An Introduction to the Internet, Part 2: Obtaining Access

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Although the Internet has been around more than 25 years, it has only been within the last two to three years that access has become relatively inexpensive and widely available to the general public. There are several reasons for this, but one of the main reasons is the explosive growth of proprietary Internet access providers (IAPs) that has markedly driven down the cost of connecting to the Internet. In addition to traditional IAPs, whose primary or only function was to sell Internet access, telecommunication companies and vendors of online computer services are now also offering Internet access, providing individuals a variety of methods for connecting to the Internet.

DEFINING INTERNET ACCESS

Before describing methods of Internet access, a more complete discussion of what it means to be connected to the Internet will be given. As stated in the first article in this four-part series, the Internet can be formally defined as an interconnected group of computer networks. All of the computers on the Internet send and receive messages using a common communication standard, the TCP/IP protocol. Furthermore, every computer on the Internet is identified by a unique IP number or address. By this definition, there were over 70,000 computer networks and 5 million computers on the Internet in early 1995. In practical terms, however, this definition of the Internet is too restrictive. Computer networks, from small local networks to large international networks, were common by the late 1980s. Few of these networks were on the Internet. Since TCP/IP was infrequently used outside the academic community (the major portion of the Internet at that time), computer manufacturers and software companies developed their own proprietary communication protocols such as DECNET from Digital Equipment Corporation, Netware from Novell and AppleTalk from Apple which were incompatible with each other and TCP/IP. Computers on computer networks that do not use TCP/IP can, nevertheless, communicate with the Internet through special computers (or to be more precise, special computer programs) called gateways. Although the term gateway can have several somewhat different meanings, in this context a gateway functions by converting a message from one protocol to another. Thus, a network of Apple computers running AppleTalk can route messages to a gateway that changes it into the TCP/IP format allowing the message to be sent over the Internet. Only the gateway itself would be running TCP/IP and have an Internet address, but all computers on the network could communicate with the Internet. E-mail gateways are the most common form of this type of gateway. Computers that do not run TCP/IP but can communicate with the Internet through gateways are usually not considered part of the Internet, but it becomes a subtle matter of definition deciding whether these computers are or are not on the Internet.

Another situation applies to individuals with personal computers that are not part of a network. Using a modem and appropriate communication software, almost any personal computer can access the Internet through the computers of various commercial or noncommercial IAPs. Though these computers are not considered part of the Internet, they can access most of its resources. In addition, using a special type of access (SLIP or PPP, described below), a personal computer can run TCP/IP software and temporarily be assigned an IP address making it a full-fledged Internet computer while it is connected to its IAP. Once the connection to the provider is terminated, the IP address is reassigned. Since TCP/IP software is now available for essentially all types of computers and operating systems, one could argue that potentially all computers on earth could be connected to the Internet and thus be considered part of it.

Connecting to the Internet is in many cases not an all or none phenomenon but, rather, a matter of degrees or even, perhaps, a state of mind. Many large corporations do not use TCP/IP on their own networks yet have e-mail gateways to the Internet. If an individual's only concern is sending and receiving e-mail, that person may feel that he is fully connected to the Internet. If, however, someone wants to send

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real-time video images over the Internet, even large organizations with high-speed connections to the Internet may not have fast enough links to permit this, and thus, one may conclude that he is not fully connected to the Internet.

Further complications arise over security issues. Network administrators may decide that messages from some networks or that certain types of Internet services such as telnet, ftp, and the World Wide Web (these and other Internet services will be discussed in the third article in this series) are too much of a security risk and block access to these networks or services. In extreme instances, access could be allowed to only a few computers or specific services. Again, whether this constitutes being connected to the Internet is a matter of definition.

INTERNET BASIC ACCESS REQUIREMENTS

In order to access the Internet, you need three things: appropriate hardware, appropriate software and a means of connecting to the Internet. The requirements for a computer connected to a network are different from those of a personal computer accessing the Internet over a modem. For a computer connected through a network, most of decisions about Internet access, network software and application programs for Internet services are decided by the network administrator or by the policies of the institution that owns the network. Since these considerations are unique to each institution or network, this type of access is mentioned only briefly in this article. The major portion of this article discusses how an individual with a personal computer and a modem can access the Internet through standard telephone lines.

HARDWARE REQUIREMENTS

Nearly any computer, if it runs the correct software, can access Internet services such as e-mail, logging on to remote computers or transferring files. For high-level applications, such as downloading and displaying graphical images from the World Wide Web, more powerful computers with certain memory requirements are necessary. To connect to the World Wide Web with graphical display programs such as Mosaic or Netscape, the minimum requirements for an IBM or IBM-compatible PC are an 80386 processor with 4 megabytes of random access memory (RAM) running under Windows and a 9600 bps modem. An 80486 processor with 8 megabytes of RAM is recommended along with a faster modem. For a Macintosh computer, the minimum requirements are System 7 or later, 4 megabytes of RAM and a 9600 bps modem.

An individual accessing the Internet by a personal computer over standard telephone lines needs a modem (an acronym for MOdulator-DEModulator) which can be an external device connected to the computer or an internal device that plugs into a slot on the computer's main circuit board. A modem sends a message by converting (modulating) the digital signal from a computer into an electrical analog signal that can be sent over telephone lines. A receiving modem converts (demodulates) this signal back into digital form.

Often the main limitation to sending and receiving data is the data transfer rate of the modem which is much slower than the speed at which a computer operates. In general, one would always prefer using the fastest possible modem. The rate at which data can be transferred is limited by the bandwidth of the telephone line which corresponds to the sound frequencies of normal conversation: 300 to 3300 hertz (cycles/second). The bandwidth is the difference between the highest and the lowest frequencies, and thus, for standard telephone lines, is 3000 hertz (*1*). Three terms are used to describe data transfer rates by a modem: the baud (or baud rate), bits per second (bps) and the throughput. The baud rate is the number of signal changes per second. The earliest modems represented a bit of data by one signal change so that the baud rate was equal to the bits per second. Using this method, a modem would be limited to a maximum speed of 2400 bps (the number of signal changes per second cannot be higher, and is usually somewhat lower, than the bandwidth of the telephone line). All modern high-speed modems, however, incorporate several bits into a signal change so that the baud rate is usually appreciably less than the bps. The bps is a better description of the data transfer rate, and modem speeds are given in bps, although this is often incorrectly stated as the baud rate.

At present, the highest speed modems transfer data at 28,800 bps (28.8 kbps). Faster data transfer rates can be achieved by encoding (or as more commonly stated, compressing) the data using data compression algorithms. Algorithms that are widely used become standards and are given various designations, usually beginning with the letter V (*2*). Present standards can produce data compression to a maximum ratio of 4 to 1, so that a modem operating at 28,800 bps can have an effective data transfer rate of 115,200 bps. This effective data transfer rate is called the throughput. In practice, however, these rates are rarely achieved for several reasons. Different types of data can be compressed to varying degrees. For example, image data in certain formats, such as the widespread GIF format, cannot be significantly compressed. In addition, the higher the data transfer rate, the more susceptible a signal is to degradation by noise in the telephone line. Modems have various error correction algorithms, but if a signal is too degraded, it must be retransmitted. This cuts down the data transfer rate, and if the line is too noisy, very little signal may get through. One solution is to temporarily switch to a lower data transfer rate (common settings are 2400, 9600, 14,400 and 28,800 bps). If the problem persists, the telephone company should be called and the line tested for noise. If the noise level is too high, it should be corrected.

SOFTWARE REQUIREMENTS

The next major consideration is the type of software used to access the Internet. All Internet access requires TCP/IP software and programs for the various Internet services. For individuals who connect to an IAP by modem, some type of

communication software must be used, either as a stand-alone program, such as ProComm, or as part of the TCP/IP software if it is running on the personal computer. The main decision to be made in choosing software is the type of Internet access the user desires. If an individual wants to download and display graphical images from the World Wide Web, the most popular Internet service, a different type of access is required than that for a simple text interface. (Of course, one must also have a system, such as a Windows or a Macintosh computer, that can display images.) There are basically two main types of access methods to IAPs: dial-up access and SLIP or PPP access.

Dial-up access is the usual type of access employed for contacting bulletin board systems (BBSs). All that is required in terms of software is a communication program for controlling the modem. In this type of access, after logging on to the remote system, a personal computer is essentially transformed into a terminal, i.e., a simple input/output device for giving commands to the operating system of the remote computer. Communication programs have different features such as the ability to capture text displayed on the computer screen or to download files from the IAP's computer using transfer methods such as kermit, x-modem, or z-modem. After logging on, a user may be presented with a menu system. Some systems display a prompt at which a command recognized by the operating system of the remote computer must be entered. The most commonly used operating system is UNIX, a widely available multi-user operating system with well-developed networking capabilities. With UNIX and other systems, the user interacts with the operating system through a program called a shell, and dial-up access is often referred to as a shell account.

With dial-up access, the programs for interacting with the Internet—the TCP/IP software and programs for the various Internet services—are all on the IAP's computer. The user can interact with the Internet only through the programs provided by the IAP's computer, but e-mail, telnet, ftp, gopher, and newsgroups (USENET) are usually available. No graphical images can be displayed with this type of access and, therefore, the World Wide Web is usually not accessible (some programs are available that display only the text portion of documents on the World Wide Web, but they are usually not standard features for most shell accounts). With shell accounts, a user's personal computer is not an Internet computer and, therefore, any file transferred from the Internet ends up in the user's account on the IAP's computer. If the user wants to transfer the file to his personal computer, a second file transfer using the communication program on his personal computer must be performed.

The second method of access to an IAP is through a SLIP (Serial Line Internet Protocol) or PPP (Point to Point Protocol) connection. A user who employs this type of access must run all the Internet software on his personal computer, i.e., TCP/IP software and the software for any Internet services. When the user logs on, he is assigned an IP address, and thus, his personal computer becomes a full-fledged Internet computer. When the connection is terminated, the IP address becomes inactive and can be reassigned to another computer. The main reason for purchasing this type of access is to employ the full graphical, audio and video capabilities of the World Wide Web which is accessed through programs called Web browsers such as Mosaic and Netscape. This type of access also permits direct downloading of files from the Internet to the user's personal computer. The main drawback of this approach, until recently, was that obtaining the TCP/IP software and the programs for the Internet services, setting up the SLIP or PPP connection, and properly configuring complex programs such as Mosaic were often arduous and time-consuming tasks. The enormous popularity of the World Wide Web, however, has sparked an intense competition among IAPs and software manufacturers to develop easy to use and easy to install systems. They have been largely successful in this regard. All types of communication programs, TCP/IP software and Internet application programs such as telnet, ftp, gopher and Web browsers are freely available from several sites on the Internet. There is also a large amount of commercial Internet software that can be bought as stand-alone products or as part of the latest operating systems of the major computer vendors: IBM, Microsoft and Apple (see below).

INTERNET ACCESS PROVIDERS

Internet access providers are commercial or noncommercial entities that provide a user or an organization with the physical link to the Internet. Until recently, the IAPs' major or only function was to provide Internet access to individuals or organizations. Since telecommunication companies and online computer services, described below, now offer various degrees of Internet access, they can also be considered IAPs.

Large organizations usually lease high-speed, dedicated communication lines that link their networks to the IAP. Leased lines are priced according to the maximum rate of data transfer. The most common speeds are 56,000 bps (56 Kbps), 1.54 million bps (1.54 Mbps, referred to as T1) and 45 Mbps (referred to as T3). For the individual user, connection to the IAP is usually by a modem connected to standard telephone lines. Most IAPs allow connections at 14.4 Kbps and many allow 28.8 Kbps access.

There is a large number of IAPs from which to choose, at least in metropolitan areas. IAPs offer a variety of services, pricing schedules and access methods. The quality of service varies between providers, and an IAP with an attractive pricing schedule may be difficult to connect to during peak hours or may offer limited technical support. There are many ways to locate IAPs. IAPs advertise widely in newspapers, magazines (especially computer-oriented and technical publications), the yellow pages and on the Internet itself. There are local, regional, national and international vendors of Internet access. A list of IAPs can be obtained by sending an e-mail message to info-deli-server@netcom.com. The subject is arbitrary, and the complete text of the message should be "send pdial" without the quotes. There are also places on

the Internet that list IAPs. One such location is the Internet Network Information Center (the InterNIC) which can be reached by gopher or the World Wide Web at is.internic.net. The list is composed of regional and nationwide IAPs and can be found by choosing the *InterNIC Directory and Database Services* item on the main menu and the *InterNIC Directory of Directories* and *Providers* items on the submenus.

A good place to look for Internet access may be an individual's place of employment. Some of the highest quality Internet access is through organizations that have dedicated high-speed links to the Internet. Academic and research institutions, medical centers and other large organizations often provide free or low-cost accounts to their members. These organizations may not advertise the availability of these accounts, and it is worthwhile for anyone belonging to these institutions to check with their computing centers to see if such access can be obtained. As an example, the Veterans Affairs system has had its e-mail system connected to the Internet for several years, but there are still many individuals who are unaware of this. Even if an institution does not offer Internet access, it may be possible to obtain an account through affiliated organizations. Again, as an example, most Veterans Affairs Hospitals do not offer full Internet access, but employees may be able to obtain access from affiliated medical schools.

ONLINE COMPUTER SERVICES

There are a large number of commercial, online computer networks and BBSs that specialize in areas such as finance, law, medicine and many other topics. Some of these networks and BBSs are connected to the Internet. There are also several general purpose online services that have graduated pricing schedules for access to various subject areas. The major general purpose online services are America Online, CompuServe, Prodigy, GEnie and Delphi. Each of these vendors offers Internet access as an option. Except for Delphi, none of these vendors had Internet access before the middle of 1994. Delphi was the first online service that offered a fairly complete package of Internet services. By the end of 1994, all other vendors had established at least e-mail gateways to the Internet and different levels of support for other services such as newsgroups, gopher and ftp. By May 1995, all these vendors (except, ironically, Delphi) offered Internet access by Web browsers to the World Wide Web. As with all their other services, software is provided free, and customers are charged for online access time.

NEW INTERNET ACCESS PROVIDERS

Because of the marked increase in demand for Internet services, computer hardware and software manufacturers as well as telecommunication companies have entered the Internet access arena. A brief overview of what is available as of this writing will be presented. This area is changing rapidly and individuals interested in these services should consult the vendors directly and look for advertisements in newspapers and magazines, especially those dealing with computers.

The major vendors of personal computer software systems—IBM, Apple and Microsoft—have now all established their own proprietary online networks that offer a variety of services including Internet access. IBM's OS/2 Warp operating system has a complete set of Internet services, including a Web browser, and TCP/IP software with preconfigured access to their proprietary network, the IBM Global Network. This worldwide network is fully connected to the Internet. Microsoft is offering TCP/IP software as part of their new operating system, Windows 95 (scheduled for release in August 1995). It will have preconfigured access to the Microsoft Network. As of this writing, the network will have an e-mail gateway to the Internet as well as access to newsgroups. Apple's new operating system, System 7.5, has integrated TCP/IP software and preconfigured access to their online service, eWorld. At present, only an e-mail gateway is planned for accessing the Internet.

All the major telecommunications companies offer some form of Internet access and services. MCI offers the most complete set of services from individual and business access accounts to routing of Internet traffic on its nationwide fiber optic network. Sprint sells Internet access to businesses and other organizations, but does not sell individual accounts. It also provides a good deal of Internet long-distance routing. AT&T is the least involved in direct Internet services. It leases its long-distance lines to other IAPs who sell their services to third parties.

CHOOSING AN INTERNET ACCESS PROVIDER

Price is often a major deciding factor when choosing an IAP, but prices vary so much and are changing so rapidly that no attempt will be made to discuss this issue in detail. In general, IAPs charge a one-time setup fee. A shell account can usually be obtained for $20.00 per month with unlimited access time. SLIP or PPP access is around $30.00 per month with a certain number of free hours and hourly charges of $1.00 to $5.00 after that. There are large differences in price between vendors, and you should contact individual vendors for their pricing schedules. Other considerations include availability of service, ease of setting up access, and most importantly the needs and desires of an individual. For shell accounts, aside from entering the proper settings on the communication program, no extra software is needed to access the Internet. If a text-based interface is all that is required, this type of access is entirely adequate. Running Internet programs on the user's computer requires loading and configuring software and obtaining a SLIP or PPP access. A user can choose to purchase only a SLIP or PPP access from a vendor and obtain all the rest of the software for free from the Internet. High quality TCP/IP software as well as programs for all the Internet services can be obtained at many sites around the Internet. This can be time consuming, but the user has a wide choice of programs. Alternately,

an individual can buy commercial versions of TCP/IP software and the other Internet applications programs and run these over a SLIP/PPP connection. Again, there is a wide variety of programs available, and you should consult computer magazines and vendors of computer software for information on products.

Some IAPs offer a complete packaged SLIP/PPP account with their own proprietary TCP/IP software and Internet application programs. Setting up Internet access is relatively simple with these vendors since the entire setup procedure can be done from a disk or from software that can be downloaded by modem from a vendor's computer. The first vendor to offer this service along with the first commercial Web browser was Netcom On-line Communication Service, Inc. Other vendors that are using this approach include PSI (Performance Systems International) with their product InterRamp and MCI with InternetMCI.

SPECIAL ACCESS METHODS

For anyone accessing the Internet through a modem, there is another charge that is rarely mentioned: the cost of telephone service. All large and most medium-sized metropolitan areas can connect to IAPs through local telephone numbers. In these instances, the cost is the same as that of a local telephone call. If an individual is in a rural area where there is no local access to an IAP or connects to an IAP by a long distance call, the major cost of Internet access may be telephone charges. Many IAPs offer access by 800 numbers, in which case, the individual user will not be billed by the telephone company for these calls; the charge for the 800 service is paid for by the IAP. Since these charges are expensive, IAPs pass these costs along to the user by adding a surcharge to the accounts of users who employ this type of access. These surcharges can be expensive, and individuals who are considering this type of access should first check the IAP's rate schedules.

Another method of connecting to IAPs who do not have local access numbers is by public data networks (PDNs). These are special networks designed for data transfer. They have multiple points of local access throughout the U.S. and a lesser number internationally. The user is billed by the telephone companies for a local call (assuming one uses a local access number). PDNs are the equivalent of 800 access for long distance connections to an IAP. As with 800 access, the IAP adds a surcharge for connecting by this method. There are three PDNs in the U.S.: CompuServe Packet Network operated by CompuServe, Sprintnet (Telenet) by Sprint and Tymnet by MCI. It is not necessary to have an account with these organizations to use their networks. Local access numbers can be obtained from their customer service departments, from the IAPs who use PDNs or through online access to directory services.

For those individuals who want or need high speed, high-quality access for their personal computers, a special type of data service called ISDN (Integrated Services Digital Network) can be purchased. An ISDN line transmits digital rather than analog signals permitting much higher rates of data transfer ranging from 128 Kbps to over 100 Mbps (*2,3*). Even at 128 Kbps, data transfer is usually several times faster than the fastest modems. For a 128 Kbps line, the equipment and setup costs currently are about $1000.00 and flat rate monthly charges run about $50.00. It is likely that these costs will decrease as more IAPs offer this service and the technology matures.

A new method of Internet access is being developed that allows a personal computer to connect to the Internet through a standard television cable. Unlike a voice-grade telephone line which has a maximum transmission speed of about 28,800 bps, a television cable can transmit data at 3 to 10 million bps. At these speeds, real-time video is possible as well as other applications that require high data transfer rates. At present, these systems are being tested at several locations around the U.S. To access this service, a computer needs to have an Ethernet card installed. The computer is connected to the television cable by a special type of modem (a cable modem) capable of handing the high data rates. The only company that has announced this service so far is @Home™ that can be reached on the World Wide Web at http://www.home.net. General public access is planned for 1996. Prices have not been announced, but an Ethernet card can be obtained for $75.00. Current costs for a cable modem are $600.00, and initially a flat rate monthly fee of $100.00 is likely (*4*). Connection to the Internet will be provided by the company's own network, and connections to other online services (e.g., the Microsoft Network) are also planned.

SUMMARY

Internet access, which until a few years ago was available only at large academic, research or governmental organizations, is now widely available to the general public. At the present time, more and more Internet access providers are entering the market. This has driven down the cost of Internet access, a trend that will probably continue in the near future. Nearly any type of personal computer can be used to access the Internet, although the type of computer and modem will determine what Internet services are available.

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