PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04L 12/28 | A1

(11) International Publication Number: **WO 00/67428**

(43) International Publication Date: 9 November 2000 (09.11.00)

(21) International Application Number: PCT/CA00/00491

(22) International Filing Date: 2 May 2000 (02.05.00)

(30) Priority Data:
60/132,173 3 May 1999 (03.05.99) US

(71) Applicant *(for all designated States except US)*: BRIDGEWATER SYSTEMS CORPORATION [CA/CA]; 555 Leggett Drive, Suite 800, Kanata, Ontario K2K 2X3 (CA).

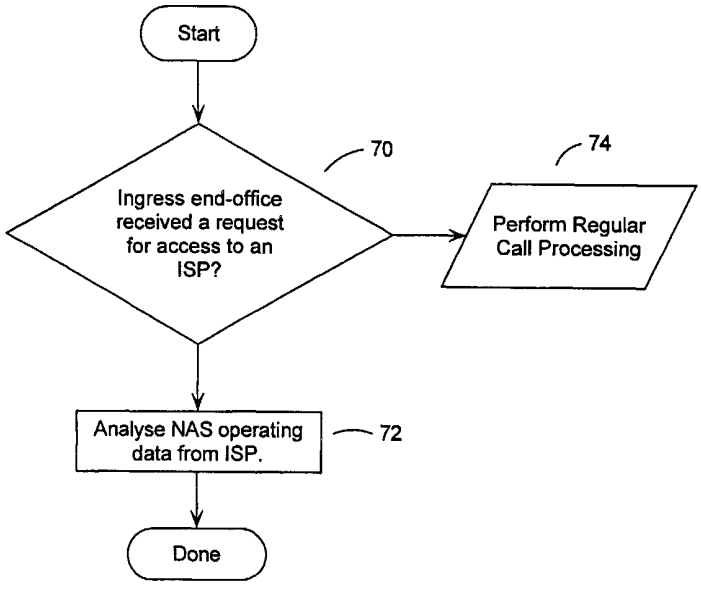
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: SHAW, Goutam [CA/CA]; 2120 Johnston Road, Ottawa, Ontario K1G 5J7 (CA). TEED, Dave [CA/CA]; 18 Nesbitt Street, Nepean, Ontario K2H 8C6 (CA). LUZINE, Chris [CA/CA]; 1A Craig Street, Ottawa, Ontario K1S 4B6 (CA).

(74) Agents: O'NEILL, Gary et al.; Gowling Lafleur Henderson LLP, Suite 2600, 160 Elgin Street, Ottawa, Ontario K1P 1C3 (CA).

(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SYSTEM AND METHOD OF INTERNET ACCESS AND LOAD MANAGEMENT



(57) Abstract

The present invention relates generally to telecommunications, and more specifically, to a system and method of internet access and management. It is common to provide Internet access over the existing public switched telephone network (PSTN) due to its reliability and widespread access, but the PSTN does not allow this access to be managed with any consideration for the loading the Internet Service Provider's Network Access Servers (NASs), or different telephone numbers that these NASs may have. The invention provides a system and method of access management which communicates with both the PSTN network and the Internet, so that access may be coordinated with consideration for the loading and availability of NASs, proximity of the end user to the NASs, the end user's profile data such as quality of service (QoS), and other such factors.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

SYSTEM AND METHOD OF INTERNET ACCESS AND LOAD MANAGEMENT

The present invention relates generally to telecommunications, and more specifically, to a system and method of Internet access and management.

Background of the Invention

The use of computers and computer software in all of their various forms is widespread and is growing everyday. As well, powerful communication networks such as the Internet, have developed which allow computer software programs and data files to be easily accessed, exchanged, copied and distributed. The Internet is now a common medium for operating online auctions, academic and public forums, distributing publications such as newspapers and magazines, and performing electronic commerce and electronic mail transactions.

The demand for Internet services has grown far faster than the implementation of new and dedicated Internet infrastructure all the way to user's homes and businesses, so it has been common to rely on the existing Public Switched Telephone Network (PSTN) to provide the "last mile" of communication. The PSTN is the international telephone system which enjoys almost pervasive access in industrialized countries. The PSTN provides reliable and predictable quality that is suitable for "dial-up" Internet access.

Dial-up access refers to connecting a computing device such as a personal computer (PC), laptop computer or personal digital assistant (PDA) to a computing network via a modem and the PSTN. Dial-up access is much like a voice telephone connection, except that the parties at the two ends are computer devices rather than people. Information is transmitted over PSTN lines in analogue form, while computers manipulate data in digital form. Hence, a modem (modulator/ demodulator), is required to convert the computer's digital data to and from the analogue form that the PSTN carries.

Figure 1 presents an exemplary layout of a dial-up Internet communication system **30**. The Internet **32** itself is represented by a number of routers **34** interconnected by an Internet backbone **36** network designed for high-speed transport of large amounts of data. User's computers **38** may access the Internet in a number of manners including modulating and demodulating data over a telephone line **40** using analogue audio frequencies, which requires a modem **42** and

connection to the Public Switched Telephone Network (PSTN) **44.** The PSTN **44** in turn, connects to the Internet **32** via Network Access Servers (NAS) **46**.

Web sites are maintained on servers **48** also connected to the Internet **32**, which provide content and software applications to the User's computers **38**. As Internet Service Provider (ISP) **50** may have one or many servers **48** under its supervision. Communications between user's computers **38** and the rest of the network **30** are standardized by means of defined communication protocols.

Internet Service Providers (ISPs) **50** or Internet Access Providers (IAPs), are companies that provide access to the Internet. For a monthly fee, ISPs **50** generally provide end users with the necessary software, username, password and access to the Internet and other services. ISPs **50** are considered by some to be distinguished from IAPs in that they also provide content and services to their subscribers, but in the context of this disclosure the distinction is not significant. Equipped with a telephone line **40** and modem **42**, one can dial the telephone number of an ISP or ASP, to log on to the Internet **32** and browse the World Wide Web, and send and receive e-mail.

Figure 1 is something of a simplification, as ISPs **50** are often connected to the Internet **32** through Network Access Points (NAPs), rather than directly as shown in **Figure 1**. As well, the Internet itself is far more complex than that shown in **Figure 1**, as the Internet consists of a vast interconnection of computers, servers, routers, computer networks and public telecommunication networks. However, these details would be well known to one skilled in the art.

Although dial-up access to the Internet over PSTN lines is very common, this architecture does have significant limitations, including the following:

1. while an ISP **50** may have several NASs **46**, each NAS **46** may be connected to the PSTN **44** via several trunks (PRI or T1/E1) and each one of the trunks (or set of trunks) might have a unique DN associated with it. This is regardless of the fact whether they are in the same location or spread across the nation. Therefore, users may have to dial several telephone numbers before they find a NAS **46** that has the capacity available for them to log on;
2. it does not allow ISPs **50** to balance the loading across their NASs **46** (also referred to as Points of Presence or PoPs);
3. it does not allow ISPs **50** to route calls around failed PoPs **46**; and
4. it does not allow ISPs **50** to overflow calls from one PoP **46** to another.

Of course, until the user has access to the Internet **32**, the Internet **32** cannot assist in establishing the telephone line **40** connection. Therefore, one must look to the PSTN **44** to provide the assistance. The PSTN **44** does have additional intelligence that may be employed to assist with Internet access in limited ways.

The intelligent layer that exists for the PSTN **44** is called the IN (Intelligent Network). An Intelligent Network (IN) is a telephone network architecture in which the service logic for a call is located separately from the switching facilities, allowing services to be added or changed without having to redesign switching equipment. IN is described as a "service-specific" architecture, that is, a certain portion of a dialled phone number, such as 800 or 900, triggers a request for a specific service. An IN may also be implemented as a "service-independent" architecture in which a given part of a telephone number can interpreted differently by different services depending on factors such as time of day, caller identity, and type of call. These architectures are generally referred as an Advanced Intelligent Network (AIN) in North America, and an Intelligent Network (IN) in Europe.

The IN is typically used to route voice calls across the PSTN **44** network, an example being toll-free access using 1 - 800 - xxx - xxxx numbers in North America. An exemplary layout of a PSTN/IN network **58** is present in **Figure 2**. When a call is placed on a telephone **60** using a toll-free number, the Central Office **62** to which the telephone **60** is connected, identifies the call as requiring IN processing. This determination is made by the nature of the dialed number. The CO **62** then directs the call through the Signal Transfer Point (STP) network **64** to access a central database called the Service Control Point (SCP) **66**, to be processed. The SCP **66** decides where to route the call based on some static criteria such as the closest customer support center from where the call is being placed. In the case of a 1 - 800 - xxx - xxxx number, the SCP **66** will index its database with the dialled number and find a "regular" telephone number which corresponds to the 1 - 800 number. These "regular" telephone numbers are referred to as North American Numbering Plan (NANP) numbers in the art. This regular number is returned to the CO **62**, and the call is routed accordingly.

However, the IN and AIN systems **58** are static; all the call routing logic has to be programed into the SCP **66** ahead of time, before it can make a decision as to where to route a call. Therefore, the existing IN infrastructure **58** cannot be used to route dial-up calls for Internet access because the SCP **66** does not have knowledge

of dynamic status of the related components in the IP (Internet Protocol) network needed to make a proper routing decision.

There is therefore a need for a system and method of Internet access and management.

Summary of the Invention

It is therefore an object of the invention to provide a novel system and method of Internet access and management which obviates or mitigates at least one of the disadvantages of the prior art.

One aspect of the invention is broadly defined as a method of managing public switched telephone network (PSTN) dial-up Internet access comprising the steps of: responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by: analysing Network Application Server (NAS) operating data from said ISP.

Another aspect of the invention is defined as an apparatus operable to execute the method steps of: responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by: analysing Network Application Server (NAS) operating data from said any one of claims 1 through 13.

An additional aspect of the invention is defined as a system for executing the method the steps of: responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by: analysing Network Application Server (NAS) operating data from said ISP.

An additional aspect of the invention is defined as a carrier signal incorporating software code executable to perform the method steps of: responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by: analysing Network Application Server (NAS) operating data from said ISP.

A further aspect of the invention is defined as a computer readable memory medium for storing software code executable to perform the method steps of: responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by: analysing Network Application Server (NAS) operating data from said ISP.

Brief Description of the Drawings

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings in which:

Figure 1 presents a physical layout of an exemplary Internet network **30** as known in the prior art;

Figure 2 presents a physical layout of an exemplary PSTN Intelligent Network **58** as known in the prior art;

Figure 3 presents a flow chart of a method of Internet access and management in a broad embodiment of the invention;

Figure 4 presents a physical layout of a system of Internet access and management in a preferred embodiment of the invention; and

Figure 5 presents a block diagram of an apparatus for performing Internet access and management in a preferred embodiment of the invention; and

Figures 6a, 6b and **6c** present a flow chart of a method of Internet access and management in a preferred embodiment of the invention.

Detailed Description of Preferred Embodiments of the Invention

A method which addresses the objects outlined above, is presented as a flow chart in **Figure 3**. This figure presents a flow chart of a method of managing public switched telephone network (PSTN) dial-up Internet access. This method may be effected by responding to the receipt of a request for access to an Internet Service Provider (ISP) **50** from a central office (CO) **62** at step **70**, by analysing Network Application Server (NAS) **46** operating data from the ISP **50** at step **72**.

As described in the Background to the Invention, the PSTN **44** provides a convenient means of accessing the Internet **32** via a modem **42**, using dial-up access, but the lack of management of this access results in several significant problems. The existing PSTN **44** can be modified to identify calls to an ISP **50** in the same manner as the existing IN or AIN calls are identified. If an incoming call is not identified as an ISP call at step **70**, regular processing may be performed at step **74**, or some other action may be taken, such as querying the caller, or dropping the PSTN connection. This identification may be made at the end office or central office (CO) **62** of the PSTN **44**, or at any other suitable point.

In response, the ISP call will initiate an analysis of the NAS **46** operating data from the ISP **50**. These data may include, for example: Network Access Server

(NAS) **46** load, its proximity to the caller, and subscriber profile data such as QoS (Quality of Service). As well, the analysis performed on these data may be a matter of some simple binary tests, such as stepping through a list of available NASs **46** and detecting whether the NAS **46** has capacity, or be far more complex, as in the case of balancing or predicting loading of NASs **46**, or re-distributing connections in the event of an NAS **46** failure.

The invention provides a number of advantages over the functionality available in the art. As noted above, the current SCPs **66** employed by the PSTN **44** are static databases which do not have the ability to communicate intelligently with the components of the IP network **32**, such as routers and servers. Hence, the SCPs **66** are not able to make proper routing decisions for the Internet dial-up calls based on the policies governed by the IP network **32** elements and the values of real time parameters. The policies include subscriber policies, network status policies and many others that are only available on the IP network **32**. In general, the invention allows the existing PSTN-based IN infrastructure to work with the IP-based network infrastructure to enable dial-up call routing based on the policies such as network and subscriber status, on a dynamic basis for every call.

With the IN infrastructure having visibility into the IP network **32** in this manner, the ISP **50** is able to offer the advantages of:

1. single telephone number access to an ISP **50**, either locally or across the nation, with a single telephone number for multiple NASs **46** or PoPs;
2. load balancing of Internet traffic across their NASs **46** or PoPs;
3. routing of calls around failed NASs **46**, PoPs, NAS ports or PRIs (a PRI is an ISDN service called a primary rate interface. It is described in greater detail hereinafter); and
4. transferring overflow calls to other PoPs **46**.

To the PSTN local exchange carrier who buys and implements the system of the invention, it allows them to:

1. enter the Internet market;
2. generate additional revenues by providing enhanced IP access services to the ISPs **50** and Corporations;
3. reduce the congestion in their PSTN (Public Switched Telephone Network) **44** by intelligently and efficiently routing Internet dial-up calls to the ISP **50** and Corporate PoP (Point of Presence) locations; and

4. allows the ISPs **50** to continue to own their Network Access Servers **46** and be able to buy IN (Intelligent Network) enabled IP access services from the carrier which they would not be able to use otherwise since they are not licensed as carriers.

The end user benefits from the improved functionality and efficiency that his ISP **50** enjoys, as well as improved ease of access to their ISP **50**. The end user no longer has to dial multiple numbers to obtain access; a single telephone number is sufficient. Other advantages would be clear to one skilled in the art from the description of the invention herein.

The preferred embodiment of the invention is presented with respect to the layout of **Figure 4**. This system **80** includes components described in the Background of the Invention: the Internet **32,** user's computer **38**, telephone line **40**, modem **42**, Network Access Servers (NASs) **46**, Internet Service Provider (ISP) **50**, Central Office (CO) **62** and Signal Transfer Point (STP) network **64**.

In the ISP domain of the this layout, the ISP **50** is shown to comprise both a Network Management Server (NMS) **82** and an Authentication, Authorization and Accounting Server (AAA) **84**.

Generally, an AAA **84** server receives the user's requests over the Internet **32** and an NMS server **82** administers the ISP's resources to supply the requested services. An AAA server **84** provides the NASs **46** with information that is used to authenticate hosts or users (authentication), to assign network privileges (authorization), and to record user network activity (accounting).

Authentication is the process of confirming that a person or device is who they claim to be. For example, to authenticate a remote host or person, a local host requests a username and password (from the other host or person) and then verifies that the username and password are valid by comparing them to values stored on an AAA server **84**.

Authorization is the process of negotiating network access privileges and assigning the privileges to an interface. When assigned to an interface, these privileges apply to any person or device using the interface to gain access to the network.

Accounting is the basic back-end bookkeeping services required for cost allocation and statistical analysis.

In the Access Provider's Domain, the invention adds the Multispan Service Point™ (MSP) **86**, and the optional Intelligent Peripheral **88**. The MSP **86** is the active database and intelligent processor which interfaces with both the IN of the PSTN **44**, and the ISP servers **82**, **84**. The structure of the MSP **86** is described with respect to **Figure 5**, and the functionality with respect to the flow charts of **Figures 6a, 6b** and **6c.**

The optional Intelligent Peripheral **88** is used to collect additional dialed digits and pass them to the MSP **86**. In the preferred embodiment described hereinafter, the Intelligent Peripheral **88** collects a personal identification number (PIN#) for authentication of the caller.

The general structure of the MSP **86** is presented as a block diagram in **Figure 5**. At the hub of this apparatus lies a central processing unit **90**, which may consist of one or more microprocessors, micro-controllers, ASICs (application specific integrated circuits) and/or digital signal processors, or similar devices as known in the art, as well as any necessary supporting logic. The central processing unit **90** communicates with the PSTN **44** via an SS7 interface **92**, and communicates with the Internet **32** via a TCP/IP interface **94**. SS7 or CCS7 is the protocol used by the telephone systems worldwide to set up calls and provide transaction services; the TCP/IP (Transmission Control Protocol/Internet Protocol) is the suite of communications protocols used to connect hosts on the Internet. Both SS7 and TCP/IP are well known in their respective arts.

The invention is not limited to such protocols, as any required interface may be substituted. As well, the invention is not limited by the format of communication between the interfaces **90**, **92** and the central processing unit **90**.

A storage medium **96** is also provided to store programming information as well as temporarily caching ISP performance data. This storage medium may be implemented in many ways, including any one of the following, or combinations of: RAM (random access memory), PROM (programmable read only memory) and its variations such as EPROM, EEPROM and Flash ROM, magnetic storage media such as hard disk drives, floppy disk drives and magnetic tape drives, optical storage media such as compact disk drives, or similar storage media as known in the art.

A terminal or personal computer (PC) **96** is also provided to serve as an interface for the system administrator, which may be used to monitor and program the MSP **86**. This terminal **96** may be directly connected to the central processing

unit **90** as shown, or may be interconnected with a LAN (local area network), or remote connection, in a manner known in the art.

The preferred method of the invention is presented as a flow chart in **Figures 6a, 6b** and **6c**. These flow charts describe the steps of call set up and tear down and the interaction between various components on the network for an Internet dial-up call.

At step **100**, the subscriber uses his computing device **38** and modem **42** to dial a PSTN directory number (DN) to access an ISP **50**. This operation is described in greater detail herein above.

The ingress central office **62** or end-office, receives this call at step **102** and identifies an IN (Intelligent network) PODP (Public Office Dial Plan) trigger against the dialed DN, which causes processing to proceed to step **104**. Such PODP triggers are standard to IN and AIN systems, and may consist of a single 7-digit number, a range of numbers, or a longer string of digits. If the call does not contain such a trigger, then regular PSTN call processing is performed at step **106**.

At step **104**, the ingress end-office **62** then builds and sends an IN routing query message to the MSP **86** for resolution. The IN protocol would depend on what protocol is supported by the local PSTN **44**, and could be, for example:

1. TCAP (Transaction Capabilities Application Part), which is the application part of signalling system #7 (SS7). As noted above, SS7 is the protocol used by North American telephone systems to set up calls and provide transaction services.
2. INAP (Intelligent Network Application Protocol) which specifies the information flows to be exchanged between the different entities of the IN functional model in terms of protocol data units (PDUs) described by ASN.1 (Abstract Syntax Notation #1). The PDUs themselves represent Remote Operations in the scope of the Transaction Capability Application Part (TCAP); or
3. any other suitable variant of IN protocol.

For the central office switch **62**, the MSP **86** is seen as another SCP **66**. Therefore, when configuring the PODP trigger against a number in the CO **62** one has to tell it which SCP **66** it needs to send the routing query to; which is normal configuration practice. The destination SCP address is determined by a parameter called "point code". Point codes are used as addresses to identify network elements

in the SS7 network similar to that of IP addresses that are used to identify hosts in the IP network.

The MSP **86** receives the IN query at step **108** and decodes it to extract the called number and other fields. Based on this information, the MSP **86** indexes its database **96** to find the ISP profile to validate other parameters like port quota.

At step **110**, the MSP **86** then sends a RADIUS (Remote Authentication Dial-in User Service) authentication proxy query message to the ISP **50** asking it to validate the user based on the calling number.

RADIUS is a protocol to authenticate users who dial in to private networks. Typically, dial-in network access servers challenge callers for user name and password, which are checked against a RADIUS server. Optionally, the switch can collect PIN# (Personal Identification Number) from the user (using the Intelligent Peripheral **88**) and send the PIN# as username authentication parameter to the ISP's Authentication, Authorization, and Accounting (AAA) server **82**.

The AAA server **82** of the ISP **50** then authenticates the caller at step **112** of **Figure 6b**, based on either the calling number or the PIN#, and sends a RADIUS "authentication accept" response back to the MSP **86**. As noted above, the AAA server **82** provides authentication, authorization and accounting services.

While step **114** shows the transmission of performance information such as the ISP's **50** NAS **46** resources, port/PRI status and NAS **46** status being sent to the Access Provider's MSP **86** by the ISP's **50** Network Management System (NMS) **84** as a finite step, it is preferably done on a continuous and real-time basis. This transmission is done using one or more of the protocols:

1. SNMP (Simple Network Management Protocol), which is a widely-used network monitoring and control protocol. Data is passed from SNMP agents, which are hardware and/or software processes reporting activity in each network device (hub, router, bridge, etc.) to the workstation console used to oversee the network. The agents return information contained in a MIB (Management Information Base), which is a data structure that defines what is obtainable from the device and what can be controlled (turned off, on, etc.).
2. DIAMETER, which is an AAA protocol like RADIUS, though DIAMETER has several other advantages over RADIUS which may result in the growth of its use in the industry. RADIUS was designed to function only with Serial Line Internet Protocol and PPP for standard analog modems, while DIAMETER

can be used for access authentication of handheld or other wireless computing devices, cellular phones or Ethernet-based virtual private networks (VPN). As well, DIAMETER allows remote servers to send unsolicited messages to clients, and has longer address spaces.

3. MGCP (Media Gateway Control Protocol), which is an IETF protocol for IP telephony. Working in conjunction with the Gateway Location Protocol (GLP), it enables a caller with a PSTN phone number to locate the destination device and establish a session. It provides the gateway-to-gateway interface for the Session Initialization Protocol (SIP), a less-complex alternative to the H.323 protocol, which is an ITU standard for transporting voice, video and data over packet-switched networks such as local area networks (LANs) and the Internet.

Having received the "authorization accept" message, the MSP **86** selects a routing number at step **116**, based on the service logic parameters such as:

1. least cost routing;
2. traffic congestion on a route;
3. ISP's **50** NAS (Network Access Server) **46** and port availability corresponding to the routing number; or
4. NAS **46** type.

Other parameters may also be considered, which would be clear to one skilled in the art.

The MSP **86** generates an active interim accounting record for the call setup at step **118**. It also keeps track of number of calls per NAS **46** and per PRI basis to efficiently load-balance the traffic across the PoPs (Points of Presence) in a wide area network.

Primary Rate Interface (PRI) is an ISDN service designed for larger organizations. PRI includes 23 B-channels (30 in Europe) that can carry voice or data at rate of 64Kbps, and one D-Channel which carries call-control information. In contrast, BRI (Basic Rate Interface), which is designed for individuals and small businesses, contains just two B-channels and one D-channel. PRI service is generally transmitted through a T1 line (or an E1 line in Europe). A T1 line is a dedicated phone connection supporting data rates of 1.544Mbits per second. A T1 line actually consists of 24 individual channels, each of which supports 64Kbits per second. Each 64Kbit/second channel can be configured to carry voice or data traffic.

Although this is the preferred communication medium, the invention is not limited to any particular medium.

At step **120**, the MSP **86** then sends the IN response message containing the destination Routing Number for terminating the call on the chosen PRI connected to the NAS **46**. The response message also contains a "send notification" parameter that allows the MSP **86** to be notified after the call is torn down.

After receiving the IN response message from the MSP **86**, the ingress end office switch **62** delivers the call to the destination Routing Number, that is, to the ISP **50** NAS **46** at step **122**.

At step **124**, the NAS **46** then answers the call and goes through the user authentication process by sending a RADIUS Authentication-Request message to ISP's **50** own AAA server **82**. Clearly, this processed can be changed accordingly if a different authentication method is used, or no authentication is performed at all.

The NAS **46** would then send a RADIUS Acct-Start message to the ISP's **50** AAA server **82** at step **126**, authorizing the access. At step **128**, the subscriber is now connected to the ISP **50** and will remain in this loop until he disconnects from the ISP **50**.

When the subscriber disconnects, the ingress end-office switch sends a IN "terminate notification" to the MSP **86** over the SS7 network at step **130**, and the ISP **50** generates an Automatic Messaging Account (AMA) record for the subscriber dial-in session, at step **132**. An AMA record is a set of software features that provide billing information such as the control, collection, and recording of calls charged, and any other pertinent information required to record the calling and process the billing. Subsequent processing of this billing information may be processed periodically, such as monthly, but otherwise the teardown of the call is now complete.

While particular embodiments of the present invention have been shown and described, it is clear that changes and modifications may be made to such embodiments without departing from the true scope and spirit of the invention.

The method steps of the invention may be embodiment in sets of executable machine code stored in a variety of formats such as object code or source code. Such code is described generically herein as programming code, or a computer program for simplification. Clearly, the executable machine code may be integrated with the code of other programs, implemented as subroutines, by external program calls or by other techniques as known in the art.

The embodiments of the invention may be executed by a computer processor or similar device programmed in the manner of method steps, or may be executed by an electronic system which is provided with means for executing these steps. Similarly, an electronic memory medium such computer diskettes, CD-Roms, Random Access Memory (RAM), Read Only Memory (ROM) or similar computer software storage media known in the art, may be programmed to execute such method steps. As well, electronic signals representing these method steps may also be transmitted via a communication network.

The invention could, for example, be applied to computers, smart terminals, personal digital assistants and Internet-ready telephones. Again, such implementations would be clear to one skilled in the art, and do not take away from the invention.

WHAT IS CLAIMED IS:

1. A method of managing public switched telephone network (PSTN) dial-up Internet access comprising the steps of:

responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) via said PSTN by:

analysing Network Application Server (NAS) operating data from said ISP.

2. A method as claimed in claim 1, where said step of analysing further comprises the step of:

analysing Network Access Server (NAS) load data.

3. A method as claimed in either of claims 1 or 2, where said step of responding further comprises the step of:

an end office of said PSTN responding to the receipt of said request.

4. A method as claimed in any one of claims 1 to 3, where said step of analysing further comprises the step of:

returning a PSTN routing number to said end office determined by said analysis.

5. A method as claimed in any one of claims 1 to 4, further comprising the step of:

querying said ISP for said NAS operating data.

6. A method of managing public switched telephone network (PSTN) dial-up Internet access comprising the steps of:

an end office of said PSTN responding to the receipt of a request for dial-up access to an Internet Service Provider (ISP) by:

forwarding a routing query to an intelligent network (IN);

said IN responding to said routing query by:

querying said ISP for Network Application Server (NAS) operating and load data;

responding to the receipt of said NAS operating and load data by:

analysing said NAS operating and load data; and

returning a PSTN routing number to said end office, directing said dial-up access to a desired one of said NASs.

7. A method as claimed in claim 6, where said step of analysing further comprises the step of:

analysing the proximity of said NASs to said end office.

8. A method as claimed in either of claims 6 or 7, where said step of analysing further comprises the step of:

analysing subscriber profile data such as Quality of Service (QoS).

9. A method as claimed in any one of claims 6 to 8, where said step of returning further comprises the step of:

returning a PSTN routing number to said end office, directing said dial-up access to a desired one of said NASs to effect load sharing between NASs of said ISP.

10. A method as claimed in any one of claims 6 to 8, where said step of returning further comprises the step of:

returning a PSTN routing number to said end office, directing said dial-up access to avoid failed NASs.

11. A method as claimed in any one of claims 6 to 8, where said step of returning further comprises the step of:

returning a PSTN routing number to said end office, directing said dial-up access to avoid overloaded NASs.

12. A method as claimed in any one of claims 6 to 11, where said steps of querying said ISP and responding to the receipt of said NAS operating and load data are performed using an Internet Protocol.

13. A method as claimed in any one of claims 6 to 12, where said steps of forwarding a routing query and returning a PSTN routing number are performed using a Signalling System 7 protocol.

14. An apparatus operable to execute the method steps of any one of claims 1 through 13.

15. A system for executing the method of any one of claims 1 through 13.

16. A computer readable memory medium for storing software code executable to perform the method steps of any one of claims 1 through 13.

17. A carrier signal incorporating software code executable to perform the method steps of any one of claims 1 through 13.

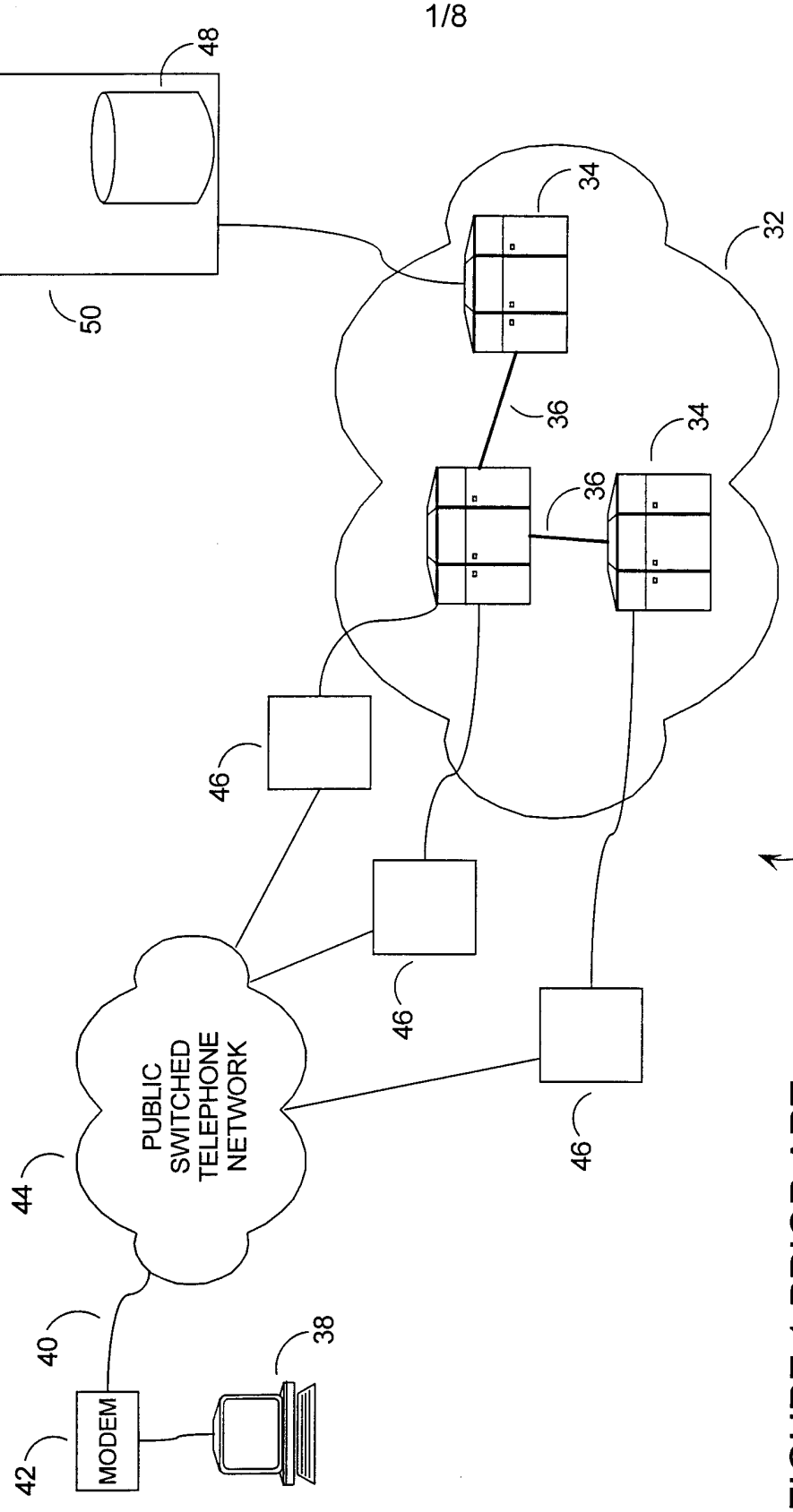


FIGURE 1 PRIOR ART

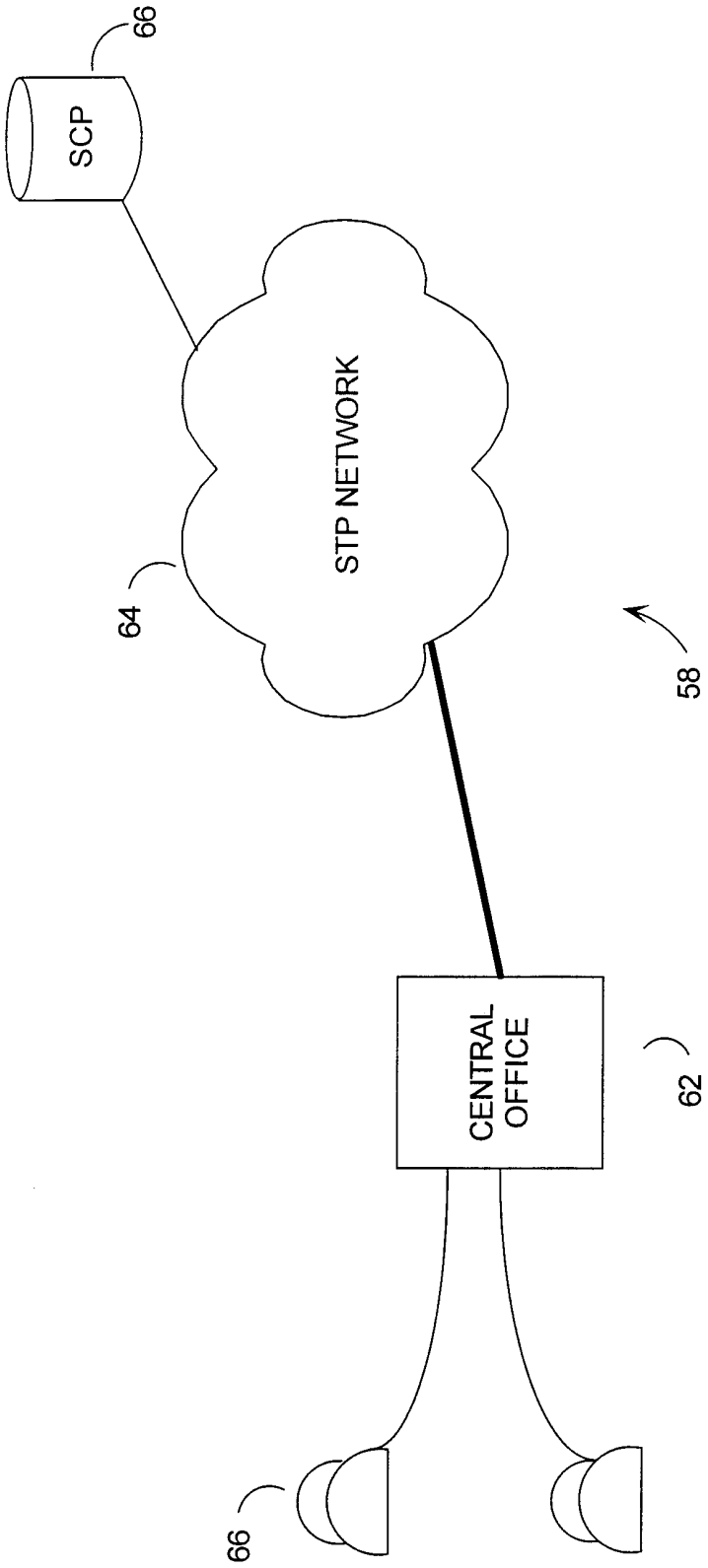
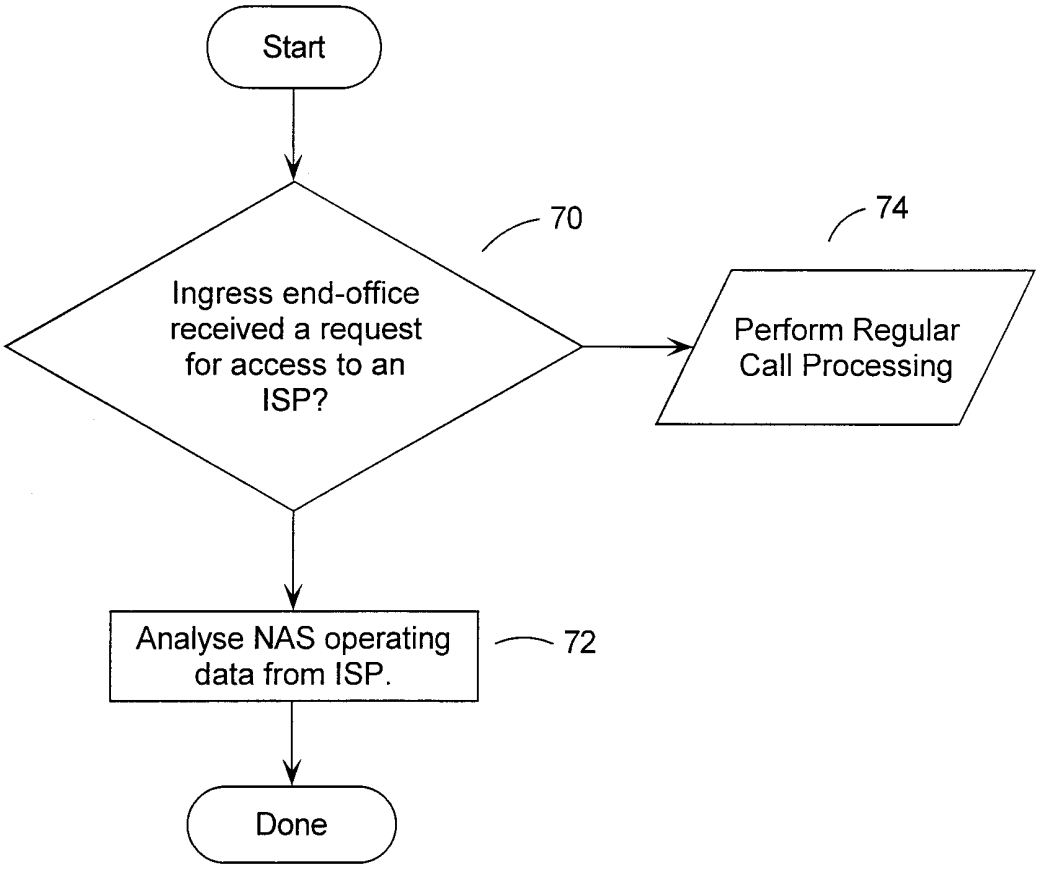


FIGURE 2 PRIOR ART

FIGURE 3


Start
70
Ingress end-office received a request for access to an ISP?
74
Perform Regular Call Processing
Analyse NAS operating data from ISP.
72
Done

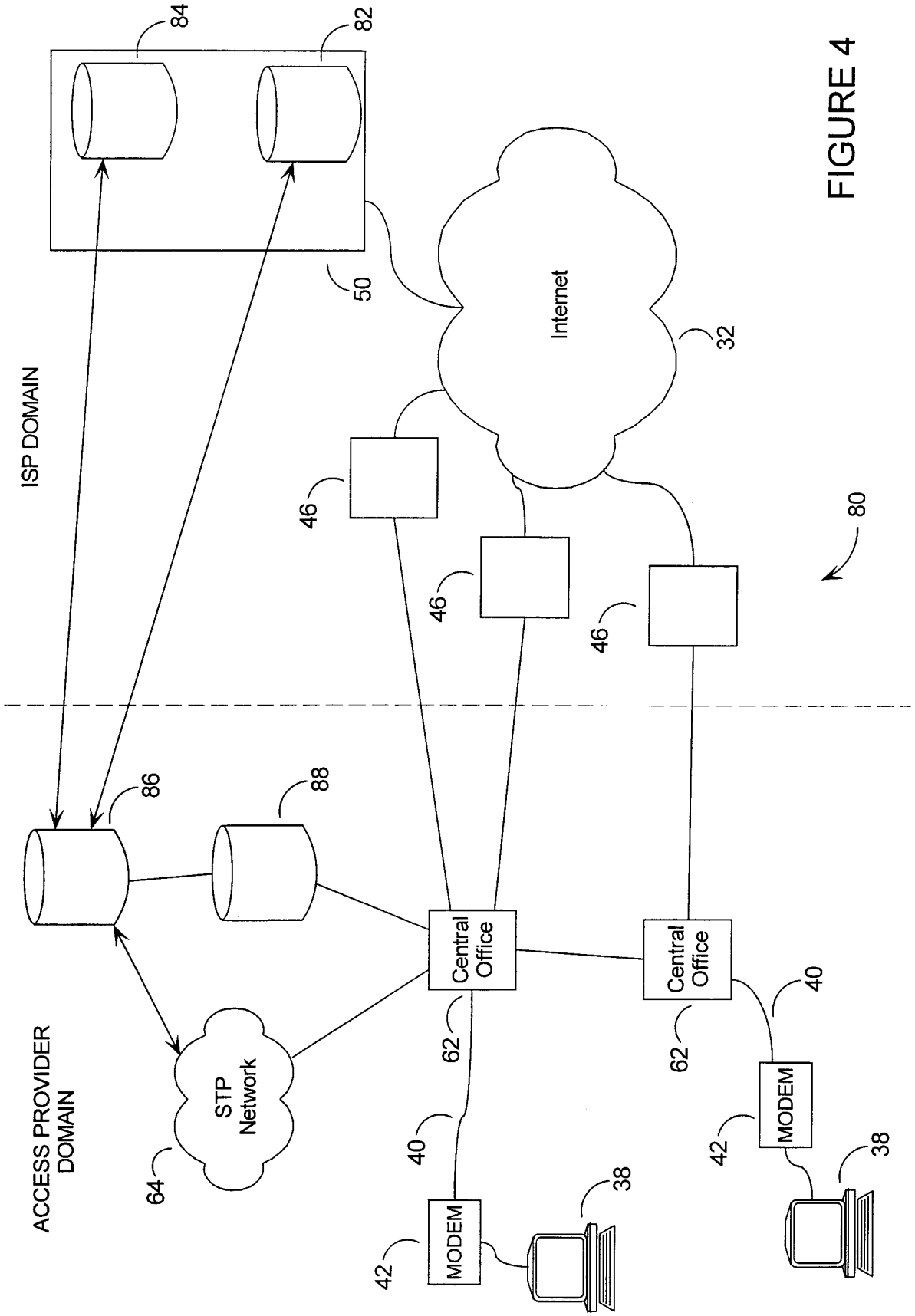

ISP DOMAIN
ACCESS PROVIDER DOMAIN
Internet
STP Network
Central Office
Central Office
MODEM
MODEM
80
82
84
86
88
50
32
46
46
46
62
62
64
40
40
42
42
38
38

FIGURE 4

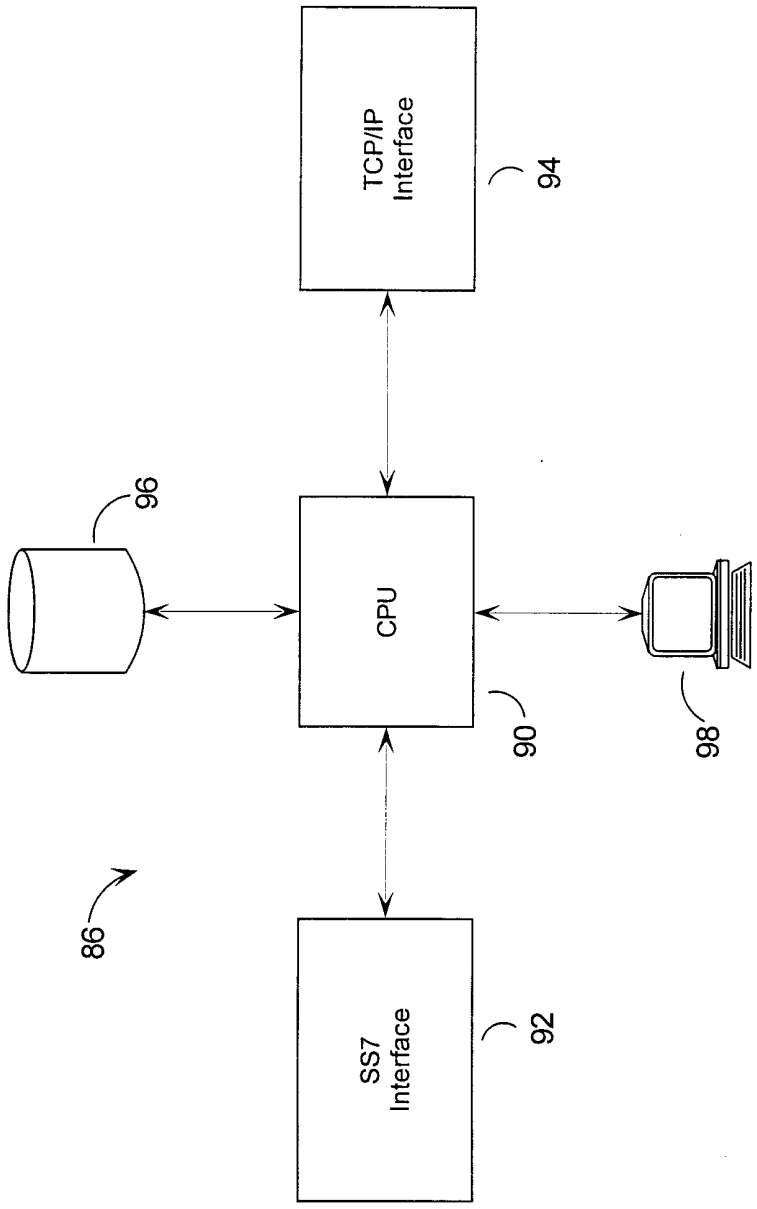


FIGURE 5

FIGURE 6a

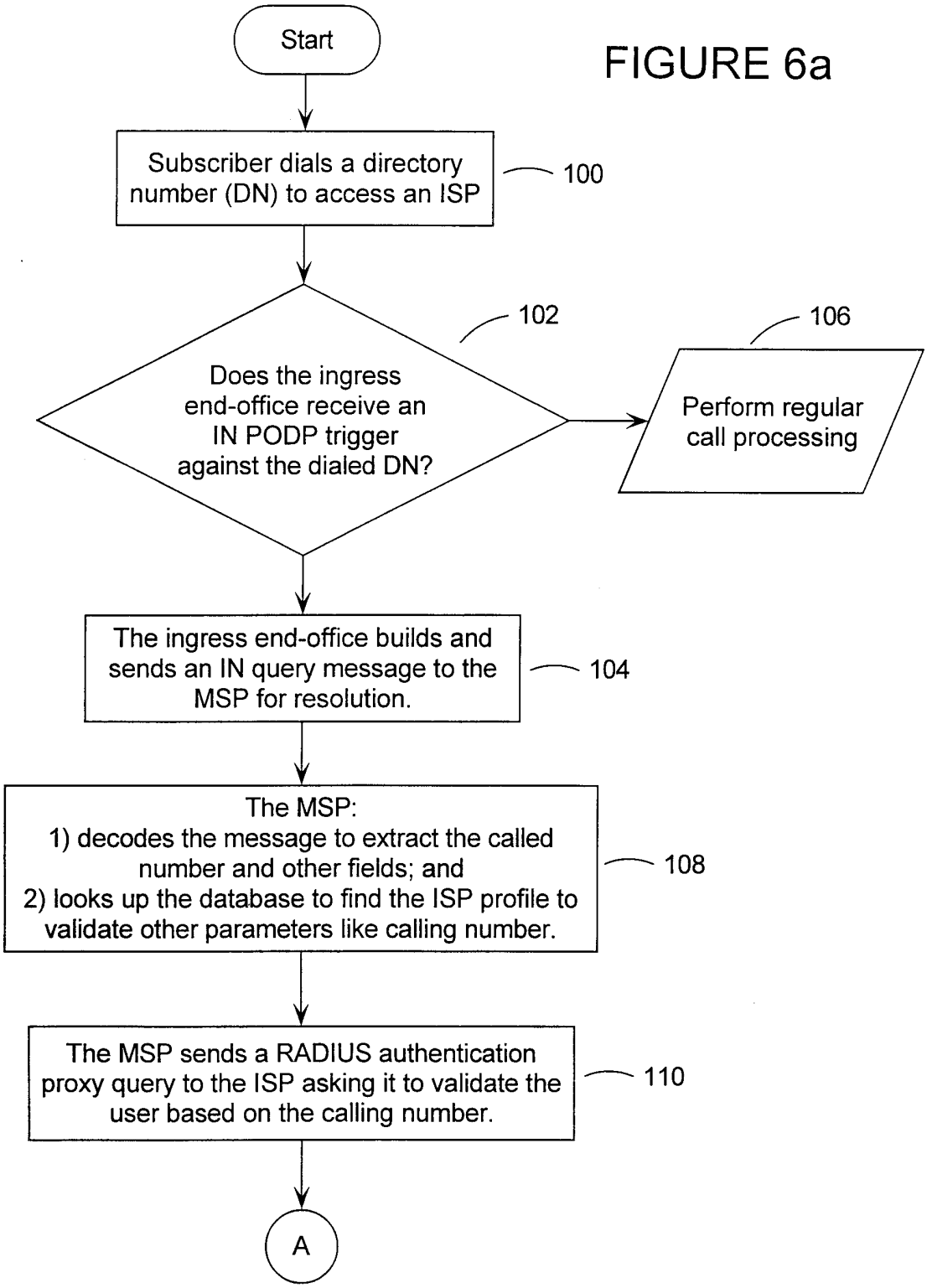

Start
Subscriber dials a directory number (DN) to access an ISP
100
102
Does the ingress end-office receive an IN PODP trigger against the dialed DN?
106
Perform regular call processing
The ingress end-office builds and sends an IN query message to the MSP for resolution.
104
The MSP:
1) decodes the message to extract the called number and other fields; and
2) looks up the database to find the ISP profile to validate other parameters like calling number.
108
The MSP sends a RADIUS authentication proxy query to the ISP asking it to validate the user based on the calling number.
110
A

FIGURE 6b

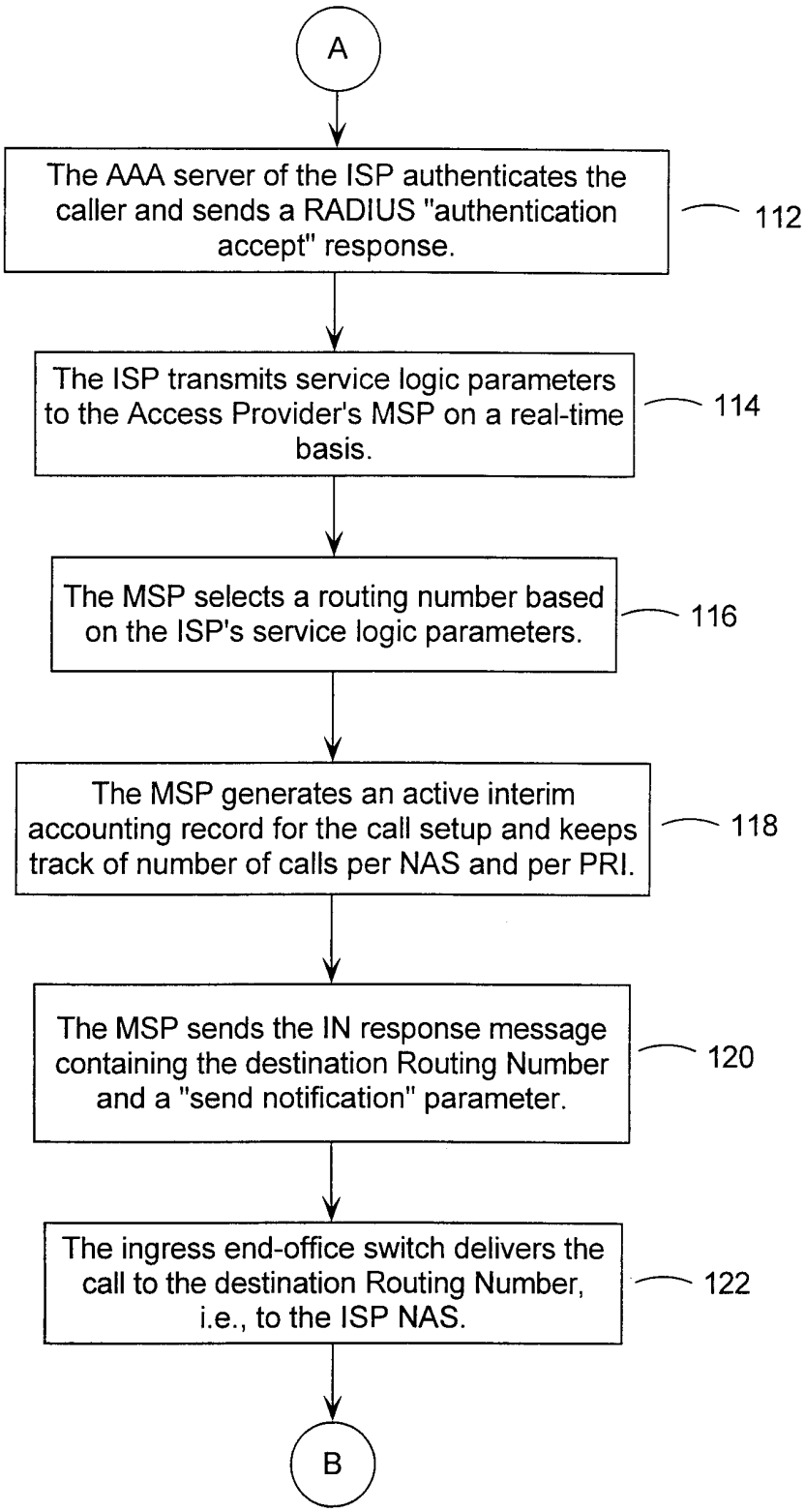
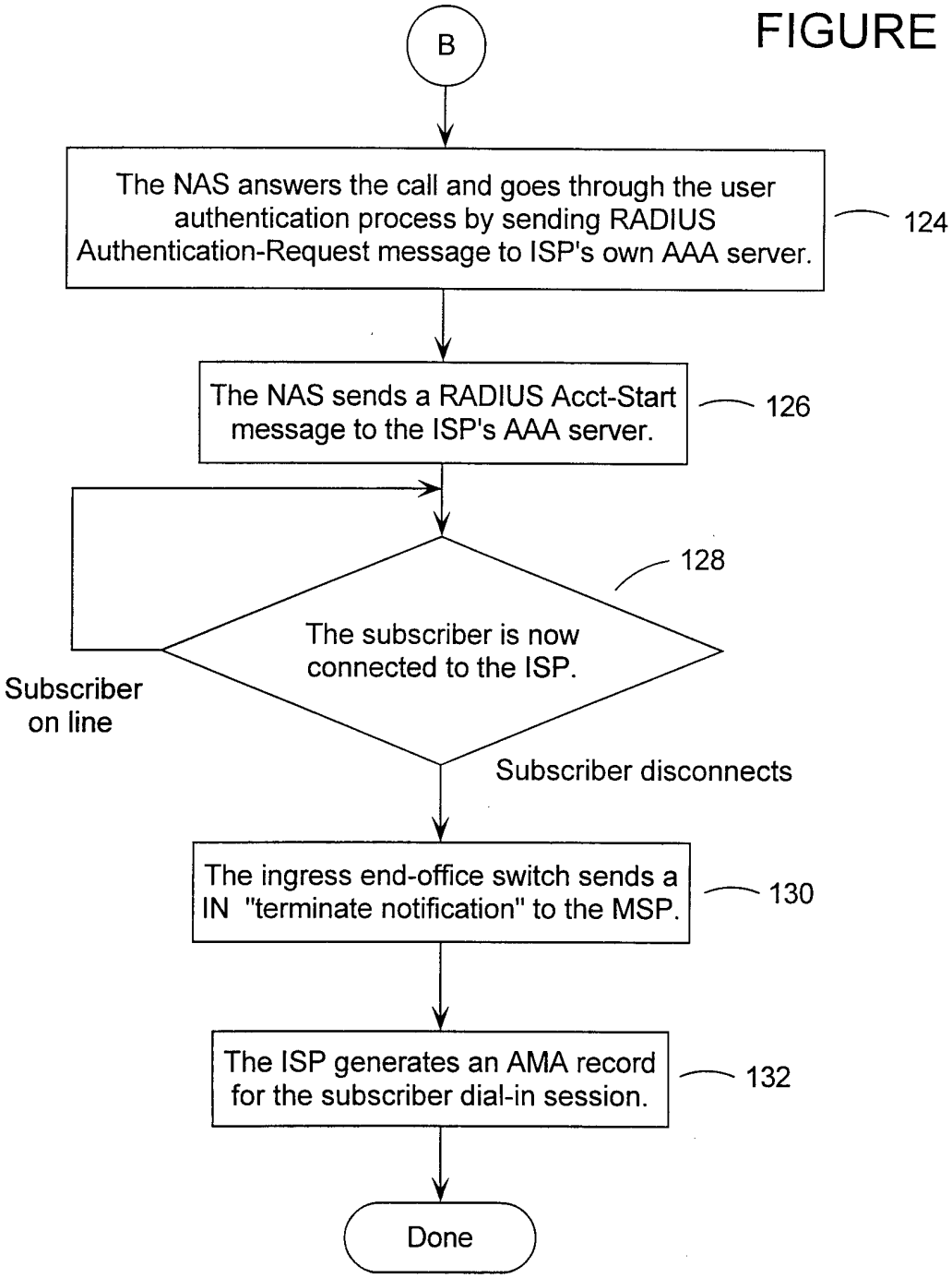

A
The AAA server of the ISP authenticates the caller and sends a RADIUS "authentication accept" response.
112
The ISP transmits service logic parameters to the Access Provider's MSP on a real-time basis.
114
The MSP selects a routing number based on the ISP's service logic parameters.
116
The MSP generates an active interim accounting record for the call setup and keeps track of number of calls per NAS and per PRI.
118
The MSP sends the IN response message containing the destination Routing Number and a "send notification" parameter.
120
The ingress end-office switch delivers the call to the destination Routing Number, i.e., to the ISP NAS.
122
B

FIGURE 6c


B
The NAS answers the call and goes through the user authentication process by sending RADIUS Authentication-Request message to ISP's own AAA server.
124
The NAS sends a RADIUS Acct-Start message to the ISP's AAA server.
126
128
The subscriber is now connected to the ISP.
Subscriber on line
Subscriber disconnects
The ingress end-office switch sends a IN "terminate notification" to the MSP.
130
The ISP generates an AMA record for the subscriber dial-in session.
132
Done

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/CA 00/00491

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 802 690 A (SIEMENS AG) 22 October 1997 (1997-10-22) column 1, line 3 - line 22 column 2, line 4 - line 13 column 3, line 26 -column 4, line 3 figure 2	1,3,4, 14-17
A	---	6-13
X	WO 98 54868 A (NORTHERN TELECOM LTD) 3 December 1998 (1998-12-03) page 14, line 14 -page 15, line 4 page 15, line 30 -page 17, line 15	1-3, 14-17
A	---	6-13
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 September 2000	22/09/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Tous Fajardo, J

3

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/CA 00/00491

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
P,X	US 5 933 490 A (FARRIS ROBERT D ET AL) 3 August 1999 (1999-08-03) column 4, line 2 -column 5, line 12 column 6, line 26 - line 43 column 7, line 3 - line 4 column 7, line 15 - line 19 column 14, line 17 -column 18, line 23	1-6, 8-11, 13-17
E	EP 1 014 634 A (SIEMENS AG) 28 June 2000 (2000-06-28) paragraph '0001! paragraph '0004! paragraph '0006! - paragraph '0007! paragraph '0015! - paragraph '0016! paragraph '0026! - paragraph '0029! paragraph '0032! paragraph '0035!	1-6, 9-11, 14-17
P,X	WO 99 22499 A (ERICSSON GE MOBILE INC) 6 May 1999 (1999-05-06) page 8, line 4 - line 26 page 9, line 10 - line 31 figure 4	1-3, 14-17
P,X	WO 00 10343 A (BELLSOUTH INTELLECTUAL PROPERT) 24 February 2000 (2000-02-24) page 5, line 16 -page 6, line 7 page 7, line 9 - line 15 page 15, line 11 -page 22, line 11	1-4, 14-17

3

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter ›nal Application No
PCT/CA 00/00491

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0802690 A	22-10-1997	NONE	
WO 9854868 A	03-12-1998	CA 2206616 A	30-11-1998
		EP 0985295 A	15-03-2000
		US 6070192 A	30-05-2000
US 5933490 A	03-08-1999	NONE	
EP 1014634 A	28-06-2000	NONE	
WO 9922499 A	06-05-1999	US 6084875 A	04-07-2000
		AU 1284099 A	17-05-1999
WO 0010343 A	24-02-2000	AU 5005199 A	06-03-2000