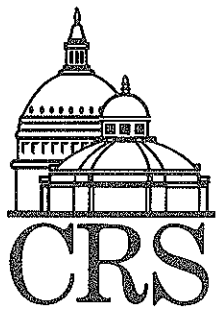
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CRS Report for Congress

Welcome to Cyberia: An Internet Overview

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Rita Tehan
Information Research Specialist
Congressional Reference Division



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Welcome to Cyberia:
An Internet Overview

SUMMARY

The Internet is an international, cooperative computer network of networks that links many types of users, such as governments, schools, libraries, corporations, hospitals, individuals, and others. No single organization owns, manages, or controls the Internet, and the Internet is not free. The major costs of running the network are shared by its primary users: universities, national laboratories, high-tech corporations, and governments.

The original network, ARPANET, was created in the late 1960s. Its purpose was to allow defense contractors, universities, and DOD staff working on defense projects to communicate electronically, and to share the computing resources of the few powerful, but geographically separate, computers of the time. In 1990, ARPANET ceased operation because NSFNet and various midlevel networks, sponsored by the National Science Foundation, made the Internet viable for commercial traffic. The Department of Defense continues to run a military network.

The last few years have seen dramatic expansion in Internet connections by corporations, governments, schools, and individuals, with an almost nine-fold increase in the Internet host computer count. The Internet connects over 103,000 networks and more than 16 million host computers in more than 120 countries.

The most powerful Internet application is the World Wide Web. With the appropriate browser software, a user can view images, listen to audio files, or see motion pictures.

While the Internet offers almost limitless possibilities for the free communication of ideas, research, and information, there are serious business and consumer issues concerning accessibility, cost, privacy, fraud, security, copyright, and standardization.

This report provides background information on the history, growth, and costs of the Internet, and discusses the benefits and problems facing Internet users.

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Welcome to Cyberia: An Internet Overview

Preface

The Internet is an international, cooperative computer network of networks that links many types of users, such as governments, schools, libraries, corporations, hospitals, individuals, and others. An immense amount of information is available on the Internet -- speeches by world leaders; full texts of books, magazines, and newspaper articles; radio broadcasts; movies; medical fact sheets; electronic discussion groups; library catalogs; college courses; recipes; games; Supreme Court rulings; legislation; scientific papers; government documents; music lyrics; software; sports schedules; weather reports; résumés; satellite images; and much more.

This report provides background information on the history, growth, and costs of the Internet. In addition, it describes the applications available on the Internet (e-mail, telnet, and FTP) and some online tools for using the Internet -- Gopher, Archie, Veronica, Jughead, Wide Area Information Servers, the World Wide Web, Java (a new programming language used for writing mini-applications called "applets" that run inside Web browsers), and push technologies (servers that receive documents from various sources, then consult a preference profile for individual users, and download it to the user) such as PointCast and BackWeb. Finally, the report discusses the benefits (rapid global communication) and problems (security, growth, universal access) facing the Internet.

Organization

No single organization owns, manages, or controls the Internet. It is a cooperative fusion of independent networks. Member networks may have presidents or CEOs, but there is no single authority for the Internet as a whole. Substantial influence over the Internet's future now resides with the Internet Society, which is a voluntary membership organization whose purpose is to promote global information exchange through Internet technology.

A number of volunteer groups keep the Internet working through their efforts at standards development and consensus building. They include the Internet Society, the Internet Engineering Task Force (IETF), and the Internet Architecture Board. A group of invited volunteers, the Internet Architecture

Board (IAB), meets regularly to approve standards and write engineering rules, for example, on how to assign Internet addresses.[1]

Internet users express their opinions on how the Internet should operate to the Internet Engineering Task Force (IETF), a volunteer organization of 1,000 members, who meet three times a year to discuss operational and technical problems of the Internet. If a problem deserves special attention, the IETF sets up a working group to discuss it. The working group eventually issues a report or recommendation, which can be either voluntarily accepted, or sent to the IAB to be declared a standard. Among the key technical standards the IETF is currently working on is the next generation of the Internet Protocol (IP), the foundation of the Internet. Version 6 will offer a variety of new services, such as enhanced security, and will greatly expand the capacity of network addresses.[2] This new version is critical to the continued growth of the Internet.[3] Standards that affect the Internet are also developed in other places, such as the Asynchronous Transfer Mode (ATM) Forum, and the World Wide Web Consortium.

In the United States, the Internet has various components: local networks, mid-level networks, and the various national "backbone" networks.[4] Local networks are the local and wide area networks (LANs and WANs) within an organization. Examples of local networks range from agency-wide computer systems to PC-based LANs. It is through a local network that most users access the Internet. Mid-level (regional) computer networks provide Internet access to large organizations such as universities and federal agencies in a given geographic area. There are about 20 mid-level networks in the United States, for example, BBN Planet in the southeast, NYSERnet in New York State, and BARRnet in the San Francisco area.[5]

Internet access is also provided via online service providers such as America Online, Compuserve, Prodigy, and Microsoft Network. Most services offer a month's trial with a few free hours, and a flat-rate price per month upon subscription. These services typically provide Internet/Web access, e-mail, chat

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[1] Anthes, Gary H., and Kim S. Nash. Internet wizards keep chaos at bay. *Computer World*, v. 12, December 26, 1995. p. 1.

[2] For information on Internet Protocol Version 6 (IPv6), see: Internet Engineering Task Force *Ipv6 Network Prefix Notation* at:
http://www.internic.net/internet-drafts/draft-durand-ipv6prefix-00.txt
and also, NASA's Ames Research Center *IPv6* at:
http://www.ipv6.nas.nasa.gov/

[3] Anthes, p. 12.

[4] For information on the Internet's underlying infrastructure, see: *Internet Technology*, by Ivan P. Kaminow and Jane Bortnick Griffith, March 25, 1997. 6 p. CRS Report 97-392

[5] For a map of the Network Access Points and regional network connections, see *Inter-regional Connectivity Under the New Internet Architecture*, at:
http://www.cerf.net/cerfnet/about/interconnects.html

rooms, games, news, reference sources, online publications, and technical support. According to the latest quarterly census by the Information and Interactive Services, the number of online service subscribers in the United States grew to 18.1 million subscribers at the end of 1996, up from 11.3 million subscribers at the end of 1995 and 6.3 million at the end of 1994 (a 78.9% increase).[6]

The National Science Foundation's NSFNet once served as the Internet's primary U.S. "backbone." On April 30, 1995, however, that role was phased out, and the backbone has been replaced by connections supplied by commercial network service providers, such as ANS, Sprint, PSI, MCI, BBN Planet, Netcom, UUnet Technologies, and others.[7] These service providers connect mid-level networks to each other and also offer services directly to customers in some areas of the country.

For different computers on the Internet to connect with each other, they use protocols, which are rules or agreements on how to communicate. The language of Internet is TCP/IP, which stands for Transmission Control Protocol/Internet Protocol. Any computer seeking to communicate on the Internet must "speak" TCP/IP. This standard is an "open" standard, meaning it is not a proprietary product of any single company. The predominant operating system is UNIX, but the Internet standard has been adapted for use on the most commonly used systems, such as UNIX, PC, and Macintosh.

History

The existing Internet in the United States began as a program of the Defense Advanced Research Projects Agency in the Department of Defense. The Pentagon needed a military command and control system that would continue to operate in the event of a nuclear war. In 1964, a researcher at the Rand Corporation named Paul Baran designed a computer-communications network that had no hub, no central switching station, and no governing authority. In this system, each message was cut into tiny strips and stuffed into "electronic envelopes," called packets, each marked with the address of the sender and the intended receiver. The packets were then released like confetti into the web of interconnected computers, where they were tossed back and forth over high-speed wires in the general direction of their destination and reassembled when they arrived. Baran's packet-switching network, as it came to be called, became the technological underpinning of the Internet.

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[6] *Online and Internet Facts*, Interactive Services Association. Updated quarterly. Last update: August 30, 1996 at:
http://www.isa.net/intfacts/onlineserv.html

[7] Information on the National Science Foundation's NSFNet transition is explained in *Overview of the New Networking Architecture*, Merit Network, Inc., at: http://www.merit.edu/nsf.architecture/.about.architecture.html

The original network, ARPANET, was created in the late 1960s. Its purpose was to allow defense contractors, universities, and DOD staff working on defense projects to communicate electronically, and to share the computing resources of the few powerful, but geographically separate, computers of the time.

In 1984, ARPANET was split into two networks: ARPANET and the Defense Data Network (DDN). DDN continues today as one of Internet's component networks. (MILNET is the unclassified portion of DDN). In 1990, ARPANET ceased operation because NSFNet and various mid-level networks, sponsored by the National Science Foundation, made the Internet viable for commercial traffic. The Department of Defense continues to run a military network.[8]

Types of Applications Available on the Internet

The major applications of the Internet are electronic mail and discussion lists (mail), and the World Wide Web.

Electronic Mail and Email Discussion Lists

Internet electronic mail is used for two main purposes: person-to-person communication and participation in electronic discussion groups. A listserv is an organized system in which a group of people are sent messages pertaining to a particular topic. The messages can be articles, comments, or whatever is appropriate to that topic. There are more than 71,000 electronic mailing lists covering every imaginable topic.[9]

Another popular use is the electronic journal, or e-journal, in which full-text issues of journals are available electronically to subscribers of e-mail lists. Other electronic magazines are available via FTP or at World Wide Web home pages (for example, the *New England Journal of Medicine* is available through the NEJM Web site at: http://www.nejm.org/JHome.htm).

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[8] Information on Internet history was taken from the following sources:

Adam, John. Geek Gods: how cybergeniuses Bob Kahn and Vint Cerf turned a Pentagon project into the Internet and connected the world. *Washingtonian*, v. 32, November 1996. p. 108-113.

Anderson, Christopher. The accidental superhighway. *The Economist*, v. 336, July 1, 1995. p. 1-18 (special supplement).

Carnevale, Mary Lu. World-Wide Web: begun as a government experiment, what is now called the Internet has taken on a life of its own. *Wall Street Journal*, November 15, 1993. p. R7.

[9] A good guide to electronic discussion lists is available at Liszt, a Mailing List Directory at: http://www.liszt.com

World Wide Web

The World Wide Web is currently the most powerful Internet search tool because as a hypertext information browser, it is a seamless integration of linked text, graphics, audio, and video. Hypertext allows a user doing research on one document to jump to a related item in another document through hypertext links. With the appropriate software (such as Netscape, MOSAIC, NetCruiser, WebExplorer, InternetWorks, MacWeb, WinWeb, and Lynx), a user can view images, listen to audio files, or see motion pictures through the World Wide Web.

The most noteworthy Internet development in the last few years has been the expansion of the World Wide Web (WWW). In 1992, the Web was little more than a research tool for researchers, scientists, and computer hobbyists. Now it is being used by corporations, government agencies, and individuals.

In 1990, the main architect of the Web, Tim Berners-Lee, a programmer employed at CERN, the European Particle Physics Institute in Geneva, Switzerland, collaborated with colleague Robert Caillau on a design document that explained hypertext as a way to link and access information. It described how documents would be interwoven in a network of links called a web. The 1990 document discussed notions fundamental to the Web as it is known today: the ability of links to cross machine boundaries; a simple common protocol for exchanging documents (Hypertext Transfer Protocol, or HTTP); a common document protocol for the suppliers and consumers of information (Hypertext Markup Language, or HTML); support for index searches; and ability to view these documents with text or graphics browsers.[10]

Java

Java, a new programming language based on C++, launched by Sun Microsystems in May 1995, is a new technology that could change the way people interact with their home computers. Programmers use Java to write mini-applications called "applets" that run inside Web browsers such as HotJava, Netscape Navigator, or Microsoft's Internet Explorer. Applets can be anything -- a spell checker, writing program, game, animation, etc.

Programmers use Java to write "platform-independent" software, instead of different versions for Windows, Mac, Unix, etc. The applets also run on virtually any type of computer, from hand-held personal organizers to large mainframes. Instead of residing in a desktop computer hard disk like most programs, Java applets reside on network servers. Whenever a user needs to perform certain computing functions, such as opening a word processor, an

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[10] Wiggins, Richard W. Webolution: the evolution of the revolutionary World-Wide Web. *Internet World*, v. 6, April 1995. p. 35-38.

applet is sent from the server to the desktop computer.[11] Since Java programs are maintained centrally on servers and run on inexpensive, scaled-down computers, the new software has the potential to bring down the cost of maintaining desktop PCs. Like a lot of new technologies, Java is not bug-free. There were reports of "hostile Java apps" that could cause a browser or operating system to freeze by devouring all the computer's memory.[12]

Push Technologies

Another new Internet development is termed "push technology." Currently, most people get access to Internet content by "pulling" it. When an individual clicks a link on his World Wide Web browser, the browser sends a request to the Web server (a pull), asking for the relevant page. With push, the server does not wait for someone to request a page; instead, when the user profile is established, the server runs a search against a database and delivers or pushes the results automatically to the user's computer so the user can read (or hear or watch) the information whenever desired.[13] The push providers compare their content-delivery method with television: customers subscribe to the "channels" they wish to view. With push technology, however, the content is "narrowcast" to an individual, not broadcast to an entire region or nation.

Other Applications

In addition to the World Wide Web, the Internet supports other online tools to help find and retrieve information: Telnet, FTP, Gopher, Archie, Veronica, Jughead, Wide Area Information Servers (WAIS), and search engines:

- Telnet -- Telnet allows Internet-connected computers to contact and search other computers. Once a connection is established with a remote computer, via telephone lines and a modem, users can search that remote system as if their computer were a hard-wired terminal of that computer. An Internet user can connect to a computer on the other side of the world as easily as he or she can connect to one in the next building.

- FTP (File Transfer Protocol) -- The FTP command allows an Internet-connected computer to contact another computer; log on

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[11] For information on Java, see:
http://www.javasoft.com/ (FAQs, developer news and links to Java applets from Sun Microystems' Java division)
http://www.yahoo.com/headlines/960606/compute/stories/livewire_1.html

[12] Blundon, William. The Truth about Java. *Internet World*, v. 7, December 1996. p. 59-63.

[13] Leonard, Drew. Channel turf: push content stakes out your screen. *CNET Reviews-comparative reviews*, February 26, 1997. Available online from: http://www.cnet.com/Content/Reviews/Compare/Push/

anonymously; retrieve texts, graphics, audio, or computer program files; and transfer desired files back to itself.

- Gopher -- This software program, developed at the University of Minnesota, organizes information into a series of menus. Using gopher is like browsing a table of contents: a user crawls through a set of "nested" menus to zero in on a specific subject. There are more than 2,000 gopher servers on the Internet, some dealing with very narrow topics and others more broadly based.

- Archie -- Archie helps find files available at File Transfer Protocol (FTP) hosts. When searching for a particular term, Archie searches the database and displays the name of each FTP host that has that file or directory and the exact path to that directory.

- Veronica and Jughead -- Veronica is an indexer that can query every gopher on the gopher system to search for a key word or phrase in a menu title and give the address of all menus with those key words. Jughead works like Veronica but usually restricts its search to a single gopher on a local campus. It provides a menu-item search of the files located on a local gopher server.

- WAIS -- WAIS is in important respects a more powerful retrieval tool than gopher, because it actually searches the full text of a document to look for key words. WAIS accepts plain-English queries, which makes it easier to use than Boolean logic. There are more than 250 WAIS libraries on the Internet. However, since the information is maintained by volunteers, usually in academia, subject material tends to favor research and the computer sciences.

- Internet search engines -- Search engines such as Lycos, Yahoo, AltaVista, InfoSeek, WebCrawler, and Open Text collect and index Internet resources automatically. These software agents roam Internet sites (mostly World Wide Web, gopher, and FTP sites), search them, and create databases from them that can be searched to provide requested information to the user.

Growth

The last few years have seen dramatic expansion, with the Internet more than tripling in size. The Internet connects over 103,000 networks and more than 16 million host computers in more than 120 countries. More than half the computers connecting to the Internet reside in the United States.[14] These figures do not include military computers, which for security reasons are

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[14] For a comprehensive article on the size of the Internet, see: Kantor, Andrew and Michael Neubarth. Off the charts: how big is the Internet? *Internet World*, v. 7, December 1996. p. 45-51.

invisible to other users, or the hundreds of people who may share a single Internet host. Nor does it include the millions more who dial into the Internet through the growing number of commercial gateways, such as Delphi, Netcom, PSI, and others.[15]

A host is a computer hooked to the Internet. The Internet links millions of host computers around the world.

YEAR	NUMBER OF INTERNET HOSTS
08/1981	213 hosts
08/1983	562 hosts
12/1987	28,174 hosts
07/1988	33,000 hosts
07/1989	130,000 hosts
10/1990	313,000 hosts
07/1991	535,000 hosts
07/1992	992,000 hosts
07/1993	776,000 hosts
07/1994	2,217,000 hosts
07/1995	6,642,000 hosts
01/1996	9,472,000 hosts
01/1997	17,753,266 hosts[16]

Packet traffic, a measure of the amount of data flowing over the network, continues to increase exponentially. MCI, which completed a $60 million upgrade in 1996 for its Internet backbone (quadrupling its speed), plans to double its backbone capacity during 1997. MCI estimates that Internet traffic is growing at a rate of 30% a month.[17]

Although the number of host computers can be counted fairly accurately, the number of people using the Internet can only be estimated. Many hosts

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[15] Bournellis, Cynthia. Internet '95: the Internet's phenomonenal growth is mirrored in startling statistics. *Internet World*, v. 6, October 1995. p. 47-52.
For an explanation of problems associated with defining Internet usage, see: *Summary of the Results, Third TIC/MIDS Internet Demographic Survey* (February 1996) from Matrix Information and Directory Services (MIDS) at:
http://www.mids.org/ids3/pr9510.html

[16] Internet statistics are compiled by Mark Lottor of Network Wizards. The Internet Domain Survey attempts to discover every host on the Internet by doing a complete search of the Domain Name System (DNS). Survey results are available from Network Wizards at:
http://www.nw.com/zone/host-count-history
and from the Internet Society at: ftp://ftp.isoc.org/charts2/growth/90s-host.txt
Graphs are available from General Magic at:
http://www.genmagic.com/Internet/Trends/slide-3.html

[17] Tedesco, Richard. MCI completes major Internet upgrade. *Broadcasting & Cable*, November 25, 1996. p. 62.

support multiple users, and hosts in some organizations support hundreds or thousands of users. A number of organizations have attempted to estimate the Internet's size, and the figures vary wildly, from 9 million to 47 million worldwide users. Two organizations with expertise in Internet surveys are more in agreement: International Data Corp. found 23.5 million users, while Matrix Information and Directory Services found 26.4 million users.[18]

Host computers are identified by their type of organization: commercial, government, educational, military, nonprofit, or network. The Internet's commercial domain (.com) has been the fastest growing segment over the last 2 years and is now the largest domain. The educational domain is now the second largest segment.

In February 1997, the International Ad Hoc Committee (IAHC)[19] announced a proposal to add seven new generic Top Level Domains (GTLDS) in addition to the existing ones (.com, .net., .org, .edu, .mil, .gov) under which Internet users may register Internet names.[20] The new GTLDS and the intended fields of use are:

--	.firm	for businesses or firms
--	.store	for businesses offering goods to purchase
--	.web	for entitities emphasizing activities relating to the WWW
--	.arts	for entitites emphasizing cultural and entertainment
--	.rec	for entities emphasizing recreation/entertainment
--	.info	for entitities providing information services
--	.nom	for those wishing individual or personal nomenclature

In addition, up to 28 new registrars (with more to follow) will be established to grant registrations for second-level domain names. The new registrars will be selected by lottery from applicants who fulfill specific requirements established by the IAHC.[21] There is controversy on all sides of

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[18] Kantor and Neubarth. Off the charts, p. 46-47.

There are many sources of Internet statistics. One good source is *Nua Internet Surveys*, a free monthly newsletter which compiles worldwide news on Internet demographics. To subscribe, send an email to: *surveys-request@nua.ie* with the word "subscribe" (without the quotation marks) in the body of the message. In addition, current and archived issues can be found at:

http://www.nua.ie/surveys/

[19] Organizations naming members to the IAHC include: the Internet Society (ISOC), the Internet Assigned Numbers Authority (IANA), the Internet Architecture Board (IAB), the Federal Networking Council (FNC), the International Telecommunication Union (ITU), the International Trademark Association (INTA), and the World Intellectual Property Organization (WIPO).

[20] For information on the plan to add new top level domain names, see the Internet Society's press release at:

http://www.isoc.org/whatsnew/iahcreport.html

[21] Ibid.

this proposal. Critics call the plan unworkable and unfair. The main points of contention are the lottery system used to pick new registrars, and the monopoly of Network Solutions, Inc., now the only licensed registry (although on April 23, 1997, the National Science Foundation issued a statement that it will not renew its agreement with Network Solutions, Inc. when it expires in 1998). In spite of the conflicts, however, a global agreement was signed by 57 major companies, public bodies, and international organizations in Geneva on May 1, 1997. An additional 23 companies have indicated thier willingness to sign, but a number of other companies, including AT&T, IBM, and PSINet are either still considering the proposal, or have offered their opposition to the plan. The U.S. government and the European Commission have also expressed their reservations.

Starting September 14, 1995, businesses and private organizations paid to register their domain name addresses on the Internet. Previously, the National Science Foundation had been funding the administrative costs of registering the addresses, but it became increasingly burdened with these costs. In 1993, there were 7,500 addresses, and in September 1995, there were 110,000, 90% of which are registered by companies. Internet domain registration is expected to grow exponentially, with 20,000 new addresses being assigned each month.[22]

The fee does not apply to the millions of Americans who get their Internet access indirectly through employers, commercial online or Internet services, schools, or other organizations. The government will continue to subsidize the cost of addresses for educational institutions and federal agencies, and the online service providers will pay the fees on behalf of their subscribers. Rather, the fee applies only to businesses, organizations, and individuals who register domain names directly. All applicants pay $100 to register a name for 2 years, plus $50 per year thereafter. The fee is paid to Network Solutions, Inc., of Herndon, Virginia, which handles Internet registration under contract to the National Science Foundation.[23]

There is also a proposal by the InterNic, the North American registrar for Internet Protocol (IP) addresses and domain names, to create a new nonprofit organization called ARIN (American Registry for Internet Numbers), which will charge a fee to manage the new IP address databases.[24] IP addresses and domain names are different. IP addresses are embedded in the TCP/IP software. They are meaningful to connectivity providers, with strong technical (i.e., routing) implications. Domain names, like whitehouse.gov, are mostly for ease of use purposes. They are meaningful to users and have strong trademark (i.e., legal) implications. To keep IP addresses globally unique, there has to be a top-

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[22] Lewis, Peter H. A private Internet street will now cost $50 a year. *New York Times*, September 14, 1995. p. D1, D6.

[23] Information on the domain name registration fee is available from the InterNIC's World Wide Web site at:

http://rs.internic.net/announcements/fee-policy.html

[24] Snyder, Joel. Upside to IP fees. *Internet World*, April 1997. p. 94-95.

level registry in charge of making sure that no two organizations use the same address. In North America, the registrar for IP addresses is the InterNic.

Who Pays for It?

The Internet is not free. Some of the networks are partially funded by certain government agencies, especially the National Science Foundation and other science agencies, for use by scientists, researchers, and the education community.

The major costs of running the network are shared by its primary users: universities, national laboratories, high-tech corporations, and governments. Each institution, organization, corporation, or individual with access to the Internet purchases that access through a Network Service Provider offering Internet access in its area.

Universities, agencies, and other institutions with direct connections via a mid-level network usually absorb the cost of Internet connections in the data processing budget without charging the costs back to the end users. This is why many Internet users refer to Internet as being "free." In reality, however, direct connections usually require a one-time, up-front capital investment in hardware and software (usually $10,000-$20,000). The cost of the connection itself varies depending on its speed -- from $20,000-$25,000 for a T1 connection (1.544 Mbps), to $70,000-$80,000 for a 10Mbps ethernet connection. The mid-level network also may assess an annual membership and/or maintenance fee (again, from several hundred dollars on up). These costs are frequently absorbed by the computer or communications department, and/or distributed evenly throughout an organization.

Individual users without the benefit of organizational access to the Internet must get their access from commercial Internet providers, such as Delphi, PSI, The WELL, Portal, Panix, and Netcom. Users need a computer and a modem, and can gain access, usually through a local telephone call, to a terminal server (computer). The costs vary from $10 to several hundred dollars per month on a connect-time basis, but many commercial providers charge a flat-rate monthly fee. In addition, "free nets" have been established in an increasing number of cities for no-cost or low-cost public access to the Internet.[25]

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[25] Information on free nets is available from:
Organization for Community Networks, P.O. Box 32175, Euclid OH 44132, and from their World Wide Web site at: http://www.ocfn.org
Center for Civic Networking, P.O. Box 53152, Washington, DC 20009, and from their World Wide Web site at: http://www.civic.net:2401/ccn.html

Problems

The Internet offers almost limitless possibilities for the free communication of ideas, research, and information; it brings knowledge, experience, and information on nearly every subject directly to individual microcomputers.

Millions around the world log on to the Internet to browse library catalogs, view satellite weather photos, download free computer programs, and participate in discussion groups with everyone from Vice President Gore, to physicists, to Muppet lovers.

The Internet is also, at times, an information highway burdened with potholes, accidents, and traffic jams. Recitations of what happens when things go wrong are endless, and they range from minor hassles to systemwide catastrophes. Employers find it frustrating to develop training programs, invest in new equipment, or learn new procedures, knowing that they may all be obsolete the next year. For those without user-friendly Web browsers, the Internet's technical rules and nonintuitive commands may confound novice users, who can expect frustrations, like frequent "busy signals" when attempting an Internet connection, cryptic messages and commands, and incompatible editing or word processing programs, which can make Internet-retrieved documents unreadable.

Security and Legal Issues

In 1988, Robert Morris, a Cornell University graduate student, created a computer worm that tied up most of the computing power of 10% of the computers on the Internet, preventing them from carrying out their normal functions. The incident led to the Defense Department's creation of the Computer Emergency Response Team (CERT) in 1988.[26]

CERT, which operates out of the ARPA-funded Software Engineering Institute (SEI) of Carnegie-Mellon University in Pittsburgh, provides a 24-hour international information and support service to government agencies, universities, and corporations that are connected to the Internet. CERT has no legal power to arrest or prosecute. Instead, CERT counsels computer centers on how to secure systems against past, current, or future intrusions.

The number of incidents of security breaches has far outpaced CERT's resources and funding to respond to them. In 1995, CERT began decreasing its rapid-response role in favor of research into computer security. CERT operates more as a clearinghouse for gathering statistics and responding to large incidents rather than as an emergency response team for all Internet users. Although CERT limits the incidents it investigates, it continues to accept calls

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[26] Information on the Computer Emergency Response Team (CERT) is available from their Home Page at: http://www.sei.cmu.edu/SEI/programs/cert/

and give general information to the growing Internet community.[27] In 1996, CERT handled 2573 security incidents, affecting more than 10,700 sites.[28] FedCIRC, the Federal Computer Incident Response Capability, was established in 1996 as a joint effort of the National Institute of Standards and Technology (NIST), the CERT Coordination Center, and the Computer Incident Advisory Capability (CIAC). FedCIRC provides incident response and other security-related services to federal civilian agencies.[29]

The network depends on cooperation, and it is difficult to guarantee privacy, authenticity, or protection. These problems are being addressed by organizations worldwide, and it appears that eventually there will be encryption, digital watermarks, and other standards to enhance security.[30]

Security attacks also underscore a vulnerability of computer networks at a time when more and more companies and consumers have begun using them to communicate and conduct business. If scientists cannot be certain that their research data will not be altered, if patients do not trust the privacy of their medical records, and if the safety of financial information is in doubt, then the value of the Internet will be severely limited. Because of security concerns, Internet users are increasingly turning to encryption techniques to safeguard information in transit over the networks.

Another concern is the perception that pornography is easily available on the Internet, and that children can easily gain access to it. Although the vast majority of online information is benign, there are legitimate parental concerns about obscene language and photographs, groups that promote bigotry, drug use or violence, and potentially harmful chat rooms. The major online services, such as America Online, Prodigy, and Compuserve, offer different types of protection. For example, they let parents close off chat rooms, news groups, and e-mail, and offer "kids only" areas.

Several software companies have created filtering applications that claim to make the Internet safer for children. Each application uses a slightly different method to block obscene or pornographic material.[31] The programs

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[27] CERT advisories and other information on computer network security can be obtained from CERT's World Wide Web site at:
ftp://info.cert.org/pub/cert_advisories/
ftp://info.cert.org/pub/tech_tips/security_info

[28] See *CERT Coordination Center 1996 Annual Report (Summary)*, from the CERT Coordination Center at: http://www.cert.org/cert.report.96.html

[29] Information on FedCIRC is available at: http://csrc.nist.gov/fedcirc/

[30] *Encryption Technology: Congressional Issues* by Marcia S. Smith, (continually updated). CRS Issue Brief 96039.

[31] For a comparison of filtering programs, see *8 Programs to Porn-Proof the Net*, Cnet Reviews, 1996 at:
http://www.cnet.com/Content/Reviews/Compare/Safesurf/

(continued...)

apply two approaches to the problem of Net censoring: filtering and rating. Those that use filtering allow access to the Internet at large but attempt to block material the programs' publishers deem offensive. The rating method programs display only sites that contain a particular rating, and block all others. In most cases the programs follow the ratings of one of two organizations, Recreational Software Advisory Council (RSAC) or SafeSurf.

The Telecommunications Act of 1996 (P.L. 104-104) included the Communications Decency Act, a provision banning the use of the Internet or online services to disseminate indecent or patently offensive material to minors. This raised a significant First Amendment free speech issue, and Congress requested expedited judicial review of the new law, putting it on a fast track to the Supreme Court. The Court heard oral arguments in this case on March 19, 1997. A decision is expected in the summer of 1997.[32]

Criminal uses of the Internet and law enforcement's responses are matters of concern. While the technology of cyberspace advances daily, a legal model for organizing the Internet has not yet evolved. Already, cases are reaching the courts in which plaintiffs complain of improper and unlawful activities by defendants in cyberspace. The law has not yet met this technology with coherent doctrines that take into account the transnational dimensions of a global network.[33]

Universal Access

Another area of concern is how accessible the Internet will be to the poor and less educated. Many people cannot afford a computer and modem, and in remote areas users must pay long-distance telephone charges to gain access to the Internet. Individuals who do not have access through school or work may miss opportunities to retrieve useful information and to participate in an

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[31](...continued)

Information about Labeling and Rating Systems, MIT Student Assocation for Freedom of Expression Labeling and Rating Information, 1997 at:
http://www.mit.edu/activities/safe/safe/labeling/summary.html

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[32] See *The Communications Decency Act of 1996* by Henry Cohen, updated March 5, 1997. 25p. CRS Report 96-321.

[33] For information on legal issues and the Internet, see Burnstein, Matthew R. Conflicts on the Net: choice of law in transnational cyberspace. *Vanderbilt Journal of Transnational Law*, v. 29, January 1996. p. 75-116.

For information on computer law issues, see the *Cyberspace Law for Non-Lawyers* Web site, presented by the Cyberspace Law Institute and Counsel Connect at: http://www.counsel.com/cyberspace, *Cyberspace Law Abstracts*, published by the Legal Scholarship Network, a division of the Social Science Research Network at: http://www.ssrn.com/CyberLaw/lawpaper.html

electronic community that could affect their lives. Policymakers are pursuing proposals to ensure widespread access to networked information through schools, libraries, and other public service institutions.

The Federal Communications Commission is seeking comments on section 254(h) of the Telecommunications Act of 1996, the universal service provision. The Federal-State Joint Board on Universal Service recommended that eligible schools and libraries be able to purchase any telecommunications services, internal connections, and access to the Internet at discounted rates. The Joint Board did not recommend a standard communication package, but concluded that it would be more efficient to let schools and libraries determine what services they need and want.

The 1996 Telecommunications Act states that all public and non-public elementary and secondary schools that do not operate for a profit and do not have endowments exceeding $50 million are eligible for a discount of 20% to 90% on all telecommunications services. On May 7, 1997, the FCC adopted the Joint Board's recommendations for providing eligible schools and libraries discounts on the purchase of all commercially available telecommunications services, Internet access, and internal connections. Eligible schools and libraries will receive discounts ranging from 20% to 90%, with the higher discounts being provided to the most disadvantaged schools and libraries and those in high cost areas. Total expenditures for universal service support for schools and libraries is capped at $2.25 billion per year, with a roll-over into following years of funding authority, if necessary, for funds not disbursed in any given year.[34]

The Senate Commerce Committee held a hearing on universal service policy on March 12, 1997. FCC Chairman Reed Hundt updated the Committee on the progress of the Commission's implementation on the 1996 Telecommunications Act.[35]

Conclusion

Historically speaking, almost every major breakthrough in technology has held out the promise of wondrous benefits for society, and actually brought about unimagined and sometimes undesirable changes as well.

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[34] For information on discounted Internet access for schools and libraries, see the Federal Communications Commission's *Universal Service* page at: http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/1997/nrcc7032.html See also the Universal Services Library section of the Benton Foundation's Home Page at: http://www.fcc.gov/ccb/universal_service/welcome.html

[35] Chairman Hundt's and other participants' testimonies before the Senate Commerce Committee are available at:

http://www.senate.gov/~commerce/hearings/uniserv/uniserv.htm

While the Internet offers almost limitless possibilities for the free communication of ideas, research, and information, there are serious business and consumer issues concerning accessibility, cost, privacy, fraud, security, copyright, and standardization.

The Internet has a long way to go if there is to be universal access at a reasonable price for all citizens. This is a daunting technical challenge and will require that very complex social and political questions be addressed as well. The Internet expands and diversifies every day, and planning and managing these changes is a challenge for the future.

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