Cisco Systems, Inc.. A network access server (NAS) 72 is typically used for dial-up accounts. By way of example, the network access server 72 may take the form of a server made by US Robotics Communications or by Livingston Enterprises, Inc. An ISDN router 74 is used for communication over ISDN lines. By way of example, such devices are made by Ascend Communications, Inc. A leased line router 76 is typically used for high speed communications over a leased line using, for example, a frame relay circuit standard. By way of example, leased line routers are currently sold by Cisco Systems, Inc. A cable router 78 may be used to communicate over a cable television network.

Now having described an embodiment of the Internet, Figure 4 illustrates an arrangement 80 in which an Internet access device 100 facilitates communication between end users 92 and the Internet 10. Figures 4, 5, and 6 illustrate an embodiment of an Internet access device while Figures 7 through 12 show and describe a technique by which such an Internet access device may connect to and configure itself for communication with the Internet.

Internet access device 100 connects to a POP 42 of an Internet service provider 14 which in turn connects to a global carrier 16. In this fashion, access is provided to the Internet. In one embodiment, Internet access device 100 connects to a local area network (LAN) 90 at a customer site. By way of example, LAN 90 may take the form of an Ethernet LAN of a corporate or other customer. LAN 90 may connect end users 92, an administrator 94, a server 96, and any number of other devices 98. End users 92 may be a wide variety of users using a wide variety of computing devices. By way of example, end users 92 may use a single personal computer, a network computer, a laptop computer, a workstation, any type of super computer, or any other type of computer used by a user or operating on its own to request, gather, process, send or display information. The administrator 94 is typically a computer used by a system administrator or the like to monitor and administer the LAN 90. Server 96 may be any type of server such as an e-mail server, file server, or other server used for storing information which may be accessed by users on the LAN 90. Other devices 98 may include printers, routers, facsimile machines, gateways, etc.

Internet access device 100 includes an analog modem 104, an ISDN adapter 106, or a synchronous serial interface 108 that are all used to connect through communication line 82 to the POP 42. One or all of these interface devices may be present within the Internet access device 100, although typically only one is in use at a given time for communication with the Internet. Other types of interfaces devices may also be included. By way of example, it is expected that in the near future ADSL and other very high speed modems will be commercially available for use with POTS lines. It is contemplated that such modems can readily be incorporated in the described access device either in place of or in addition to

a standard analog modem. Internet access device 100 also includes a router 240 for communicating between one of the interfaces 104, 106 or 108 and the LAN 90.

Figure 5 shows in greater detail an embodiment of the hardware architecture of the Internet access device 100 shown in Figure 4. Internet access device 100 includes a system bus 101 to which are connected various devices such as an analog modem 104, an ISDN adapter 106, a synchronous serial interface 108, an Ethernet LAN adapter 112, a power supply 114, a CPU 116, RAM 118, a hard disk drive 120, a keypad 122, an LCD display 124, and a speaker 126.

Typically, analog modem 104 is present in the Internet access device, while devices 106 and 108 may be present if the customer desires one of these types of connections to the Internet. Analog modem 104 may be any suitable analog modem used for communicating over an analog line. By way of example, analog modem 104 is a V.34 28.8 Kbps modem. ISDN adapter 106 may be any suitable ISDN adapter used for communicating over an ISDN line. Synchronous serial interface 108 may be any suitable device used for communicating via a high-speed serial port, and in one embodiment is arranged for communicating using a frame relay packet based interface standard. In one embodiment, Internet access device 100 acts as a frame relay access device (FRAD) when communication using frame relay technology is desired. It is contemplated that other communications interface devices such as 104, 106 and 108 may be used within the Internet access device 100 in order to communicate over a particular type of communication line and using a particular protocol.

LAN adapter 112 may be any suitable device for providing an interface between the Internet access device 100 and a LAN 90. By way of example, LAN adapter 112 may be based upon a LocalTalk or a token ring standard. In the embodiment shown,, LAN adapter 112 is for an Ethernet LAN with an integral 4-port 10BaseT hub, although of course, a wide variety of other LAN adapters may be used in conjunction with or alternately to the adapter shown. Internet access device 100 also includes a power supply 114 that includes a battery backup. CPU (central processing unit) 116 may be any suitable CPU and in the embodiment shown, is an Intel 80486 CPU. RAM 118 provides random access memory used to store temporary data such as routing tables, packet buffers, program storage, etc. for the Internet access device. Hard disk drive 120 may be any suitable hard disk, and in one embodiment is a 1.2GB IDE hard disk drive used for storing user information such as accounts, electronic mail, web pages, etc. Of course, it is expected that each of the described components may be upgraded as more powerful components become available and cost effective.

Keypad 122 may be any suitable keypad for entering numbers and information by a user to the Internet access device. By way of example, keypad 122 may take the form of an 18 key keypad including a numeric keypad similar to that found on a push button telephone, and other keys for inputting information to the Internet access device. LCD display 124 is provided for presenting information to the user, along with status lights indicating the status of the Internet access device. The status lights include information such as power, system activity, disk activity, LAN activity, and WAN activity. In the described embodiment, the LCD display 124 takes the form of a 128x 64 pixel LCD display, although other displays are possible. Speaker 126 is any suitable speaker for presenting audible information to a user.

Figure 6 illustrates an embodiment of the software architecture 200 of the Internet access device 100 of Figure 5. The software architecture 200 includes an operating system 210 that communicates with each of an e-mail server 212, an FTP daemon 214, a LAN Manager/AppleTalk file server 216, an automatic configuration engine 218, a web server 220, and other servers 222. These elements 212-222 are each in communication with a system administration module 228 that uses a graphical user interface.

Operating system 210 may be any suitable operating system. By way of example, in the described embodiment, operating system 210 is the BSD UNIX operating system. This operating system 210 includes an Ethernet driver 230, PPP (Point to Point Protocol) software 232, and a frame relay driver 234 in communication with an IP Routing/address translation module 240. Ethernet driver 230 communicates over line 231 to an Ethernet card. PPP software communicates over line 233 to either a modem or an ISDN adapter. Frame relay driver 234 communicates over line 235 to a synchronous serial interface card. The address translation module 234 allows for both host (1-N) and network (N-N) address translation. The module 240 is also in communication with a domain name server (DNS) and a dynamic host configuration protocol (DHCP) server 238 which supply appropriate connectivity protocols to the Internet. The IP routing may be performed by any suitable routing software used for receiving information over the Internet and routing it to the appropriate device on LAN 90. By way of example, a GateD router with support for OSPF, RIP and BGP routing protocols may be used.

E-mail server 212 provides e-mail service both internally to users of a LAN 90 of a company, and also externally to the world via the Internet. Every user on the LAN 90 is provided with their own unique e-mail address. FTP (file transfer protocol) daemon 214 is used for both internal and external file storage and transfer using industry standard Internet file transfer protocols. LAN Manager/AppleTalk file server 216 is a file server providing a central location by which users may exchange files. Automatic configuration engine 218 provides for the automatic configuration of the Internet access device 100 for

communication with the Internet. An embodiment of how this automatic configuration engine configures the Internet access device will be discussed in more detail below with reference to the flow charts of Figures 10, 11 and 12.

Web server 220 may be any suitable web server for providing both internal and public web pages for not only a company, but also for each user on the LAN 90. In one embodiment, web server 220 is an Apache HTTP web server. Other servers 222 include such servers as directory servers, news servers, catalog servers, search engines, proxy servers, authentication servers, etc.

System administration module 228 provides a graphical user interface by which a system administrator and/or individual users may access the Internet access device in order to manage e-mail and web pages, perform system administration, allow access by individual users, and in general monitor and support the functioning of the Internet access device by users on the LAN 90. In one embodiment, system administration module 222 uses an HTML-based animated user interface for use with either Netscape NAVIGATOR or Microsoft INTERNET EXPLORER that allows all-in-one administration from any desktop and from any platform. System administration module 228 also provides for self-maintenance via an agent based metaphor, automated backups of any user data to any workstation on the LAN 90 or to the ISP, automated software management for software updates, and automated log and audit management. An aspect of system administration module 228 is disclosed in greater detail in U.S. Patent Application entitled "Automatic Setup Of Services For Computer System Users" referenced above.

Now that an embodiment of an Internet access device has been described, a method of advantageously using such a device will be described. The Internet access device is advantageous because, once installed at a customer site it is able to automatically connect itself to an appropriate location on the Internet, download configuration information and configure itself for a level of service desired by the customer. Figures 10, 11 and 12 illustrate one embodiment of a method of automatically configuring the Internet access device. Before the Internet access device configures itself, the customer and an Internet service provider communicate in order to determine an appropriate level of service for that customer and corresponding configuration information for the Internet access device. This interaction will now be described.

When a customer first determines that he or she desires a connection to the Internet the customer contacts an Internet service provider to request a particular level of service. This desired level of service includes many different variables. For example, the customer must first determine if they wish to connect a LAN to the ISP or simply a single machine to the ISP. Also, the type of connection must be determined. A customer may be connecting

to the ISP over a dial-up line or over a permanent leased line. Also, the customer may desire an analog line using a conventional or high speed modem, an ISDN line using an ISDN adapter, or a leased line that may be a T-1 or a T-3 line using frame relay technology. Other types of lines and levels of service may also be specified by the customer. The customer may also determine a desired domain name, and a range of IP addresses that it requires. A customer with only a single host computer may need only a dynamic IP address, while a customer such as a corporation or provider of information may require not only a static IP address but also a range of addresses for various computers connected to a LAN. Other information from the customer may also be required by the ISP such as the number of users on the LAN, geographic location (used to determine which POP to connect to), anticipated storage needed for a web site, etc.

Once the customer has specified his needs, the ISP assembles all of this customer information and inputs it into an ISP database. Some of this customer information comes from the customer itself (e.g., a desired domain name), while some information is generated by the ISP itself (e.g., the IP address block). Using the information in this database, the ISP is then able to generate a configuration file for future use by the customer. The configuration file contains all of the configuration needed by the customer to configure his Internet access device for the customer's desired level of service. Any suitable form and language for a configuration file may be used. By way of example, one such suitable configuration language for representing customer configuration information may be found in the Appendix.

If the configuration file is stored on the configuration server as a flat text file it is possible to create this file manually using any text editor. It is also possible that a configuration file may be automatically generated from the ISP customer database once all of the customer information has been entered, or the configuration file may be generated on the fly from the customer database when a request is made from an Internet access device to download a particular configuration file from a configuration server.

Once a configuration file has been generated, this configuration file is stored by the ISP onto a configuration server. In one embodiment, the configuration file is stored as a configuration record of a database on a dedicated configuration server. This configuration server may be located on an IP network within the ISP itself, or the configuration server may be located at any appropriate location on the Internet that is accessible by an address. In other embodiments, the configuration server may be located outside of the Internet or an internet, in a location that is accessible by a customer desiring access to a configuration file.

A more detailed description of the types of information contained within this configuration file is explained below with reference to Figure 12. Once the ISP has

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