 FIG. **4**) to respond to the incorrect length message by transmitting a message back to the telephone (**12** shown in FIG. **1**) to indicate that an invalid number has been dialled.

Still referring to FIG. **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 FIG. **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 FIG. **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 FIG. **14**) from the callee DID bank table record (**300** in FIG. **14**) into the callee ID buffer (**211** in FIG. **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 FIG. **8**A.

Subscriber to Subscriber Calls Between Different Nodes

Referring to FIG. **8**A, block **280** directs the processor (**202** of FIG. **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 FIG. **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 FIG. **10**. If the corresponding prefixes are not the same, block **302** in FIG. **8**A directs the processor (**202** in FIG. **7**) to set a call type flag in the buffer memory (**207** in FIG. **7**) to indicate the call is a cross-domain call. Then, block **350** of FIG. **8**A directs the processor (**202** of FIG. **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 FIG. **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 FIG. **18**, for example, if the prefix is 20, the supernode address associated with that prefix is sp.yvr.digifonica.com.

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

Referring back to FIG. **8**B, if at block **257**, the callee identifier stored in the callee id buffer (**211** in FIG. **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 FIG. **10**. In FIG. **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 FIG. **8**B.

Block **382** directs the processor (**202** of FIG. **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 FIG. **10**. If not, block **384** of FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** of FIG. **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 FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** for further processing as described above.

Referring back to FIG. **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 FIG. **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 FIG. **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 FIG. **10**) followed by the caller area code (as indicated by the local area code

field **267** of the caller profile shown in FIG. **10**). The processor (**202**) is then directed to block **263** of FIG. **8**B for further processing as described above.

Referring back to FIG. **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 FIG. **10**) and the caller maximum local number length field (**270** in FIG. **10**), block **402** directs the processor **202** of FIG. **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 FIG. **10** of dialing profiles to find a dialing profile having user name field contents (**258** in FIG. **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 FIG. **8**A. Thus, the call is classified as a private network call when the callee identifier identifies a subscriber to the private network.

From FIG. **8**B, it will be appreciated that there are certain groups of blocks of codes that direct the processor **202** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **7** when it executes block **269** in FIG. **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 FIG. **8**B which causes it to set the contents of the callee id buffer **211** of FIG. **7** equal to the newly formatted callee identifier, i.e., a number compatible with the E.164 standard. Then, block **410** of FIG. **8**B directs the processor (**202**) to search a database of route or master list records associating route identifiers with dialing codes shown in FIG. **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 FIG. **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 FIG. **7** uses at block **410** in FIG. **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 FIG. **20** with exemplary field contents as shown.

Referring back to FIG. **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 FIG. **7** to find a master list record such as the one shown in FIG. **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 FIG. **8**B, the process continues as shown in FIG. **8**D. Referring to FIG. **8**D, block **412** directs the processor **202** of FIG. **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 FIG. **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 FIGS. **22**, **23** and **24** for the exemplary suppliers shown at **20** in FIG. **1**, namely Telus, Shaw and Sprint.

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

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

Referring to FIGS. **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 FIG. **25** first.

Block **562** in FIG. **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 FIG. **25**. At block **563** of FIG. **8**D, the contents of the route identifier field **546** of FIG. **21** of the record associated with the supplier "Telus" are added by the processor **202** of FIG. **7** to the routing message buffer shown in FIG. **25** after an @ sign delimiter, and then block **564** in FIG. **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 FIG. **21** in the routing message buffer of FIG. **25**. Accordingly, a first part of the routing message for the Telus gateway is shown generally at **570** in FIG. **25**.

Referring back to FIG. **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 FIG. **25** relates to the second supplier identified by the record shown in FIG. **23**. Referring back to FIG. **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 FIG. **24**.

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

Subscriber to Subscriber Calls Within the Same Node

Referring back to FIG. **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 FIG. **11** or **12**, for example. Block **602** of FIG. **8**A then directs the processor **202** of FIG. **7** to get call block, call forward and voicemail records from the database **18** of FIG. **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 FIGS. **26**, **27**, **28** and **30** for example.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **27**, block **608** directs the processor **202** of FIG. **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 FIG. **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 FIG. **32**. Referring back to FIG. **8**A, block **612** then directs the processor **202** to determine whether or not call forwarding is required.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **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 FIG. **8**C. If there are entries in the call forwarding table **27**, block **622** in FIG. **8**A directs the processor **202** to search the dialing profile table to find a dialing profile record as shown in FIG. **9**, for the user identified by the destination number field **616** of the call forward record shown in FIG. **28**. The processor **202** of FIG. **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 FIG. **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 FIG. **7** to add to the routing message buffer all call forwarding usernames and domains associated with the callee.

Referring back to FIG. **8**A, if at block **612** there are no call forwarding records, then at block **620** in FIG. **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 FIG. **30** in a voicemail table stored in the database **18** shown in FIG. **1**.

Referring to FIG. **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 FIG. **8**C, at block **620** if the processor **202** of FIG. **7** finds a voicemail record as shown in FIG. **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 FIG. **8**C directs the processor **202** to FIG. **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 FIG. **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 FIG. **8**C, block **644** then directs the processor **202** of FIG. **7** to store the IP address of the current node in the routing message buffer as shown at **656** in FIG. **32**. Block **646** then directs the processor **202** to send the routing message shown in FIG. **32** to the call controller **14** in FIG. **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 FIG. **1**, the routing message whether of the type shown in FIG. **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 FIG. **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 FIG. **32** is received by the call controller **14**, the routing to gateway routine **122** shown in FIG. **4** may direct the processor **102** to cause a message to be sent back through the interne **13** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **1**, if the call controller **14** receives a routing message of the type shown in FIG. **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 FIGS. **33**A and **33**B, a process for determining a time to live value for any of blocks **642** in FIG. **8**C, **350** in FIG. **8**A or **564** in FIG. **8**D above is described. The process is executed by the processor **202** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **1** and store it locally in the subscriber bundle record buffer at the RC **14**.

Referring to FIG. **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.

FIG. **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 FIG. **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**) to determine whether or not there is a bundle override table record for the master list ID value that was determined at block **410** in FIG. **8**B. An exemplary bundle override table record is shown at **714** in FIG. **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 FIG. **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 FIG. **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 FIG. **33**A, if at block **712** the processor finds a bundle override record of the type shown in FIG. **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 FIG. **37** is stored in the bundle override record buffer at the RC as shown in FIG. **7**. Still referring to FIG. **33**A, block **730** then directs the RC processor to determine whether or not the subscriber bundle table record **706** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **33**B, after copying and storing the subscriber account record shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **39** and the quotient of the contents of the funds balance field **740** in the subscriber account record for the call shown in FIG. **39** and the cost per second determined at block **750** of FIG. **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 FIG. **37**. This process is shown in greater detail at **760** in FIG. **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 FIG. **40**, the process for producing the second time value begins with a first block **762** that directs the processor **202** in FIG. **7** to set a remainder value equal to the difference between the time to live value calculated at block **756** in FIG. **33**B and the contents of the first interval field **722** of the record shown in FIG. **37** modulus the contents of the second interval field **724** of FIG. **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 403 divided by 6 is 1.

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 433 minus the remainder of 1, i.e., 432 seconds. The processor is then returned back to block **758** of FIG. **33**B.

Referring back to FIG. **40**, if at block **764** the remainder is not greater than zero, block **768** directs the processor **202** of FIG. **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 FIG. **37**. If so, then block **770** of FIG. **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 not greater than zero and the first time value is less than the first billing interval. 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 FIG. **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 **642**, **350** or **564**.

Cost Per Second

Referring back to FIG. **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 FIG. **41**, a process for calculating a cost per unit time is shown generally at **780**. The process is executed by the processor **202** in FIG. **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 FIG. **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**B.

Referring to FIG. **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 FIG. **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 FIG. **41**, if at block **782** a record such as the one shown in FIG. **43** is located in the system operator special rates table, the processor is directed to block **800** in FIG. **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 FIG. **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 FIG. **42**.

FIG. **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.

FIG. **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 FIG. **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 FIG. **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 FIG. **46**, having the "all" code in the reseller field **806**. The processor is then directed to block **800**.

Referring back to FIG. **41**, at block **800**, the processor **202** of FIG. **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 FIG. **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 been calculated and the process shown in FIG. **41** is ended.

If at block **824** the conditions of that block are not met, the processor **202** of FIG. **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 FIG. **7** to determine whether or not the bundle override record **726** in FIG. **37** located at block **712** in FIG. **33**A has a master list ID equal to the stored master list ID that was determined at block **410** in FIG. **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 FIG. **8**B. An exemplary reseller special destinations table record is shown in FIG. **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 FIG. **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 FIG. **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 FIG. **41**, the record shown in FIG. **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 FIG. **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 FIG. **47**, for example. The contents of the fields of this record **860** may be set according to system operator preferences, for example.

Referring to FIG. **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 FIG. **41**, should the processor get to block **832**, the reseller global mark-up table record as shown in FIG. **50** is retrieved from the database and stored locally at the RC. As seen in FIG. **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 FIG. **41**.)

It will be appreciated that the located record could be a bundle override record of the type shown in FIG. **37** or the located record could be a reseller special destination record of the type shown in FIG. **48** or the record could be a reseller global mark-up table record of the type shown in FIG. **50**. After the override and first and second increment variables have been set at block **862**, the processor **202** of FIG. **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 FIG. **41**, plus the contents of the override variable calculated in block **862** in FIG. **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 FIG. **33**B, for example.

Terminating the Call

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 FIG. **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 FIG. **3**.

Thus, for example, referring to FIG. **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 FA10 @ 192.168.0.20, which is the call ID for the call.

The SIP bye message shown in FIG. **52** is received at the call controller **14** and the call controller executes a process as shown generally at **910** in FIG. **53**. The process includes a first block **912** that directs the call controller processor **102** of FIG. **4** 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 FIG. **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 FIG. **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 FIG. **54**. An RC call stop message specifically associated with the call made to the Calgary callee is shown generally at **1020** in FIG. **55**.

Referring to FIG. **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 FIG. **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 FIG. **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 FA10 @ 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 FIG. **53**, after having produced an RC call stop message, block **920** directs the processor **102** of FIG. **4** to send the RC stop message compiled in the RC call stop message buffer to the RC **16** of FIG. **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 FIG. **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 FIGS. **56**A, **56**B and **56**C. Referring to FIG. **56**A, the RC stop message process **950** begins with a first block **952** that directs the processor **202** in FIG. **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 FIG. **41**, specifically blocks **826** or **862** thereof. If this condition is met, then block **954** of FIG. **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 FIG. **41**. If at block **952** of FIG. **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 FIG. **41**. Then, the processor is directed to block **958** of FIG. **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 FIG. **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 FIG. **39**. If this condition is satisfied, block **966** of FIG. **56**A directs the processor to set the free time field **742** in the record shown in FIG. **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 FIG. **7** was directed to Block **966** which causes the free time field (**742** of FIG. **39**) to be set to zero, referring to FIG. **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 FIG. **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 FIG. **33**B. Block **976** then directs the processor to decrement the funds balance field (**740**) of the subscriber account record shown in FIG. **39** by the contents of the user cost variable calculated at Block **974**.

After completing Block **976** or after completing Block **970** in FIG. **56**A, block **978** of FIG. **56**B directs the processor **202** of FIG. **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 FIG. **45** and the communication session time determined at Block **916** in FIG. **53**. Then, Block **980** of FIG. **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 FIG. **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 FIG. **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 FIG. **58** are incremented by the reseller cost calculated at block **978** of FIG. **56**B.

Still referring to FIG. **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 FIG. **7** calculate a system operator cost as the product of the system operator cost per second, as set at block **822** in FIG. **41**, and the communication session time as determined at Block **916** in FIG. **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 FIG. **59**. This record includes a system operator balance field **996** holding an accumulated charges balance. Referring to FIG. **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 FIG. **56**B.

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

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

What is claimed is:

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**,

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 claim **1**, 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 claim **2**, 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 claim **1**, 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 claim **1**, 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 claim **1**, 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 claim **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.

11. The method of claim **2**, wherein the external network routing message comprises a code identifying a communication supplier associated with the gateway to the external network.

12. 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.

13. The apparatus of claim **12**,

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.

14. The apparatus of claim **13**, 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.

15. The apparatus of claim **13**, 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.

16. The apparatus of claim **13**, 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.

17. 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.

18. The apparatus of claim **17**,

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.

19. The apparatus of claim **17**, 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.

20. A non-transitory computer readable medium encoded with

program code for directing the at least one processor to execute the method of claim **1**.

21. The apparatus of claim **17**,

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.

22. The apparatus of claim **17**, 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.

23. The apparatus of claim **17**, 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.

24. The apparatus of claim **17**, 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.

25. The apparatus of claim **17**, 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.

26. The apparatus of claim **17**, 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.

27. The apparatus of claim **17**,

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.

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

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.

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

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

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

32. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **3**.

33. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **4**.

34. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **5**.

35. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **6**.

36. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **8**.

37. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **28**.

38. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **29**.

39. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **30**.

40. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **31**.

* * * * *

EXHIBIT 3

US009826002B2

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Perreault et al.

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(45) **Date of Patent: *Nov. 21, 2017**

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(54) **PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS**

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H04L 29/12	(2006.01)
H04M 7/00	(2006.01)

(52) **U.S. Cl.**
CPC ***H04L 65/1069*** (2013.01); ***H04L 61/2007*** (2013.01); ***H04L 65/1033*** (2013.01); ***H04M 7/006*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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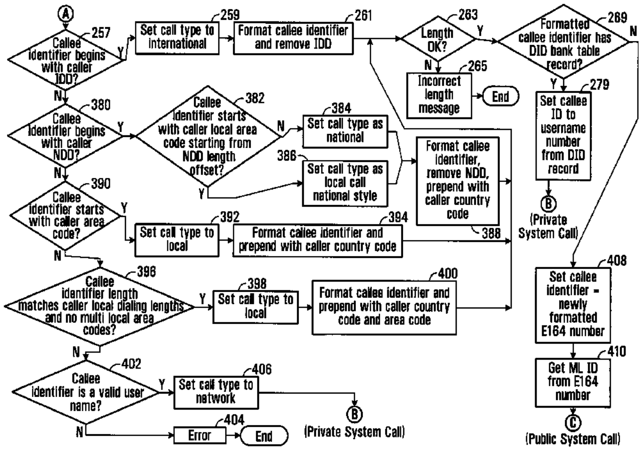
(57) **ABSTRACT**

A process and apparatus to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated is disclosed. In response to initiation of a call by a calling subscriber, a caller identifier and a callee identifier are received. Call classification criteria associated with the caller identifier are used to classify the call as a public network call or a private network call. A routing message identifying an address, on the private network, associated with the callee is produced when the call is classified as a private network call and a routing message identifying a gateway to the public network is produced when the call is classified as a public network call.

40 Claims, 32 Drawing Sheets



Related U.S. Application Data

No. 14/877,570, filed on Oct. 7, 2015, now Pat. No. 9,537,762, which is a continuation of application No. 13/966,096, filed on Aug. 13, 2013, now Pat. No. 9,179,005, which is a continuation of application No. 12/513,147, filed as application No. PCT/CA2007/001956 on Nov. 1, 2007, now Pat. No. 8,542,815.

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Petitioner AT&T Services, Inc. Exhibit 1003, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *AT&T Services, Inc.*, Petitioner v. *Digifonica* (*International*) *Limited* Patent Owner, U.S. Pat. No. 9,179,005, Inter Partes Review No. IPR2017-01384; Declaration of James Bress in Support of Petition for Inter Partes Review of U.S. Pat. No. 9,179,005; with Appendices A through II, 2085 pages.
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Petitioner AT&T Services, Inc. Exhibit 1008, Case No. IPR2017-01384; Decision, Institution of Inter Partes Review, 37 C.F.R. § 42.108, Paper 6, Entered Nov. 21, 2016, United States Patent and Trademark Office, Before the Patent Trial and Appeal Board, *Apple Inc.*, Petitioner, v. *Voip-Pal.com Inc.*, Patent Owner, Case IPR2016-01198, U.S. Pat. No. 9,179,005 B2, Before Barbara A. Benoit, Lynne E. Pettigrew, and Stacy B. Margolies, Administrative Patent Judges, 32 pages.
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Petitioner AT&T Services, Inc. Exhibit 1012, Case No. IPR2017-01384; Telcordia Notes on the Networks, SR-2275, Issue 4, Oct. 2000, p. 10-7, 3 pages.
Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Petitioner's Reply to Patent Owner's Response, Dated May 17, 2017, 34 pages.
Petitioner Apple Inc. Exhibit 1007, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No, IPR2016-01201; U.S. Pat. No. 8,542,815; Discovery Deposition of William Henry Mangione-Smith, taken on Apr. 19, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 213 pages.
Petitioner Apple Inc. Exhibit 1008, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Discovery Deposition of John Rutter, taken (by phone) on Apr. 5, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 43 pages.
Petitioner Apple Inc. Exhibit 1009, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Discovery Deposition of David Terry, taken on Mar. 24, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 95 pages.
Petitioner Apple Inc. Exhibit 1010, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Discovery Deposition of Clay Perreault, taken on Apr. 12, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 118 pages.
Petitioner Apple Inc. Exhibit 1011, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Complaint for Patent Infringement [Jury Demand], United States District Court, District of Nevada, Case No. 2:16-CV-00260, *Voip-Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Apple, Inc.*, a California corporation, Defendants, filed Feb. 9, 2016, 8 pages.
Petitioner Apple Inc. Exhibit 1012, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01201; U.S. Pat. No. 8,542,815; Discovery Deposition of Johan Emil Viktor Bjorsell, taken on Mar. 24, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 204 pages.
Petitioner Apple Inc. Exhibit 1013, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No, IPR2016-01201; U.S. Pat. No. 8,542,815; Letter dated Apr. 21, 2017 to Adam P. Seitz et al., ERISE IP, P.A., re: IPR2016-01198 & IPR1026-

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Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com Inc.*, Patent Owner; Case No. IPR2016-01198; U.S. Pat. No. 9,179,005; Petitioner's Reply to Patent Owner's Response, Paper 34, Dated May 17, 2017, 33 pages.

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Petitioner Apple Inc. Exhibit 1011, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01198; U.S. Pat. No. 9,179,005; Discovery Deposition of John Rutter, taken (by phone) on Apr. 5, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 43 pages.

Petitioner Apple Inc. Exhibit 1012, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01198; U.S. Pat. No. 9,179,005; Discovery Deposition of David Terry, taken on Mar. 24, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 95 pages.

Petitioner Apple Inc. Exhibit 1013, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No. IPR2016-01198; U.S. Pat. No. 9,179,005; Discovery Deposition of Clay Perreault, taken on Apr. 12, 2017 in Case No. IPR2016-01198; U.S. Pat. No. 9,179,005, 118 pages.

Petitioner Apple Inc. Exhibit 1014, United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com, Inc.*, Patent Owner; Case No, IPR2016-01198; U.S. Pat. No. 9,179,005; Complaint for Patent Infringement [Jury Demand], United States District Court, District of Nevada, Case No. 2:16-CV-00260, *Voip-Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Apple, Inc.*, a California corporation, Defendants, filed Feb. 9, 2016, 8 pages.

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Document Title: United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc.*, Petitioner v. *Voip-Pal.com.Inc.*, Patent Owner, Case No. IPR2016-01198, U.S. Pat. No. 9,179,005; Patent Owner Objections to Apple Evidence Served With Petitioner's Reply, Filed on behalf of Patent Owner Voip-Pal.com Inc., Filed: May 24, 2017, 6 pages.

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Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *Voip-Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Verizon Wireless Services, LLC*, a Delaware limited liability corporation; Verizon Communications, Inc., a Delaware corporation; AT&T, Inc., a Delaware corporation; AT&T Corp., a Delaware corporation; and DOES I through X, inclusive, Defendants; Case No. 2:16-CV-00271; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Exhibit E; Chart 1 to Exhibit E; Chart 2 to Exhibit E; Chart 3 to Exhibit E; Chart 4 to Exhibit E; Chart 5 to Exhibit E; Chart 6 to Exhibit E; Exhibit F; Chart 1 to Exhibit F; Chart 2 to Exhibit F; Chart 3 to Exhibit F; Chart 4 to Exhibit F; Chart 5 to Exhibit F; Chart 6 to Exhibit F; Exhibit G; Exhibit H; and Addendum 1 to Exhibit H.

Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *Voip-Pal.com, Inc.*, a Nevada corporation, Plaintiff, v. *Apple, Inc.*, a California corporation; Defendants; Case No. 2:16-

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CV-00260; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Chart 1 to Exhibit D; Chart 2 to Exhibit D; Chart 3 to Exhibit D; Chart 4 to Exhibit D; Exhibit E; Exhibit F; and Addendum 1 to Exhibit F.

Letter dated Nov. 30, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Apple Inc. in the U.S.

Letter dated Dec. 1, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Verizon Communications in the U.S.

Letters dated Dec. 18, 2015, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Airtel in India; Alcatel-Lucent in France; Avaya Inc. in the U.S.; AT&T in the U.S.; Blackberry in Canada; Cable One in the U.S.; CenturyLink in the U.S.; Charter Communications in the U.S.; Cisco Systems in the U.S.; Comcast in the U.S.; Cox Communications in the U.S.; Cricket Wireless in the U.S.; Facebook in the U.S.; Freedom Pop in the U.S.; Frontier Communications in the U.S.; Google Inc. in the U.S.; HP in the U.S.; Juniper Networks in the U.S.; LoopPay, Inc. in the U.S.; Magic Jack in the U.S.; MetroPCS in the U.S.; Ooma in the U.S.; PayPal in the U.S.; Republic Wireless in the U.S.; Rok Mobile in the U.S.; Samsung Electronics—America in the U.S.; ShoreTel, Inc. in the U.S.; Siemens in Germany; Skype USA in the U.S.; Sprint in the U.S.; Square Cash in the U.S.; Suddenlink Communications in the U.S.; Talktone in the U.S.; Tango in the U.S.; Time Warner Cable in the U.S.; T-mobile in the U.S.; Twitter in the U.S.; US Cellular in the U.S.; Venmo in the U.S.; Virgin Mobile USA in the U.S.; Vodafone in the UK; and Vonage in the U.S.

Letters dated Jan. 4, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Rogers Communications Inc. in Canada; Shaw Cable in Canada; Walmart in Alaska; and WIND Mobile in Canada.

Letters dated Jan. 21, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Alibaba (China) Co., Ltd in China; Comwave Telecommunications in Canada; and Intel in the U.S.

Letters dated Feb. 2, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here. only to the first letter.) Sent to the following companies: Netflix Inc. in the U.S.; Skype Technologies in the U.S.; and WhatsApp Inc. in the U.S.

Document Title: Petition for Inter Partes Review of U.S. Pat. No. 8,542,815; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc.*, Petitioner v. *Voip-Pal.com Inc.*, Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Dated May 24, 2016. 64 sheets.

Document Title: Declaration of Michael Caloyannides; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc.*, Petitioner v. *Voip-Pal.com Inc.*, Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Signed May 23, 2016; Filed May 24, 2016. 84 sheets.

Document Title: Public Switched Telephone Networks: A Network Analysis of Emerging Networks; Daniel Livengood, Jijun Lin and Chintan Vaishnav; Engineering Systems Division; Massachusetts Institute of Technology; Submitted May 16, 2006; to Dan Whitney, Joel Moses and Chris Magee. 27 sheets.

Document Title: A Brief History of VoIP; Document One—The Past; Joe Hallock; joe@sitedifference.com; date on cover page: Nov. 26, 2004; Evolution and Trends in Digital Media Technologies—COM 538; Masters of Communication in Digital Media; University of Washington. 17 sheets.

Document Title: Petitioner's Voluntary Interrogatory Responses; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc.*, Petitioner v. *Voip-Pal.com Inc.*, Patent Owner; IPR20161082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Signed and Filed not later than May 24, 2016. 8 sheets.

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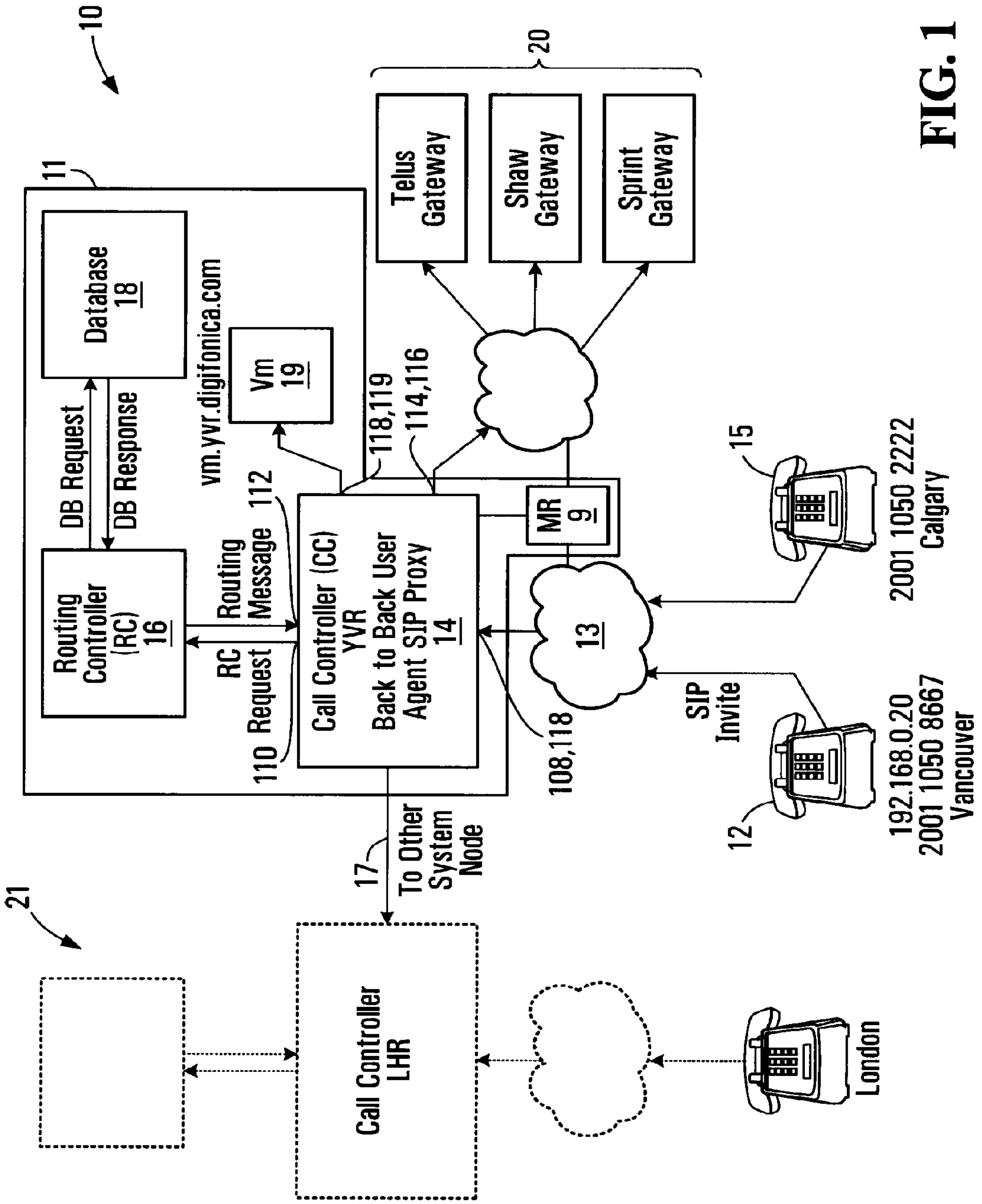

10
11
Database
18
DB Request
DB Response
Routing
Controller
(RC)
16
vm.yvr.digifonica.com
Vm
19
Routing
Message
112
RC
110 Request
Call Controller (CC)
YVR
Back to Back User
Agent SIP Proxy
14
118,119
114,116
MR
9
13
108,118
20
Telus
Gateway
Shaw
Gateway
Sprint
Gateway
15
2001 1050 2222
Calgary
SIP
Invite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

FIG. 1

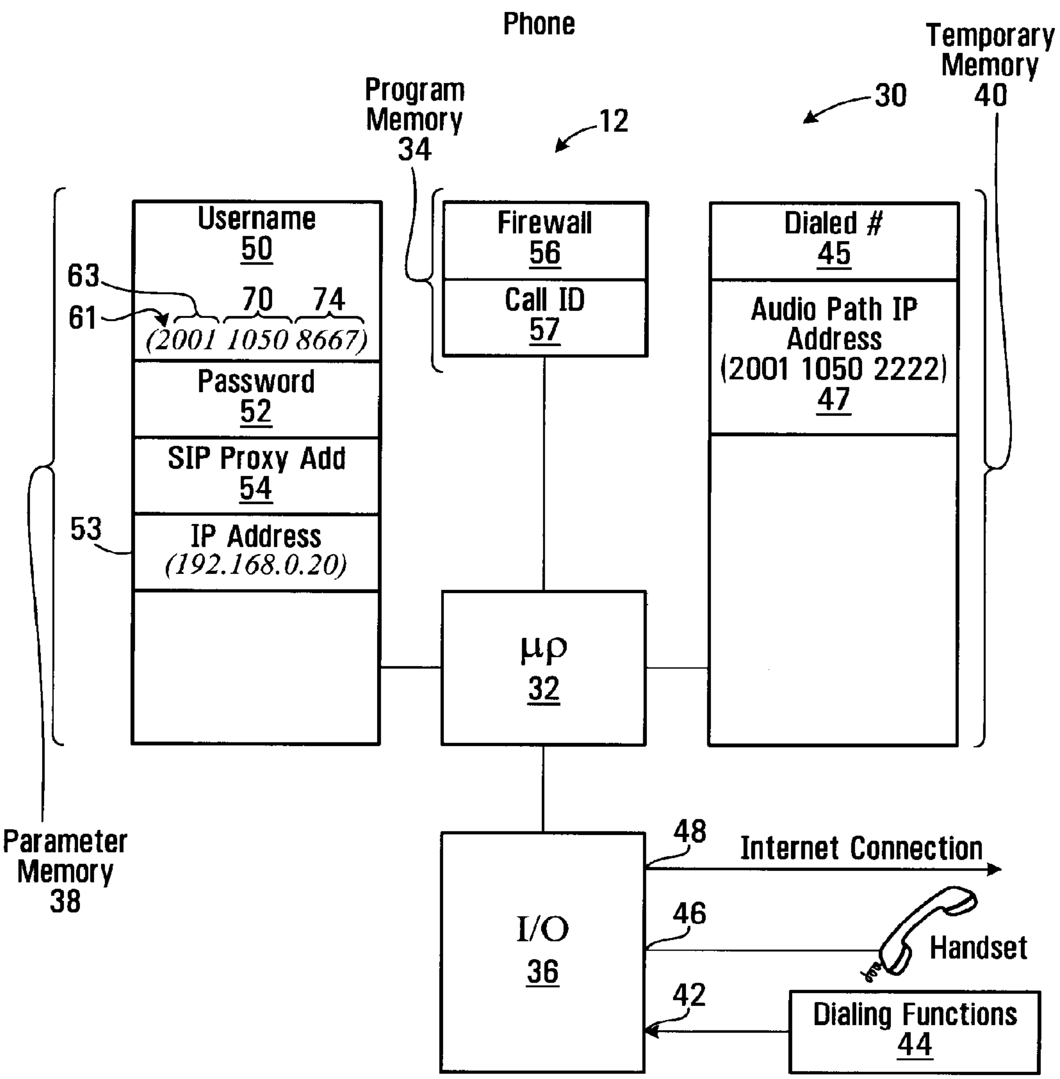

Phone
Program Memory 34
12
30
Temporary Memory 40
Username 50
63
61
70
74
(2001 1050 8667)
Password 52
SIP Proxy Add 54
53
IP Address (192.168.0.20)
Firewall 56
Call ID 57
Dialed # 45
Audio Path IP Address (2001 1050 2222) 47
μp 32
I/O 36
48
Internet Connection
46
Handset
42
Dialing Functions 44
Parameter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

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

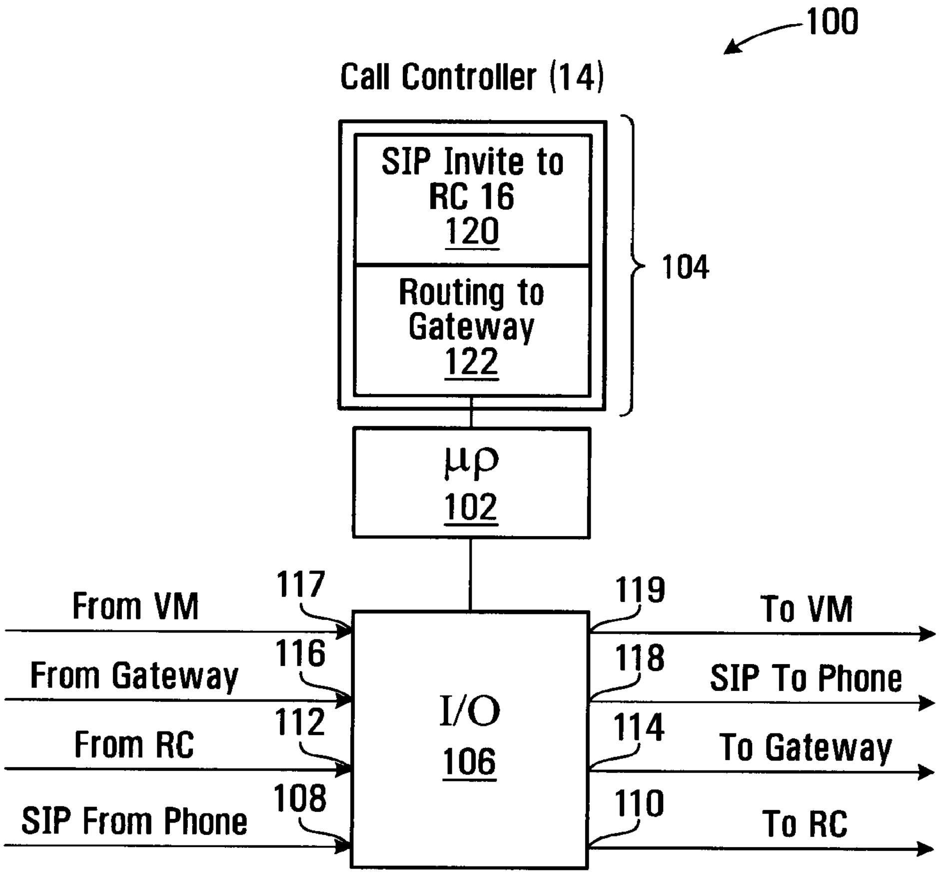


FIG. 4

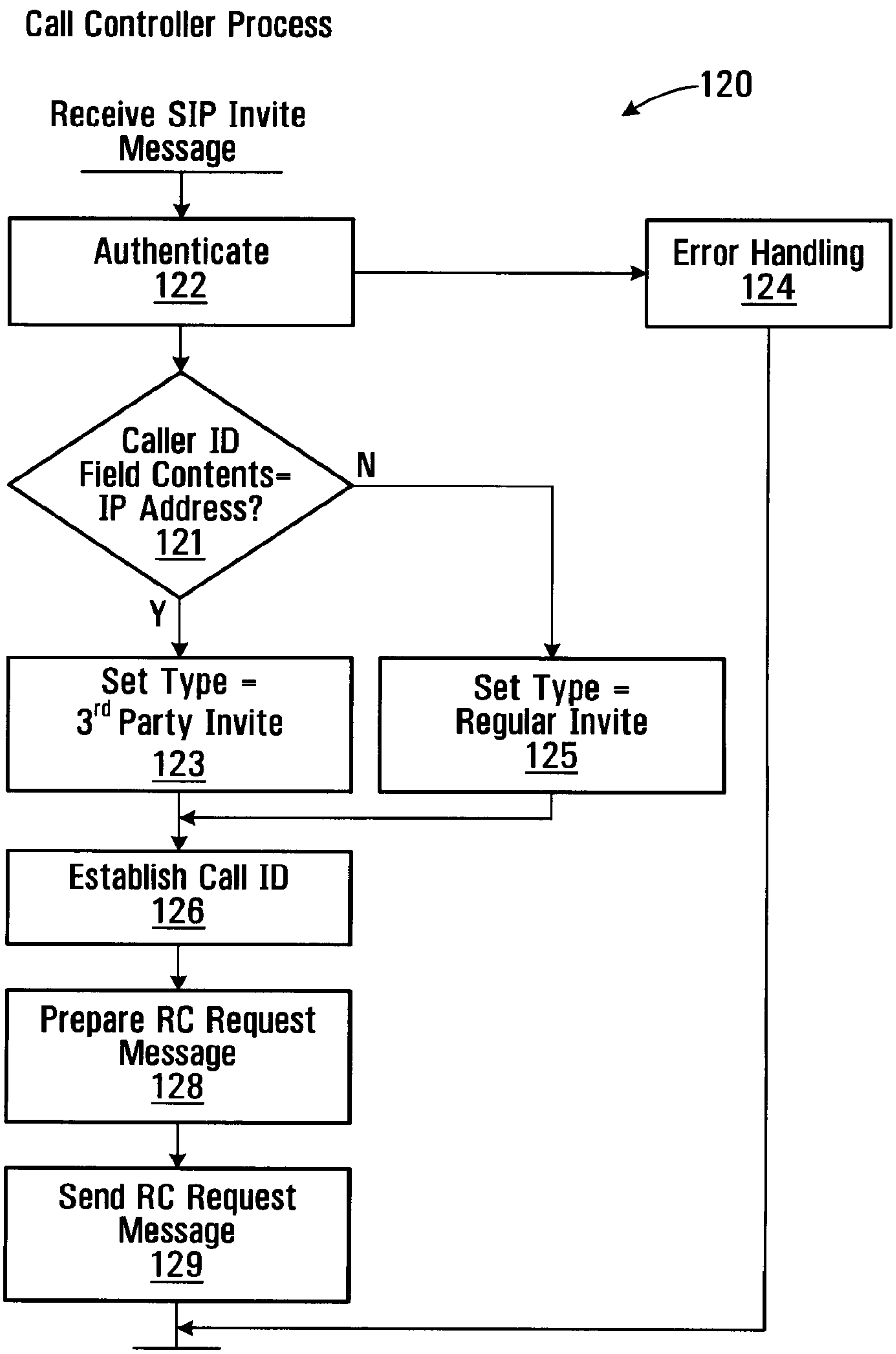

Call Controller Process
120
Receive SIP Invite Message
Authenticate 122
Error Handling 124
Caller ID Field Contents= IP Address? 121
N
Y
Set Type = 3rd Party Invite 123
Set Type = Regular Invite 125
Establish Call ID 126
Prepare RC Request Message 128
Send RC Request Message 129

FIG. 5

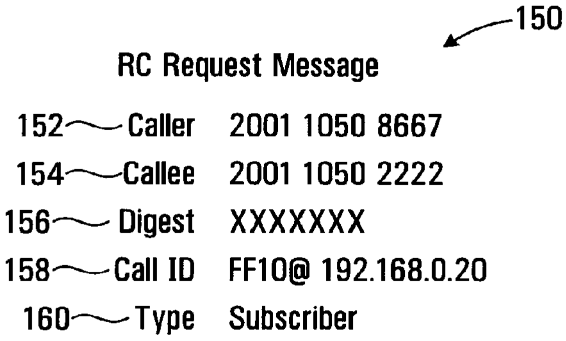

150
RC Request Message
152 Caller 2001 1050 8667
154 Callee 2001 1050 2222
156 Digest XXXXXXX
158 Call ID FF10@ 192.168.0.20
160 Type Subscriber

FIG. 6

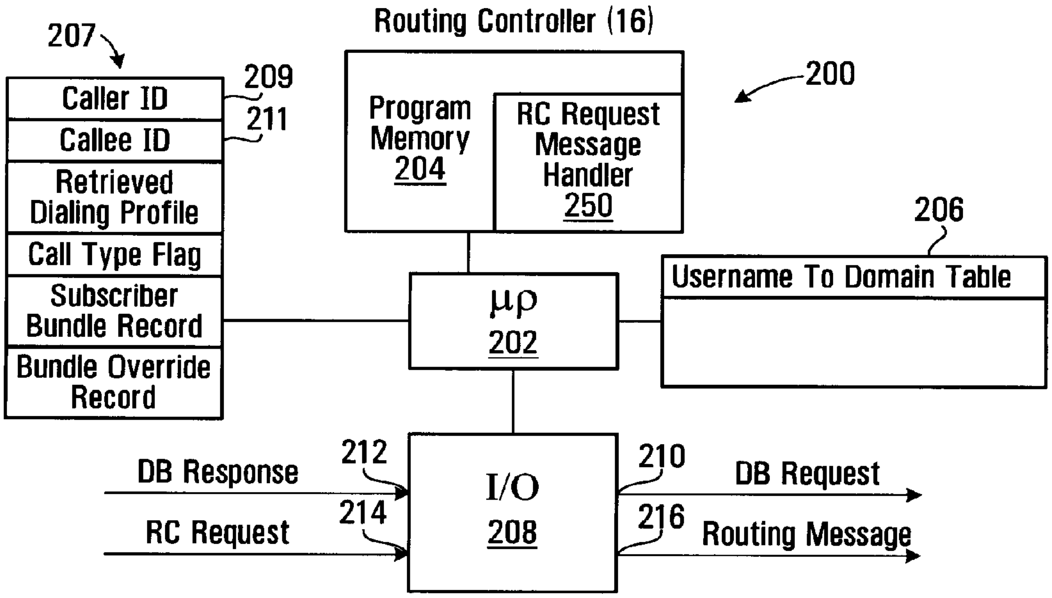

207
Caller ID
Callee ID
Retrieved Dialing Profile
Call Type Flag
Subscriber Bundle Record
Bundle Override Record
209
211
Routing Controller (16)
Program Memory 204
RC Request Message Handler 250
200
206
Username To Domain Table
μp 202
I/O 208
DB Response
212
RC Request
214
210
DB Request
216
Routing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

FIG. 7

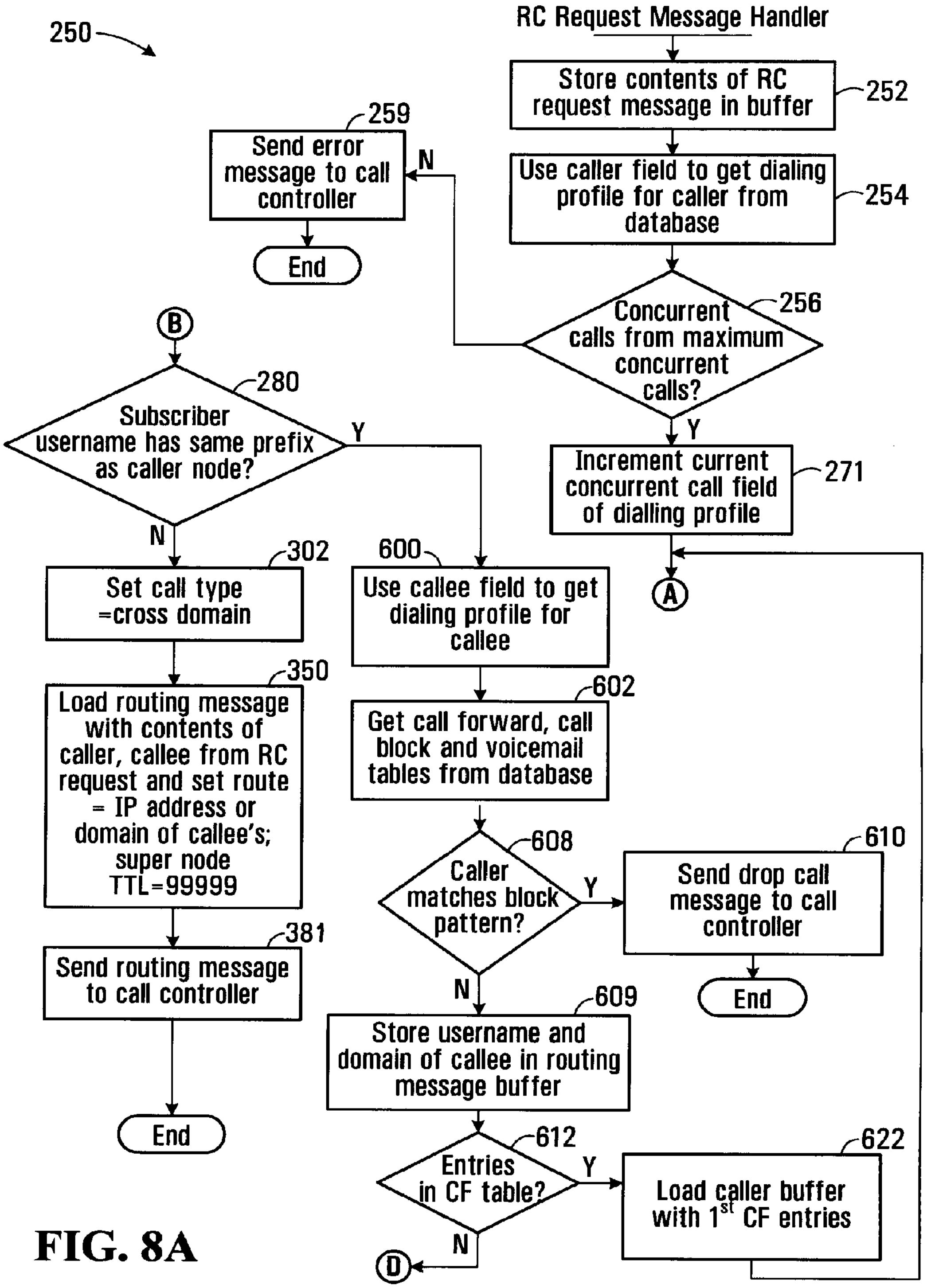

250
RC Request Message Handler
Store contents of RC request message in buffer
252
Use caller field to get dialing profile for caller from database
254
Concurrent calls from maximum concurrent calls?
256
N
Y
Send error message to call controller
259
End
Increment current concurrent call field of dialling 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
N
Send drop call message to call controller
610
End
Store username and domain of callee in routing message buffer
609
Entries in CF table?
612
Y
N
D
Load caller buffer with 1st CF entries
622

FIG. 8A

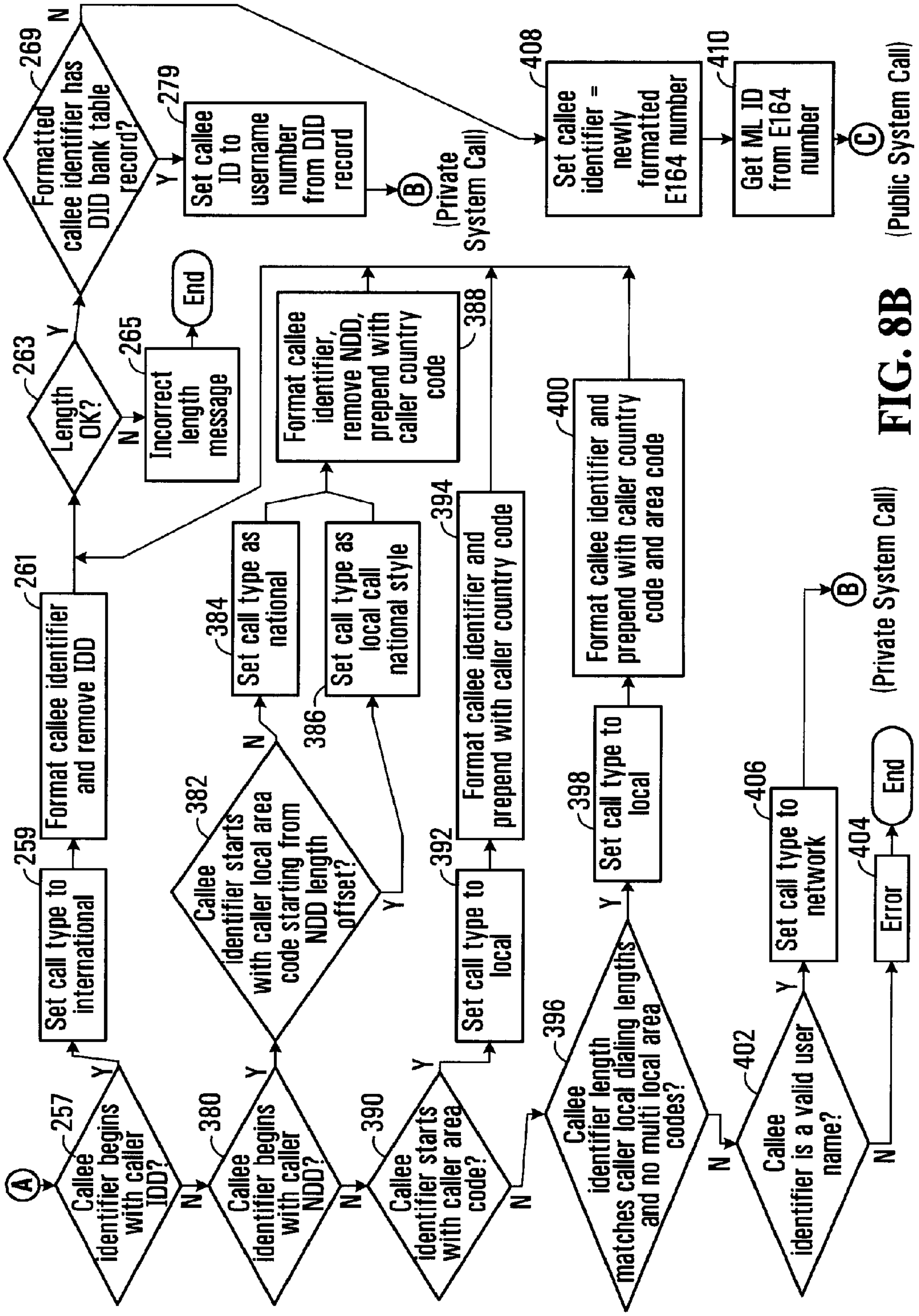

A
Callee identifier begins with caller IDD?
257
Y
N
Set call type to international
259
Format callee identifier and remove IDD
261
Length OK?
263
Y
N
Incorrect length message
265
End
Formatted callee identifier has DID bank table record?
269
Y
N
Set callee ID to username number from DID record
279
B
(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
Y
N
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
Error
404
End
Set call type to network
406
B
(Private System Call)
Set callee identifier = newly formatted E164 number
408
Get ML ID from E164 number
410
C
(Public System Call)

FIG. 8B

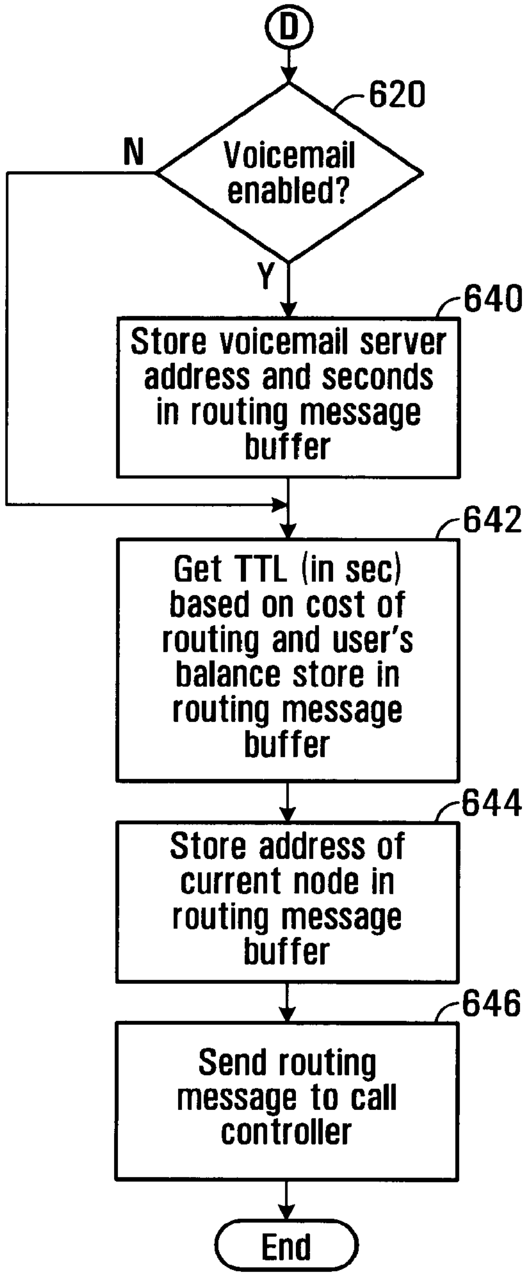

D
620
Voicemail enabled?
N
Y
640
Store voicemail server address and seconds in routing message buffer
642
Get TTL (in sec) based on cost of routing and user's balance store in routing message buffer
644
Store address of current node in routing message buffer
646
Send routing message to call controller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

FIG. 8C

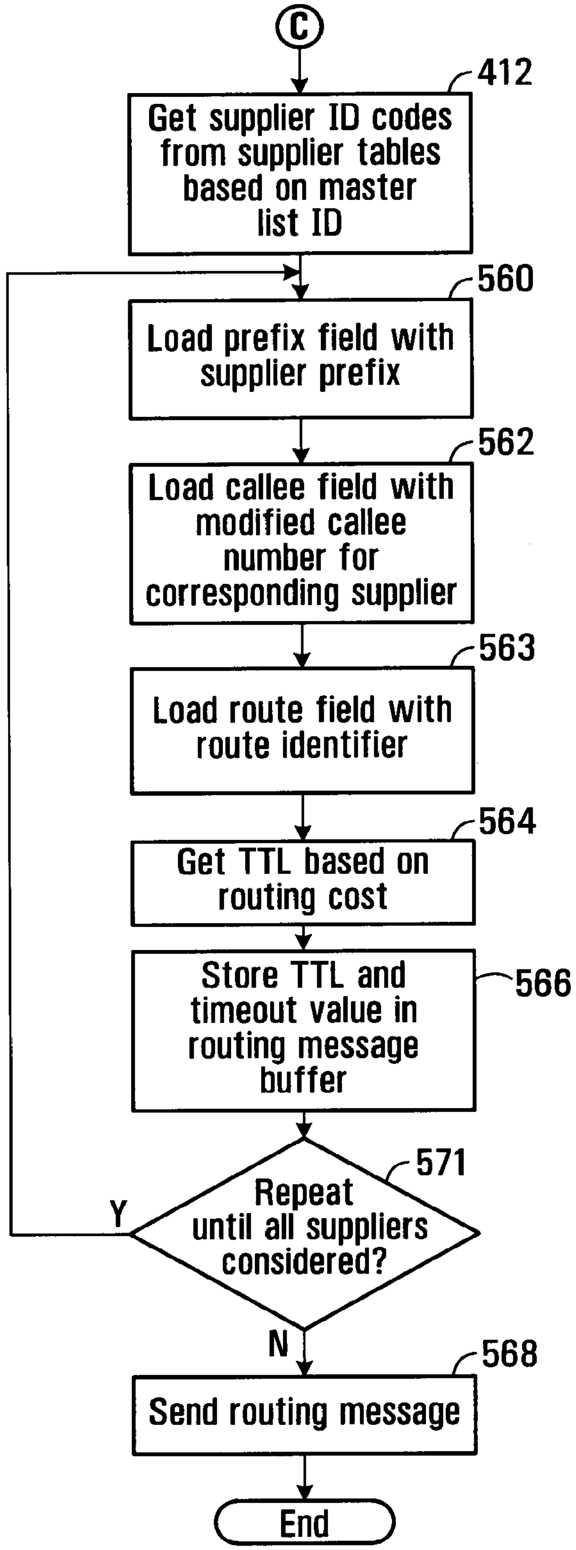
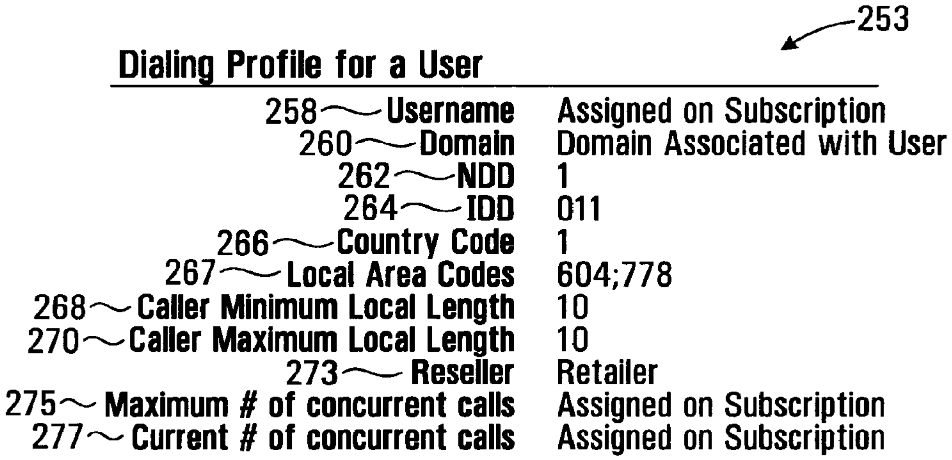

C
412
Get supplier ID codes from supplier tables based on master list ID
560
Load prefix field with supplier prefix
562
Load callee field with modified callee number for corresponding supplier
563
Load route field with route identifier
564
Get TTL based on routing cost
566
Store TTL and timeout value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

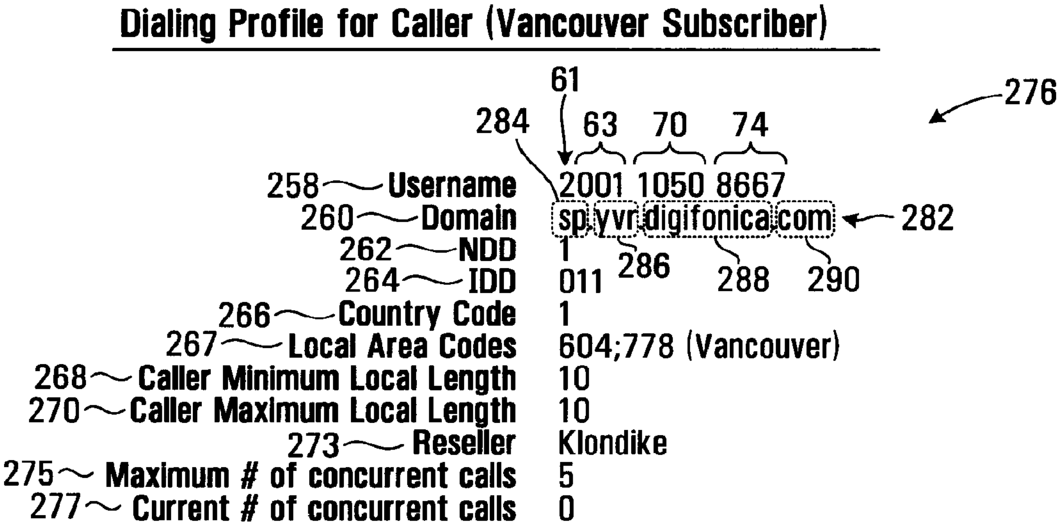
FIG. 8D



Dialing Profile for a User

Username	Assigned on Subscription
Domain	Domain Associated with User
NDD	1
IDD	011
Country Code	1
Local Area Codes	604;778
Caller Minimum Local Length	10
Caller Maximum Local Length	10
Reseller	Retailer
Maximum # of concurrent calls	Assigned on Subscription
Current # of concurrent calls	Assigned on Subscription

FIG. 9



Dialing Profile for Caller (Vancouver Subscriber)

Username	2001 1050 8667
Domain	sp.yvr.digifonica.com
NDD	1
IDD	011
Country Code	1
Local Area Codes	604;778 (Vancouver)
Caller Minimum Local Length	10
Caller Maximum Local Length	10
Reseller	Klondike
Maximum # of concurrent calls	5
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

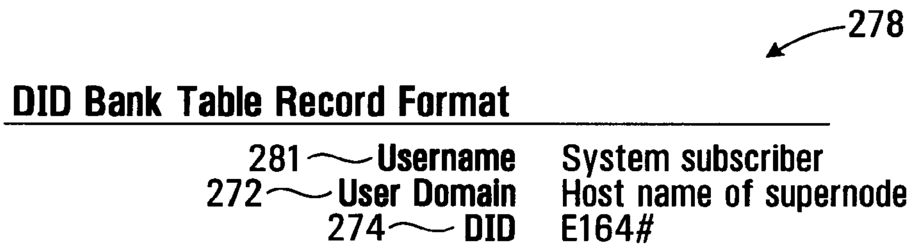

278
DID Bank Table Record Format
281 Username System subscriber
272 User Domain Host name of supernode
274 DID E164#

FIG. 13

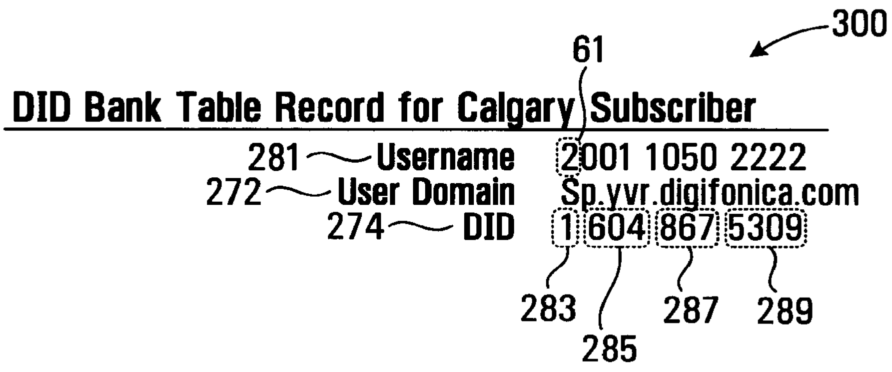

300
61
DID Bank Table Record for Calgary Subscriber
281 Username 2001 1050 2222
272 User Domain Sp.yvr.digifonica.com
274 DID 1 604 867 5309
283
285
287
289

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

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

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

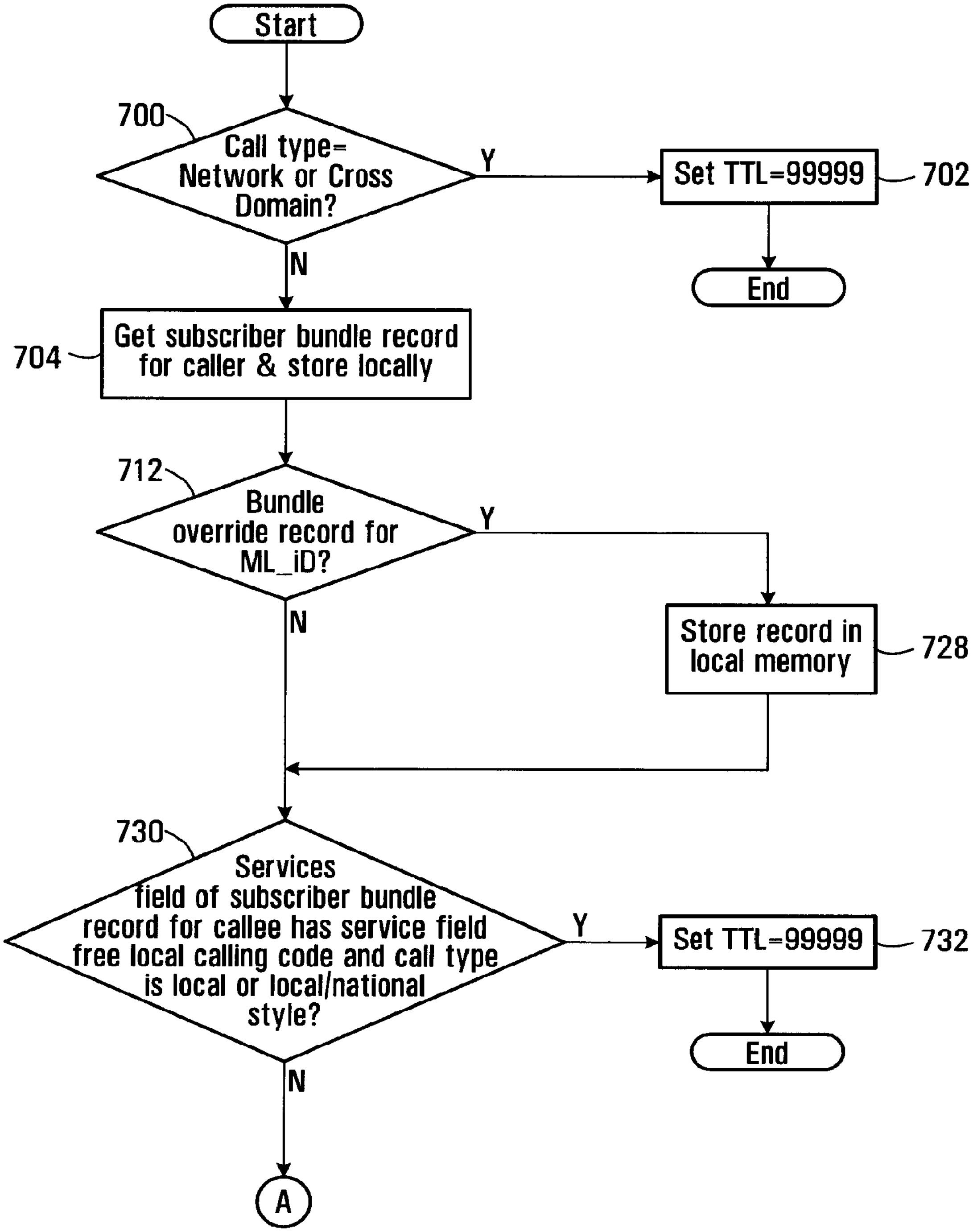

Start
700
Call type= Network or Cross Domain?
Y
Set TTL=99999
702
End
N
704
Get subscriber bundle record for caller & store locally
712
Bundle override record for ML_iD?
Y
Store record in local memory
728
N
730
Services field of subscriber bundle record for callee has service field free local calling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

FIG. 33A

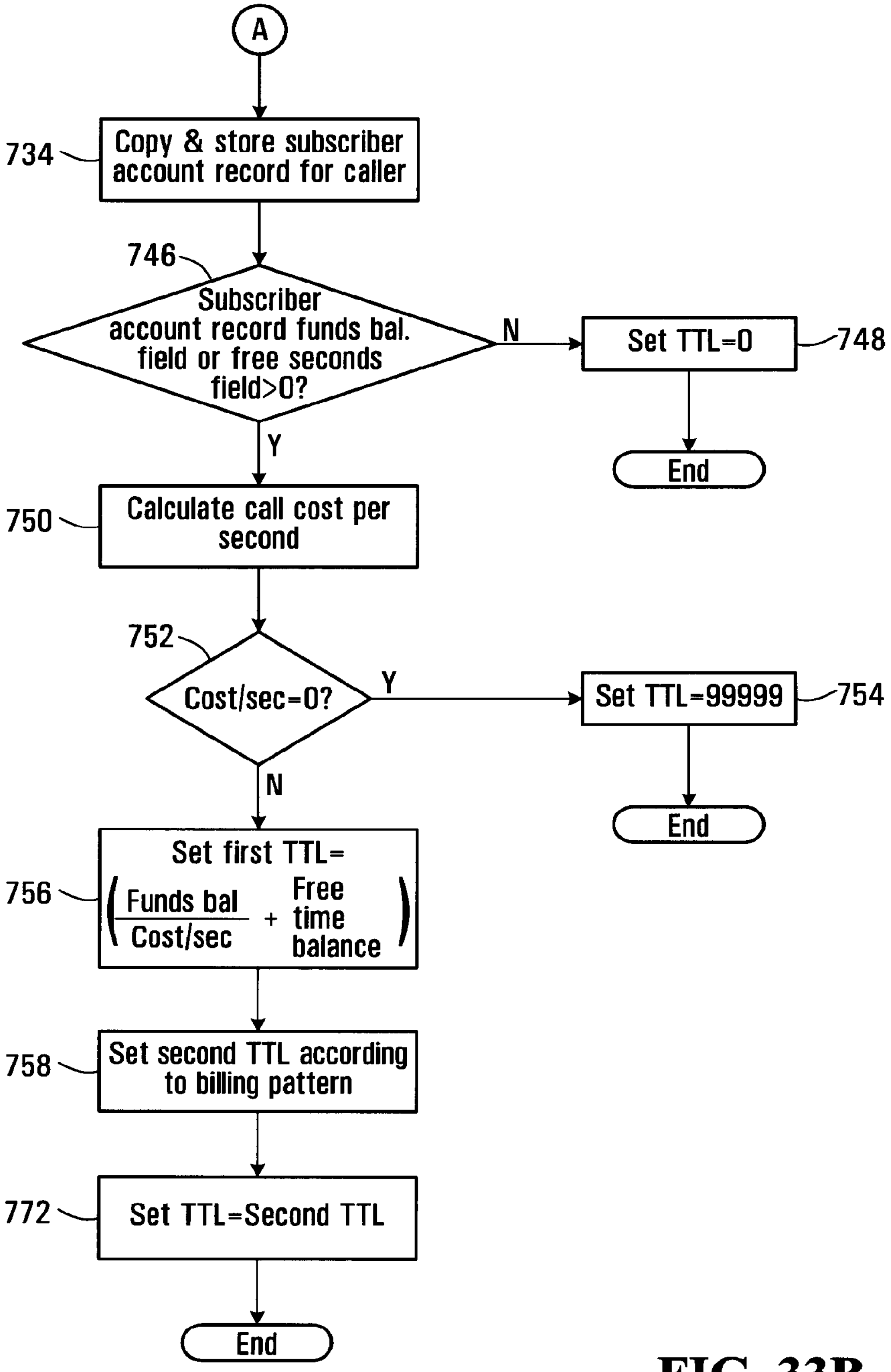

A
734
Copy & store subscriber account record for caller
746
Subscriber account record funds bal. field or free seconds field>0?
N
Set TTL=0
748
End
Y
750
Calculate call cost per second
752
Cost/sec=0?
Y
Set TTL=99999
754
End
N
756
Set first TTL=
Funds bal / Cost/sec + Free time balance
758
Set second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

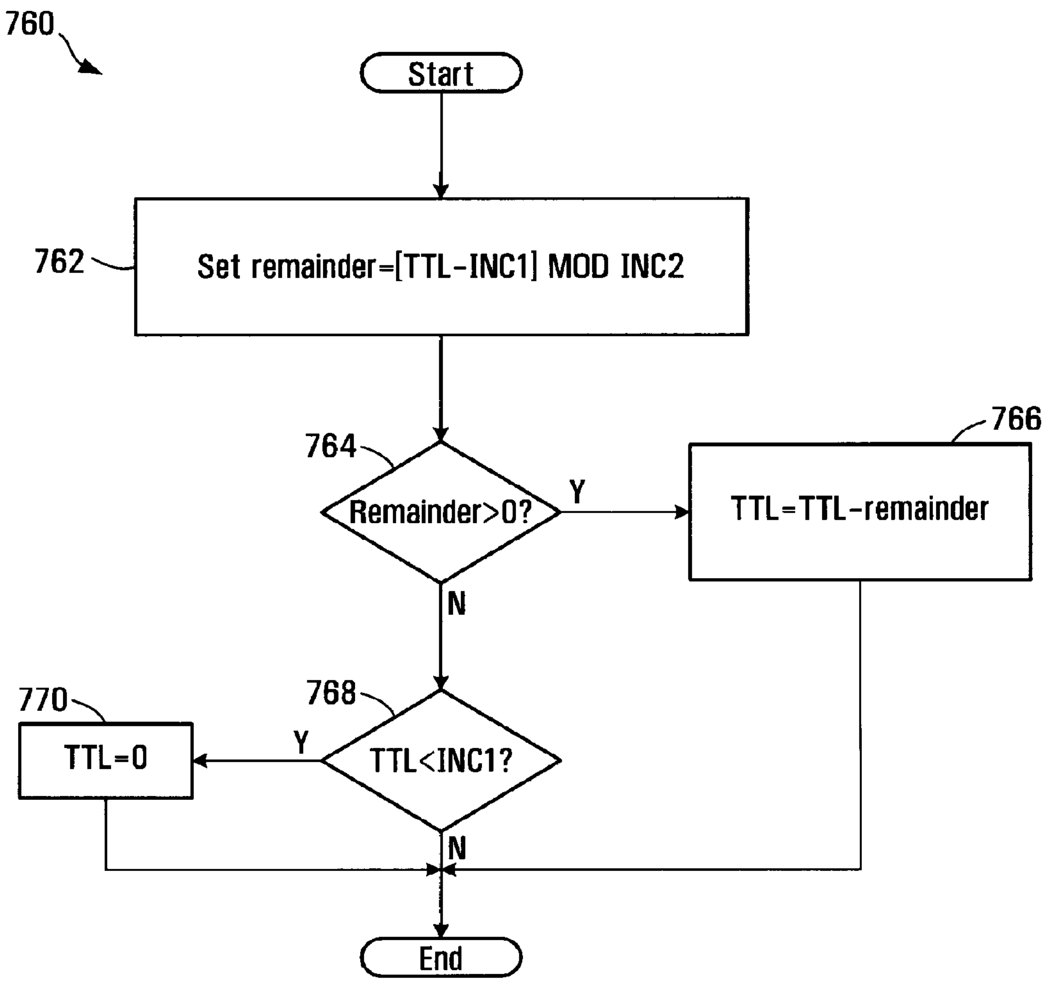

760
Start
762
Set remainder=[TTL-INC1] MOD INC2
764
Remainder>0?
Y
766
TTL=TTL-remainder
N
770
768
TTL=0
Y
TTL<INC1?
N
End

FIG. 40

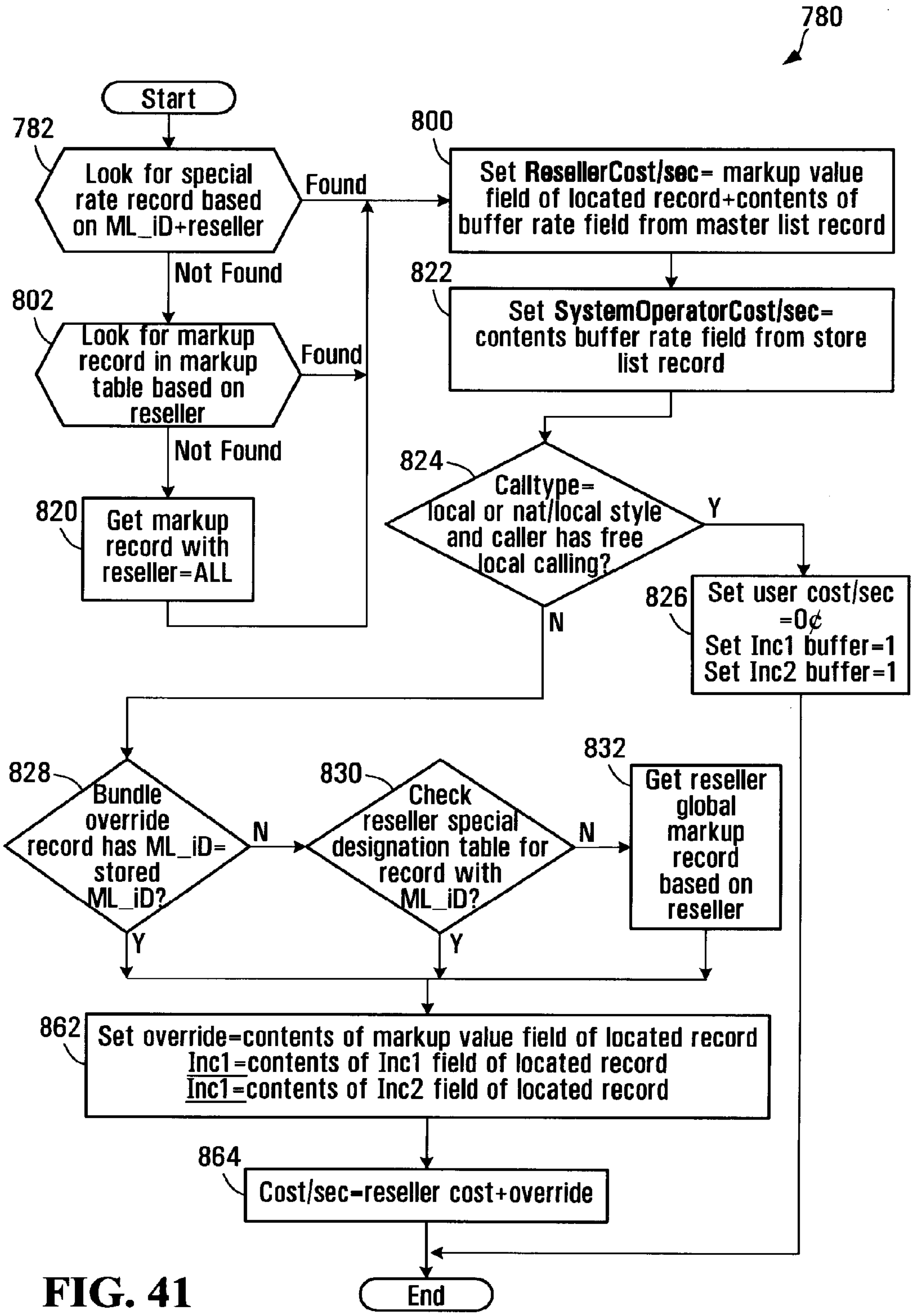

780
Start
782
Look for special rate record based on ML_iD+reseller
Found
Not Found
800
Set ResellerCost/sec= markup value field of located record+contents of buffer rate field from master list record
802
Look for markup record in markup table based on reseller
Found
Not Found
822
Set SystemOperatorCost/sec= contents buffer rate field from store list record
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

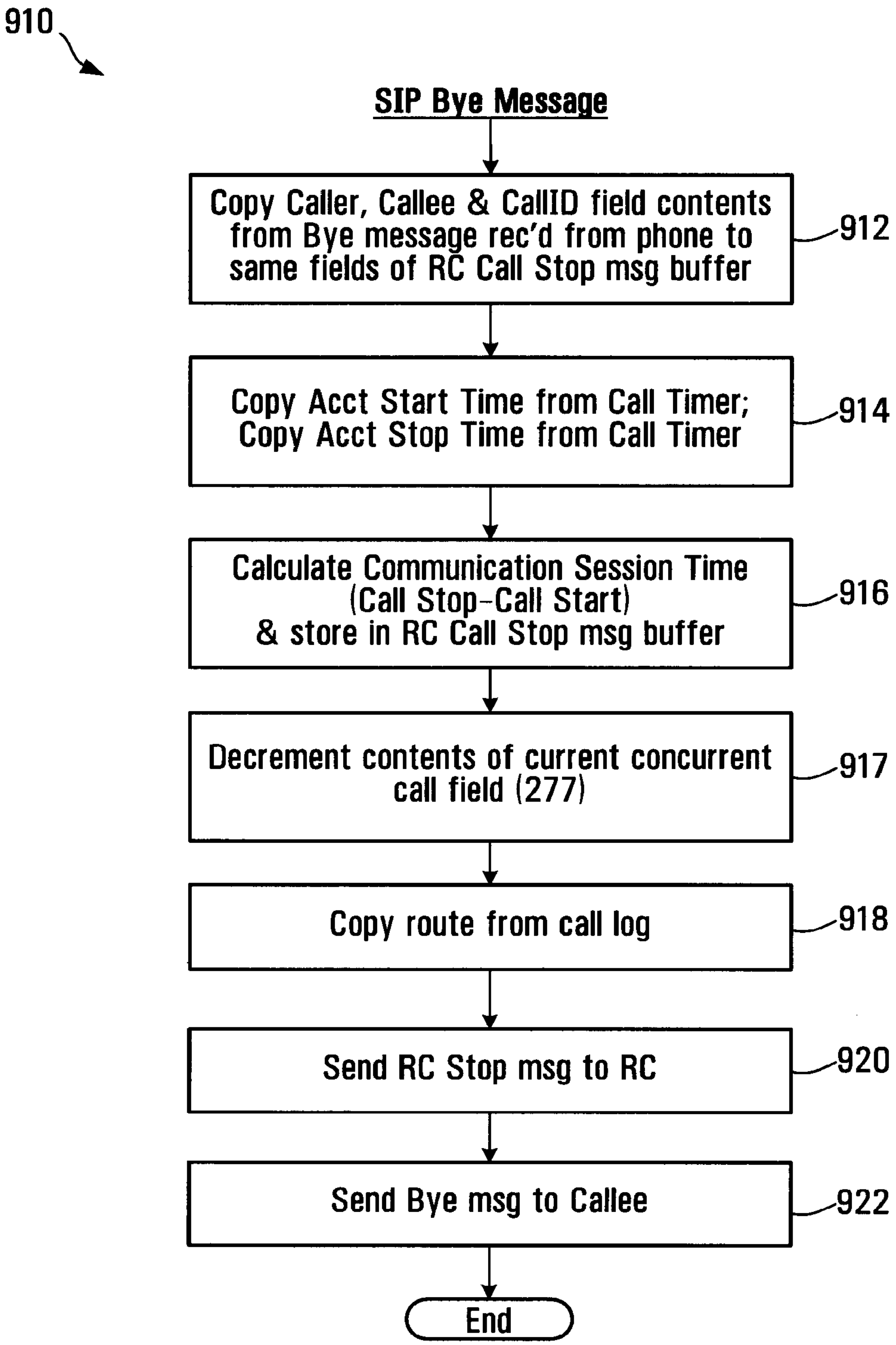
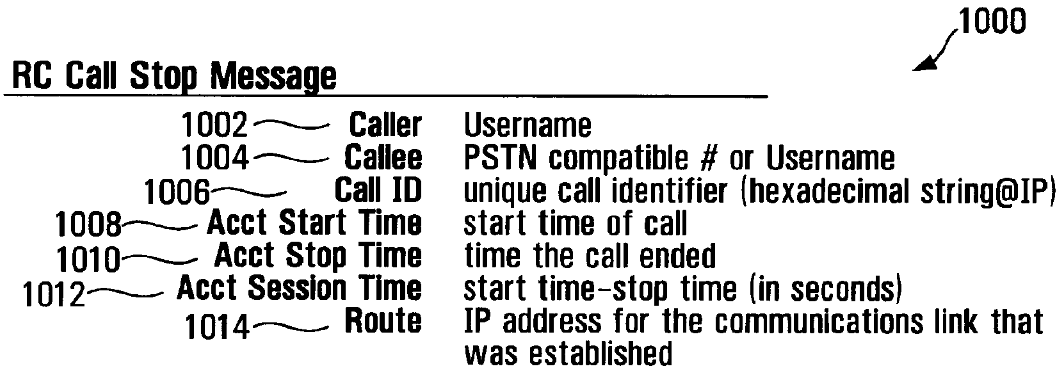

910
SIP Bye Message
Copy Caller, Callee & CallID field contents from Bye message rec'd from phone to same fields of RC Call Stop msg buffer
912
Copy Acct Start Time from Call Timer; Copy Acct Stop Time from Call Timer
914
Calculate Communication Session Time (Call Stop-Call Start) & store in RC Call 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

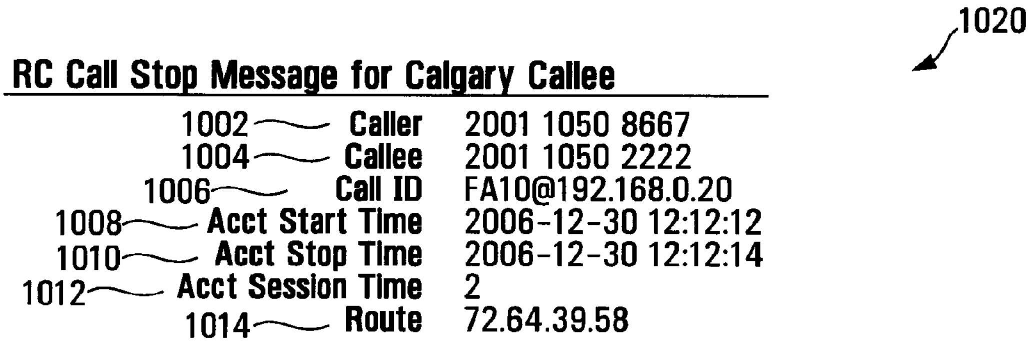
FIG. 53



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



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

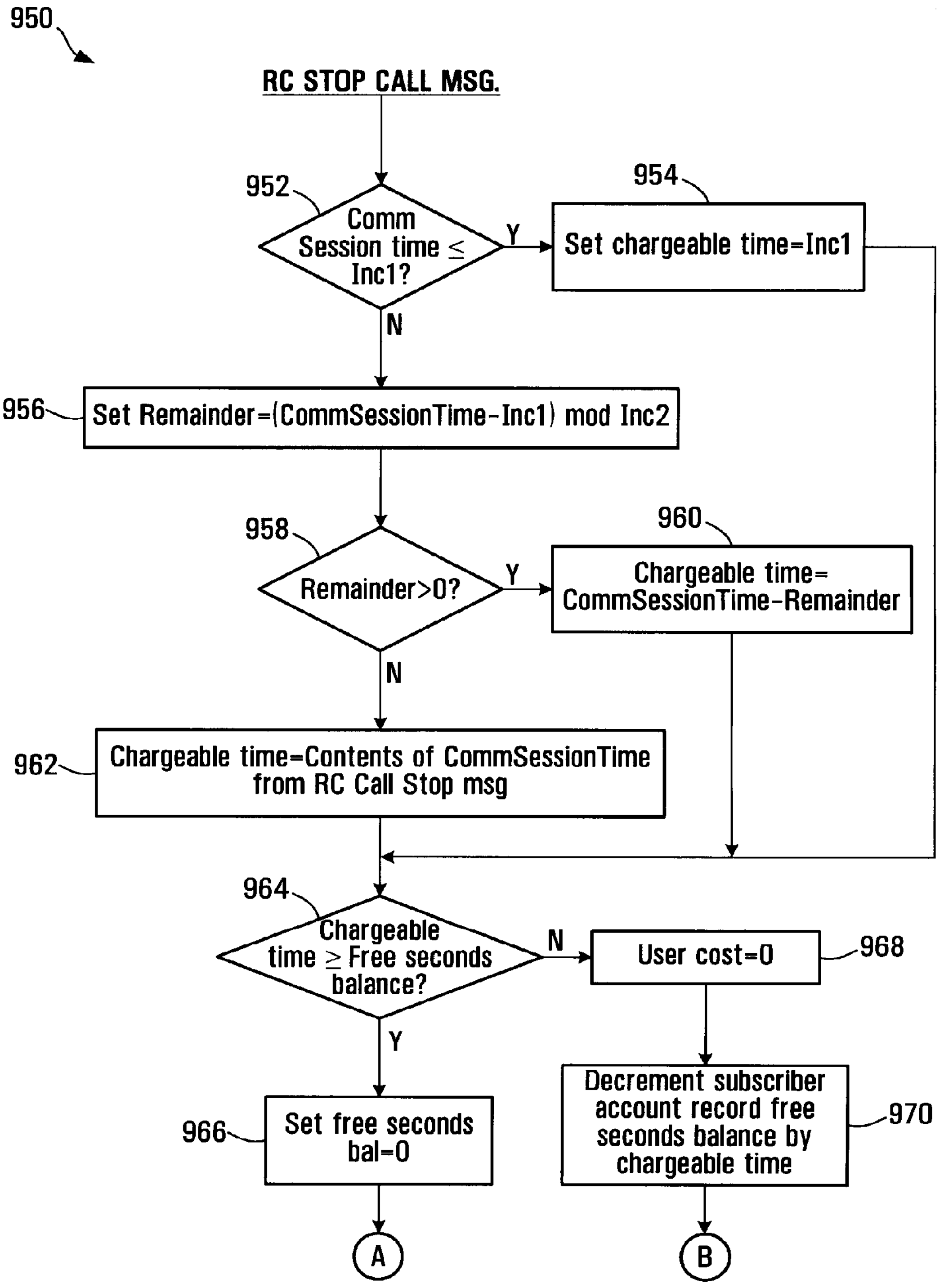

950
RC STOP CALL MSG.
952
Comm Session time ≤ Inc1?
Y
N
954
Set chargeable time=Inc1
956
Set Remainder=(CommSessionTime-Inc1) mod Inc2
958
Remainder>0?
Y
N
960
Chargeable time= CommSessionTime-Remainder
962
Chargeable time=Contents of CommSessionTime from RC Call Stop msg
964
Chargeable time ≥ Free seconds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

FIG. 56A

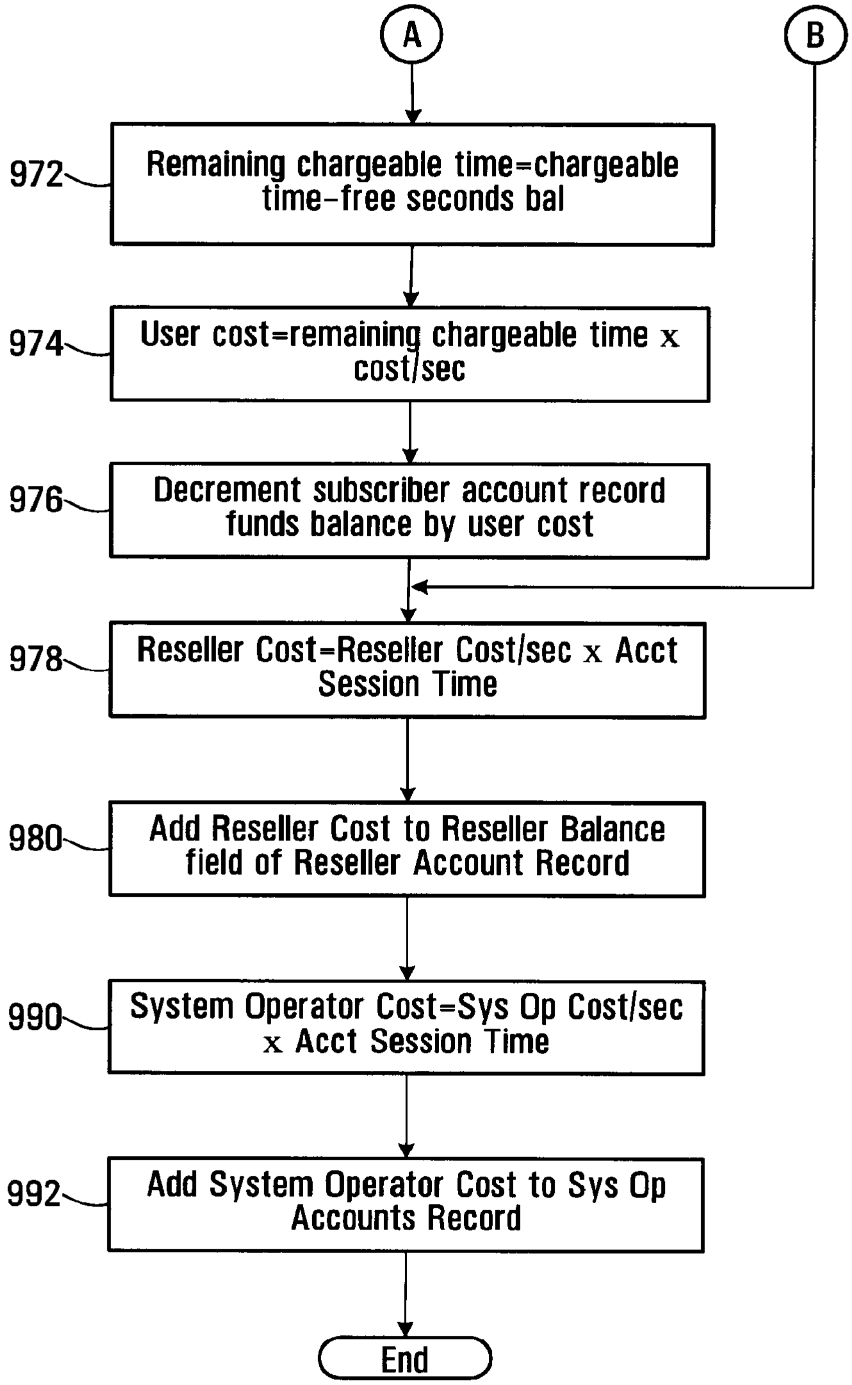

A
B
972
Remaining chargeable time=chargeable time-free seconds bal
974
User cost=remaining chargeable time x cost/sec
976
Decrement subscriber account record funds balance by user cost
978
Reseller Cost=Reseller Cost/sec x Acct Session Time
980
Add Reseller Cost to Reseller Balance field of Reseller 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

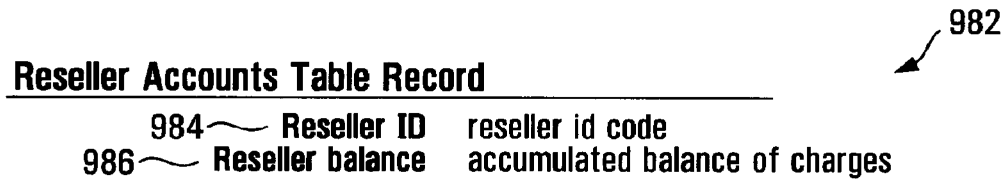


FIG. 57

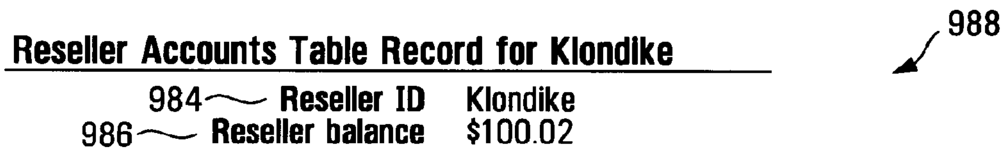


FIG. 58

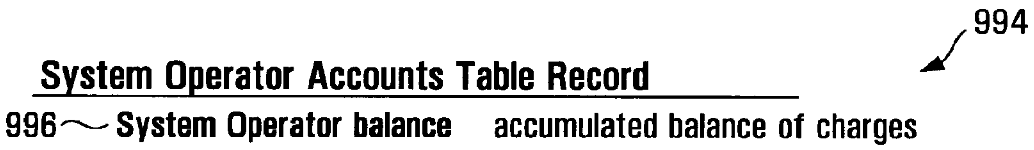


FIG. 59

FIG. 60

PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS

This application is a continuation of U.S. application Ser. No. 15/396,344, filed Dec. 30, 2016, which is a continuation of U.S. application Ser. No. 14/877,570, filed Oct. 7, 2015, now U.S. Pat. No. 9,537,762, which is a continuation of U.S. application Ser. No. 13/966,096, filed Aug. 13, 2013, now U.S. Pat. No. 9,179,005, which is a continuation of U.S. application Ser. No. 12/513,147, filed Mar. 1, 2010, now U.S. Pat. No. 8,542,815, which is a national phase entry of PCT/CA2007/001956, filed Nov. 1, 2007, which claims priority to U.S. Provisional Application No. 60/856,212, filed Nov. 2, 2006, all of which are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of Invention

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 (SS7) 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 OF THE INVENTION

In accordance with one aspect of the invention, there is provided a process for operating a call routing controller to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The process involves, in response to initiation of a call by a calling subscriber, receiving a caller identifier and a callee identifier. The process also involves using call classification criteria associated with the caller identifier to classify the call as a public network call or a private network call. The process further involves 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. The process also involves producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The process may involve receiving a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

Using the call classification criteria may involve searching a database to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

Locating a record may involve locating a caller dialing profile comprising a username associated with the caller, a domain associated with the caller, and at least one calling attribute.

Using the call classification criteria may involve comparing calling attributes associated with the caller dialing profile with aspects of the callee identifier.

Comparing may involve determining whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier has a length within a range specified in the caller dialing profile.

The process may involve formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

Formatting may involve removing an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

Formatting may involve removing a national dialing digit from the callee identifier and prepending a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

Formatting may involve prepending a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

Formatting may involve prepending a caller country code and an area code to the callee identifier when the callee identifier has a length that matches a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The process may involve classifying the call as a private network call when the re-formatted callee identifier identifies a subscriber to the private network.

The process may involve determining whether the callee identifier complies with a pre-defined username format and if so, classifying the call as a private network call.

The process may involve causing a database of records to be searched to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and if the DID bank table record is found, classifying the call as a private network call and if a DID bank table record is not found, classifying the call as a public network call.

Producing the routing message identifying a node on the private network may involve setting a callee identifier in response to a username associated with the DID bank table record.

Producing the routing message may involve determining whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

Determining whether a node associated with the reformatted callee identifier is the same as a node associated the caller identifier may involve determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

When the node associated with the caller is not the same as the node associated with the callee, the process involves producing a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and communicating the routing message to a call controller.

When the node associated with the caller is the same as the node associated with the callee, the process involves determining whether to perform at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee.

Producing the routing message may involve producing a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The process may involve communicating the routing message to a call controller.

Producing a routing message identifying a gateway to the public network may involve searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve loading a routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The process may involve communicating a routing message involving the contents of the routing message buffer to a call controller.

The process may involve causing the dialing profile to include a maximum concurrent call value and a concurrent call count value and causing the concurrent call count value to be incremented when the user associated with the dialing profile initiates a call and causing the concurrent call count value to be decremented when a call with the user associated with the dialing profile is ended.

In accordance with another aspect of the invention, there is provided a call routing apparatus for facilitating communications between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The apparatus includes receiving provisions for receiving a caller identifier and a callee identifier, in response to initiation of a call by a calling subscriber. The apparatus also includes classifying provisions for classifying the call as a private network call or a public network call according to call classification criteria associated with the caller identifier. The apparatus further includes provisions for 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. The apparatus also includes provisions for producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The receiving provisions may be operably configured to receive a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

The apparatus may further include searching provisions for searching a database including records associating calling attributes with subscribers to the private network to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

The records may include dialing profiles each including a username associated with the subscriber, an identification of a domain associated with the subscriber, and an identification of at least one calling attribute associated with the subscriber.

The call classification provisions may be operably configured to compare calling attributes associated with the caller dialing profile with aspects of the callee identifier.

The calling attributes may include an international dialing digit and call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

The calling attributes may include an national dialing digit and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

The calling attributes may include an area code and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

The calling attribute may include a number length range and the call classification provisions may be operably configured to determine whether the callee identifier has a length within a number length range specified in the caller dialing profile.

The apparatus may further include formatting provisions for formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

The formatting provisions may be operably configured to remove an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

The formatting provisions may be operably configured to remove a national dialing digit from the callee identifier and prepend a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

The formatting provisions may be operably configured to prepend a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

The formatting provisions may be operably configured to prepend a caller country code and area code to the callee identifier when the callee identifier has a length that matches

a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The classifying provisions may be operably configured to classify the call as a private network call when the reformatted callee identifier identifies a subscriber to the private network.

The classifying provisions may be operably configured to classify the call as a private network call when the callee identifier complies with a pre-defined username format.

The apparatus may further include searching provisions for searching a database of records to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and the classifying provisions may be operably configured to classify the call as a private network call when the DID bank table record is found and to classify the call as a public network call when a DID bank table record is not found

The private network routing message producing provisions may be operably configured to produce a routing message having a callee identifier set according to a username associated with the DID bank table record.

The private network routing message producing provisions may be operably configured to determine whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

The private network routing provisions may include provisions for determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

The private network routing message producing provisions may be operably configured to produce a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and to communicate the routing message to a call controller.

The private network routing message producing provisions may be operably configured to perform at least one of the following forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee, when the node associated with the caller is the same as the node associated with the callee.

The provisions for producing the private network routing message may be operably configured to produce a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The apparatus further includes provisions for communicating the routing message to a call controller.

The provisions for producing a public network routing message identifying a gateway to the public network may include provisions for searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes provisions for searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes a routing message buffer and provisions for loading the routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The apparatus further includes provisions for communicating a routing message including the contents of the routing message buffer to a call controller.

The apparatus further includes means for causing said dialing profile to include a maximum concurrent call value and a concurrent call count value and for causing said concurrent call count value to be incremented when the user associated with said dialing profile initiates a call and for causing said concurrent call count value to be decremented when a call with said user associated with said dialing profile is ended.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes dialing profile records comprising fields for associating with respective subscribers to the system, a subscriber user name, direct-in-dial records comprising fields for associating with respective subscriber usernames, a user domain and a direct-in-dial number, prefix to node records comprising fields for associating with at least a portion of the respective subscriber usernames, a node address of a node in the system, whereby a subscriber name can be used to find a user domain, at least a portion of the a subscriber name can be used to find a node with which the subscriber identified by the subscriber name is associated, and a user domain and subscriber name can be located in response to a direct-in-dial number.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes master list records comprising fields for associating a dialing code with respective master list identifiers and supplier list records linked to master list records by the master list identifiers, said supplier list records comprising fields for associating with a communications services supplier, a supplier id, a master list id, a route identifier and a billing rate code, whereby communications services suppliers are associated with dialing codes, such that dialing codes can be used to locate suppliers capable of providing a communications link associated with a given dialing code.

In accordance with another aspect of the invention, there is provided a method for determining a time to permit a communication session to be conducted. The method 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.

Calculating the first time value may involve retrieving a record associated with the participant and obtaining from the record at least one of the free time and the funds balance.

Producing the second time value may involve 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.

Producing the second time value may involve setting a difference between the first time value and the remainder as the second time value.

The method may further involve setting the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

Calculating the cost per unit time may involve 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 the record in a database may involve locating 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 markup record.

Calculating the cost per unit time value further may involve 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, a default operator markup record specifying a default cost per unit time.

The method may further involve 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 method may further involve receiving a communication session time representing a duration of the communication session and incrementing a reseller balance by the product of the reseller rate and the communication session time.

The method may further involve receiving a communication session time representing a duration of the communication session and incrementing a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided an apparatus for determining a time to permit a communication session to be conducted. The apparatus includes a processor circuit, a computer readable medium coupled to the processor circuit and encoded with instructions for directing the processor circuit to calculate a cost per unit time for the communication session, calculate 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 produce 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.

The instructions may include instructions for directing the processor circuit to retrieve a record associated with the participant and obtain from the record at least one of the free time and the funds balance.

The instructions may include instructions for directing the processor circuit to produce the second time value by 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.

The instructions may include instructions for directing the processor circuit to produce the second time value comprises setting a difference between the first time value and the remainder as the second time value. The instructions may include instructions for directing the processor circuit to set the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

The instructions for directing the processor circuit to calculate the cost per unit time may include instructions for directing the processor circuit to locate a record in a database, the record comprising a markup type indicator, a markup value and a billing pattern and set a reseller rate equal to the sum of the markup value and the buffer rate.

The instructions for directing the processor circuit to locate the record in a database may include instructions for directing the processor circuit 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 markup record. The instructions for directing the processor circuit to calculate the cost per unit time value may further include instructions for directing the processor circuit to locate 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, a default operator markup record specifying a default cost per unit time.

The instructions may include instructions for directing the processor circuit 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.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a reseller balance by the product of the reseller rate and the communication session time.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided a process for attributing charges for communications services. The process involves determining a first chargeable time in response to a communication session time and a pre-defined billing pattern, determining a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, changing an account balance associated with the user in response to a user cost per unit time. The process may further involve changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

Determining the first chargeable time may involve locating at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and setting as the

pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may involve a first billing interval and a second billing interval.

Determining the first chargeable time may involve setting the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

Determining the first chargeable time may involve producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and setting the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and setting the first chargeable time to the communication session time when the remainder is not greater than zero.

The process may further involve determining a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Determining the second chargeable time may involve setting the second chargeable time to a difference between the first chargeable time.

The process may further involve resetting the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Changing an account balance associated with the user may involve calculating a user cost value in response to the second chargeable time and the user cost per unit time.

The process may further involve changing a user free cost balance in response to the user cost value.

The process may further involve setting the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The process may further involve changing a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided an apparatus for attributing charges for communications services. The apparatus includes a processor circuit, a computer readable medium in communication with the processor circuit and encoded with instructions for directing the processor circuit to determine a first chargeable time in response to a communication session time and a pre-defined billing pattern, determine a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, change an account balance associated with the user in response to a user cost per unit time.

The instructions may further include instructions for changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

The instructions for directing the processor circuit to determine the first chargeable time may further include instructions for causing the processor circuit to communicate with a database to locate at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and instructions for setting as the pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may include a first billing interval and a second billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for directing the processor circuit to set the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and instructions for causing the processor circuit to set the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and instructions for causing the processor circuit to set the first chargeable time to the communication session time when the remainder is not greater than zero.

The instructions may further include instructions for causing the processor circuit to determine a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to determine the second chargeable time may include instructions for causing the processor circuit to set the second chargeable time to a difference between the first chargeable time.

The instructions may further include instructions for causing the processor circuit to reset the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to change an account balance associated with the user may include instructions for causing the processor circuit to calculate a user cost value in response to the second chargeable time and the user cost per unit time.

The instructions may further include instructions for causing the processor circuit to change a user free cost balance in response to the user cost value.

The instructions may further include instructions for causing the processor circuit to set the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The instructions may further include instructions for causing the processor circuit to change a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided a computer readable medium encoded with codes for directing a processor circuit to execute one or more of the methods described above and/or variants thereof.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon

review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

FIG. **1** is a block diagram of a system according to a first embodiment of the invention;

FIG. **2** is a block diagram of a caller telephone according to the first embodiment of the invention;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

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

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

FIG. **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;

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

FIG. **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;

FIGS. **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;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

FIGS. **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 FIG. **1**;

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

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

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

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

DETAILED DESCRIPTION

Referring to FIG. **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 FIG. **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 the description of the embodiments of this invention, 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 been 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 FIG. **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.

Subscriber Telephone

In greater detail, referring to FIG. **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 FIG. **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 FF10@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 FIG. **3**, to the routing controller **16** shown in FIG. **1**. This SIP invite message is essentially to initiate a call by a calling subscriber.

Referring to FIG. **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 FIG. **2**. In addition, referring back to FIG. **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 FIG. **2**. The digest parameters field **64** includes digest parameters and the call ID field **65** includes a code comprising a generated prefix code (FF10) 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.

Call Controller

Referring to FIG. **4**, a call controller circuit of the call controller **14** (FIG. **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 FIG. **3**, from the telephone shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **3**, block **122** of FIG. **5** directs the call controller circuit **100** of FIG. **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 FIG. **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 FIG. **3**. The type field **160** contains the type code established at blocks **123** or **125** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIGS. **8**A through **8**D.

RC Request Message Handler

Referring to FIG. **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 FIG. **7**, one of which includes the caller ID buffer **209** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **2**.

Referring back to FIG. **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 "corn" 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 FIG. **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 FIGS. **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 FIG. **13** is added to a direct-in-dial bank table in the database (**18** in FIG. **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 FIG. **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 FIG. **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 FIG. **9** and DID records as shown in FIG. **13** when a user registers with the system, call blocking records of the type shown in FIG. **26**, call forwarding records of the type shown in FIG. **28** and voicemail records of the type shown in FIG. **30** may be added to the database **18** when a new subscriber is added to the system.

Referring back to FIG. **8**A, after retrieving a dialing profile for the caller, such as shown at **276** in FIG. **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 than 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 FIG. **6**, of the RC request message **150**. These checks are shown in greater detail in FIG. **8**B.

Referring to FIG. **8**B, the processor (**202** in FIG. **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 FIG. **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 FIG. **4**) to respond to the incorrect length message by transmitting a message back to the telephone (**12** shown in FIG. **1**) to indicate that an invalid number has been dialled.

Still referring to FIG. **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 FIG. **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 FIG. **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 FIG. **14**) from the callee DID bank table record (**300** in FIG. **14**) into the callee ID buffer (**211** in FIG. **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 FIG. **8**A.

Subscriber to Subscriber Calls Between Different Nodes

Referring to FIG. **8**A, block **280** directs the processor (**202** of FIG. **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 FIG. **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 FIG. **10**. If the corresponding prefixes are not the same, block **302** in FIG. **8**A directs the processor (**202** in FIG. **7**) to set a call type flag in the buffer memory (**207** in FIG. **7**) to indicate the call is a cross-domain call. Then, block **350** of FIG. **8**A directs the processor (**202** of FIG. **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 FIG. **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 FIG. **18**, for example, if the prefix is 20, the supernode address associated with that prefix is sp.yvr.digifonica.com.

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

Referring back to FIG. **8**B, if at block **257**, the callee identifier stored in the callee id buffer (**211** in FIG. **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 FIG. **10**. In FIG. **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 FIG. **8**B.

Block **382** directs the processor (**202** of FIG. **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 FIG. **10**. If not, block **384** of FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** of FIG. **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 FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** for further processing as described above.

Referring back to FIG. **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 FIG. **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 FIG. **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 predefined 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 FIG. **10**) followed by the caller area code (as indicated by the local area code

field **267** of the caller profile shown in FIG. **10**). The processor (**202**) is then directed to block **263** of FIG. **8**B for further processing as described above.

Referring back to FIG. **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 FIG. **10**) and the caller maximum local number length field (**270** in FIG. **10**), block **402** directs the processor **202** of FIG. **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 FIG. **10** of dialing profiles to find a dialing profile having user name field contents (**258** in FIG. **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 FIG. **8**A. Thus, the call is classified as a private network call when the callee identifier identifies a subscriber to the private network.

From FIG. **8**B, it will be appreciated that there are certain groups of blocks of codes that direct the processor **202** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **7** when it executes block **269** in FIG. **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 FIG. **8**B which causes it to set the contents of the callee id buffer **211** of FIG. **7** equal to the newly formatted callee identifier, i.e., a number compatible with the E.164 standard. Then, block **410** of FIG. **8**B directs the processor (**202**) to search a database of route or master list records associating route identifiers with dialing codes shown in FIG. **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 FIG. **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 FIG. **7** uses at block **410** in FIG. **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 FIG. **20** with exemplary field contents as shown.

Referring back to FIG. **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 FIG. **7** to find a master list record such as the one shown in FIG. **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 FIG. **8**B, the process continues as shown in FIG. **8**D. Referring to FIG. **8**D, block **412** directs the processor **202** of FIG. **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 FIG. **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 FIGS. **22**, **23** and **24** for the exemplary suppliers shown at **20** in FIG. **1**, namely Telus, Shaw and Sprint.

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

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

Referring to FIGS. **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 FIG. **25** first.

Block **562** in FIG. **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 FIG. **25**. At block **563** of FIG. **8**D, the contents of the route identifier field **546** of FIG. **21** of the record associated with the supplier "Telus" are added by the processor **202** of FIG. **7** to the routing message buffer shown in FIG. **25** after an @ sign delimiter, and then block **564** in FIG. **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 FIG. **21** in the routing message buffer of FIG. **25**. Accordingly, a first part of the routing message for the Telus gateway is shown generally at **570** in FIG. **25**.

Referring back to FIG. **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 FIG. **25** relates to the second supplier identified by the record shown in FIG. **23**. Referring back to FIG. **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 FIG. **24**.

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

Subscriber to Subscriber Calls within the Same Node

Referring back to FIG. **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 FIG. **11** or **12**, for example. Block **602** of FIG. **8**A then directs the processor **202** of FIG. **7** to get call block, call forward and voicemail records from the database **18** of FIG. **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 FIGS. **26**, **27**, **28** and **30** for example.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **27**, block **608** directs the processor **202** of FIG. **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 FIG. **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 FIG. **32**. Referring back to FIG. **8**A, block **612** then directs the processor **202** to determine whether or not call forwarding is required.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **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 FIG. **8**C. If there are entries in the call forwarding table **27**, block **622** in FIG. **8**A directs the processor **202** to search the dialing profile table to find a dialing profile record as shown in FIG. **9**, for the user identified by the destination number field **616** of the call forward record shown in FIG. **28**. The processor **202** of FIG. **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 FIG. **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 FIG. **7** to add to the routing message buffer all call forwarding usernames and domains associated with the callee.

Referring back to FIG. **8**A, if at block **612** there are no call forwarding records, then at block **620** in FIG. **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 FIG. **30** in a voicemail table stored in the database **18** shown in FIG. **1**.

Referring to FIG. **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 FIG. **8**C, at block **620** if the processor **202** of FIG. **7** finds a voicemail record as shown in FIG. **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 FIG. **8**C directs the processor **202** to FIG. **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 FIG. **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 FIG. **8**C, block **644** then directs the processor **202** of FIG. **7** to store the IP address of the current node in the routing message buffer as shown at **656** in FIG. **32**. Block **646** then directs the processor **202** to send the routing message shown in FIG. **32** to the call controller **14** in FIG. **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 FIG. **1**, the routing message whether of the type shown in FIG. **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 FIG. **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 FIG. **32** is received by the call controller **14**, the routing to gateway routine **122** shown in FIG. **4** may direct the processor **102** to cause a message to be sent back through the internet **13** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **1**, if the call controller **14** receives a routing message of the type shown in FIG. **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 FIGS. **33**A and **33**B, a process for determining a time to live value for any of blocks **642** in FIG. **8**C, **350** in FIG. **8**A or **564** in FIG. **8**D above is described. The process is executed by the processor **202** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **1** and store it locally in the subscriber bundle record buffer at the RC **14**.

Referring to FIG. **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.

FIG. **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 FIG. **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**) to determine whether or not there is a bundle override table record for the master list ID value that was determined at block **410** in FIG. **8**B. An exemplary bundle override table record is shown at **714** in FIG. **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 FIG. **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 FIG. **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 FIG. **33**A, if at block **712** the processor finds a bundle override record of the type shown in FIG. **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 FIG. **37** is stored in the bundle override record buffer at the RC as shown in FIG. **7**. Still referring to FIG. **33**A, block **730** then directs the RC processor to determine whether or not the subscriber bundle table record **706** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **33**B, after copying and storing the subscriber account record shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **39** and the quotient of the contents of the funds balance field **740** in the subscriber account record for the call shown in FIG. **39** and the cost per second determined at block **750** of FIG. **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 FIG. **37**. This process is shown in greater detail at **760** in FIG. **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 FIG. **40**, the process for producing the second time value begins with a first block **762** that directs the processor **202** in FIG. **7** to set a remainder value equal to the difference between the time to live value calculated at block **756** in FIG. **33**B and the contents of the first interval field **722** of the record shown in FIG. **37**, modulus the contents of the second interval field **724** of FIG. **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 403 divided by 6 is 1. 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 433 minus the remainder of 1, i.e., 432 seconds. The processor is then returned back to block **758** of FIG. **33**B.

Referring back to FIG. **40**, if at block **764** the remainder is not greater than zero, block **768** directs the processor **202** of FIG. **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 FIG. **37**. If so, then block **770** of FIG. **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 not greater than zero and the first time value is less than the first billing interval. 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 FIG. **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 **642**, **350** or **564**.

Cost Per Second

Referring back to FIG. **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 FIG. **41**, a process for calculating a cost per unit time is shown generally at **780**. The process is executed by the processor **202** in FIG. **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 FIG. **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 FIG. **8**B.

Referring to FIG. **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 FIG. **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 FIG. **41**, if at block **782** a record such as the one shown in FIG. **43** is located in the system operator special rates table, the processor is directed to block **800** in FIG. **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 FIG. **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 FIG. **42**.

FIG. **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.

FIG. **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 FIG. **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 FIG. **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 FIG. **46**, having the "all" code in the reseller field **806**. The processor is then directed to block **800**.

Referring back to FIG. **41**, at block **800**, the processor **202** of FIG. **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 FIG. **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 been calculated and the process shown in FIG. **41** is ended.

If at block **824** the conditions of that block are not met, the processor **202** of FIG. **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 FIG. **7** to determine whether or not the bundle override record **726** in FIG. **37** located at block **712** in FIG. **33**A has a master list ID equal to the stored master list ID that was determined at block **410** in FIG. **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 FIG. **8**B. An exemplary reseller special destinations table record is shown in FIG. **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 FIG. **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 FIG. **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 FIG. **41**, the record shown in FIG. **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 FIG. **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 FIG. **47**, for example. The contents of the fields of this record **860** may be set according to system operator preferences, for example.

Referring to FIG. **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 FIG. **41**, should the processor get to block **832**, the reseller global mark-up table record as shown in FIG. **50** is retrieved from the database and stored locally at the RC. As seen in FIG. **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 FIG. **41**.)

It will be appreciated that the located record could be a bundle override record of the type shown in FIG. **37** or the located record could be a reseller special destination record of the type shown in FIG. **48** or the record could be a reseller global mark-up table record of the type shown in FIG. **50**. After the override and first and second increment variables have been set at block **862**, the processor **202** of FIG. **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 FIG. **41**, plus the contents of the override variable calculated in block **862** in FIG. **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 FIG. **33**B, for example.

Terminating the Call

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 FIG. **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 FIG. **3**.

Thus, for example, referring to FIG. **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 FA10 @ 192.168.0.20, which is the call ID for the call.

The SIP bye message shown in FIG. **52** is received at the call controller **14** and the call controller executes a process as shown generally at **910** in FIG. **53**. The process includes a first block **912** that directs the call controller processor **102** of FIG. **4** 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 FIG. **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 FIG. **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 FIG. **54**. An RC call stop message specifically associated with the call made to the Calgary callee is shown generally at **1020** in FIG. **55**.

Referring to FIG. **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 FIG. **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 FIG. **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 FA10 @ 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 FIG. **53**, after having produced an RC call stop message, block **920** directs the processor **102** of FIG. **4** to send the RC stop message compiled in the RC call stop message buffer to the RC **16** of FIG. **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 FIG. **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 FIGS. **56**A, **56**B and **56**C. Referring to FIG. **56**A, the RC stop message process **950** begins with a first block **952** that directs the processor **202** in FIG. **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 FIG. **41**, specifically blocks **826** or **862** thereof. If this condition is met, then block **954** of FIG. **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 FIG. **41**. If at block **952** of FIG. **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 FIG. **41**. Then, the processor is directed to block **958** of FIG. **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 FIG. **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 FIG. **39**. If this condition is satisfied, block **966** of FIG. **56**A directs the processor to set the free time field **742** in the record shown in FIG. **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 FIG. **7** was directed to Block **966** which causes the free time field (**742** of FIG. **39**) to be set to zero, referring to FIG. **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 FIG. **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 FIG. **33**B. Block **976** then directs the processor to decrement the funds balance field (**740**) of the subscriber account record shown in FIG. **39** by the contents of the user cost variable calculated at Block **974**.

After completing Block **976** or after completing Block **970** in FIG. **56**A, block **978** of FIG. **56**B directs the processor **202** of FIG. **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 FIG. **45** and the communication session time determined at Block **916** in FIG. **53**. Then, Block **980** of FIG. **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 FIG. **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 FIG. **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 FIG. **58** are incremented by the reseller cost calculated at block **978** of FIG. **56**B.

Still referring to FIG. **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 FIG. **7** calculate a system operator cost as the product of the system operator cost per second, as set at block **822** in FIG. **41**, and the communication session time as determined at Block **916** in FIG. **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 FIG. **59**. This record includes a system operator balance field **996** holding an accumulated charges balance. Referring to FIG. **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 FIG. **56**B.

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

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

What is claimed is:

1. A method of 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, the second participant identifier being associated with the second participant device;

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

processing the second participant identifier, using the at least one processor, based on at least one of the plurality of first participant attributes obtained from a user profile for the first participant, to produce a new second participant identifier;

classifying the communication, based on the new second participant identifier, 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 associated with the second participant device, 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**, wherein classifying the communication further comprises 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.

4. The method of claim **1**, wherein classifying the communication further comprises causing the at least one processor to:

determine whether a user profile associated with the new second participant identifier exists in the database; and

if a user profile associated with the new second participant identifier does not exist in the database, classify the communication as the external network communication.

5. The method of claim **4**, wherein classifying the communication further comprises causing the at least one processor to:

if a user profile associated with the new second participant identifier exists in the database, classify the communication as the system communication.

6. The method of claim **5**, wherein the Internet address associated with the second participant device is based on the user profile associated with the new second participant identifier.

7. The method of claim **2**, wherein classifying the communication further comprises causing the at least one processor to:

determine whether a user profile associated with the new second participant identifier exists in the database;

if a user profile associated with the new second participant identifier does not exist in the database, classify the communication as the external network communication;

and

if a user profile associated with the new second participant identifier exists in the database, classify the communication as the system communication, wherein the Internet address associated with the second participant device is based on the user profile associated with the new second participant identifier.

8. The method of claim **1**, 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. A method of 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 over the Internet, receiving, by a controller comprising at least one processor, a first participant identifier and a second participant identifier, the second participant identifier being associated with the second participant device;

causing the at least one processor to access at least one database using the first participant identifier, the at least one database comprising user profiles and each user profile associating a respective plurality of attributes with a respective user, to locate a plurality of first participant attributes including at least one user-specific attribute associated with the first participant;

processing the second participant identifier, using the at least one processor, based on at least one of the plurality of first participant attributes obtained from a user profile for the first participant to produce a new second participant identifier;

determining whether a user profile associated with the new second participant identifier exists in the at least one database;

classifying the communication, based on the new second participant identifier, as a system communication if a user profile associated with the new second participant identifier exists in the at least one database, and as an external network communication if a user profile associated with the new second participant identifier does not exist in the at least one database;

when the communication is classified as a system communication, using the at least one processor to produce a system routing message identifying an Internet address associated with the second participant device based on the user profile associated with the new second participant identifier, causing the communication to be established entirely over an Internet protocol (IP) network;

when the communication is classified as an external network communication, using the at least one processor to produce an external network routing message identifying an Internet address associated with a gateway to an external network, causing at least a portion of a path taken by the communication to be established over a circuit switched network; and

updating the at least one database to cause at least one of the plurality of first participant attributes to be modified.

10. The method of claim **9**, 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.

11. The method of claim **9**,

wherein processing the second participant identifier comprises causing the at least one processor to modify the second participant identifier, based on at least one of the plurality of first participant attributes, to produce the new second participant identifier;

wherein producing the system routing message comprises causing the at least one processor to determine the Internet address associated with the second participant device based on a user profile for the second participant; and

wherein producing the external network routing message comprises causing the at least one processor to select the Internet address associated with the gateway to the external network from among a plurality of Internet addresses associated with a respective plurality of gateways to the external network, and wherein the external network routing message comprises a code identifying a communication supplier associated with the gateway to the external network.

12. 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, the second participant identifier being associated with the second participant device;

access a database comprising user profiles, using the first participant identifier, each user profile associating a respective plurality of attributes with a respective user, to locate a plurality of first participant attributes including at least one user-specific attribute associated with the first participant;

process the second participant identifier, based on at least one of the plurality of first participant attributes obtained from a user profile for the first participant, to produce a new second participant identifier;

classify the communication, based on the new second participant identifier, 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 associated with the second participant device, 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.

13. The apparatus of claim **12**,

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.

14. The apparatus of claim **13**, 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.

15. The apparatus of claim **13**, wherein the at least one processor is further operably configured to:

determine whether a user profile associated with the new second participant identifier exists in the database; and

if a user profile associated with the new second participant identifier does not exist in the database, classify the communication as the external network communication.

16. The apparatus of claim **15**, wherein the at least one processor is further operably configured to:

if a user profile associated with the new second participant identifier exists in the database, classify the communication as the system communication, wherein the Internet address associated with the second participant device is determined based on the user profile associated with the new second participant identifier.

17. The apparatus of claim **13**, 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.

18. The apparatus of claim **13**, wherein the at least one processor is further operably configured to update the database to cause at least one of the plurality of first participant attributes to be modified.

19. The apparatus of claim **13**, wherein the external network routing message comprises a code identifying a communication supplier associated with the gateway to the external network.

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

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

wherein processing the second participant identifier comprises causing the at least one processor to modify the second participant identifier, based on at least one of the plurality of first participant attributes, to produce the new second participant identifier.

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

wherein producing the system routing message comprises causing the at least one processor to determine the Internet address associated with the second participant device based on a user profile for the second participant.

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

wherein producing the external network routing message comprises causing the at least one processor to select the Internet address associated with the gateway to the external network from among a plurality of Internet addresses associated with a respective plurality of gateways to the external network, and wherein the external network routing message comprises a code identifying a communication supplier associated with the gateway to the external network.

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

wherein the Internet address associated with the second participant device comprises an IP address or domain name of a first communication system node associated with the second participant device, the first 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.

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

wherein the first communication system node is operably configured to establish the communication to the second participant device, the first communication system node being identified by a first Internet address, and wherein the second participant device is identified by a second Internet address distinct from the first Internet address;

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

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

26. The method of claim **1**, further comprising:

accessing the database to locate communication blocking information associated with the second participant, using the at least one processor; and

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

27. The apparatus of claim **13**, wherein the at least one processor is further operably configured to:

modify the second participant identifier, based on at least one of the plurality of first participant attributes, to produce the new second participant identifier.

28. The apparatus of claim **13**, wherein the at least one processor is further operably configured to:

determine the Internet address associated with the second participant device based on a user profile for the second participant.

29. The apparatus of claim **12**, wherein the at least one processor is further operably configured to:

select the Internet address associated with the gateway to the external network from among a plurality of Internet addresses associated with a respective plurality of gateways to the external network.

30. The apparatus of claim **12**,

wherein the 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; and

wherein the Internet address associated with the gateway to the external network is selected from among a plurality of Internet addresses associated with a respective plurality of gateways to the external network.

31. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **2**.

32. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **3**.

33. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **4**.

34. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **7**.

35. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **8**.

36. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **9**.

37. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **21**.

38. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **22**.

39. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **23**.

40. A non-transitory computer readable medium encoded with program code for directing the at least one processor to execute the method of claim **26**.

* * * * *

EXHIBIT 4

US009948549B2

(12) **United States Patent**
Perreault et al.

(10) **Patent No.: US 9,948,549 B2**
(45) **Date of Patent: *Apr. 17, 2018**

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(54) **PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS**

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

This patent is subject to a terminal disclaimer.

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(Continued)

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H04L 12/725	(2013.01)
H04M 7/00	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04L 45/3065*** (2013.01); ***H04M 3/4211*** (2013.01); ***H04M 7/006*** (2013.01); ***H04M 7/0075*** (2013.01); ***H04Q 3/70*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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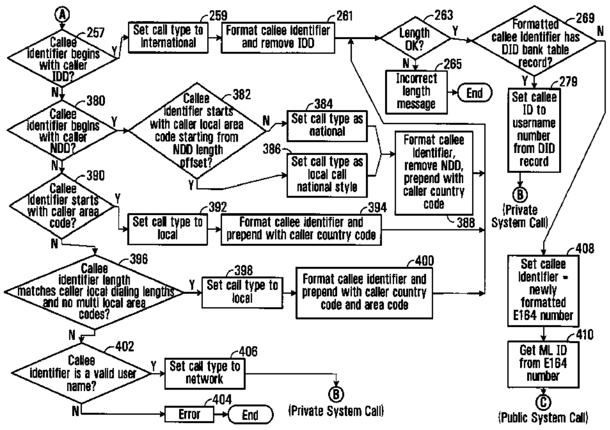
(57) **ABSTRACT**

A process and apparatus to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated is disclosed. In response to initiation of a call by a calling subscriber, a caller identifier and a callee identifier are received. Call classification criteria associated with the caller identifier are used to classify the call as a public network call or a private network call. A routing message identifying an address, on the private network, associated with the callee is produced when the call is classified as a private network call and a routing message identifying a

(Continued)



gateway to the public network is produced when the call is classified as a public network call.

30 Claims, 32 Drawing Sheets

Related U.S. Application Data

continuation of application No. 14/877,570, filed on Oct. 7, 2015, now Pat. No. 9,537,762, which is a continuation of application No. 13/966,096, filed on Aug. 13, 2013, now Pat. No. 9,179,005, which is a continuation of application No. 12/513,147, filed as application No. PCT/CA2007/001956 on Nov. 1, 2007, now Pat. No. 8,542,815.

(60) Provisional application No. 60/856,212, filed on Nov. 2, 2006.

(51) **Int. Cl.**

H04Q 3/70	(2006.01)
H04M 3/42	(2006.01)

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Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *VoIP-PAL.Com, Inc*., a Nevada corporation, Plaintiff, v. *Verizon Wireless Services, LLC*, a Delaware limited liability corporation; *Verizon Communications, Inc*., a Delaware corporation; *AT&T, Inc*., a Delaware corporation; *AT&T Corp*., a

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Delaware corporation; and DOES I through X, inclusive, Defendants; Case No. 2:16-CV-00271; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Exhibit E; Chart 1 to Exhibit E; Chart 2 to Exhibit E; Chart 3 to Exhibit E; Chart 4 to Exhibit E; Chart 5 to Exhibit E; Chart 6 to Exhibit E; Exhibit F; Chart 1 to Exhibit F; Chart 2 to Exhibit F; Chart 3 to Exhibit F; Chart 4 to Exhibit F; Chart 5 to Exhibit F; Chart 6 to Exhibit F; Exhibit G; Exhibit H; and Addendum 1 to Exhibit H.

Document Title: Complaint for Patent Infringement [Jury Demand] ; Case Title: *VoIP-Pal.Com, Inc*., a Nevada corporation, Plaintiff, v. *Apple, Inc*., a California corporation; Defendants; Case No. 2:16-CV-00260; Court: United States District Court District of Nevada. Attachments: Table of Exhibits; Exhibit A; Exhibit B; Exhibit C; Exhibit D; Chart 1 to Exhibit D; Chart 2 to Exhibit D; Chart 3 to Exhibit D; Chart 4 to Exhibit D; Exhibit E; Exhibit F; and Addendum 1 to Exhibit F.

Letter dated Nov. 30, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Apple Inc. in the U.S.

Letter dated Dec. 1, 2015, from VoIP-Pal.com Inc. giving notice and inviting the company listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. Sent to the following company: Verizon Communications in the U.S.

Letters dated Dec. 18, 2015, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Airtel in India; Alcatel-Lucent in France; Avaya Inc. in the U.S.; AT&T in the U.S.; Blackberry in Canada; Cable One in the U.S.; CenturyLink in the U.S.; Charter Communications in the U.S.; Cisco Systems in the U.S.; Comcast in the U.S.; Cox Communications in the U.S.; Cricket Wireless in the U.S.; Facebook in the U.S.; Freedom Pop in the U.S.; Frontier Communications in the U.S.; HP in the U.S.; Juniper Networks in the U.S.; LoopPay, Inc. in the U.S.; Magic Jack in the U.S.; MetroPCS in the U.S.; Ooma in the U.S.; PayPal in the U.S.; Republic Wireless in the U.S.; Rok Mobile in the U.S.; Samsung Electronics-America in the U.S.; ShoreTel, Inc. in the U.S.; Siemens in Germany; Skype USA in the U.S.; Sprint in the U.S.; Square Cash in the U.S.; Suddenlink Communications in the U.S.; Talktone in the U.S.; Tango in the U.S.; Time Warner Cable in the U.S.; T-mobile in the U.S.; Twitter in the U.S.; US Cellular in the U.S.; Venmo in the U.S.; Virgin Mobile USA in the U.S.; Vodafone in the UK; and Vonage in the U.S.

Letters dated Jan. 4, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Rogers Communications Inc. in Canada; Shaw Cable in Canada; Walmart in Alaska; and WIND Mobile in Canada.

Letters dated Jan. 21, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Alibaba (China) Co., Ltd in China; Comwave Telecommunications in Canada; and Intel in the U.S.

Letters dated Feb. 2, 2016, from VoIP-Pal.com Inc. giving notice and inviting the companies listed herein below to contact VoIP-Pal.com about U.S. Pat. Nos. 9,179,005 and 8,542,815 and related patents listed in the accompanying Attachment A. (Please Note: Attachment A is attached here only to the first letter.) Sent to the following companies: Netflix Inc. in the U.S.; Skype Technologies in the U.S.; and WhatsApp Inc. in the U.S.

Document Title: Petition for *Inter Partes* Review of U.S. Pat. No. 8,542,815; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc*., Petitioner v. *VoIP-Pal.Com Inc*., Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Dated May 24, 2016. 64 sheets.

Document Title: Declaration of Michael Caloyannides; United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Unified Patents Inc*., Petitioner v. *VoIP-Pal.Com Inc*., Patent Owner; IPR2016-01082; U.S. Pat. No. 8,542,815; Producing Routing Messages for Voice Over IP Communications; Signed May 23, 2016; Filed May 24, 2016. 84 sheets.

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Apple Exhibit 1022, IPR2016-01201, Telephonic Hearing Before the Administrative Patent Judges; Jan. 19, 2018; 14 pages.

Case: 18/1456; Document: 1-1; Filed: Jan. 23, 2018, 1 page: United States Court of Appeals for the Federal Circuit; *Notice of Docketing*; 18-1456—*Apple Inc.* v. *Voip-Pal.com, Inc*.; Date of Docketing: Jan. 23, 2018, IPR2016-01198; 1 page.

Case: 18-1456; Document: 1-2; Filed: Jan. 23, 2018, 34 pages: United States Court of Appeals for the Federal Circuit; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; IPR2016-01198, U.S. Pat. No. 9,179,005; Notice of Appeal, (Dated: Jan. 22, 2018, 5 pages); with Paper 53; Entered: Nov. 20, 2017; Final Written Decision; 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73; (29 pages).

Case: 18-1456; Document 6; Filed: Jan. 25, 2018; 14 pages: In the United States Court of Appeals for the Federal Circuit, *Apple Inc*., Petitioner—Appellant, v. *VoIP-Pal.com, Inc*., Patent Owner—Appellee. On Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board, in Case No. IPR2016-01198; Motion of Appellant Apple Inc. to Stay Appeal or for a Limited Remand to Allow Conclusion of Administrative Proceedings.

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Case: 18-1457; Document: 1-2; Flied: Jan. 23, 2018, 34 pages: United States Court of Appeals for the Federal Circuit; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; IPR2016-01201, U.S. Pat. No. 8,542,815; Notice of Appeal, (Dated: Jan. 22, 2018, 5 pages); with Paper 54; Entered: Nov. 20, 2017; Final Written Decision; 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73; (29 pages).

Case: 18-1457; Document 6; Filed: Jan. 25, 2018; 14 pages: in the United States Court of Appeals for the Federal Circuit, *Apple Inc*., Petitioner—Appellant, v. *VoIP-Pal.com, Inc*., Patent Owner—Appellee. On Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board, in Case No. IPR2016-01201; Motion of Appellant Apple Inc. to Stay Appeal or for a Limited Remand to Allow Conclusion of Administrative Proceedings.

United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; Case No. IPR2016-01198, U.S. Pat. No. 9,179,005; Petitioner's Reply in Support of Its Motion for Entry of Judgment in Favor of Petitioner as a Sanction for Improper *Ex Parte* Communications by Patent Owner, or, Alternatively, for New and Constitutionally Correct Proceedings, Date: Jan. 26, 2018, 11 pages.

United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; Case No. IPR2016-01198, U.S. Pat. No. 9,179,005; Petitioner's Updated Exhibit List, Date: Jan. 26, 2018, 4 pages.

Apple Exhibit 1023, IPR2016-01198, Voip-Pal Issues a Correction to its Press Release of Sep. 18, 2017; Jan. 12, 2018, 1 page.

United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; Case No. IPR2016-01201, U.S. Pat. No. 8,542,815; Petitioner's Reply in Support of Its Motion for Entry of Judgment in Favor of Petitioner as a Sanction for Improper *Ex Parte* Communications by Patent Owner, or, Alternatively, for New and Constitutionally Correct Proceedings, Date: Jan. 26, 2018, 11 pages.

United States Patent and Trademark Office; Before the Patent Trial and Appeal Board; *Apple Inc*., Petitioner, v. *VoIP-Pal.com, Inc*., Patent Owner; Case No. IPR2016-01201, U.S. Pat. No. 8,542,815; Petitioner's Updated Exhibit List, Date: Jan. 26, 2018, 4 pages.

Apple Exhibit 1023, IPR2016-01201, Voip-Pal Issues a Correction to Its Press Release of Sep. 18, 2017; Jan. 12, 2018, 1 page.

Case: 18-1456; Document 7; Filed: Jan. 29, 2018; 2 pages: United States Court of Appeals for the Federal Circuit, Order; consolidating the appeals.

Case: 18-1457; Document 7; Filed: Jan. 29, 2018; 2 pages: United States Court of Appeals for the Federal Circuit, Order; consolidating the appeals.

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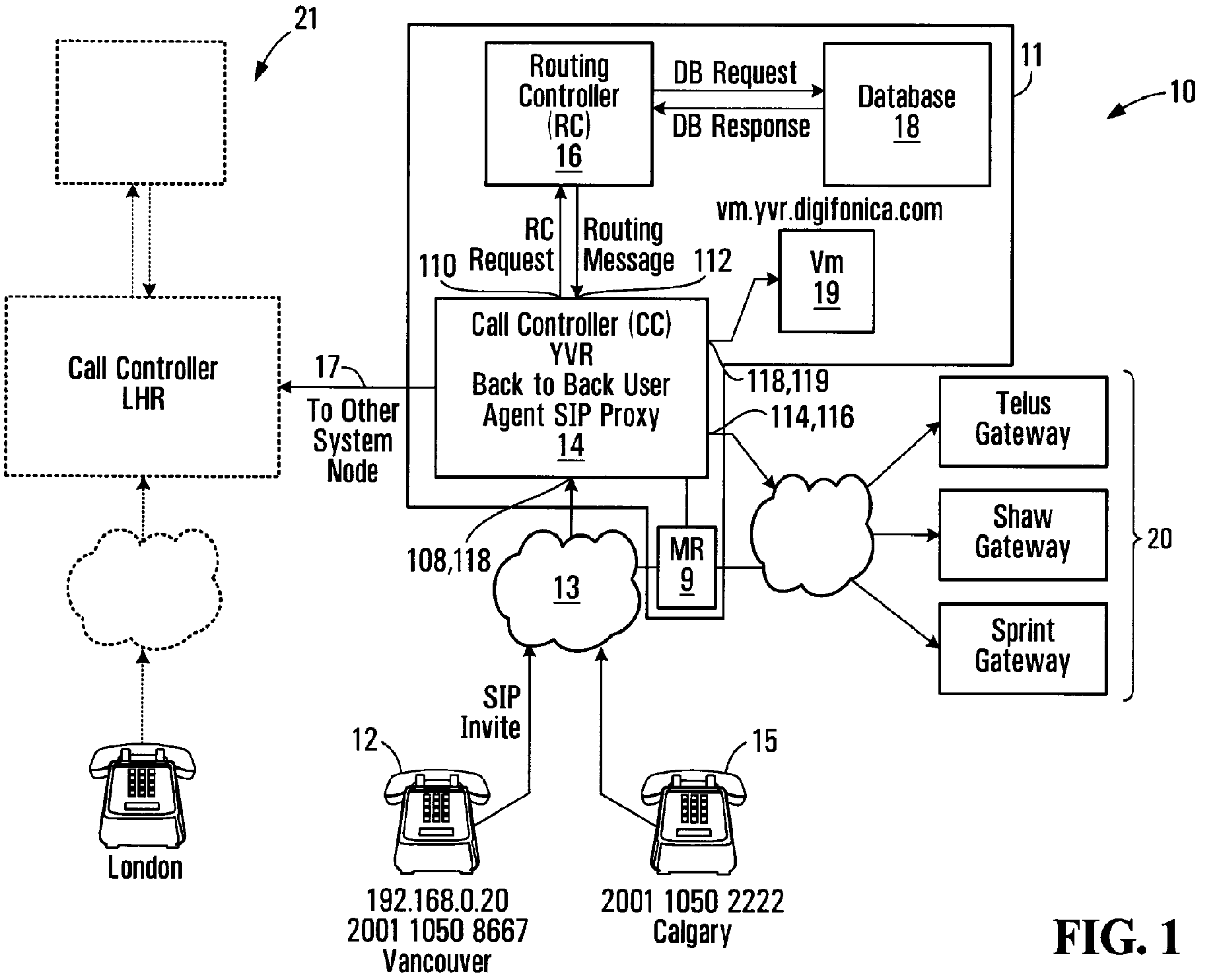

21
10
11
Routing Controller (RC) 16
DB Request
DB Response
Database 18
vm.yvr.digifonica.com
Vm 19
110 RC Request
Routing Message 112
Call Controller (CC) YVR Back to Back User Agent SIP Proxy 14
118,119
114,116
Call Controller LHR
17
To Other System Node
108,118
13
MR 9
Telus Gateway
Shaw Gateway
Sprint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

FIG. 1

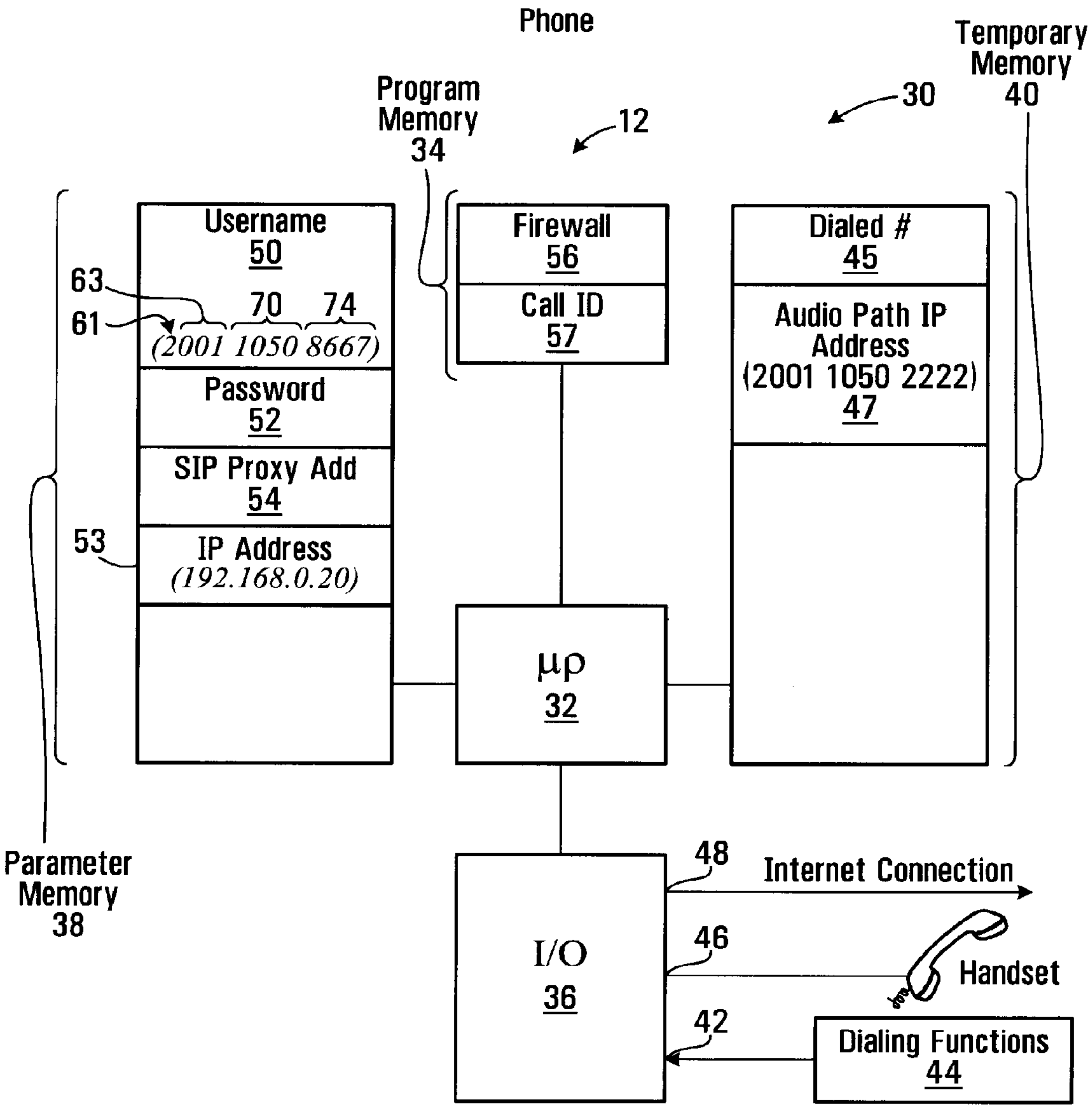

Phone
Program Memory 34
12
30
Temporary Memory 40
Username 50
63
61
70
74
(2001 1050 8667)
Password 52
SIP Proxy Add 54
53
IP Address (192.168.0.20)
Firewall 56
Call ID 57
Dialed # 45
Audio Path IP Address (2001 1050 2222) 47
µp 32
Parameter Memory 38
I/O 36
48
Internet Connection
46
Handset
42
Dialing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

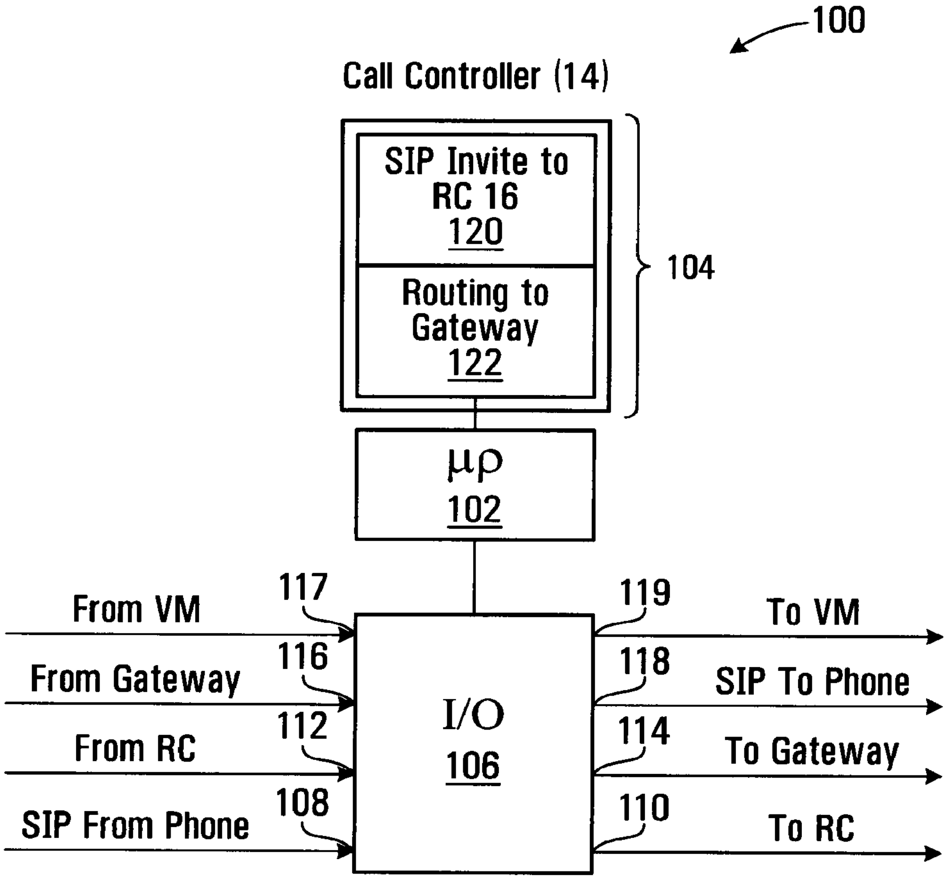


FIG. 4

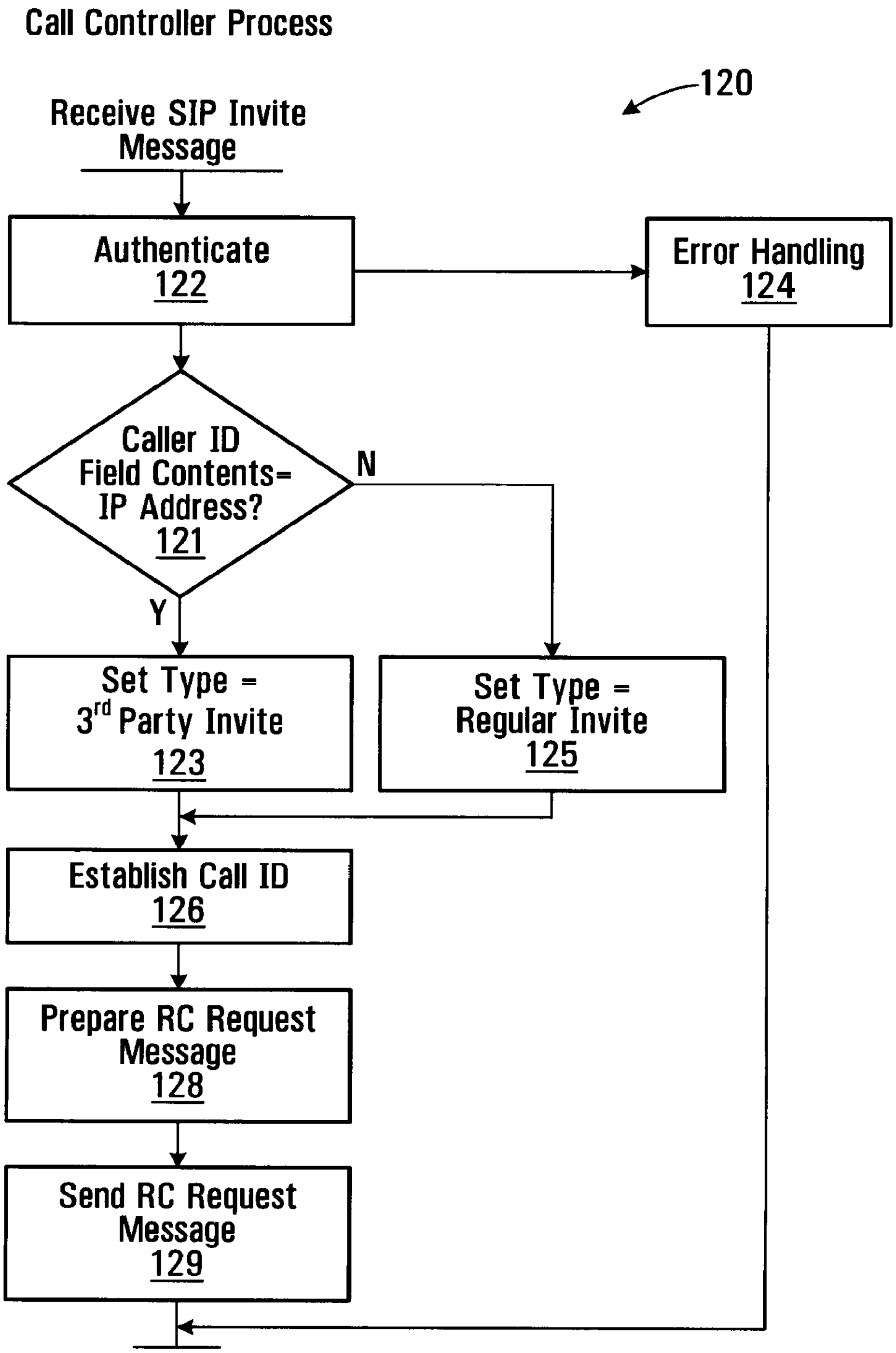
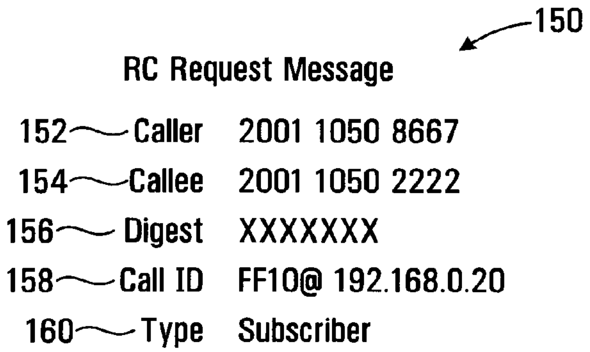

Call Controller Process
120
Receive SIP Invite Message
Authenticate 122
Error Handling 124
Caller ID Field Contents= IP Address? 121
N
Y
Set Type = 3rd Party Invite 123
Set Type = Regular Invite 125
Establish Call ID 126
Prepare RC Request Message 128
Send RC Request Message 129

FIG. 5



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

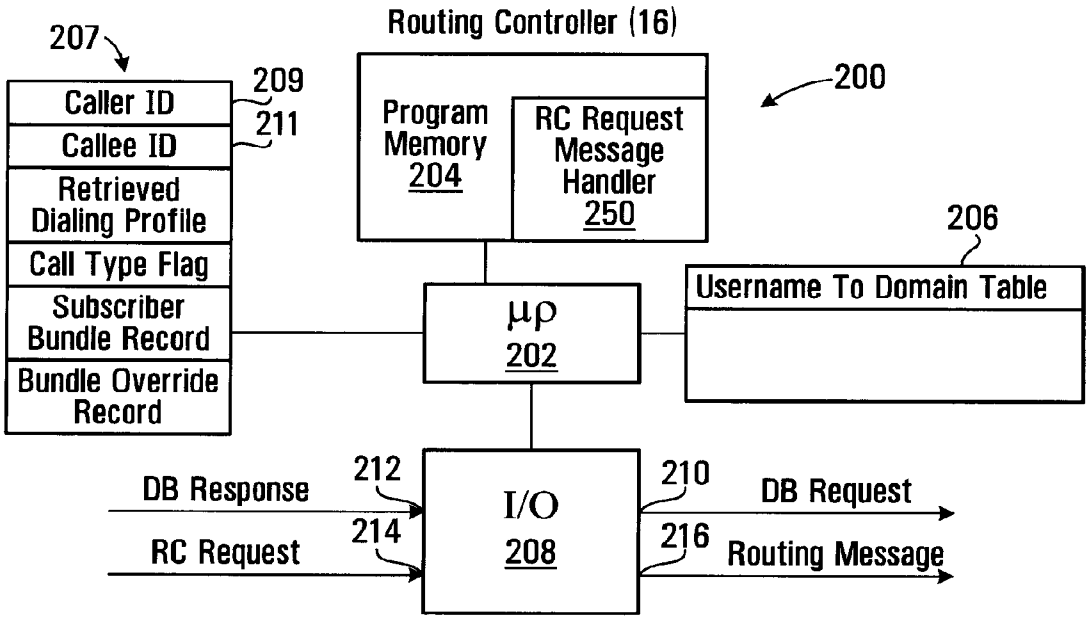


FIG. 7

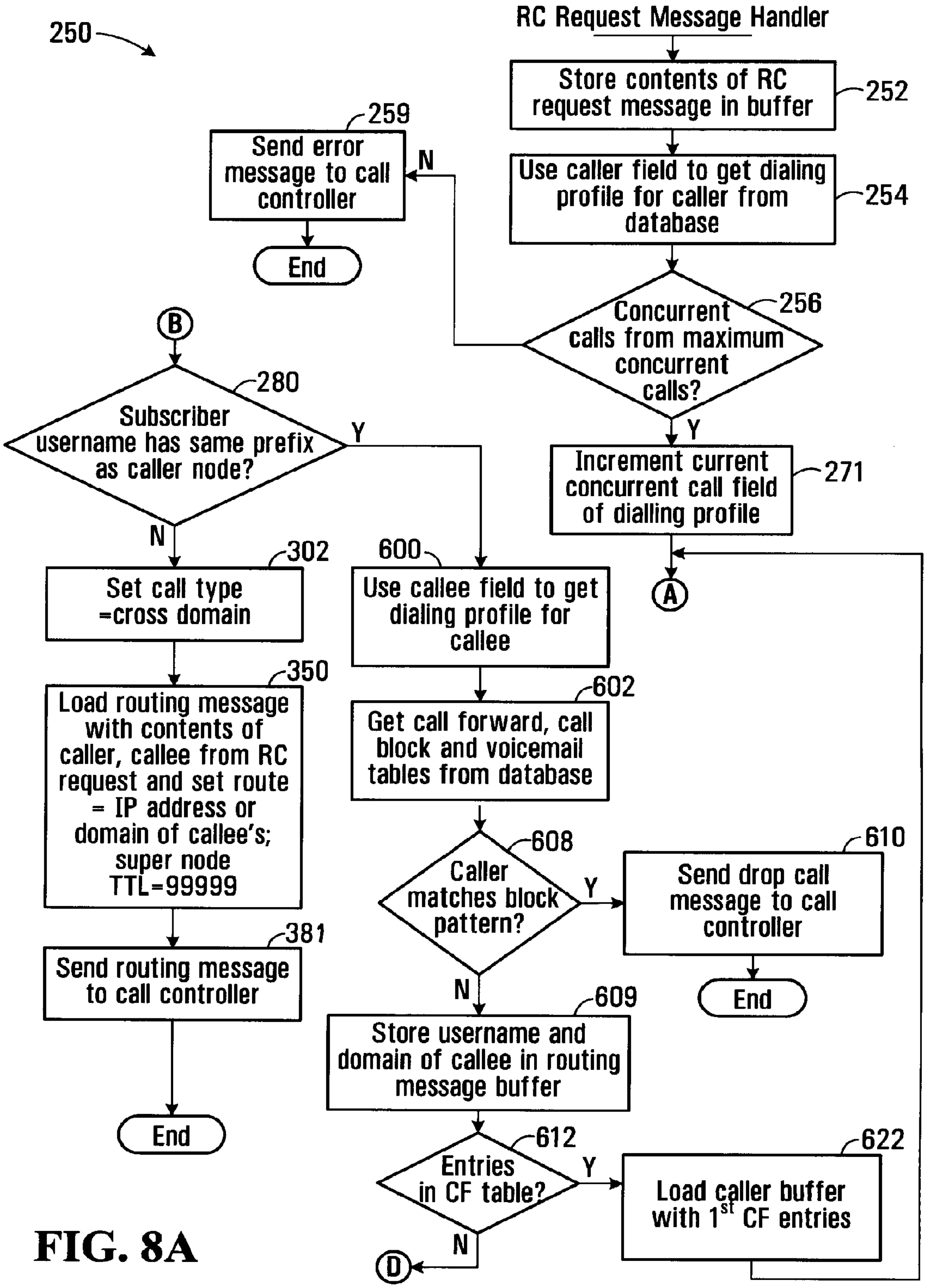

250
RC Request Message Handler
Store contents of RC request message in buffer
252
Use caller field to get dialing profile for caller from database
254
Concurrent calls from maximum concurrent calls?
256
N
Send error message to call controller
259
End
Y
Increment current concurrent call field of dialling 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
600
Use callee field to get dialing profile for callee
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

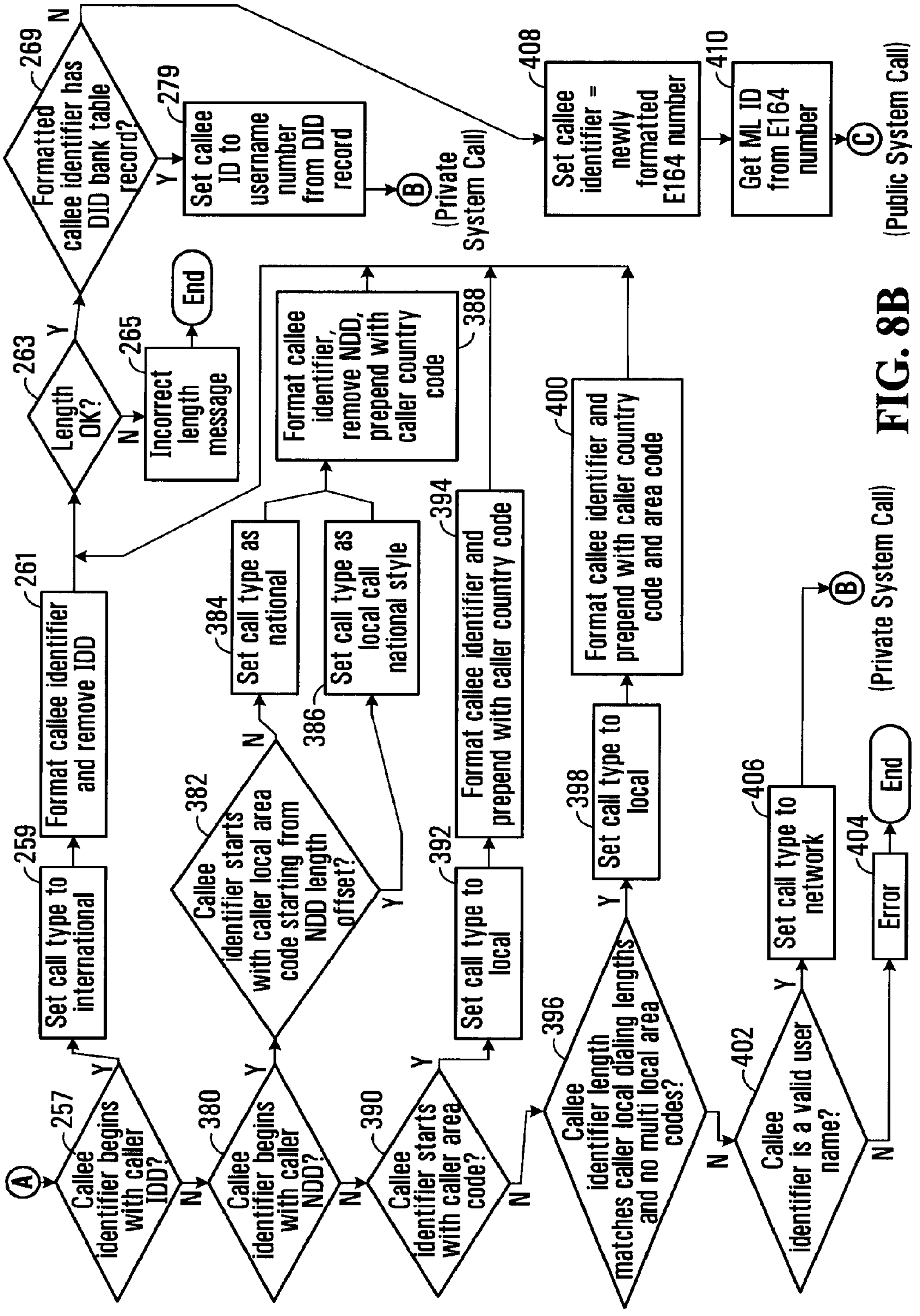

A
257
Callee identifier begins with caller IDD?
Y
N
259
Set call type to international
261
Format callee identifier and remove IDD
263
Length OK?
Y
N
265
Incorrect length message
End
269
Formatted callee identifier has DID bank table record?
Y
N
279
Set callee ID to username number from DID record
B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

FIG. 8B

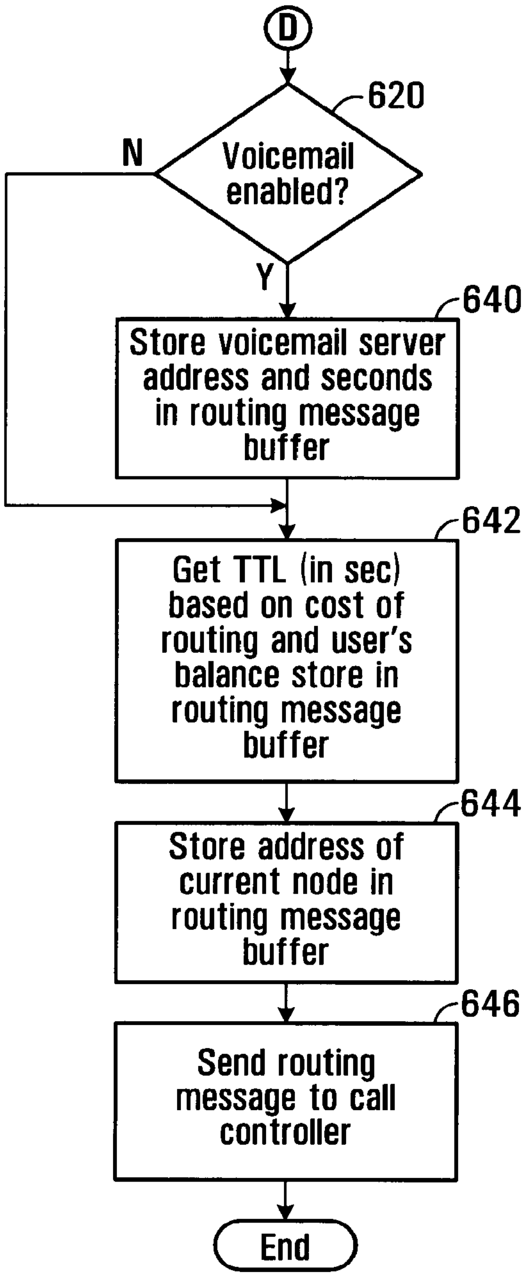

D
620
Voicemail enabled?
N
Y
640
Store voicemail server address and seconds in routing message buffer
642
Get TTL (in sec) based on cost of routing and user's balance store in routing message buffer
644
Store address of current node in routing message buffer
646
Send routing message to call controller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

FIG. 8C

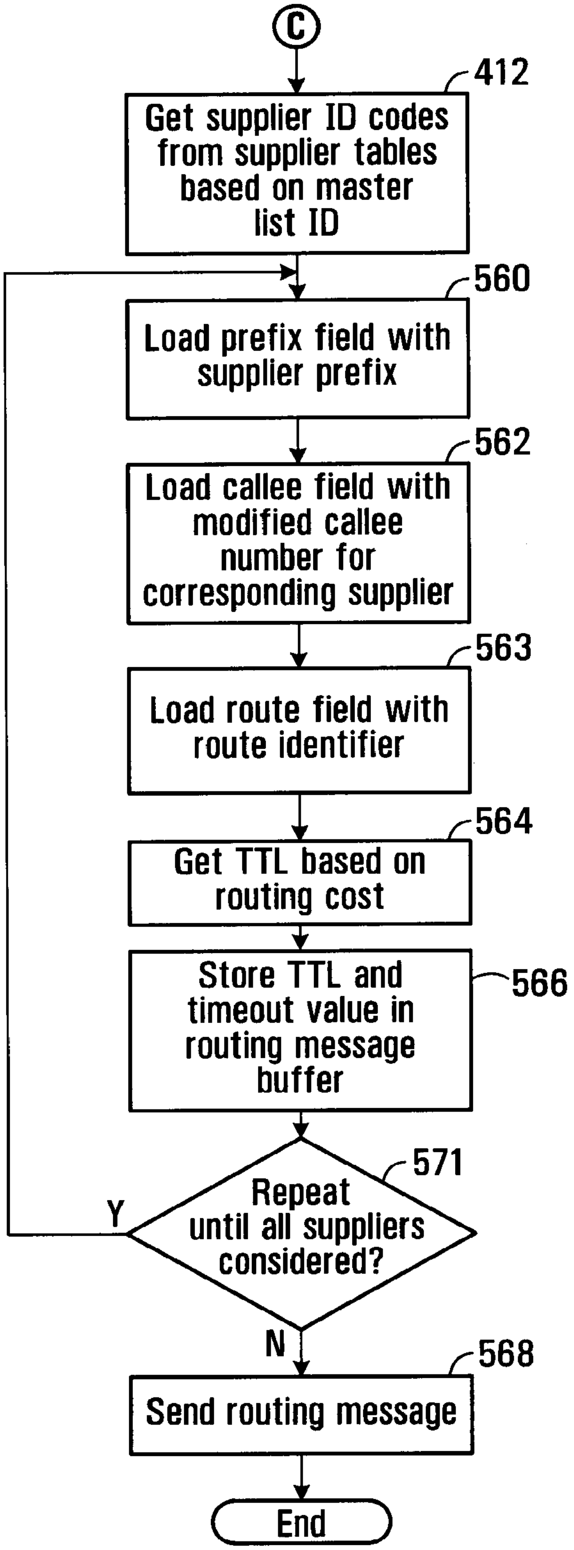

C
412
Get supplier ID codes from supplier tables based on master list ID
560
Load prefix field with supplier prefix
562
Load callee field with modified callee number for corresponding supplier
563
Load route field with route identifier
564
Get TTL based on routing cost
566
Store TTL and timeout value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

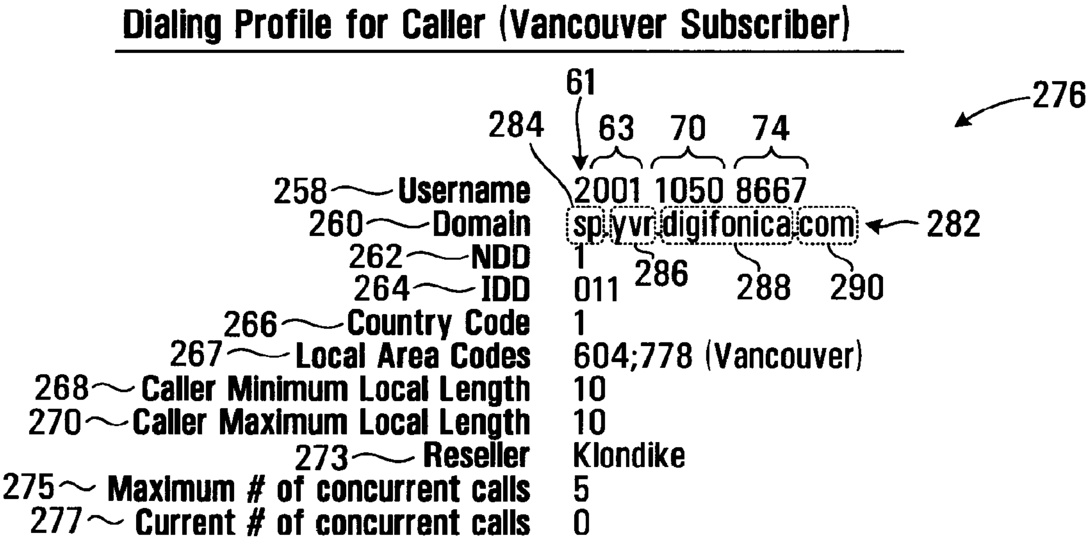
FIG. 8D

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)

258	Username	2001 1050 8667
260	Domain	sp.yvr.digifonica.com
262	NDD	1
264	IDD	011
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

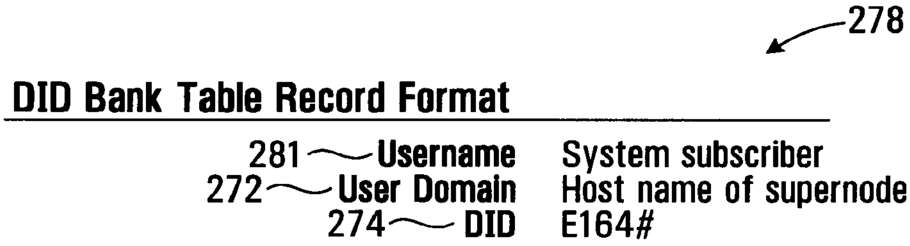
Username	2001 1050 2222
Domain	sp.yvr.digifonica.com
NDD	1
IDD	011
Country Code	1
Local Area Codes	403 (Calgary)
Caller Minimum Local Length	7
Caller Maximum Local Length	10
Reseller	Deerfoot
Maximum # of concurrent calls	5
Current # of concurrent calls	0

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

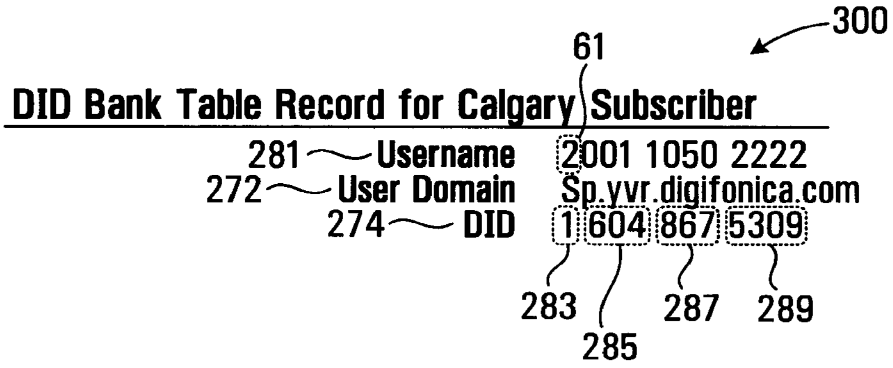
FIG. 12



DID Bank Table Record Format

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

FIG. 13



DID Bank Table Record for Calgary Subscriber

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

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

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

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

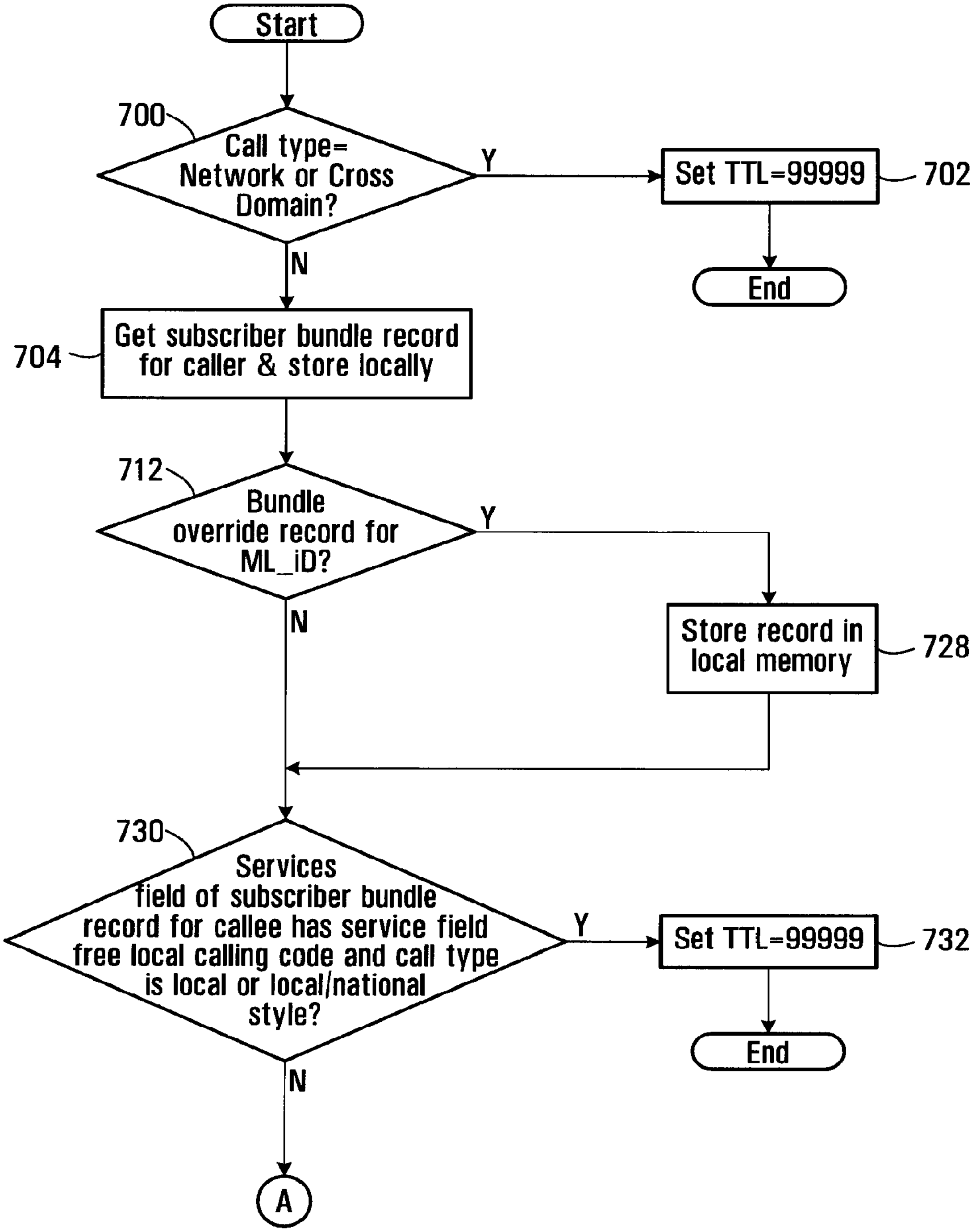

Start
700
Call type= Network or Cross Domain?
Y
Set TTL=99999
702
End
N
704
Get subscriber bundle record for caller & store locally
712
Bundle override record for ML_iD?
Y
Store record in local memory
728
N
730
Services field of subscriber bundle record for callee has service field free local calling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

FIG. 33A

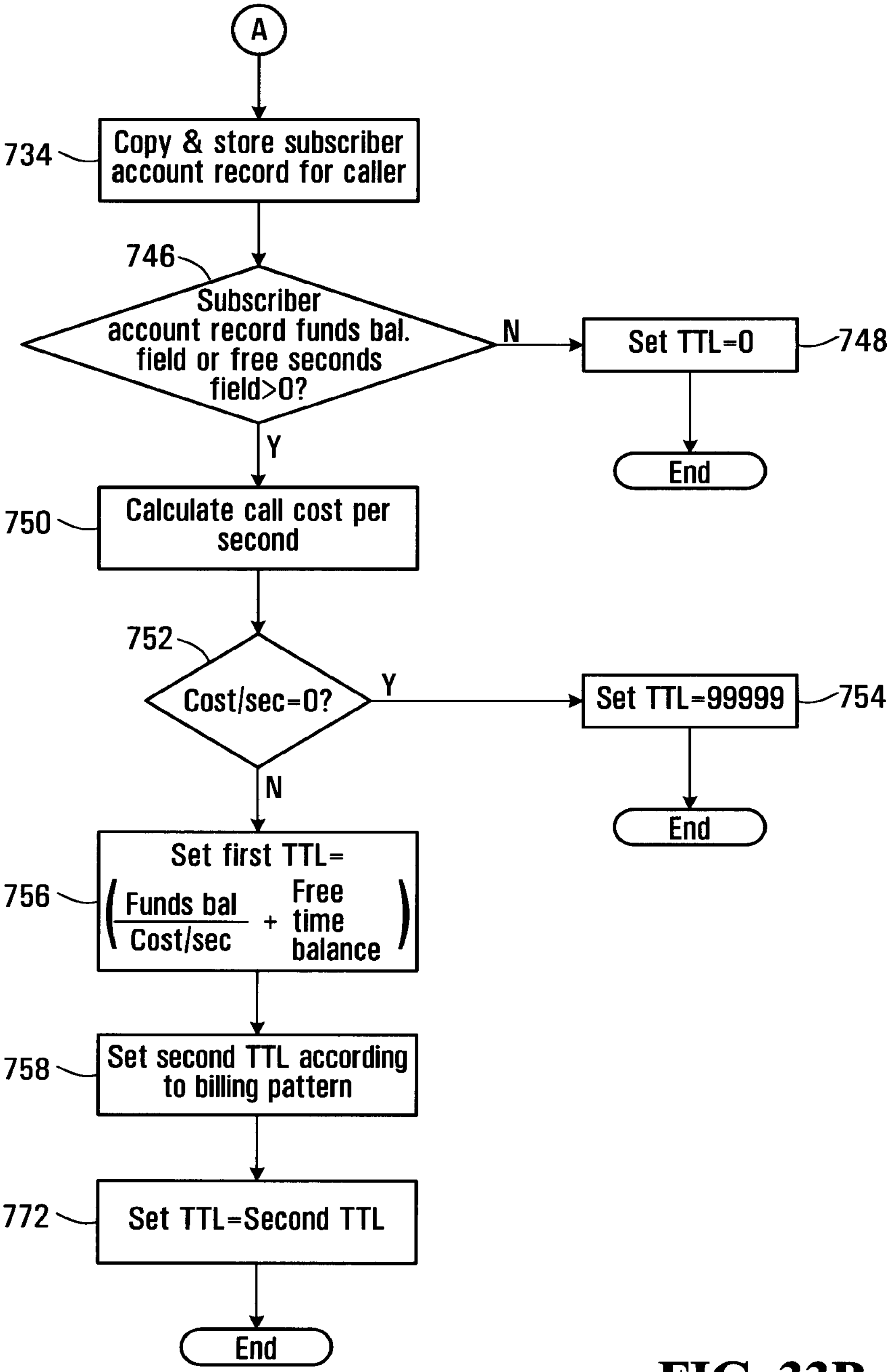

A
734
Copy & store subscriber account record for caller
746
Subscriber account record funds bal. field or free seconds field>0?
N
Set TTL=0
748
End
Y
750
Calculate call cost per second
752
Cost/sec=0?
Y
Set TTL=99999
754
End
N
756
Set first TTL= (Funds bal / Cost/sec + Free time balance)
758
Set second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

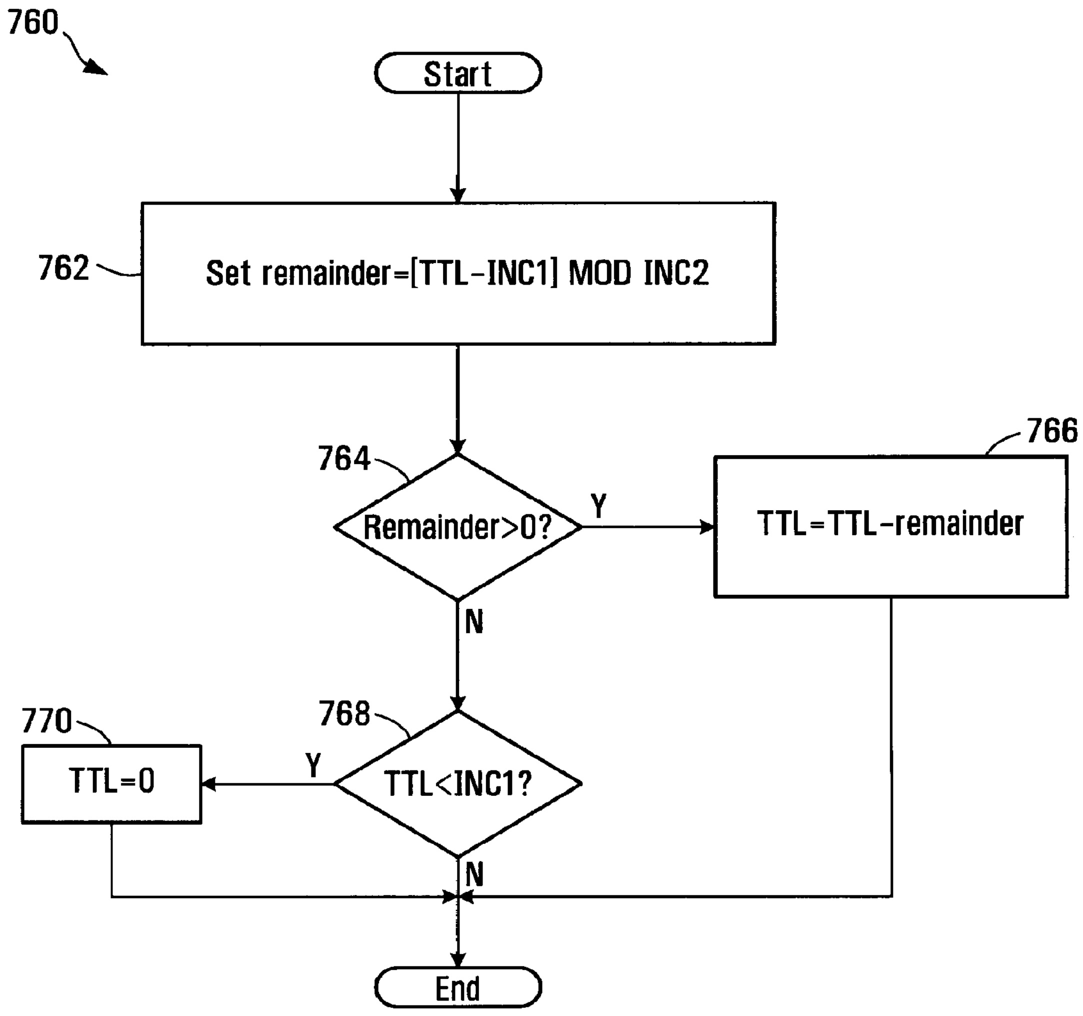

760
Start
762
Set remainder=[TTL-INC1] MOD INC2
764
Remainder>0?
Y
766
TTL=TTL-remainder
N
768
TTL<INC1?
Y
770
TTL=0
N
End

FIG. 40

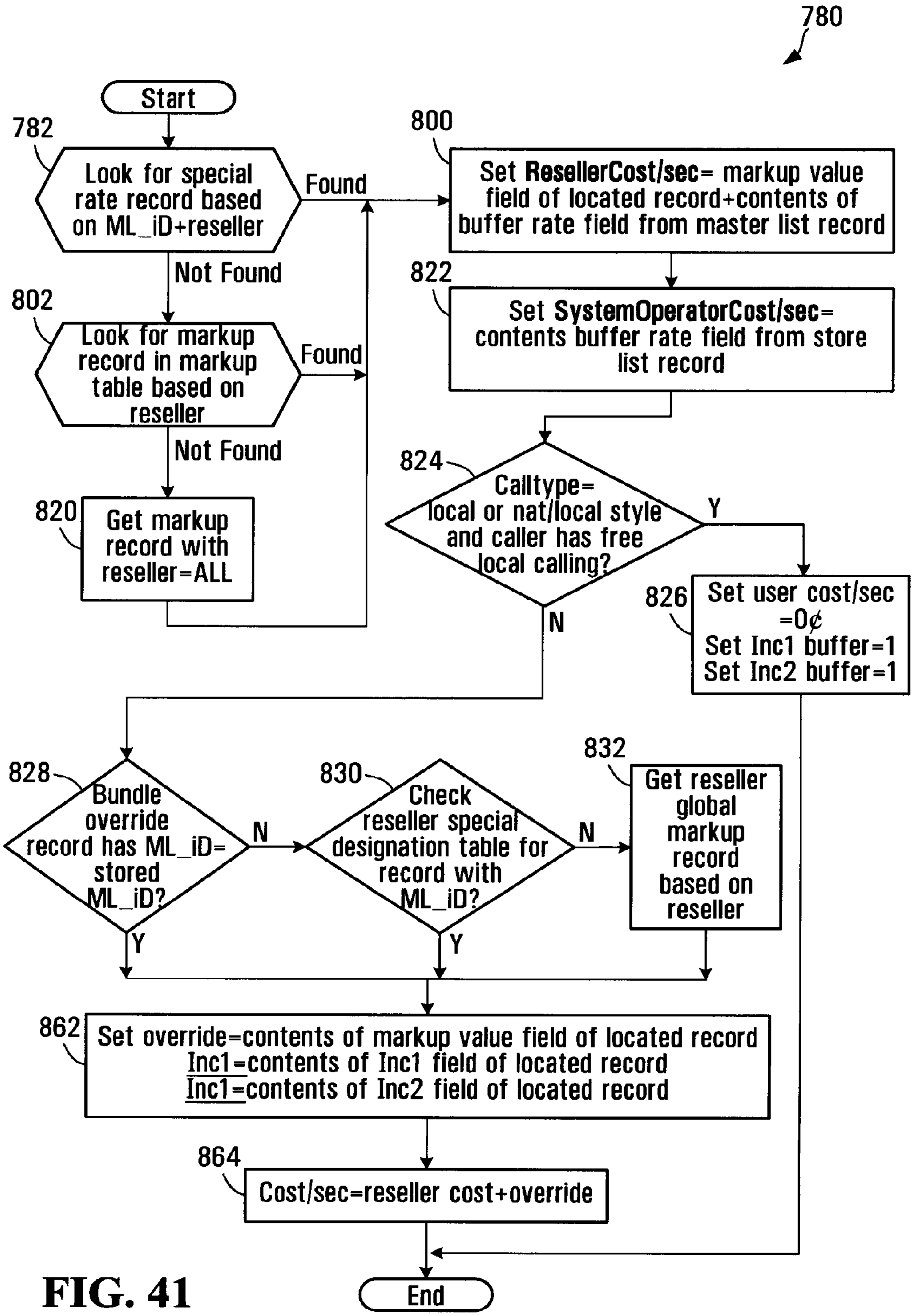

780
Start
782
Look for special rate record based on ML_iD+reseller
Found
Not Found
800
Set **ResellerCost/sec**= markup value field of located record+contents of buffer rate field from master list record
822
Set **SystemOperatorCost/sec**= contents buffer rate field from store list record
802
Look for markup record in markup table based on reseller
Found
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

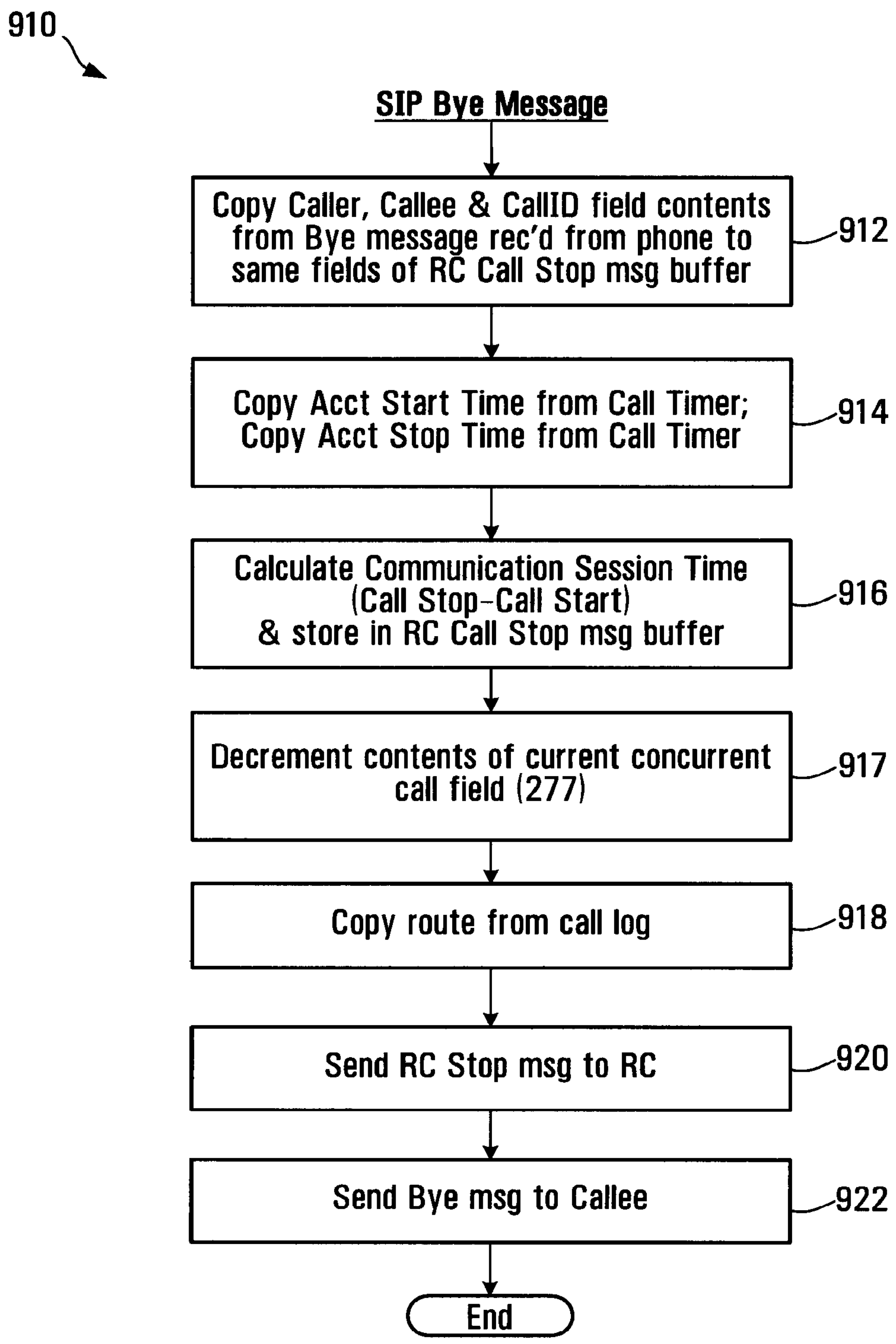

910
SIP Bye Message
Copy Caller, Callee & CallID field contents from Bye message rec'd from phone to same fields of RC Call Stop msg buffer
912
Copy Acct Start Time from Call Timer; Copy Acct Stop Time from Call Timer
914
Calculate Communication Session Time (Call Stop-Call Start) & store in RC Call 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

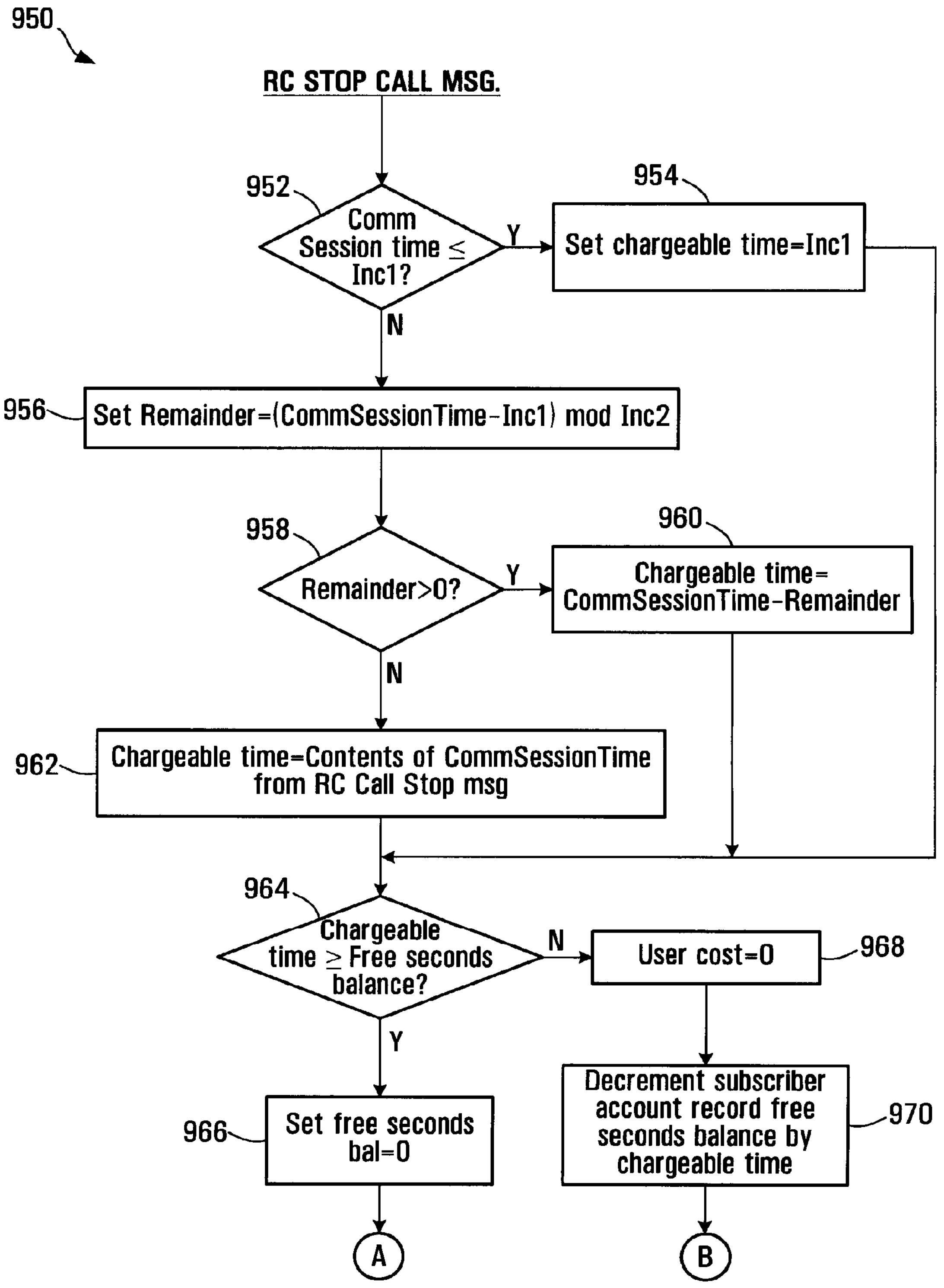

950
RC STOP CALL MSG.
952
Comm Session time ≤ Inc1?
Y
954
Set chargeable time=Inc1
N
956
Set Remainder=(CommSessionTime-Inc1) mod Inc2
958
Remainder>0?
Y
960
Chargeable time= CommSessionTime-Remainder
N
962
Chargeable time=Contents of CommSessionTime from RC Call Stop msg
964
Chargeable time ≥ Free seconds 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

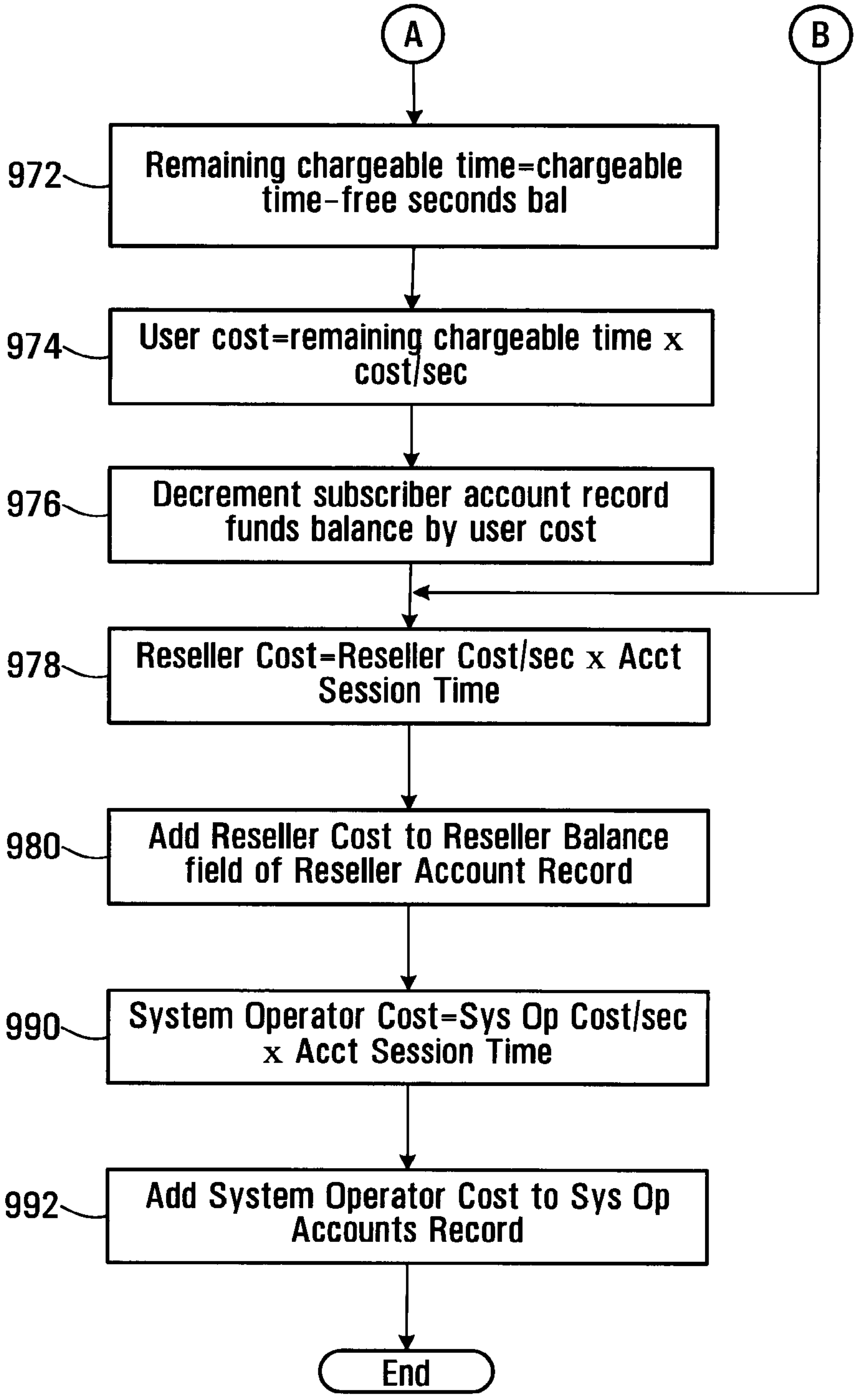
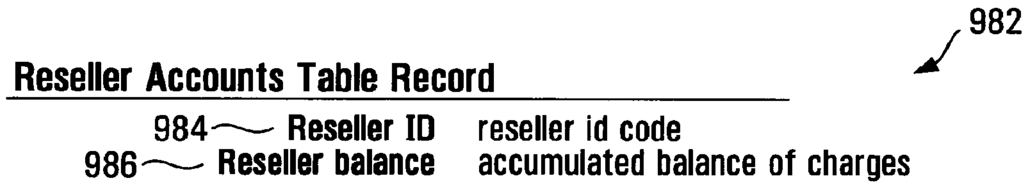

A
B
972
Remaining chargeable time=chargeable time-free seconds bal
974
User cost=remaining chargeable time x cost/sec
976
Decrement subscriber account record funds balance by user cost
978
Reseller Cost=Reseller Cost/sec x Acct Session Time
980
Add Reseller Cost to Reseller Balance field of Reseller 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

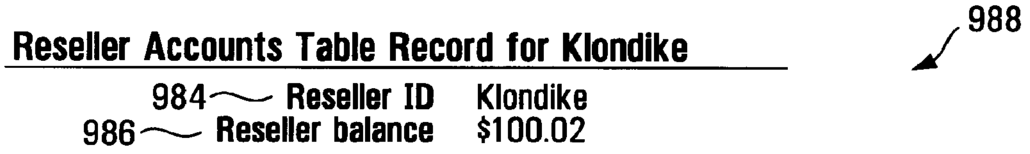
FIG. 56B



Reseller Accounts Table Record

Reseller ID	reseller id code
Reseller balance	accumulated balance of charges

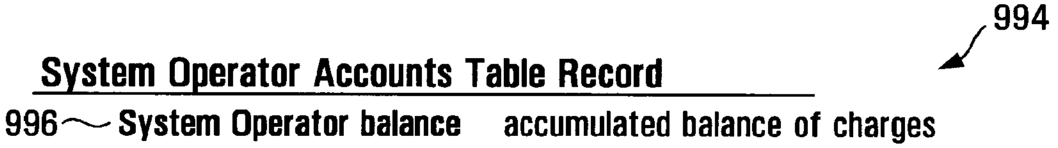
FIG. 57



Reseller Accounts Table Record for Klondike

Reseller ID	Klondike
Reseller balance	$100.02

FIG. 58



System Operator Accounts Table Record

System Operator balance	accumulated balance of charges

FIG. 59

System Operator Accounts Record for this System Operator

System Operator balance	$1000.02

FIG. 60

PRODUCING ROUTING MESSAGES FOR VOICE OVER IP COMMUNICATIONS

This is a continuation of U.S. application Ser. No. 15/396,344, filed Dec. 30, 2016, which is a continuation of U.S. application Ser. No. 14/877,570filed Oct. 7, 2015, now U.S. Pat. No. 9,537,762, which is a continuation of U.S. application Ser. No. 13/966,096, filed Aug. 13, 2013, now U.S. Pat. No. 9,179,005, which is a continuation of U.S. application Ser. No. 12/513,147, filed Mar. 1, 2010, now U.S. Pat. No. 8,542,815, which is a national phase entry of PCT/CA2007/001956, field Nov. 1, 2007, which claims priority to U.S. Provisional Application No. 60/856,212, filed Nov. 2, 2006, all of which are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

Field of Invention

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

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 OF THE INVENTION

In accordance with one aspect of the invention, there is provided a process for operating a call routing controller to facilitate communication between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The process involves, in response to initiation of a call by a calling subscriber, receiving a caller identifier and a callee identifier. The process also involves using call classification criteria associated with the caller identifier to classify the call as a public network call or a private network call. The process further involves 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. The process also involves producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The process may involve receiving a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

Using the call classification criteria may involve searching a database to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

Locating a record may involve locating a caller dialing profile comprising a username associated with the caller, a domain associated with the caller, and at least one calling attribute.

Using the call classification criteria may involve comparing calling attributes associated with the caller dialing profile with aspects of the callee identifier.

Comparing may involve determining whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

Comparing may involve determining whether the callee identifier has a length within a range specified in the caller dialing profile.

The process may involve formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

Formatting may involve removing an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

Formatting may involve removing a national dialing digit from the callee identifier and prepending a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

Formatting may involve prepending a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

Formatting may involve prepending a caller country code and an area code to the callee identifier when the callee identifier has a length that matches a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The process may involve classifying the call as a private network call when the re-formatted callee identifier identifies a subscriber to the private network. The process may involve determining whether the callee identifier complies with a pre-defined username format and if so, classifying the call as a private network call.

The process may involve causing a database of records to be searched to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and if the DID bank table record is found, classifying the call as a private network call and if a DID bank table record is not found, classifying the call as a public network call.

Producing the routing message identifying a node on the private network may involve setting a callee identifier in response to a username associated with the DID bank table record.

Producing the routing message may involve determining whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

Determining whether a node associated with the reformatted callee identifier is the same as a node associated the caller identifier may involve determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

When the node associated with the caller is not the same as the node associated with the callee, the process involves producing a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and communicating the routing message to a call controller.

When the node associated with the caller is the same as the node associated with the callee, the process involves determining whether to perform at least one of the following: forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee.

Producing the routing message may involve producing a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The process may involve communicating the routing message to a call controller.

Producing a routing message identifying a gateway to the public network may involve searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The process may involve loading a routing message buffer with the reformatted callee identifier and an identification of specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The process may involve communicating a routing message involving the contents of the routing message buffer to a call controller.

The process may involve causing the dialing profile to include a maximum concurrent call value and a concurrent call count value and causing the concurrent call count value to be incremented when the user associated with the dialing profile initiates a call and causing the concurrent call count value to be decremented when a call with the user associated with the dialing profile is ended.

In accordance with another aspect of the invention, there is provided a call routing apparatus for facilitating communications between callers and callees in a system comprising a plurality of nodes with which callers and callees are associated. The apparatus includes receiving provisions for receiving a caller identifier and a callee identifier, in response to initiation of a call by a calling subscriber. The apparatus also includes classifying provisions for classifying the call as a private network call or a public network call according to call classification criteria associated with the caller identifier. The apparatus further includes provisions for 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. The apparatus also includes provisions for producing a routing message identifying a gateway to the public network when the call is classified as a public network call.

The receiving provisions may be operably configured to receive a request to establish a call, from a call controller in communication with a caller identified by the callee identifier.

The apparatus may further include searching provisions for searching a database including records associating calling attributes with subscribers to the private network to locate a record identifying calling attributes associated with a caller identified by the caller identifier.

The records may include dialing profiles each including a username associated with the subscriber, an identification of a domain associated with the subscriber, and an identification of at least one calling attribute associated with the subscriber.

The call classification provisions may be operably configured to compare calling attributes associated with the caller dialing profile with aspects of the callee identifier.

The calling attributes may include an international dialing digit and call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an IDD associated with the caller dialing profile.

The calling attributes may include an national dialing digit and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an NDD associated with the caller dialing profile.

The calling attributes may include an area code and the call classification provisions may be operably configured to determine whether the callee identifier includes a portion that matches an area code associated with the caller dialing profile.

The calling attribute may include a number length range and the call classification provisions may be operably configured to determine whether the callee identifier has a length within a number length range specified in the caller dialing profile.

The apparatus may further include formatting provisions for formatting the callee identifier into a pre-defined digit format to produce a re-formatted callee identifier.

The formatting provisions may be operably configured to remove an international dialing digit from the callee identifier, when the callee identifier begins with a digit matching an international dialing digit specified by the caller dialing profile associated with the caller.

The formatting provisions may be operably configured to remove a national dialing digit from the callee identifier and prepend a caller country code to the callee identifier when the callee identifier begins with a national dialing digit.

The formatting provisions may be operably configured to prepend a caller country code to the callee identifier when the callee identifier begins with digits identifying an area code specified by the caller dialing profile.

The formatting provisions may be operably configured to prepend a caller country code and area code to the callee identifier when the callee identifier has a length that matches

a caller dialing number format specified by the caller dialing profile and only one area code is specified as being associated with the caller in the caller dialing profile.

The classifying provisions may be operably configured to classify the call as a private network call when the reformatted callee identifier identifies a subscriber to the private network.

The classifying provisions may be operably configured to classify the call as a private network call when the callee identifier complies with a pre-defined username format.

The apparatus may further include searching provisions for searching a database of records to locate a direct in dial (DID) bank table record associating a public telephone number with the reformatted callee identifier and the classifying provisions may be operably configured to classify the call as a private network call when the DID bank table record is found and to classify the call as a public network call when a DID bank table record is not found

The private network routing message producing provisions may be operably configured to produce a routing message having a callee identifier set according to a username associated with the DID bank table record.

The private network routing message producing provisions may be operably configured to determine whether a node associated with the reformatted callee identifier is the same as a node associated with the caller identifier.

The private network routing provisions may include provisions for determining whether a prefix of the re-formatted callee identifier matches a corresponding prefix of a username associated with the caller dialing profile.

The private network routing message producing provisions may be operably configured to produce a routing message including the caller identifier, the reformatted callee identifier and an identification of a private network node associated with the callee and to communicate the routing message to a call controller.

The private network routing message producing provisions may be operably configured to perform at least one of the following forward the call to another party, block the call and direct the caller to a voicemail server associated with the callee, when the node associated with the caller is the same as the node associated with the callee.

The provisions for producing the private network routing message may be operably configured to produce a routing message having an identification of at least one of the callee identifier, an identification of a party to whom the call should be forwarded and an identification of a voicemail server associated with the callee.

The apparatus further includes provisions for communicating the routing message to a call controller.

The provisions for producing a public network routing message identifying a gateway to the public network may include provisions for searching a database of route records associating route identifiers with dialing codes to find a route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes provisions for searching a database of supplier records associating supplier identifiers with the route identifiers to locate at least one supplier record associated with the route identifier associated with the route record having a dialing code having a number pattern matching at least a portion of the reformatted callee identifier.

The apparatus further includes a routing message buffer and provisions for loading the routing message buffer with the reformatted callee identifier and an identification of

specific routes associated respective ones of the supplier records associated with the route record and loading the routing message buffer with a time value and a timeout value.

The apparatus further includes provisions for communicating a routing message including the contents of the routing message buffer to a call controller.

The apparatus further includes means for causing said dialing profile to include a maximum concurrent call value and a concurrent call count value and for causing said concurrent call count value to be incremented when the user associated with said dialing profile initiates a call and for causing said concurrent call count value to be decremented when a call with said user associated with said dialing profile is ended.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes dialing profile records comprising fields for associating with respective subscribers to the system, a subscriber user name, direct-in-dial records comprising fields for associating with respective subscriber usernames, a user domain and a direct-in-dial number, prefix to node records comprising fields for associating with at least a portion of the respective subscriber usernames, a node address of a node in the system, whereby a subscriber name can be used to find a user domain, at least a portion of the a subscriber name can be used to find a node with which the subscriber identified by the subscriber name is associated, and a user domain and subscriber name can be located in response to a direct-in-dial number.

In accordance with another aspect of the invention, there is provided a data structure for access by an apparatus for producing a routing message for use by a call routing controller in a communications system. The data structure includes master list records comprising fields for associating a dialing code with respective master list identifiers and supplier list records linked to master list records by the master list identifiers, said supplier list records comprising fields for associating with a communications services supplier, a supplier id, a master list id, a route identifier and a billing rate code, whereby communications services suppliers are associated with dialing codes, such that dialing codes can be used to locate suppliers capable of providing a communications link associated with a given dialing code.

In accordance with another aspect of the invention, there is provided a method for determining a time to permit a communication session to be conducted. The method 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.

Calculating the first time value may involve retrieving a record associated with the participant and obtaining from the record at least one of the free time and the funds balance.

Producing the second time value may involve 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.

Producing the second time value may involve setting a difference between the first time value and the remainder as the second time value.

The method may further involve setting the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

Calculating the cost per unit time may involve 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 the record in a database may involve locating 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 markup record.

Calculating the cost per unit time value further may involve 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, a default operator markup record specifying a default cost per unit time.

The method may further involve 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 method may further involve receiving a communication session time representing a duration of the communication session and incrementing a reseller balance by the product of the reseller rate and the communication session time.

The method may further involve receiving a communication session time representing a duration of the communication session and incrementing a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided an apparatus for determining a time to permit a communication session to be conducted. The apparatus includes a processor circuit, a computer readable medium coupled to the processor circuit and encoded with instructions for directing the processor circuit to calculate a cost per unit time for the communication session, calculate 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 produce 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.

The instructions may include instructions for directing the processor circuit to retrieve a record associated with the participant and obtain from the record at least one of the free time and the funds balance.

The instructions may include instructions for directing the processor circuit to produce the second time value by 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.

The instructions may include instructions for directing the processor circuit to produce the second time value comprises setting a difference between the first time value and the remainder as the second time value. The instructions may include instructions for directing the processor circuit to set the second time value to zero when the remainder is greater than zero and the first time value is less than the free time associated with the participant.

The instructions for directing the processor circuit to calculate the cost per unit time may include instructions for directing the processor circuit to locate a record in a database, the record comprising a markup type indicator, a markup value and a billing pattern and set a reseller rate equal to the sum of the markup value and the buffer rate.

The instructions for directing the processor circuit to locate the record in a database may include instructions for directing the processor circuit 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 markup record. The instructions for directing the processor circuit to calculate the cost per unit time value may further include instructions for directing the processor circuit to locate 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, a default operator markup record specifying a default cost per unit time.

The instructions may include instructions for directing the processor circuit 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.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a reseller balance by the product of the reseller rate and the communication session time.

The instructions may include instructions for directing the processor circuit to receive a communication session time representing a duration of the communication session and increment a system operator balance by a product of the buffer rate and the communication session time.

In accordance with another aspect of the invention, there is provided a process for attributing charges for communications services. The process involves determining a first chargeable time in response to a communication session time and a pre-defined billing pattern, determining a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, changing an account balance associated with the user in response to a user cost per unit time. The process may further involve changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

Determining the first chargeable time may involve locating at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and setting as the

pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may involve a first billing interval and a second billing interval.

Determining the first chargeable time may involve setting the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

Determining the first chargeable time may involve producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and setting the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and setting the first chargeable time to the communication session time when the remainder is not greater than zero.

The process may further involve determining a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Determining the second chargeable time may involve setting the second chargeable time to a difference between the first chargeable time.

The process may further involve resetting the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

Changing an account balance associated with the user may involve calculating a user cost value in response to the second chargeable time and the user cost per unit time.

The process may further involve changing a user free cost balance in response to the user cost value.

The process may further involve setting the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The process may further involve changing a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided an apparatus for attributing charges for communications services. The apparatus includes a processor circuit, a computer readable medium in communication with the processor circuit and encoded with instructions for directing the processor circuit to determine a first chargeable time in response to a communication session time and a pre-defined billing pattern, determine a user cost value in response to the first chargeable time and a free time value associated with a user of the communications services, change an account balance associated with the user in response to a user cost per unit time.

The instructions may further include instructions for changing an account balance associated with a reseller of the communications services in response to a reseller cost per unit time and the communication session time and changing an account balance associated with an operator of the communications services in response to an operator cost per unit time and the communication session time.

The instructions for directing the processor circuit to determine the first chargeable time may further include instructions for causing the processor circuit to communicate with a database to locate at least one of an override record specifying a route cost per unit time and billing pattern 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 and billing pattern associated with the reseller for the communication session and a default record specifying a default cost per unit time and billing pattern and instructions for setting as the pre-defined billing pattern the billing pattern of the record located. The billing pattern of the record located may include a first billing interval and a second billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for directing the processor circuit to set the first chargeable time equal to the first billing interval when the communication session time is less than or equal to the first billing interval.

The instructions for causing the processor circuit to determine the first chargeable time may include instructions for producing a remainder value representing a portion of the second billing interval remaining after dividing the second billing interval into a difference between communication session time and the first interval when the communication session time is greater than the communication session time and instructions for causing the processor circuit to set the first chargeable time to a difference between the communication session time and the remainder when the remainder is greater than zero and instructions for causing the processor circuit to set the first chargeable time to the communication session time when the remainder is not greater than zero.

The instructions may further include instructions for causing the processor circuit to determine a second chargeable time in response to the first chargeable time and the free time value associated with the user of the communications services when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to determine the second chargeable time may include instructions for causing the processor circuit to set the second chargeable time to a difference between the first chargeable time.

The instructions may further include instructions for causing the processor circuit to reset the free time value associated with the user to zero when the first chargeable time is greater than or equal to the free time value associated with the user of the communications services.

The instructions for causing the processor circuit to change an account balance associated with the user may include instructions for causing the processor circuit to calculate a user cost value in response to the second chargeable time and the user cost per unit time.

The instructions may further include instructions for causing the processor circuit to change a user free cost balance in response to the user cost value.

The instructions may further include instructions for causing the processor circuit to set the user cost to zero when the first chargeable time is less than the free time value associated with the user.

The instructions may further include instructions for causing the processor circuit to change a user free time balance in response to the first chargeable time.

In accordance with another aspect of the invention, there is provided a computer readable medium encoded with codes for directing a processor circuit to execute one or more of the methods described above and/or variants thereof.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon

review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

FIG. **1** is a block diagram of a system according to a first embodiment of the invention;

FIG. **2** is a block diagram of a caller telephone according to the first embodiment of the invention;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

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

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

FIG. **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;

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

FIG. **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;

FIGS. **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;

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FIG. **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;

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

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

FIGS. **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 FIG. **1**;

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

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

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

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

DETAILED DESCRIPTION

Referring to FIG. **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 FIG. **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 the description of the embodiments of this invention, 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 been 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 FIG. **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.

Subscriber Telephone

In greater detail, referring to FIG. **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 dialed 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 FIG. **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 dialed number buffer **45**. In this case, assume the dialed 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 FF10@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 FIG. **3**, to the routing controller **16** shown in FIG. **1**. This SIP invite message is essentially to initiate a call by a calling subscriber.

Referring to FIG. **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 FIG. **2**. In addition, referring back to FIG. **3**, the callee identifier field **62** includes a callee identifier which in this embodiment is the user name 2001 1050 2222 that is the dialed number of the Calgary subscriber stored in the dialed number buffer **45** shown in FIG. **2**. The digest parameters field **64** includes digest parameters and the call ID field **65** includes a code comprising a generated prefix code (FF10) 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.

Call Controller

Referring to FIG. **4**, a call controller circuit of the call controller **14** (FIG. **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 FIG. **3**, from the telephone shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **3**, block **122** of FIG. **5** directs the call controller circuit **100** of FIG. **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 FIG. **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 FIG. **3**. The type field **160** contains the type code established at blocks **123** or **125** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIGS. **8**A through **8**D.

RC Request Message Handler

Referring to FIG. **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 FIG. **7**, one of which includes the caller ID buffer **209** of FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **2**.

Referring back to FIG. **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 "corn" domain.

The national dialed 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 FIG. **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 FIGS. **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 FIG. **13** is added to a direct-in-dial bank table in the database (**18** in FIG. **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 FIG. **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 FIG. **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 FIG. **9** and DID records as shown in FIG. **13** when a user registers with the system, call blocking records of the type shown in FIG. **26**, call forwarding records of the type shown in FIG. **28** and voicemail records of the type shown in FIG. **30** may be added to the database **18** when a new subscriber is added to the system.

Referring back to FIG. **8**A, after retrieving a dialing profile for the caller, such as shown at **276** in FIG. **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 than 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 FIG. **6**, of the RC request message **150**. These checks are shown in greater detail in FIG. **8**B.

Referring to FIG. **8**B, the processor (**202** in FIG. **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 FIG. **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 FIG. **4**) to respond to the incorrect length message by transmitting a message back to the telephone (**12** shown in FIG. **1**) to indicate that an invalid number has been dialed.

Still referring to FIG. **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 FIG. **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 FIG. **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 FIG. **14**) from the callee DID bank table record (**300** in FIG. **14**) into the callee ID buffer (**211** in FIG. **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 FIG. **8**A.

Subscriber to Subscriber Calls Between Different Nodes

Referring to FIG. **8**A, block **280** directs the processor (**202** of FIG. **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 FIG. **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 FIG. **10**. If the corresponding prefixes are not the same, block **302** in FIG. **8**A directs the processor (**202** in FIG. **7**) to set a call type flag in the buffer memory (**207** in FIG. **7**) to indicate the call is a cross-domain call. Then, block **350** of FIG. **8**A directs the processor (**202** of FIG. **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 FIG. **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 FIG. **18**, for example, if the prefix is 20, the supernode address associated with that prefix is sp.yvr.digifonica.com.

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

Referring back to FIG. **8**B, if at block **257**, the callee identifier stored in the callee id buffer (**211** in FIG. **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 FIG. **10**. In FIG. **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 FIG. **8**B.

Block **382** directs the processor (**202** of FIG. **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 FIG. **10**. If not, block **384** of FIG. **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 dialed digit and prepending a caller country code identified by the country code field **266** of the caller dialing profile shown in FIG. **10**. The processor (**202**) is then directed to block **263** of FIG. **8**B to perform other processing as already described above.

If at block **380**, the callee identifier does not begin with a national dialed 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 FIG. **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 FIG. **10**. The processor (**202**) is then directed to block **263** for further processing as described above.

Referring back to FIG. **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 FIG. **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 FIG. **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 predefined 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 FIG. **10**) followed by the caller area code (as indicated by the local area code

field **267** of the caller profile shown in FIG. **10**). The processor (**202**) is then directed to block **263** of FIG. **8**B for further processing as described above.

Referring back to FIG. **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 FIG. **10**) and the caller maximum local number length field (**270** in FIG. **10**), block **402** directs the processor **202** of FIG. **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 FIG. **10** of dialing profiles to find a dialing profile having user name field contents (**258** in FIG. **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 FIG. **8**A. Thus, the call is classified as a private network call when the callee identifier identifies a subscriber to the private network.

From FIG. **8**B, it will be appreciated that there are certain groups of blocks of codes that direct the processor **202** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **7** when it executes block **269** in FIG. **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 FIG. **8**B which causes it to set the contents of the callee id buffer **211** of FIG. **7** equal to the newly formatted callee identifier, i.e., a number compatible with the E.164 standard. Then, block **410** of FIG. **8**B directs the processor (**202**) to search a database of route or master list records associating route identifiers with dialing codes shown in FIG. **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 FIG. **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 dialed digit field **512**, an international dialed 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 FIG. **7** uses at block **410** in FIG. **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 dialed 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 dialed 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 FIG. **20** with exemplary field contents as shown.

Referring back to FIG. **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 FIG. **7** to find a master list record such as the one shown in FIG. **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 FIG. **8**B, the process continues as shown in FIG. **8**D. Referring to FIG. **8**D, block **412** directs the processor **202** of FIG. **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 FIG. **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 FIGS. **22**, **23** and **24** for the exemplary suppliers shown at **20** in FIG. **1**, namely Telus, Shaw and Sprint.

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

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

Referring to FIGS. **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 FIG. **25** first. Block **562** in FIG. **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 FIG. **25**. At block **563** of FIG. **8**D, the contents of the route identifier field **546** of FIG. **21** of the record associated with the supplier "Telus" are added by the processor **202** of FIG. **7** to the routing message buffer shown in FIG. **25** after an @ sign delimiter, and then block **564** in FIG. **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 FIG. **21** in the routing message buffer of FIG. **25**. Accordingly, a first part of the routing message for the Telus gateway is shown generally at **570** in FIG. **25**.

Referring back to FIG. **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 FIG. **25** relates to the second supplier identified by the record shown in FIG. **23**. Referring back to FIG. **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 FIG. **24**.

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

Subscriber to Subscriber Calls within the Same Node

Referring back to FIG. **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 FIG. **11** or **12**, for example. Block **602** of FIG. **8**A then directs the processor **202** of FIG. **7** to get call block, call forward and voicemail records from the database **18** of FIG. **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 FIGS. **26**, **27**, **28** and **30** for example.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **27**, block **608** directs the processor **202** of FIG. **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 FIG. **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 FIG. **32**. Referring back to FIG. **8**A, block **612** then directs the processor **202** to determine whether or not call forwarding is required.

Referring to FIG. **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 FIG. **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 FIG. **8**A and FIG. **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 FIG. **8**C. If there are entries in the call forwarding table **27**, block **622** in FIG. **8**A directs the processor **202** to search the dialing profile table to find a dialing profile record as shown in FIG. **9**, for the user identified by the destination number field **616** of the call forward record shown in FIG. **28**. The processor **202** of FIG. **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 FIG. **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 FIG. **7** to add to the routing message buffer all call forwarding usernames and domains associated with the callee.

Referring back to FIG. **8**A, if at block **612** there are no call forwarding records, then at block **620** in FIG. **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 FIG. **30** in a voicemail table stored in the database **18** shown in FIG. **1**.

Referring to FIG. **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 FIG. **8**C, at block **620** if the processor **202** of FIG. **7** finds a voicemail record as shown in FIG. **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 FIG. **8**C directs the processor **202** to FIG. **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 FIG. **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 FIG. **8**C, block **644** then directs the processor **202** of FIG. **7** to store the IP address of the current node in the routing message buffer as shown at **656** in FIG. **32**. Block **646** then directs the processor **202** to send the routing message shown in FIG. **32** to the call controller **14** in FIG. **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 FIG. **1**, the routing message whether of the type shown in FIG. **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 FIG. **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 FIG. **32** is received by the call controller **14**, the routing to gateway routine **122** shown in FIG. **4** may direct the processor **102** to cause a message to be sent back through the internet **13** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **1**, if the call controller **14** receives a routing message of the type shown in FIG. **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 FIGS. **33**A and **33**B, a process for determining a time to live value for any of blocks **642** in FIG. **8**C, **350** in FIG. **8**A or **564** in FIG. **8**D above is described. The process is executed by the processor **202** shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **1** and store it locally in the subscriber bundle record buffer at the RC **14**.

Referring to FIG. **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.

FIG. **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 FIG. **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**) to determine whether or not there is a bundle override table record for the master list ID value that was determined at block **410** in FIG. **8**B. An exemplary bundle override table record is shown at **714** in FIG. **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 FIG. **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 FIG. **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 FIG. **33**A, if at block **712** the processor finds a bundle override record of the type shown in FIG. **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 FIG. **37** is stored in the bundle override record buffer at the RC as shown in FIG. **7**. Still referring to FIG. **33**A, block **730** then directs the RC processor to determine whether or not the subscriber bundle table record **706** in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **33**B, after copying and storing the subscriber account record shown in FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **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 FIG. **39** and the quotient of the contents of the funds balance field **740** in the subscriber account record for the call shown in FIG. **39** and the cost per second determined at block **750** of FIG. **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 FIG. **37**. This process is shown in greater detail at **760** in FIG. **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 FIG. **40**, the process for producing the second time value begins with a first block **762** that directs the processor **202** in FIG. **7** to set a remainder value equal to the difference between the time to live value calculated at block **756** in FIG. **33**B and the contents of the first interval field **722** of the record shown in FIG. **37** modulus the contents of the second interval field **724** of FIG. **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 403 divided by 6 is 1. 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 433 minus the remainder of 1, i.e., 432 seconds. The processor is then returned back to block **758** of FIG. **33**B.

Referring back to FIG. **40**, if at block **764** the remainder is not greater than zero, block **768** directs the processor **202** of FIG. **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 FIG. **37**. If so, then block **770** of FIG. **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 not greater than zero and the first time value is less than the first billing interval. 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 FIG. **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 **642**, **350** or **564**.

Cost Per Second

Referring back to FIG. **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 FIG. **41**, a process for calculating a cost per unit time is shown generally at **780**. The process is executed by the processor **202** in FIG. **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 FIG. **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 FIG. **8**B.

Referring to FIG. **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 FIG. **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 FIG. **41**, if at block **782** a record such as the one shown in FIG. **43** is located in the system operator special rates table, the processor is directed to block **800** in FIG. **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 FIG. **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 FIG. **42**.

FIG. **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.

FIG. **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 FIG. **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 FIG. **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 FIG. **46**, having the "all" code in the reseller field **806**. The processor is then directed to block **800**.

Referring back to FIG. **41**, at block **800**, the processor **202** of FIG. **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 FIG. **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 been calculated and the process shown in FIG. **41** is ended.

If at block **824** the conditions of that block are not met, the processor **202** of FIG. **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 FIG. **7** to determine whether or not the bundle override record **726** in FIG. **37** located at block **712** in FIG. **33**A has a master list ID equal to the stored master list ID that was determined at block **410** in FIG. **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 FIG. **8**B. An exemplary reseller special destinations table record is shown in FIG. **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 FIG. **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 FIG. **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 FIG. **41**, the record shown in FIG. **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 FIG. **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 FIG. **47**, for example. The contents of the fields of this record **860** may be set according to system operator preferences, for example.

Referring to FIG. **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 FIG. **41**, should the processor get to block **832**, the reseller global mark-up table record as shown in FIG. **50** is retrieved from the database and stored locally at the RC. As seen in FIG. **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 FIG. **41**.)

It will be appreciated that the located record could be a bundle override record of the type shown in FIG. **37** or the located record could be a reseller special destination record of the type shown in FIG. **48** or the record could be a reseller global mark-up table record of the type shown in FIG. **50**. After the override and first and second increment variables have been set at block **862**, the processor **202** of FIG. **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 FIG. **41**, plus the contents of the override variable calculated in block **862** in FIG. **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 FIG. **33**B, for example.

Terminating the Call

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 FIG. **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 FIG. **3**.

Thus, for example, referring to FIG. **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 FA10 @ 192.168.0.20, which is the call ID for the call.

The SIP bye message shown in FIG. **52** is received at the call controller **14** and the call controller executes a process as shown generally at **910** in FIG. **53**. The process includes a first block **912** that directs the call controller processor **102** of FIG. **4** 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 FIG. **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 FIG. **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 FIG. **54**. An RC call stop message specifically associated with the call made to the Calgary callee is shown generally at **1020** in FIG. **55**.

Referring to FIG. **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 FIG. **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 FIG. **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 FA10@ 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 FIG. **53**, after having produced an RC call stop message, block **920** directs the processor **102** of FIG. **4** to send the RC stop message compiled in the RC call stop message buffer to the RC **16** of FIG. **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 FIG. **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 FIGS. **56**A, **56**B and **56**C. Referring to FIG. **56**A, the RC stop message process **950** begins with a first block **952** that directs the processor **202** in FIG. **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 FIG. **41**, specifically blocks **826** or **862** thereof. If this condition is met, then block **954** of FIG. **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 FIG. **41**. If at block **952** of FIG. **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 FIG. **41**. Then, the processor is directed to block **958** of FIG. **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 FIG. **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 FIG. **39**. If this condition is satisfied, block **966** of FIG. **56**A directs the processor to set the free time field **742** in the record shown in FIG. **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 FIG. **7** was directed to Block **966** which causes the free time field (**742** of FIG. **39**) to be set to zero, referring to FIG. **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 FIG. **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 FIG. **33**B. Block **976** then directs the processor to decrement the funds balance field (**740**) of the subscriber account record shown in FIG. **39** by the contents of the user cost variable calculated at Block **974**.

After completing Block **976** or after completing Block **970** in FIG. **56**A, block **978** of FIG. **56**B directs the processor **202** of FIG. **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 FIG. **45** and the communication session time determined at Block **916** in FIG. **53**. Then, Block **980** of FIG. **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 FIG. **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 FIG. **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 FIG. **58** are incremented by the reseller cost calculated at block **978** of FIG. **56**B.

Still referring to FIG. **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 FIG. **7** calculate a system operator cost as the product of the system operator cost per second, as set at block **822** in FIG. **41**, and the communication session time as determined at Block **916** in FIG. **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 FIG. **59**. This record includes a system operator balance field **996** holding an accumulated charges balance. Referring to FIG. **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 FIG. **56**B.

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

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

What is claimed is:

1. A method of 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:

causing at least one processor to access at least one memory storing a first participant profile identifying at least one first participant attribute;

receiving, by the at least one processor, a second participant identifier inputted by the first participant using the first participant device to initiate a communication, the second participant identifier being associated with the second participant device;

processing the second participant identifier, based on the at least one first participant attribute obtained from the first participant profile, to produce a new second participant identifier;

classifying the communication as a system communication or an external network communication;

when the communication is classified as a system communication, producing a system routing message, based on the new second participant identifier, that identifies an Internet Protocol (IP) address of a network element through which the communication is to be routed thereby causing 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, based on the new second participant identifier, that identifies an address associated with a gateway to an external network thereby causing the communication to the second participant device to be established by use of 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.

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

wherein producing the external network routing message causes at least a portion of a path taken by the communication to be established over a circuit switched network that is external to the communication system.

4. The method of claim **1**, wherein classifying the communication comprises causing the at least one processor to:

determine whether the second participant device is accessible to the communication system over an Internet Protocol (IP) network, and

when the second participant device is not accessible over the Internet Protocol (IP) network, classify the communication as an external network communication.

5. The method of claim **1**, wherein classifying the communication comprises causing the at least one processor to:

determine whether the second participant device is accessible to the communication system over an Internet Protocol (IP) network;

when the second participant device is not accessible over the Internet Protocol (IP) network, classify the communication as an external network communication; and

when the second participant device is accessible over the Internet Protocol (IP) network, classify the communication as a system communication.

6. The method of claim **1**, wherein classifying the communication comprises causing the at least one processor to:

determine whether the second participant device is operably configured to communicate via the communication system, and

when the second participant device is not operably configured to communicate via the communication system, classify the communication as an external network communication.

7. The method of claim **1**, wherein classifying the communication comprises causing the at least one processor to:

determine whether the second participant device is operably configured to communicate with the first participant device via an Internet Protocol (IP) network;

when the second participant device is not operably configured to communicate with the first participant device via the Internet Protocol (IP) network, classify the communication as an external network communication; and

when the second participant device is operably configured to communicate with the first participant device via the Internet Protocol (IP) network, classify the communication as a system communication.

8. The method of claim **1**, wherein classifying the communication comprises causing the at least one processor to:

determine whether a profile associated with the new second participant identifier exists in a database, and

when a profile associated with the new second participant identifier does not exist in the database, classify the communication as an external network communication.

9. The method of claim **8**, wherein,

when a profile associated with the new second participant identifier exists in the database, causing the at least one processor to classify the communication as a system communication.

10. The method of claim **1**, 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;

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 Protocol (IP) address of a network element through which the communication is to be routed or identifying an address associated with a gateway to the external network, wherein the gateway to the external network is selected from a plurality of available gateways to the external network; and

updating the first participant profile to cause at least one of the plurality of first participant attributes to be modified.

11. The method of claim **1**, further comprising:

processing a user-specific first participant attribute from the plurality of first participant attributes, using the at least one processor, to determine whether a further communication that was initiated by the first participant to a third participant device is allowed to proceed;

if the at least one processor determines that the further communication is not allowed to proceed based on the user-specific first participant attribute, preventing the further communication from being established.

12. The method of claim **11**, wherein:

if the further communication is allowed to proceed based on the user-specific first participant attribute, causing the at least one processor to search a database for communication blocking information associated with the third participant device, and if the communication blocking information is found, preventing the further communication from being established; and

if the further communication is allowed to proceed based on the at least one user- specific first participant attribute and no communication blocking information associated with the third participant device is found in the database, causing the at least one processor to produce a corresponding routing message to cause the further communication to be established to the third participant device.

13. The method of claim **11**, wherein the plurality of first participant attributes comprises at least one location-based first participant attribute that is associated with a local calling area for which the first participant has registered, and wherein the method further comprises:

causing the at least one processor to use the at least one location-based first participant attribute to determine whether a third participant identifier inputted by the first participant complies with pre-defined format criteria; and

if the third participant identifier does not comply with the pre-defined format criteria, causing the at least one processor to prevent the further communication from being established.

14. A method of 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:

causing at least one processor to access a first participant profile to load a plurality of first participant attributes into at least one memory;

receiving, by the at least one processor, a second participant identifier inputted by the first participant using the first participant device to initiate a communication, the second participant identifier being associated with the second participant device;

processing the second participant identifier based on at least one of the plurality of first participant attributes that was loaded into the at least one memory from the first participant profile to produce a new second participant identifier;

classifying the communication as a system communication, an external network communication, or a blocked communication;

when call blocking information is associated with the new second participant identifier, preventing the communication from being established;

when call blocking information is not associated with the new second participant identifier and the communication is classified as a system communication, producing a system routing message, based on the new second participant identifier, that identifies an Internet Protocol (IP) address of a network element through which the communication is to be routed thereby causing the communication to be established over an Internet Protocol (IP) network; and

when call blocking information is not associated with the new second participant identifier and the communication is classified as an external network communication, producing an external network routing message, based on the new second participant identifier, that identifies an address associated with a gateway to an external network thereby causing at least a portion of a path taken by the communication to be established over a circuit switched network.

15. The method of claim **14**, wherein classifying the communication comprises causing the at least one processor to:

determine whether the communication system is operably configured to communicate with the second participant device via the Internet Protocol (IP) network, and

when the communication system is operably configured to communicate to the second participant device via the Internet Protocol (IP) network and call blocking information is not associated with the new second participant identifier, classify the communication as a system communication.

16. The method of claim **14**, wherein classifying the communication comprises causing the at least one processor to:

determine whether a profile associated with the new second participant identifier exists in a database, and

when a profile associated with the new second participant identifier exists in the database and call blocking information is not associated with the new second participant identifier, classify the communication as a system communication.

17. An apparatus for routing a communication in a communication system between an Internet-connected first participant device and a second participant device, the apparatus comprising:

at least one processor operably configured to access at least one memory having processor readable instructions, wherein the at least one processor is operably configured by the processor readable instructions to:

access a first participant profile to load, into the at least one memory, a plurality of first participant attributes associated with communications initiated from the first participant device;

receive a second participant identifier inputted by the first participant to initiate a communication to the second participant device, the second participant identifier being associated with the second participant device;

process the second participant identifier, based on at least one of the plurality of first participant attributes loaded by use of from the first participant profile, to produce a new second participant identifier;

classify the communication as a system communication or an external network communication;

when the communication is classified as a system communication, produce a system routing message, based on the new second participant identifier, that identifies an Internet Protocol (IP) address of a network element through which the communication is to be routed to the second participant device; and

when the communication is classified as an external network communication, produce an external network routing message, based on the new second participant identifier, that identifies an address associated with a gateway to an external network;

wherein one of the system routing message or the external network routing message causes the communication to be established to the second participant device.

18. The apparatus of claim **17**,

wherein the system routing message causes the communication to be established over an Internet Protocol (IP) network.

19. The apparatus of claim **17**,

wherein the external network routing message causes at least a portion of a path taken by the communication to be established over a circuit switched network that is external to the communication system.

20. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether the second participant device is accessible to the communication system over the Internet Protocol (IP) network;

when the second participant device is not accessible over the Internet Protocol (IP) network, classify the communication as an external network communication.

21. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether the second participant device is accessible to the communication system over the Internet Protocol (IP) network;

when the second participant device is not accessible over the Internet Protocol (IP) network, classify the communication as an external network communication; and

when the second participant device is accessible over the Internet Protocol (IP) network, classify the communication as a system communication.

22. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether the second participant device is operably configured to communicate with the first participant device via the Internet Protocol (IP) network;

when the second participant device is not operably configured to communicate with the first participant device via the Internet Protocol (IP) network, classify the communication as an external network communication.

23. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether the second participant device is operably configured to communicate via the communication system;

when the second participant device is operably configured to communicate via the communication system, classify the communication as a system communication.

24. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether a profile associated with the new second participant identifier exists in a database;

when a profile associated with the new second participant identifier does not exist in the database, classify the communication as an external network communication.

25. The apparatus of claim **18**, wherein the at least one processor is operably configured to:

determine whether a profile associated with the new second participant identifier exists in a database;

when a profile associated with the new second participant identifier exists in the database, classify the communication as a system communication.

26. The apparatus of claim **17**, 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;

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 a respective Internet Protocol (IP) address of a network element through which the respective communication is to be routed or identifying a respective address associated with a gateway selected from among a plurality of gateways to the external network, wherein each routing message causes the respective communication to be routed to a respective destination; and

update the first participant profile to cause at least one of the plurality of first participant attributes to be modified.

27. The apparatus of claim **17**, wherein the first participant profile identifies a plurality of user-specific attributes of the first participant, including at least one user- specific attribute that represents a location-based service preference, and wherein the at least one processor is further operably configured to:

(a) process a first user-specific attribute from the first participant attributes to determine whether a further communication initiated by the first participant to a third participant device is allowed to proceed;

(b) if the further communication is not allowed to proceed, prevent the further communication from being established;

(c) if the further communication is allowed to proceed, classify the further communication, based on a third participant identifier associated with the third participant device, as either a system communication or an external network communication, and produce a further routing message, based on the third participant identifier, identifying an address through which the further communication can be established to the third participant device;

(d) wherein when the further communication is classified as a system communication, the further routing message is produced to identify an Internet Protocol (IP) address of a network element of the communication system through which the further communication can be established to the third participant device;

(e) wherein when the further communication is classified as an external network communication, the further routing message is produced to identify an address associated with a gateway to a communication network that is external to the communication system through which the further communication can be established to the third participant device; and

(f) wherein the further routing message causes the further communication to be established to the third participant device.

28. The apparatus of claim **17**, wherein the first participant profile identifies a plurality of user-specific attributes of the first participant, including at least one user-specific attribute that represents a location-based service preference, and wherein the at least one processor is further operably configured to:

(a) process a first user-specific attribute from the first participant attributes to determine whether a further communication initiated by the first participant to a third participant device is allowed to proceed;

(b) if the further communication is allowed to proceed, process a second user-specific attribute from the first participant attributes to determine whether a third participant identifier associated with the third participant device complies with pre-defined format criteria;

(c) if the third participant identifier complies with the pre-defined format criteria, search a database for call blocking information associated with the third participant identifier; and

(d) if the call blocking information is not found, produce a further routing message identifying an address through which the further communication can be established to the third participant device, causing the further communication to be established to the third participant device;

(e) wherein the second user-specific attribute identifies a location-based service preference.

29. The apparatus of claim **18**,

wherein the Internet Protocol (IP) address of the network element through which the communication is to be routed comprises an IP address or domain name identifying 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; and

wherein the communication system node is operably configured to send a first message to the first participant device identifying a first IP address of a media relay to which data traffic comprising the communication should be sent from the first participant device, the communication system node being operably configured to cause the media relay to establish the communication from the first participant device via the first IP address to a second IP address at which the second participant device is operably configured to receive data traffic comprising the communication.

30. A non-transitory computer readable medium encoded with instructions for directing the at least one processor to execute the method of claim **1**.

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