

# **The Internet and the Corporation**

by

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## **Abstract**

The Internet—a network of networks—was created for use by the research and government communities. In the last several years, however, corporations have found that the Internet provides significant utility for them, as well. This paper describes the history of the Internet, summarizes current commercial use of the Internet, proposes additional commercial use of the Internet, and discusses some of the unresolved issues involving such use. The paper concludes that the Internet is a powerful commercial tool; its commercial use has led to several initiatives whose aim is to correct the Internet's commercial shortcomings. These initiatives will undoubtedly succeed, and the Internet will continue to grow in importance to the corporation.

## **1. Introduction**

The Internet is a network of networks. Its power lies not in the fact that it is a network of computers, but explicitly in the fact that it is a network of *networks* of computers. The Internet was created to solve the problem of enabling the computers of one particular network—each of which, by virtue of being on a network, could communicate with all of the computers of that particular network—to communicate with computers of another—arbitrary—network. This interconnection of networks—*internetting*—is possible because all of the networks which form the Internet use a common, public (non-proprietary) protocol suite.

Research in computer networking—including that which led to the creation of the Internet—has been funded extensively by the U. S. Department of Defense, through its Defense Advanced Research Projects Agency. Originally, the Internet served research institutions and the military almost exclusively. Recently, however, it has become apparent that the wide-spread connectivity provided by the Internet has commercial value as well as research and personal communication value; today there are many commercial networks connected to the Internet. This paper will deal with what the Internet has to offer the commercial user. It will first provide a brief history of the Internet, and will then describe the current state of commercial involvement in the Internet. Next, a section will discuss how corporations can benefit from using the Internet, and a final section will discuss some concerns with the Internet that are particular to its use as a commercial tool.

## **2. A History of the Internet**

The history of the Internet can be divided into three periods: The Ancient period, the Mature Pre-Commercial period, and the Commercial period. This section will discuss the first two periods; the next section will discuss the Commercial period of the Internet.

### **2.1. The Ancient History of the Internet**

The U. S. Department of Defense's Advanced Research Projects Agency (ARPA; now DARPA, for Defense Advanced Research Projects Agency) decided, in the middle 1960s, that packet

switching<sup>1</sup> was preferable to other networking methods (such as circuit switching)<sup>2</sup> in terms of both costs and resource availability and utilization. In 1969 they awarded a contract to Bolt, Beranek and Newman (BBN) to implement a packet-switched network, called ARPANET; in September, 1969, ARPANET consisted of a single node (at UCLA). In December, 1969 there were four nodes on ARPANET, and by September, 1972, there were thirty-four, serving many more than thirty-four host computers. The number of nodes was different from the number of *hosts* because an ARPANET node consisted of a special purpose Interface Message Processor (IMP) which was the interface between the network and one or more hosts. Many of the hosts were incompatible with each other, but each communicated with the IMP to which it was connected by using the network standard Network Control Program (NCP). In the early 1970s the ARPANET extended from California to Massachusetts, primarily using 50-kilobit per second (kbps) leased lines; by 1975 there were also satellite links to Hawaii and Norway.<sup>3</sup>

By the mid 1970s, ARPA had changed its name to DARPA, and it had changed its focus from networking incompatible computers to networking incompatible networks. The first demonstration of a three network Internet was in July, 1977. For this demonstration, packets were sent from a packet radio network in San Francisco to the ARPANET, on which they were routed to London. From London they were sent back to the U.S. on the Atlantic Packet Satellite network (SATNET), then back to the ARPANET, on which they returned to California.<sup>4</sup> In 1979 DARPA formed the Internet Control and Configuration Board (ICCB) to coordinate the work of the various researchers working on the TCP/IP (Transmission Control Protocol/Internet Protocol) protocol suite, and on the

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<sup>1</sup>Packet switching involves breaking a message into fixed sized pieces—*packets*—and sending each packet independently to its destination. All packets of a single message do not necessarily follow the same route to the message's destination, and no direct source-to-destination connection need ever be established.

<sup>2</sup>In circuit switching, a direct connection is established between the source and destination of a message, the entire message is transmitted over this connection, and then the connection is released. The public switched telephone system uses circuit switching.

<sup>3</sup>Kleinrock, L. *Queueing Systems, Volume II: Computer Applications*. New York: John Wiley & Sons, 1976, pp. 304-314. There are many other sources for the early history of the Internet; Kleinrock was one of the original workers on the ARPANET, and his book includes references to the original papers, as well as technical and non-technical discussions of many of the issues.

<sup>4</sup>Cerf, V. "How the Internet Came to Be." In Aboba, B. *The Online User's Encyclopedia*. Reading, MA: Addison-Wesley Publishing Company, 1993, pp. 527-534.

architecture of the Internet.

## **2.2. The Mature, Pre-Commercial Internet**

The modern Internet began its existence in 1980, when DARPA began implementing the (then new) TCP/IP protocol suite on the computers connected to its research networks. The Internet was officially accepted in January, 1983, when the Office of the Secretary of Defense mandated that all of its computers connected to long haul networks must use the TCP/IP suite. Simultaneously, the ARPANET—which had become the backbone of the new Internet—was divided into two networks: one for research (which maintained the ARPANET name) and the other for military communication (which became MILNET).<sup>5</sup>

DARPA encouraged the spread of the TCP/IP protocols with selective funding: they funded BBN to implement TCP/IP for UNIX (which was the most widely used operating system at university computer science departments), and they funded the University of California at Berkeley to include this implementation with their standard UNIX distribution (which was the most common UNIX version used by university computer science departments). The availability of a UNIX distribution that included a networking protocol was especially attractive to the many departments that were acquiring multiple computers and wanted to connect them in local area networks. Berkeley UNIX included network protocols that weren't otherwise readily available.<sup>6</sup>

In the early 1980s, the National Science Foundation (NSF), decided to create a high speed (for the time) computer network to link its six national supercomputer centers with college and university campuses across the U. S. In 1986, NSF created a backbone network that it called NSFnet, to link its supercomputer centers to the ARPANET; this was at a time when many U. S. universities were creating their own local area networks. NSFnet used the TCP/IP protocol suite, so any university that connected to NSFnet could also connect to the Internet. In addition, NSF realized that they

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<sup>5</sup>Comer, D.E. *Internetworking With TCP. Vol. 1: Principles, Protocol and Architecture*. 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1991, pp. 6-8.

<sup>6</sup>*Ibid.*

would not be able to centrally administer a large network, so they encouraged the formation of consortia of institutions to form regional networks—and provided seed money for them.<sup>7</sup>

NSFnet did for the general university community what ARPANET had done for the computer science and engineering community: it introduced them to the possibilities of electronic mail, remote file transfer, and access to data from remote institutions. By 1987, the Internet connected nearly 20,000 computers; in 1990, it included more than 3,000 networks and more than 200,000 computers.<sup>8</sup> By the end of 1993, there were more than 2,000,000 hosts on the Internet,<sup>9</sup> and in October, 1994 there were over 40,000 networks and nearly four million hosts.<sup>10</sup> Traffic has also increased dramatically: ARPANET traffic grew from about 400 million bytes per month in October, 1971 to over five billion bytes per month in March, 1975.<sup>11</sup> More recently, Internet traffic has grown from one trillion bytes per month in March, 1991 to nearly eighteen trillion bytes per month in November, 1994.<sup>12</sup>

### 3. The Commercialization of the Internet

The National Science Foundation anticipated commercial use of the Internet from the time that it created the Internet's backbone NSFnet.<sup>13</sup> Thus, NSF provided only part of the funding for the regional networks whose creation it invited; the regional networks were free to solicit commercial users to help pay their bills, and they did.<sup>14</sup> Currently, NSF is in the process of privatizing the Internet; the first step in that process occurred on 31 October 1994, with the creation of four commercial, regional hubs—in San Francisco, Chicago, Washington, D.C. and Pennsauken, N.J., operated by

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<sup>7</sup>*Ibid.*

<sup>8</sup>*Ibid.*

<sup>9</sup>Waldrop, M.M. "The Seeds of the Internet Boom," *Science* 265: 5174, 1994, pp. 880-881.

<sup>10</sup>Recent statistics concerning network traffic, hosts and networks are available for anonymous ftp from **nis.nsf.net**, in directory **statistics/nsfnet**.

<sup>11</sup>Kleinrock, L. *op. cit.*, p. 483.

<sup>12</sup>From data on **nis.nsf.net**.

<sup>13</sup>Press, L. "Commercialization of the Internet." *Commun. ACM* 37:11, 1994, pp. 17-21.

<sup>14</sup>Waldrop, M.M. *op. cit.*, p. 881.

Pacific Bell, Ameritech, Sprint and Metropolitan Fiber Systems, respectively.<sup>15</sup> However, except for the presence of a few commercial enterprises—such as the Colorado Association for Research Libraries (CARL) and the Clarinet News Service—the culture of the Internet was noncommercial through the early 1990s.

### 3.1. The Recent Past

The commercial presence on the Internet has changed dramatically in the past two years—largely because of the creation of the World Wide Web and a variety of Internet “browsers” whose interface is especially attractive to non-UNIX users. For example, in October, 1994, there were an estimated 3.86 million hosts connected to the Internet—a plurality of which (1.05 million) were at commercial sites (some of these are, undoubtedly, research institutions).<sup>16</sup> What does the World Wide Web have to do with this growth in commercial use of the Internet?

The World Wide Web is the vision of programs that can understand the numerous different information-retrieval protocols (FTP, Telnet, NNTP, WAIS, gopher, ...) in use on the Internet today as well as the data formats of those protocols (ASCII, GIF, Postscript, DVI, TeXinfo, ...) and provide a single consistent user-interface to them all.<sup>17</sup>

For those people (including some readers of this paper, perhaps) who are not familiar with the Internet’s multitude of information-retrieval protocols, it is attractive to have a consistent, user-friendly, interface to the Internet. The World Wide Web (commonly referred to as WWW), which was started by the European Center for Nuclear Research (CERN) and is now being jointly developed by CERN and MIT, provides a *distributed hypermedia* service. A WWW document typically consists of a *page* of text with any combination of text, graphics, audio segments and video images *linked* to the page. Then, a *browser* such as Mosaic—today’s most popular browser, which was written at the National Center of Supercomputing Applications (NCSA)—provides a unified, point-and-click, user interface: following a hypermedia link is as simple as pointing to it (it is typically an italicized or underlined

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<sup>15</sup>Lewis, P.H. “Internet Losing U.S. Funding,” *The Denver Post*, 30 October 1994, p. H1.

<sup>16</sup>From **nis.nsf.net**.

<sup>17</sup>Torkington, N. “World Wide Web Primer.” 15 September 1993. Available for anonymous ftp from **wuarchive.wustl.edu** in the directory **/doc/misc/www**.

phrase) and clicking a mouse button. Mosaic first became available in 1993, running under the X Window system on UNIX workstations; it is currently available on UNIX workstations running X Windows, on PCs running Microsoft Windows, and on Macintosh computers.

### 3.2. The Present

What kinds of commercial things can one do on the Internet? One can order a pizza<sup>18</sup> or a compact disc<sup>19</sup> or a computer;<sup>20</sup> one can arrange to test drive an automobile<sup>21</sup> or computer software;<sup>22</sup> one can obtain detailed technical information about plastics and resins<sup>23</sup> and about beer.<sup>24</sup> This is, of course, a small sampling of the companies that provide information using the World Wide Web. And, while the WWW and its browsers make it easy for interested parties to retrieve information, they don't automatically make it easy for interested parties to *locate* that information: just as there is no way to figure out, *a priori*, the e-mail address of someone with whom one might wish to correspond, there is no way to figure out, *a priori*, how to reach a business whose home page we might wish to peruse.

When we are looking for an item but we haven't chosen a supplier, we often look in the Yellow Pages for for a list. Similarly, on the Internet, there are several "well known places" to which one can turn in order to find commercial listings. Typically, a company pays a subscription fee to one of these directory providers, in return for which its home page is listed in a directory on the home page (or, is reachable via a hypertext link from the home page) of the directory provider. It is the directory provider's responsibility, of course, to make sure that its directory's home page is, in fact, well known. Among the currently available directory providers are CommerceNet, "a non-profit

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<sup>18</sup>The WWW Universal Resource Locator (URL) for Pizza Hut's home page is <http://www.pizzahut.com>.

<sup>19</sup><http://www.netmarket.com/noteworthy/bin/main>.

<sup>20</sup><http://www.service.digital.com>.

<sup>21</sup><http://volvocars.com>. Or, for a more general selection, try <http://www.dealernet.com>, which includes automobiles, boats, RVs and trailers.

<sup>22</sup><http://www.xerox.com>.

<sup>23</sup><http://www.ge.com>.

<sup>24</sup><http://www.mgdtaproom.com>.

consortium of organizations building an open, Internet-based infrastructure for electronic commerce,”<sup>25</sup> Mecklermedia Corp.’s MecklerWeb,<sup>26</sup> the Open Market, a group that “develops products and services which facilitate commerce on the Internet and other public networks,”<sup>27</sup> and O’Reilly & Associates, Inc.’s Global Network Navigator.<sup>28</sup> Open Market, with over 1250 commercial listings, is the largest of the four; it is common for a company to have an entry in more than one of these directory services. Some of the companies reachable through one or more of these directory services include AT&T, American Express, Bank of America, Bell Atlantic, Bellcore, Digital Equipment Corporation, Dunn & Bradstreet, the Electric Power Research Institute, Federal Express, Ford, General Electric, IBM, Intel, MCI, MasterCard International, Pacific Bell, R.R. Donnelly, U S West Technologies, Wells Fargo, and Xerox.

### 3.3. The Future

What is so special about the Internet as a medium of commercial opportunity? Why does Forrester Research predict that on-line shopping will grow from about \$200 million in 1993 to about \$4.8 billion in 1998?<sup>29</sup> Why is it that “Half of the Fortune 500 Companies are on the Internet...” (according to Tony Rutkowski, president of the Internet Society)?<sup>30</sup> Why does Pat Seybold, a corporate computer consultant, claim that, “If you’re not an active Internet citizen by the mid-1990s, you’re likely to be out of business by the year 2000.”?<sup>31</sup> In short, why should a corporation connect to the Internet?

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<sup>25</sup><http://www.commerce.net>.

<sup>26</sup><http://www.mecklerweb.com>.

<sup>27</sup><http://www.openmarket.com>

<sup>28</sup><http://gnn.com>.

<sup>29</sup>Modhal, M., Colony, G. & Chowdhury, S. “Interactive Shopping.” *Forrester Report on People and Technology*. 1:1, May, 1994.

<sup>30</sup>Lewis, P. “Internet for Profit.” *Computer Shopper*, 14:11 (November, 1994), pp. 182.

<sup>31</sup>*Ibid*, p. 192.



### 3.3.1. Cost

Sundance Catalog Inc. sells American handicrafts—over the Internet, with a WWW server managed by Evergreen CyberMart. A customer finds an item of interest and clicks on the “buy” button; the item gets added to an electronic order form. At the end of a session, the customer verifies the order and provides credit card information, and the order is automatically passed to Sundance’s computers; inventory, accounting and shipping are connected to the ordering process. Rodney Joffe, president of the direct-marketing service bureau that is helping Evergreen CyberMart to sell its services to companies like Sundance, claims that traditional mail-order companies pay between \$10 and \$15 to process a telephone or mail order, but Sundance pays only \$4 for its Internet orders.<sup>32</sup>

Electronic catalogs can also be less expensive to produce and distribute than traditional catalogs. For example, Mountain Travel-Sobek pays \$2.60 to print, and \$2.50 to mail, each copy of its annual color catalog. It has placed an electronic catalog on-line through the Global Network Navigator, and expects to eventually save thousands of dollars per year on catalog printing and distribution alone.<sup>33</sup>

Advertising is another area in which businesses can expect to reduce costs by using the Internet. For example, Mecklermedia charges between \$25,000 and \$50,000 per year for a WWW “starter kit” (the higher fee includes the hardware and software required for a WWW server). This compares favorably to the cost of a similar presence on Prodigy, which is between \$27,500 and \$54,200 per *month*. Christopher Locke, president of Mecklermedia Corp., explains that high cost is, to some extent, in the eye of the beholder:

People on the Internet get nosebleeds and altitude sickness when they hear those numbers, but people in the business community say “Just \$25,000 a year? How are you going to make money on that?” We’re not selling ... bandwidth or disk space, after all. We’re selling market access.<sup>34</sup>

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<sup>32</sup>Verity, J.W. “The Internet: How it Will Change the Way You Do Business.” *Business Week*, 14 November 1994, p. 86.

<sup>33</sup>Lewis, P. “Internet for Profit.” *Op. cit.*, p. 190.

<sup>34</sup>*Ibid*, p. 191.

### **3.3.2. Advertising**

One of the advantages of the Internet, from a corporate point of view, is that it has an estimated 20 million users: this is a large number of potential customers. And although the “etiquette” of the Internet is not particularly accepting of the broadcast of “junk information,” the Internet’s very nature as a *symmetrical* communication link provides a key to the Internet’s value as an advertising medium. The symmetry of the Internet lies in the fact that there is no natural division between information producers and information consumers; one of the Internet’s maxims is “every client is a server.” Because of this, the Internet has developed so that people wishing information actively seek it rather than passively waiting for it to come their way. As long as the convention against junk information is respected, an advertiser needn’t worry about generating ill will: he or she is making information available to anyone who seeks it, but is forcing it upon no one. This symmetry—or *distributed nature*—of the Internet also makes it especially easy to advertise on a low budget. One needn’t invest in broadcast, or mass mailing, or other distribution costs; one need only connect to the Internet, and provide information.

When access to information is available only to those who seek it, however, how does one make sure that those who seek it know where to find it? This is one of the major purposes of the consortia that provide directories of members. A customer who knows what he or she is looking for but doesn’t know where to find it can browse through the home pages of these consortia. In addition, there are several searching and indexing tools available for the Internet, and more are sure to be created in the future. A searcher for information can use such a tool to find all sorts of things that he or she had no idea existed.

### **3.3.3. Strategic Market Analysis**

One of the interesting features of the Internet is *network news*, which can be described as a

“huge distributed conferencing system.”<sup>35</sup> Network news consists of thousands of newsgroups, read by millions of users, at hundreds of thousands of sites. There are news groups for most imaginable topics, and many unimaginable ones. There are groups for discussion of computers, arranged by manufacturer; there are groups for discussion of culture, arranged by nationality; there are groups for discussion of sports, arranged by team, level and sport; there are groups for discussion of science, arranged by discipline; there are groups for discussion of recreation, arranged by pastime; there are groups for discussion of miscellaneous topics, largely unarranged, etc.

The relevance of network news to strategic market analysis lies in the culture of the Internet, which tends to be open and sharing of information. Thus, for an entrepreneur interested in starting a business, one of the ideal places to examine the nature and quality of the competition, or market trends, or consumer satisfaction or dissatisfaction, is in network news.<sup>36</sup> In addition, the world-wide nature of the Internet and the growing numbers of commercial sites on the Internet (with increasing amounts of technical as well as non-technical information that commercial enterprises provide) make the Internet an excellent source of information about potential competitors, potential acquisitions, and potential customers.

### **3.3.4. Customer Service**

The Internet can be used in a variety of ways to enhance customer service. First, because it is a packet switched network (rather than a circuit switched one such as the telephone system), overload results in graceful degradation rather than in denial of service. Thus, when the phones are busy, a customer gets a busy signal (or is placed on hold), and after enough time, hangs up and complains about poor customer service. With e-mail, for example, a customer sends a message and has confidence that it will be received and acted upon. If the network happens to be extremely busy, the e-mail will take longer than usual to reach its destination, but that is of no concern to the customer;

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<sup>35</sup>Aboba, B. *The Online User's Encyclopedia*. Addison-Wesley Publishing Company: Reading, MA. 1993, p. 231.

<sup>36</sup>Network news is—with the exception of the “biz” newsgroup hierarchy—not open to commercial posting. Just what constitutes commercial posting, however, is not well defined. Thus, *lurking* (reading without posting), and asking information questions—for example, “What bicycle trailer should I buy, and why?”—is perfectly acceptable.

he or she needn't sit at the keyboard waiting for the mail's receipt, for the network takes care of delivery.

The Internet can also be used for direct delivery to customers. For example, software upgrades can be delivered via the Internet quickly, and without the cost of packaging or shipping; text can be delivered in ASCII, or PostScript, or whatever format a customer prefers. Also, record and movie companies can link audio and video clips to their home pages or order forms, for retrieval and playback via Mosaic or another hypermedia WWW browser. Even legal firms can improve customer service by using the Internet. For example, if a client of Hale & Dorr, which is based in Boston, needs to write a contract with a foreign company, the client fills out an electronic questionnaire and sends it to Hale & Dorr via the Internet. A lawyer creates a draft document and returns it to the client, along with a list of recommended lawyers from the country in which the client is doing business.<sup>37</sup>

The global connectivity of the Internet permits multi-national companies to improve customer service by taking advantage of all 24 hours of each day. Suppose a client in New York calls about a problem. The New York team can work on the problem for eight hours, then forward it, along with their intermediate results, to their European team, where it spends the next eight hours of its solution. Finally, when the Europeans are exhausted, they forward the work on to the Far East. The cycle repeats until the problem is solved; the customer knows only that problems seem to take fewer days to solve than they used to.

Finally, the Internet provides the possibility of face-to-face meetings between customers and customer service representative via videoconferencing—thereby considerably reducing a company's travel and lodging expenses.<sup>38</sup> Currently, neither the bandwidth nor the software is available for full motion video over the Internet. However, Cornell University has created prototype videoconferencing software called CU-SeeMe. With the software, with video cameras, and with Internet connections, two or a few users can participate in conferences with telephone-quality audio and several

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<sup>37</sup>Verity, J.W., *Op. cit.*, p. 81.

<sup>38</sup>Videoconferencing is, of course, a powerful tool for many aspects of corporate life in addition to customer service.

frames per second video.<sup>39</sup>

#### **4. Some Unresolved Issues**

The Internet is expanding dramatically, and so is commercial use of, and interest in, the Internet. David Cole, a former CEO of Ashton-Tate Corp. and now an Internet entrepreneur, says “I haven’t seen this much excitement since the early days of the PC industry in 1981.”<sup>40</sup> However, all is not perfect. In particular, the Internet was designed to reliably transport information, but not for commerce. Thus, the Internet was not built with particular concern for security or for privacy. In addition, the Internet is going through a transition from receiving a substantial amount of public funding (estimated at \$12 million annually<sup>41</sup>) to being completely self-sufficient. The remainder of this section will deal with some of these issues.

##### **4.1. Security and Privacy on the Internet**

Security and privacy are two sides of a coin: Security involves keeping outside intruders out, while privacy involves keeping inside information in. The Internet was designed with neither security nor privacy in mind. Indeed, for many years, most of the Internet hosts were at educational and research institutions, which, by their nature, encourage wide spread dissemination of information. Commercial activity, however, requires both a higher degree of security and a higher degree of privacy. For example, few companies would willingly share their marketing strategy or their new product plans with all interested parties (some of whom, of course, are their direct competitors); few consumers would willingly share their credit card numbers, or bank balances, with all interested parties.

Security on the Internet is often dealt with by using a *firewall*: a computer that serves as the only direct connection between a company’s internal computer(s) and the Internet. All packets into

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<sup>39</sup>The Frequently Asked Questions (FAQ) for CU-SeeMe is available for anonymous ftp from **gated.cornell.edu**, in directory **pub/video**, as **CU-SeeMe.FAQ.7-6.txt**.

<sup>40</sup>Verity, J.W. *Op. cit.*, p. 85.

<sup>41</sup>Lewis, P.H. “Internet Losing U.S. Funding.” *Op. cit.*.

and out from the company are routed via the firewall; company policy dictates what types of information are permitted to flow in either direction. A less extreme approach to the problem of security is that of user authentication, which has traditionally been done with passwords. Security conscious system administrators often implement programs that require users to select passwords that include non-alpha-numeric characters, that require passwords to have a minimum of six or more characters, and that expire users' passwords regularly and require them to choose new ones. The Kerberos authentication system, used in MIT's Athena distributed operating system, encrypts all passwords that are transmitted across the network.<sup>42</sup> This is because an unencrypted password, no matter how well chosen or how frequently changed, can be stolen by someone "listening" to traffic on the network. Kerberos uses the DES encryption algorithm, and stores all keys on a special server called the key-distribution server (KDC)—which, of course, would be an especially attractive target for someone wishing to compromise the system's security. Kerberos has been widely used since 1986, and the system administrators of MIT's computer network know of no instance of a compromise in security because of a failure in Kerberos; Kerberos is currently shipped as part of the standard OSF/1 UNIX distribution.

Encryption is a significant first step toward maintaining the privacy of private information because encrypted data are readable only by a person who has a decryption key. In its simple form, however, encryption is not sufficient for commercial uses that involve the exchange of private information: in such situations, both the sender and the receiver must be able to decrypt the information. This problem is profound, for if we assume an insecure network (which the Internet certainly is, if only because "anyone" can listen in on the phone lines over which much of its backbone traffic is carried), then how can a sender, who has encrypted some information for transmission, get the decryption key to the receiver? The sender could give the key to the receiver, person to person—but in that case, the sender might just as well give the information directly to the receiver, and dispense with the encryption and with the Internet!

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<sup>42</sup>Schiller, J.I. "Secure Distributed Computing." *Scientific American* 271:5, November, 1994, pp. 72-76.

Public key cryptography<sup>43</sup> offers an elegant and powerful solution to this problem. In a public key cryptography system, a user has two keys: a public one and a private one. The public key is known to all who are interested; the private key is known only to its owner. Public and private keys are related such that data encrypted with one person's public key can only be decrypted with that person's private key, and vice versa. Public key encryption is especially useful for establishing a *digital signature*—a way of assuring that a message comes from the person from whom it purports to come. A sender would encrypt a message with his or her private key; the receiver would know who the actual sender was, because the only public key that could decrypt the message is the one associated with the sender's private key, and only the sender has his or her private key.<sup>44</sup> So, once people have the appropriate public keys (they could be placed on a WWW home page, for example), an exchange of information using public key cryptography might go as follows:

- (1) The sender sends a message to the receiver, encrypted with the receiver's public key and signed with the sender's private key.
- (2) Only the receiver can read the message—with his or her private key—and the receiver has confidence in the identity of the sender because the signature decrypts with the sender's public key.
- (3) The receiver then returns an answer, encrypted with the sender's public key and signed with his or her private key.
- (4) The process continues as long as necessary.

One of the projects of CommerceNet is the the Secure HyperText Transfer Protocol (or S-HTTP; HTTP forms the basis for the World Wide Web), which includes the use cryptography.

S-HTTP is an extension of HTTP, providing independently applicable security services for transaction confidentiality, authenticity/integrity and non-repudiability of origin. The protocol emphasizes maximum flexibility in choice of key management mechanisms, security policies and cryptographic algo-

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<sup>43</sup>Rivest, R.L., Shamir, A. & Adelman, L.M. "A Method for Obtaining Digital Signatures and Public Key Cryptosystems." *Commun. ACM* 21:2, February, 1978, pp. 120-126.

<sup>44</sup>Actually, the receiver would know only whose private key was used to encrypt the message....

rithms by supporting option negotiation between parties for each transaction.<sup>45</sup>

#### **4.2. The Cost of Connection to the Internet**

In the early days of the ARPANET, the decision was made that hosts would forward packets that were routed through them (i.e., packets that neither originated nor terminated at their node) at no charge. Thus, connection to the Internet has, traditionally, been at a fixed price that is sensitive to the bandwidth of the connection, but not to the amount of data actually transferred. However, the Internet is simultaneously growing and becoming privatized; if demand outstrips capacity, one way to allocate limited capacity is by the institution of usage sensitive fees.<sup>46</sup> Such a policy would dramatically change the nature of the Internet, in several ways. First, non-profit organizations such as universities and public schools make use of the Internet extensively; they can afford to do so largely because there is a fixed, up-front cost for doing so, and because that cost is relatively modest.<sup>47</sup>

A second way in which a usage sensitive fee structure would impact commercial use of the Internet is in its potential for on-line shopping. One of the current attractions of the Internet is that browsing is, essentially, free. One of the reasons that the Internet is so attractive to the corporation is that customers seek out businesses rather than businesses having to seek out customers. If every byte transfer costs money, customers may still place on-line orders for items that they know they want, from companies that they know of, but they will probably be much less willing to browse—and, therefore, much less likely to discover a product that they want even though they didn't know it existed until they came upon it by accident.<sup>48</sup> It is ironic that browsing the Internet by anonymous ftp can involve relatively small data transfers, but such browsing is acceptable only to sophisticated

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<sup>45</sup>Rescorla, E. & Schiffman, A. "The Secure HyperText Transfer Protocol." Internet-Draft 35, December, 1994. It is available from <http://www.commerce.net>.

<sup>46</sup>Many commercial Internet access providers currently charge an hourly connect time; commercial "on-line" companies often charge an hourly fee and a fee for each byte transferred.

<sup>47</sup>Libby Black, Director of the Boulder Valley School District/University of Colorado-Boulder K-12 Internet Project, claims that public school districts will, simply, be unable to afford usage-sensitive fees.

<sup>48</sup>Should usage sensitive pricing be instituted, companies may decide they it is in their interest to pay for their customers' use—much as they do with 800 numbers, or with postage-paid mailers.



computer users with considerable patience. On the other hand, browsing via the World Wide Web is much more attractive to the novice computer user, but it also involves data transfers that are larger by orders of magnitude. Thus, usage sensitive fees would place a disproportionate burden upon exactly those people whom the World Wide Web has recently added to the pool of potential customers, and whose addition has made the Internet an attractive way of doing business in the first place!

A final change that would result from usage sensitive pricing is that the Internet would be less attractive to small companies, to start-up companies, or to companies where management is not quite so sure that it is interested yet in this anarchic, global, network called the Internet. For, one of the attractions of the Internet as a commercial apparatus is that a corporation can start with a rather modest investment, and increase it if results seem to warrant such increase. Usage sensitive pricing would, simply, make the Internet more expensive to use.

#### **4.3. The Availability of Connection to the Internet**

Finally, we must consider the availability of Internet connections to the population at large. Of current users of the World Wide Web, according to the New York ad agency Ogilby & Mather Direct, 80% are male, with a median income of \$54,000.<sup>49</sup> However, it is likely that corporations are interested in selling to women as well as men, and to people with a wide variety of life styles. One way of increasing access to the Internet is the wiring of public schools and public libraries—although it is not clear how many people will shop from a school or a library. The Boulder Community Network<sup>50</sup> is providing Internet access to targeted groups, like senior citizens and the handicapped. In addition, commercial Internet access providers are proliferating, their quality of Internet access is improving (from just e-mail to WWW browsers and SLIP/PPP dial-up lines), and prices are coming

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<sup>49</sup>Verity, J.W. *Op. cit.*, p. 86.

<sup>50</sup><http://bcn.boulder.co.us/Home.html>.

down, at least for the present. In addition, new products like “the internet adaptor”<sup>51</sup> and “Internet in a Box,”<sup>52</sup> and the inclusion of Internet connectivity software and World Wide Web browsers with operating systems like IBM’s OS/2 3.0 and Microsoft’s Windows 95, will all make the Internet more accessible to the typical personal computer user. However, the requirement of between \$1,000 and \$2,000 worth of hardware prices the Internet out of the reach of many people. The current debate about universal service and universal access to the National Information Infrastructure will, hopefully, resolve this issue in a manner that benefits both individuals and corporations, but such resolution is not imminent.

## 5. Summary and Conclusions

The Internet has considerable promise for the commercial user, largely because of its global reach and its decentralized operation. Table 1 summarizes the major points, as they have been detailed in this paper.

The Internet is a unique institution: it is decentralized, it is run by consensus, and it is available to everyone. Because of its origins in the research computer science community of the 1960s, the Internet has developed a culture of tolerance, information sharing, and assistance for any who ask. These are values that many Americans remember fondly from their past, when the world seemed less complicated and when people were less alienated from the communities in which they lived. The culture of the Internet is decidedly not the culture of the American corporation, and “commercialization” of the Internet brings with it the risk of culture shock.<sup>53</sup> However, commercialization of the Internet also brings with it the potential to change—hopefully for the better—the way that corporations do business, and the way that individuals interact with each other, with corporations, and with their government.<sup>54</sup> The Internet can be thought of as a precursor to, and perhaps as a

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<sup>51</sup>Information on the internet adaptor is available by anonymous ftp from **marketplace.com**, in directory **tia/docs**, as **tia.info.txt**.

<sup>52</sup><http://www.spry.com>.

<sup>53</sup>Waldrop, M.M. “Culture Shock on the Networks.” *Science* 265:5174, 1994, pp. 879-881.

<sup>54</sup><http://www.whitehouse.gov>.

<b>Commercial Uses for the Internet</b>		
<b>Features</b>	Connectivity	global; rapidly growing
	Availability	universal, with appropriate hardware and software
	Usability	with WWW and browser: interface similar to Windows/Macintosh
<b>Commercial Uses</b>	Cost	lower than traditional mail or phone order
	Advertising	consumers actively seek information about products of interest
	Market Analysis	observe/query potential and/or actual customers and/or competitors
	Customer Service	no busy signal; world-wide connectivity
<b>Unresolved Issues</b>	Security/Privacy	default: low; encryption, Secure HTTP, are available
	Cost	with privatization, future cost structure is uncertain
	Availability	still low, compared with mass media

**Table 1: Summary of Commercial Uses for the Internet**

model for, a National Information Infrastructure. It is incumbent upon us as citizens (both corporate and individual) to strive to make it a useful and equitable model, for the mutual benefit of us all.

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## 7. Related Publications of Interest

*Cybernautics Digest: Reports about converging information technologies*. A free sample issue is available via e-mail to **tw Hansen@cuix.pscu.com**; WWW: **http://www.pscu.com**.

Hughes, K. "Entering the World-Wide Web: A Guide to Cyberspace." Available in PostScript for anonymous ftp from **ftp.eit.com**, as **pub/web.guide**, or **http://www.eit.com**.

*The Internet Letter On Corporate Users, Internetworking and Information Services*. A free sample issue is available via e-mail to **levin@netweek.com**.

*Internet Society NEWS* is the publication of the Internet Society. Membership information for individuals is available via e-mail to **membership@isoc.org**; for organizations: **org-membership@isoc.org**. General information is available via e-mail to **isoc@isoc.org**, or **http://info.isoc.org**.

Torkington, N. "An Information Provider's Guide to HTML," "An Information Provider's Guide to Web Servers," and "World Wide Web Primer." All are available in PostScript, LaTeX, DVI and ASCII for anonymous ftp from **wuarchive.wustl.edu**, in directory **doc/misc/www**. Or, **http://www.vuw.ac.nz/non-local/gnat**, as **www-html.html**, **www-servers.html**, and **www-primer.html**, respectively.