Entering the World-Wide Web:

A Guide to Cyberspace

By Kevin Hughes

Enterprise
Integration
Technologies

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“The problem with the future is that it usually arrives before we’re ready for it.”

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What is the World-Wide Web?

For fifty years, people have dreamt of the concept of a universal database of knowledge – information that would be accessible to people around the world and link easily to other pieces of information so that any user could quickly find the things most important to themselves. It was in the 1960's when this idea was explored further, giving rise to visions of a "docuverse" that people could swim through, revolutionizing all aspects of human-information interaction. Only now has the technology caught up with these dreams, making it possible to implement them on a global scale.

The **World-Wide Web** is officially described as a "wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents". What the World-Wide Web (WWW, W3) project has done is provide users on computer networks with a consistent means to access a variety of media in a simplified fashion. Using a popular software interface to the Web called **Mosaic**, the Web project has changed the way people view and create information – it has created the first true global hypermedia network.

The earliest visions of such systems had as their goal the advancement of science and education. Although the World-Wide Web project has the potential to make a significant impact in these areas, it is poised to revolutionize many elements of society, including commerce, politics, and literature.

What is hypertext and hypermedia?

The operation of the Web relies mainly on **hypertext** as its means of interacting with users. Hypertext is basically the same as regular text – it can be stored, read, searched, or edited – with an important exception: hypertext contains connections within the text to other documents.

For instance, suppose you were able to somehow select (with a mouse or with your finger) the word "hypertext" in the sentence before this one. In a hypertext system, you would then have one or more documents related to hypertext appear before you – a history of hypertext, for example, or the Webster's definition of hypertext. These new texts would themselves have links and connections to other documents – continually selecting text would

take you on a free-associative tour of information. In this way, hypertext links, called **hyperlinks**, can create a complex virtual web of connections.

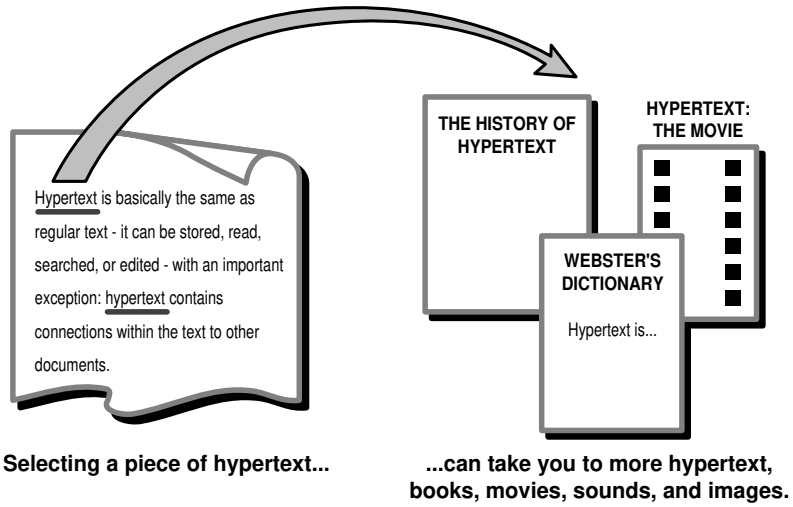


Figure 1. How hypertext works.

Hypermedia is hypertext with a difference – hypermedia documents contain links not only to other pieces of text, but also to other forms of media – sounds, images, and movies. Images themselves can be selected to link to sounds or documents. Hypermedia simply combines hypertext and multimedia. Here are some simple examples of hypermedia:

- You are reading a text on the Hawaiian language. You select a Hawaiian phrase, then hear the phrase as spoken in the native tongue.
- You are a law student studying the California Revised Statutes. By selecting a passage, you find precedents from a 1920 Supreme Court ruling stored at Cornell. Cross-referenced hyperlinks allow you to view any one of 520 related cases with audio annotations.
- Looking at a company's floor plan, you are able to select an office by touching a room. The employee's name and picture appears with a list of their current projects.
- You are a scientist doing work on the cooling of steel springs. By selecting text in a research paper, you are able to view a computer-generated movie of a cooling spring. By selecting a button you are able to receive a program which will perform thermodynamic calculations.

- A student reading a digital version of an art magazine can select a work to print or display in full. Rotating movies of sculptures can be viewed. By interactively controlling the movie, the student can zoom in to see more detail.

The Web, although still in its infancy, has already enabled many of these examples. It facilitates the easy exchange of hypermedia through networked environments from anything as small as two Macintoshes connected together to something as large as the global Internet.

What is the Internet?

The **Internet** is the catch-all word used to describe the massive world-wide network of computers. The word “internet” literally means “network of networks”. In itself, the Internet is comprised of thousands of smaller regional networks scattered throughout the globe. On any given day it connects roughly 20 million users in over 50 countries. The World-Wide Web is mostly used on the Internet; they do not mean the same thing. The Web refers to a body of information – an abstract space of knowledge, while the Internet refers to the physical side of the global network, a giant mass of cables and computers.

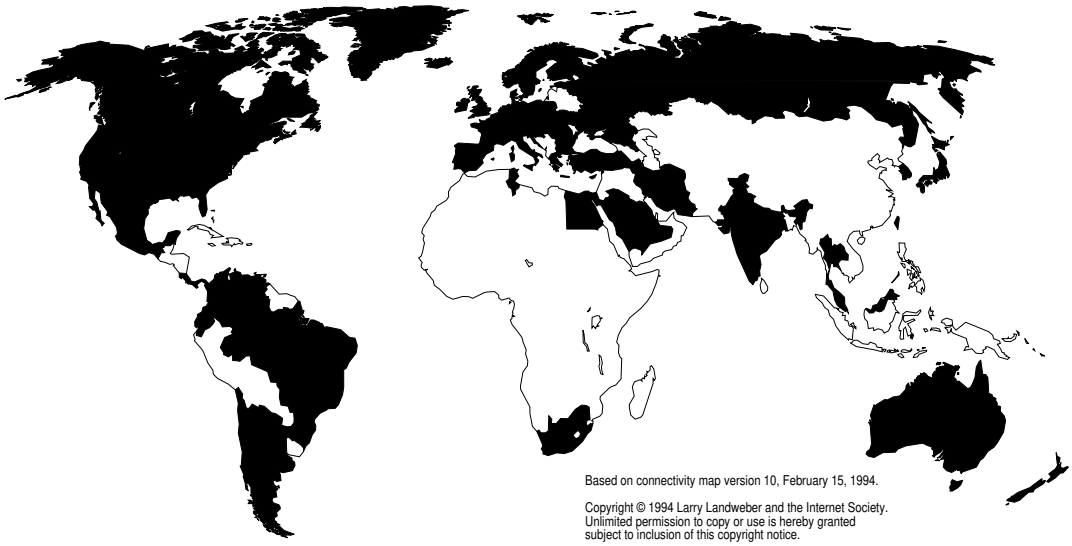


Figure 2. The countries in black have Internet connectivity. The number of people with Internet access in these countries varies widely, however. Countries in white may have access to email, local isolated networks, or no connectivity at all. Statistics available by FTP from `ftp.cs.wisc.edu`.

Nobody “owns” the Internet – although there are companies that help manage different parts of the networks that tie everything together, there is no single governing body that controls what happens on the Internet. The networks within different countries are funded and managed locally according to local policies.

Having access to the Internet usually means that one has access to a number of basic services: electronic mail, interactive conferences, access to information resources, network news, and the ability to transfer files.

The World-Wide Web uses the Internet to transmit hypermedia documents between computer users internationally. Much in the same way, nobody “owns” the World-Wide Web. People are responsible for the documents they author and make available publicly on the Web. Via the Internet, hundreds of thousands of people around the world are making information available from their homes, schools, and workplaces.

It’s possible to use World-Wide Web software without having to use the Internet. But Internet access is necessary in order to make full use of and participate in the World-Wide Web. To get more information on the Internet, how to obtain Internet access, and how to use the Internet, see the section “**How can I get more information?**”

How was the Web created?

The World-Wide Web began in March 1989, when Tim Berners-Lee of the European Particle Physics Laboratory (known as **CERN**, a collective of European high-energy physics researchers) proposed the project to be used as a means of transporting research and ideas effectively throughout the organization. Effective communications was a goal of CERN’s for many years, as its members were located in a number of countries.

The initial project proposal outlined a simple system of using networked hypertext to transmit documents and communicate among members in the high-energy physics community. There was no intention of adding sound or video, and the capability to transmit images was not considered.

By the end of 1990, the first piece of Web software was introduced on a NeXT machine. It had the capability to view and transmit hypertext documents to other people on the Internet, and came with the capability to edit hypertext documents on the screen. Demonstrations were given to CERN committees and seminars, and a demonstration was given at the Hypertext ‘91 conference. Throughout 1992 Tim continued to speak on and evangelize the project, as small handfuls of developers began to volunteer their time into working on small pieces of the World-Wide Web puzzle.

Since then hundreds of people throughout the world have contributed their time writing Web software and documents or telling others about the Web. In a way never envisioned by the original project group, the project has reached global proportions. In the first four months of 1994 alone, the World-Wide Web has been mentioned by CNN, the *Wall Street Journal*, the *Economist*, *Fortune* magazine, the *New York Times*, and dozens of computer publications.

How popular is the Web?

From January to December 1993, the amount of network traffic (in bytes) across the National Science Foundation's (NSF's) North American network attributed to Web use multiplied by 187 times. In December 1993 the Web was ranked 11th of all network services in terms of sheer byte traffic – just twelve months earlier, its rank was 127.

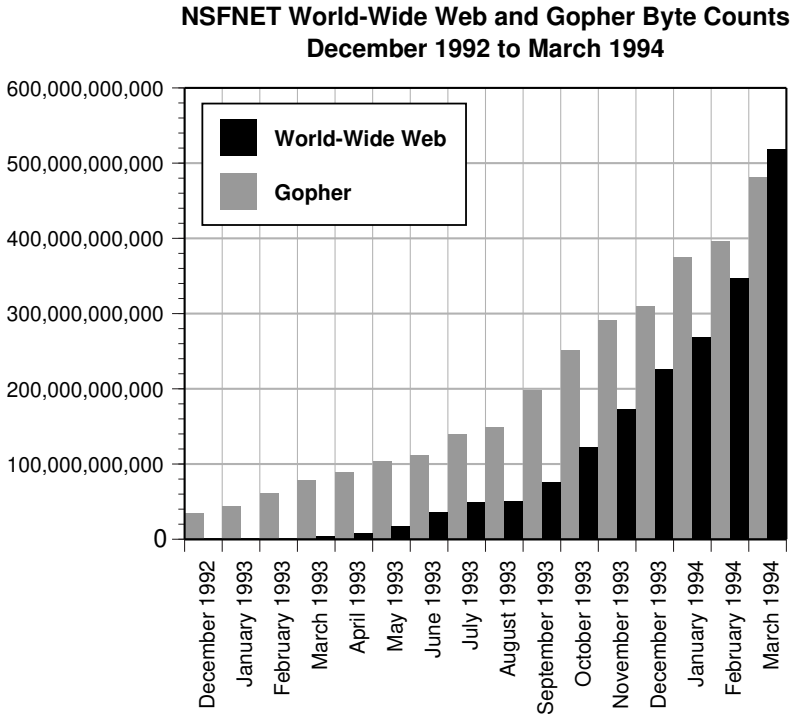


Figure 3. World-Wide Web growth. Statistics available by FTP from `nic.merit.edu`.

In June 1993, Matthew Gray at MIT ran a small program which automatically travels links within the Web network to try to determine just how many sites there are that offer information over the World-Wide Web. His small "World-Wide Web Wanderer" found around 100 sites that month and over two hundred thousand documents. In March 1994 his robot found over 1,200 unique sites. Even though the robot's programming was improved somewhat,

and a number of factors may have affected the final count, the growth rate of the Web from the last half of 1993 throughout the first half of 1994 is amazing and continues to increase.

Brian Pinkerton at the University of Washington has been maintaining a similar program called the “WebCrawler”. Its last run in mid-May 1994 found over 3,800 unique Web sites.

Given that many sites are private (hidden behind corporate firewalls or not connected to the public Internet), it can be safely stated that, as of May 1994, there are at least 4,500 hypertext Web servers in use throughout the world.

Based on Web site statistics, estimates of the number of knowledgeable Web users in the world has been as large as two million. However, considering the number of hosts that frequent the most populated areas of the Web, it is safe to say that there are around 250,000 to 500,000 current active Web users today.

A Case Study – Honolulu Community College

Honolulu Community College officially announced the opening of their hypermedia site – the first Web site in Hawaii and the first hypermedia campus-wide information system on the Web – at the end of May 1993. A campus dinosaur exhibit, interactive map, movies, and publications were offered there and immediately attracted an international audience.

By September of that year (after 105 days of service), they had received over 23,000 requests for documents and over 112,000 requests for graphics and other media from nearly 5,000 separate hosts on the network. Today, the site receives about 7,000 requests per day on average, a large majority of which comes from outside Hawaii.

Since the site’s opening, HCC has received virtual visitors from Xerox, Digital Equipment Corporation, Apple Computer, Cray, IBM, MIT’s Media Lab, NEC, Sony, Fujitsu, Intel, Rockwell, Boeing, Honeywell, and AT&T (which has been one of the most frequent visitors), among hundreds of other corporate sites on the Internet.

Collegiate visitors have originated from campuses such as Stanford, Harvard, Carnegie-Mellon, Cornell, MIT, Michigan State, Rutgers, Purdue, Rice, Georgia Tech, Columbia, University of Texas, and Washington University, as well as other campuses in the United Kingdom, Germany, and Denmark, to name but a few.

Governmental visitors have come from various departments in NASA, including their Jet Propulsion Laboratories, Lawrence Livermore National Laboratories, the National Institute of Health, the Superconducting Supercollider project, and the USDA, as well as government sites in Singapore and Australia. A few dozen Army and Navy sites throughout the world also visited the site.

Because HCC’s service began operation when there were relatively few such sites in the world, and in part due to its popularity, their growth in traffic has closely reflected the growth of the Web.

The Popularity of Other Web Sites

The *Global Network Navigator* is an electronic magazine published by O'Reilly and Associates over the World-Wide Web. It offers news, a calendar of Internet events, and a virtual marketplace in which companies can advertise their services. It has roughly 12,000 registered subscribers and receives about 150,000 to 200,000 requests for documents and media per week from people all over the Internet.

Perhaps the best example of the growth in Web usage can be seen at the **National Center for Supercomputing Applications** (**NCSA**). The NCSA produces a number of popular software products for World-Wide Web use and their Web site is used as documentation for their products as well as a repository for announcements of new events on the Web. In July 1993 NCSA's site received roughly 100,000 requests per week. Currently it receives at least one million requests per week and its traffic continues to increase.

Who Travels the Web?

An informal comparison of host statistics from 15 government, research, educational, and corporate Web sites in March 1994 shows that the people roaming the World-Wide Web follow the makeup of the Internet fairly well.

Shown are the top five Web users by domain and the average percentage of total hosts each Web site received. Next to these statistics is the estimated percentage of total hosts on the Internet for these domains.

Table 1: Top Five World-Wide Web Users, by Domain

Domain	Percent of Web Traffic	Percent of Internet Hosts*
U.S. Educational (.edu)	**49%**	**27%**
U.S. Commercial (.com)	**20%**	**26%**
U.S. Government (.gov)	**9%**	**6%**
United Kingdom (.uk)	**7%**	**5%**
Canada (.ca)	**5%**	**4%**

**From January 1994 Stanford Research Institute (SRI International) statistics, available by FTP from* `nic.merit.edu`.

In January 1994, James Pitkow (pitkow@cc.gatech.edu) and Mimi Recker at the Georgia Institute of Technology held the first World-Wide Web user survey. Out of 1,300 valid responses, the results indicated the following statistics about the respondents:

- 56% were between the ages of 21 and 30,
- 94% were male,
- 69% were located in North America, and
- 45% described themselves as professionals and 22% as graduate students.

Although it is impossible to know for sure, it can be guessed that the largest segment roaming the World-Wide Web consists of four-year campus populations within the United States.

Why Is The Web So Popular?

The Web offers a very simple-to-use interface to the traditionally hard-to-master resources on the Internet. It is probably this ease of use as well as the popularity of many graphical interfaces to the Web that caused the explosion of Web traffic in 1993.

The potential of using networked hypertext and multimedia has prompted many users to create and explore countless innovative applications on the Internet. It is perhaps no surprise that more educational users are on the Web than would be expected.

What does the Web look like?

The World-Wide Web exists virtually – there is no standard way of viewing it or navigating around it. However, many software interfaces to the Web have similar functions and generally work the same way no matter what computer or type of display is used. In fact, many users navigate around the Web using text-only interfaces and are able to see all of the textual information a user with a graphic display would.

Below is a picture of the typical graphical World-Wide Web interface that you would see on a computer screen. It may be black or white or in color. In this example the interface – called a **Web browser** – works in a window and may be a software program on any computer with a graphic interface, such as a Macintosh or an IBM-compatible computer with Microsoft Windows.

Figure 4. A typical Web browser for a graphic user interface.

The browser has a **menu bar** on top, where the user can quit, get help on using the program, and change certain display characteristics such as the screen font size, the background color, etc.

A **scroll bar** allows the user to scroll the document page up and down. Because there is no limit to how wide or small a hypermedia document can be, scroll bars are often needed in case the document is larger than the viewing window.

Although there are many different ways to represent a document on the screen, it is often called a **page**. Usually, those responsible for creating a given collection of interrelated documents also create a special document which is intended to be viewed first - one that contains introductory information and/or a master menu of

documents within that collection. This type of document is called a **home page** and is generally associated with a particular site, person, or named collection. The example shows the Flower Shop's home page.

This document has a picture of a flower, text in a bold font ("Welcome to the Flower Shop!") and hypertext in which a single word is underlined. This word ("link") is a **hyperlink** (or **link**) – typically, clicking on it with a mouse will cause another document to appear on the screen, which may hold more images and hyperlinks to other places. There is no one way to represent text that is linked to other things – some browsers underline, others use special colors, and many give the user a variety of options.

Images such as the flower picture which are part of the document and are displayed within the page are called **inline images**.

Often users create their own personal documents with collections of their favorite links or biographical information and make them publicly available. Although these pages are also called home pages (they are a virtual "home" for the user), they may be called "personal pages" or "hyplans" (hypermedia plans).

At the bottom of the screen is a set of **navigation buttons** – because a user might go to many different screens by selecting links in hypertext, there needs to be some method of retracing one's steps and reviewing the documents that have been explored. The **back** button shows the previously viewed document. The **forward** button would show the pages in the order the user previously viewed them.

An **open** button allows the user to connect to other documents and networked resources by specifying the address of the document or resource to connect to. The user might be able to connect to a document stored locally on the same machine being used or one stored somewhere in another country. Typically, such a document would be transferred over the Internet in its entirety.

The **print** button allows the user to print out the document seen on the screen. The user may be given the choice of printing the document with images and formatting as seen on the screen or as a text-only document.

The page lists an email address – `webmaster@flowers.com`. A convention on the Web is to name the person in charge of administrating a World-Wide Web site a "**webmaster**" – any problems with the hyperlinks, images, documents, or questions about the site should be mailed to a webmaster address.

What is Mosaic?

Months after CERN's original proposal, the **National Center for Supercomputing Applications** (**NCSA**) began a project to create an interface to the World-Wide Web. One of NCSA's missions is to aid the scientific research community by producing widely available, non-commercial software. Another of its goals is to investigate new research technologies in the hope that commercial interests will be able to profit from them. In these ways, the Web project was quite appropriate. The NCSA's **Software Design Group** began work on a versatile, multi-platform interface to the World-Wide Web, and called it **Mosaic**.

In the first half of 1993, the first version of NCSA's Web browser was made available to the Internet community. Because earlier beta versions were distributed, Mosaic had developed a strong following by the time it was officially released. Because it allowed documents with images to be viewed and new media formats such as video and sound to be transferred over the Internet and pointed to by documents, it became the Web browser of choice for those working on computers with graphics capability. In 1993 NCSA's Mosaic products won the Internet Multicasting Service's yearly Ima award for the Most Innovative Application and the InfoWorld Industry Achievement award.

Because of the number of traditional services it could handle, and due to its easy, point-and-click hypermedia interface, Mosaic soon became the most popular interface to the Web. Currently versions of Mosaic can run on UNIX-based machines such as Sun, Silicon Graphics, and DEC workstations as well as IBM-compatibles running Microsoft Windows and Macintosh computers.

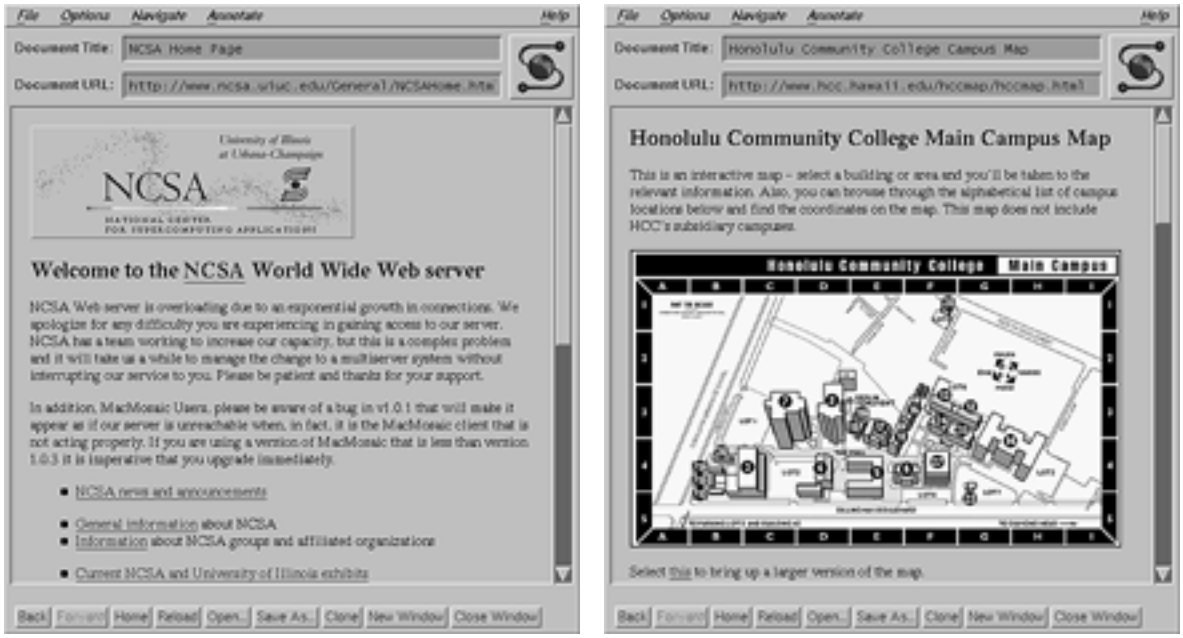


Figure 5. NCSA's Mosaic for X Windows.

What can Mosaic do?

Mosaic has the following features:

- A consistent mouse-driven graphical interface.
- The ability to display hypertext and hypermedia documents.
- The ability to display electronic text in a variety of fonts.
- The ability to display text in bold, italic, or strikethrough styles.
- The ability to display layout elements such as paragraphs, lists, numbered and bulleted lists, and quoted paragraphs.
- Support for sounds (Macintosh, Sun audio format, and others).
- Support for movies (MPEG-1 and QuickTime).
- The ability to display characters as defined in the ISO 8859 set (it can display languages such as French, German, and Spanish).
- Interactive electronic forms support, with a variety of basic forms elements, such as fields, check boxes, and radio buttons.
- Support for interactive graphics (in GIF or XBM format) of up to 256 colors within documents.
- The ability to make basic hypermedia links to and support for the following network services: FTP, gopher, telnet, NNTP, WAIS.
- The ability to extend its functionality by creating custom scripts (comparable to XCMDs in HyperCard on Macintosh computers).
- The ability to have other applications control its display remotely.
- The ability to broadcast its contents to a network of users running multiplatform groupware such as NCSA's Collage.
- Support for the current standards of HTTP and HTML.
- The ability to keep a history of travelled hyperlinks.
- The ability to store and retrieve a list of viewed documents for future use.

What is available on the Web?

Currently the Web offers the following through a hypertext, and in some cases, hypermedia interface:

- Anything served through Gopher
- Anything served through WAIS (Wide-Area Information Servers)
- Anything served through anonymous FTP sites
- Full Archie services (a FTP search service)
- Full Veronica services (a Gopher search service)
- Full CSO, X.500, and whois services (Internet phone book services)
- Full finger services (an Internet user lookup program)
- Anything on Usenet
- Anything accessible through telnet
- Anything in hytelnet (a hypertext interface to telnet)
- Anything in techinfo or texinfo (forms of campus-wide information services)
- Anything in hyper-g (a networked hypertext system in use throughout Europe)
- Anything in the form of man pages
- HTML-formatted hypertext and hypermedia documents

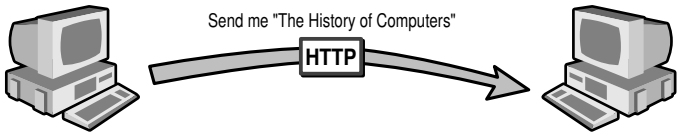
How does the Web work?

Web software is designed around a distributed **client-server architecture**. A **Web client** (called a **Web browser** if it is intended for interactive use) is a program which can send requests for documents to any Web server. A **Web server** is a program that, upon receipt of a request, sends the document requested (or an error message if appropriate) back to the requesting client. Using a distributed architecture means that a client program may be running on a completely separate machine from that of the server, possibly in another room or even in another country. Because the task of document storage is left to the server and the task of document presentation is left to the client, each program can concentrate on those duties and progress independently of each other.

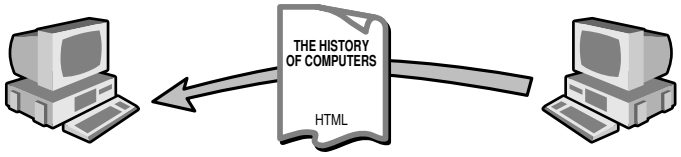
Because servers usually operate only when documents are requested, they put a minimal amount of workload on the computers they run on.

Here's an example of how the process works:

1. Running a Web **client**, the user selects a hyperlink in a piece of hypertext connecting to another document – "The History of Computers", for example.
2. The Web client uses the address associated with that hyperlink to connect to the Web server at a specified network address and asks for the document associated with "The History of Computers".
3. The **server** responds by sending the text and any other media within that text (pictures, sounds, or movies) to the client, which the client then renders for presentation on the user's screen.



The client sends an HTTP message to a computer running a Web server program and asks for a document.



The Web server sends the hypermedia HTML document to the client. You end up seeing the document on your screen.

Figure 6.A typical transaction between Web servers and clients.

The World-Wide Web is composed of thousands of these virtual transactions taking place per hour throughout the world, creating a web of information flow.

Future Web servers will include encryption and client authentication abilities – they will be able to send and receive secure data and be more selective as to which clients receive information. This will allow freer communications among Web users and will ensure that sensitive data is kept private. It will be harder to compromise the security of commercial servers and educational servers which wish to keep information local. Improvements in security will facilitate the idea of "pay-per-view" hypermedia, a concept which many commercial interests are pursuing.

The language that Web clients and servers use to communicate with each other is called the **Hypertext Transfer Protocol** (**HTTP**). All Web clients and servers must be able to speak HTTP in order to send and receive hypermedia documents. For this reason, Web servers are often called HTTP servers.

The phrase “World-Wide Web” is often used to refer to the collective network of servers speaking HTTP as well as the global body of information available using the protocol.

HTML – The Hypertext Markup Language

The standard language the Web uses for creating and recognizing hypermedia documents is the **Hypertext Markup Language** (**HTML**). It is loosely related to, but technically not a subset of, the Standard Generalized Markup Language (SGML), a method of representing document formatting languages. Languages such as HTML which follow the SGML format allow document writers to separate information from document presentation – that is, documents containing the same information can be presented in a number of different ways. Users have the option of controlling visual elements such as fonts, font size and paragraph spacing without changing the original information.

HTML is widely praised for its ease of use. Web documents are typically written in HTML and are usually named with the suffix “`.html`”. HTML documents are nothing more than standard 7-bit ASCII files with formatting codes that contain information about layout (text styles, document titles, paragraphs, lists) and hyperlinks.

Free conversion software is available for translating documents from many other formats into HTML. Filters exist that can convert files in RTF (Rich Text Format), WordPerfect and FrameMaker as well as man pages, mail archives, and text-only documents.

The current HTML standard supports basic hypermedia document creation and layout, but is limited in its capability to support many complex layout techniques found in traditional document publishing. A new version of HTML, called **HTML+**, is under development and should be completed by the end of 1994. When completed, HTML+ will be backwards compatible with HTML and will support interactive forms, defined “hot spots” in images, more versatile layout and formatting options and styles, and formatted tables.

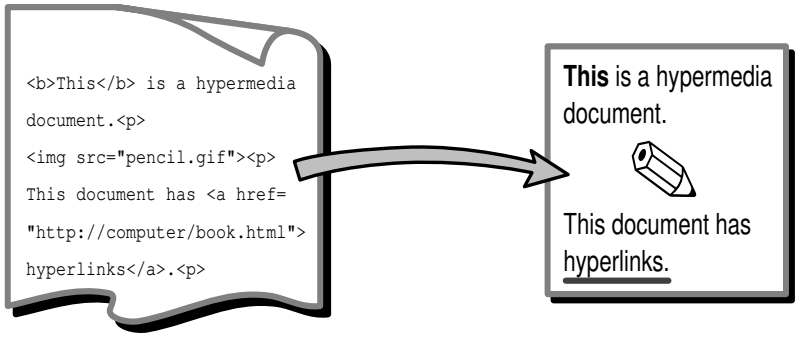


Figure 7. HTML-formatted documents allow images and hyperlinks to be displayed in documents.

About Uniform Resource Locators

The World-Wide Web uses what are called **Uniform Resource Locators** (**URLs**) to represent hypermedia links and links to network services within HTML documents. It is possible to represent nearly any file or service on the Internet with a URL.

The first part of the URL (before the two slashes) specifies the method of access. The second is typically the address of the computer the data or service is located. Further parts may specify the names of files, the port to connect to, or the text to search for in a database. A URL is always a single unbroken line with no spaces.

Sites that run World-Wide Web servers are typically named with a `www` at the beginning of the network address.

Here are some examples of URLs:

- `file://www.hcc.hawaii.edu/sound.au` – Retrieves a sound file and plays it.
- `file://www.eit.com/picture.gif` – Retrieves a picture and displays it, either in a separate program or within a hypermedia document.
- `file://www.eff.org/directory/` – Displays a directory's contents.
- `http://www.hcc.hawaii.edu/directory/book.html` – Connects to an HTTP server and retrieves an HTML file.
- `ftp://www.xerox.com/pub/file.txt` – Opens an FTP connection to `www.xerox.com` and retrieves a text file.
- `gopher://www.hcc.hawaii.edu` – Connects to the Gopher at `www.hcc.hawaii.edu`.
- `telnet://www.hcc.hawaii.edu:1234` – Telnets to `www.hcc.hawaii.edu` at port 1234.
- `news:alt.hypertext` – Reads the latest Usenet news by connecting to a user-specified news (NNTP) host and returns the articles in the `alt.hypertext` newsgroup in hypermedia format.

Most Web browsers allow the user to specify a URL and connect to that document or service. When selecting hypertext in an HTML document, the user is actually sending a request to open a URL. In this way, hyperlinks can be made not only to other texts and media, but also to other network services. Web browsers are not simply Web clients, but are also full-featured FTP, Gopher, and telnet clients.

HTML+ will include an email URL, so hyperlinks can be made to send email automatically. For instance, selecting an email address in a piece of hypertext would open a mail program, ready to send email to that address.

What software is available?

World-Wide Web **clients** (browsers) are available for the following platforms and environments:

- Text-only browsers:
  - Dumb terminal, nearly any UNIX platform
  - Text-only using curses (vt100 emulation), for SunOS 4.1.x, IBM AIX, DEC OSF/1, DEC Ultrix, and VAX Multinet.
  - Macintosh text-only, for Mac SE's and above with System 7.x.
  - Browsers written in perl are available.
  - Browsers written for the emacs environment are available.
- Browsers with graphical interfaces:
  - Sun 4/Sun OS 4.1.x
  - Silicon Graphics IRIX 4.x
  - VMS
  - Linux
  - DEC MIPS Ultrix, DEC Alpha AXP, OSF/1
  - IBM RS/6000, AIX 3.2
  - HP 9000/700, HP/UX 9.x
  - NeXT, NeXTStep 3.0
  - Commodore Amiga, AmigaOS 3.0
  - IBM compatibles, 80386 and above with 4 MB RAM, under Windows 3.1 in enhanced mode
  - Macintosh computers, System 7.x, 68020 and above or Power Macintosh.

World-Wide Web **servers** are available for the following platforms and environments:

- Most flavors of UNIX
- HP, SGI, and SUN systems
- DEC MIPS Ultrix, DEC Alpha AXP
- Perl
- Macintosh, 68020 or better, Power Macintosh, System 7.x
- NeXTStep
- VM, VM/CMS, VM/XA, VMS

- Windows 3.1 and Windows NT

For details on how to obtain Web client and server software, refer to the next section "**How can I get more information?**"

How can I get more information?

Most of this information is available on the Internet. In order to access resources specified by a URL, you may need to use a Web browser or connect to a telnet site that provides a public-access browser. Enter the URL as one unbroken line without spaces or carriage returns.

The best way to get general information on the Web without a browser is to `telnet info.cern.ch` or `gopher info.cern.ch`. Information on how to obtain software can also be found there.

If you don't know how to use FTP, Gopher, or telnet, there are dozens of good books available on how to get on and use the Internet. Although there are too many introductory books to list, here are a few mentioned by the Unofficial Internet Book List (to receive the list, send email to `savetz@rahul.net`).

The Internet Guide for New Users

Daniel P. Dern, McGraw-Hill, ISBN: 0-07-016511 (paperback)

The Internet Starter Kit for the Macintosh

Adam Engst, Hayden Books, ISBN: 1-56830-064-6

The Internet Unleashed

Martin Moore, others, Sams Publishing, ISBN: 0-672-30466-X

PC Internet Tour Guide

Michael Fraase, Ventana Press, ISBN: 1-56604-084-1

The Whole Internet User's Guide and Catalog

Ed Krol, O'Reilly and Associates, ISBN: 1-56592-025-2

Zen and the Art of Internet

Brendan Kehoe, Prentice Hall, ISBN: 0-13-010778-6

Browsers Accessible by telnet

This list is from the comprehensive list of telnet-accessible clients at `http://info.cern.ch/hypertext/WWW/FAQ/Bootstrap.html`:

`telnet info.cern.ch` (or `telnet 128.141.201.74`)

This is CERN's text-only Web browser. The site is in Geneva, Switzerland.

`telnet ukanaix.cc.ukans.edu`

This University of Kansas site uses the text-only *Lynx* browser, which works best on terminals with vt100 emulation. Log in as `www`.

`telnet www.njit.edu`

Log in as `www`. This is the New Jersey Institute of Technology's text-only browser.

`telnet vms.huji.ac.il` (or `telnet 128.139.4.3`)

This text-only browser at the Hebrew University of Jerusalem in Israel works off a dual-language Hebrew/English database.

`telnet sun.uakom.cs`

This site in Slovakia has a slow connection and should be used locally only.

`telnet fserv.kfki.hu`

This site in Hungary has a slow connection and should be used locally only. Log in as `www`.

`telnet info.funet.fi` (or `telnet 128.214.6.100`)

This site is in Finland.

General Web Information

Main CERN World-Wide Web page

`http://info.cern.ch/hypertext/WWW/TheProject.html`

Main NCSA Mosaic page

`http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/Docs/mosaic-docs.html`

Information on WWW

`http://www.bsdi.com/server/doc/web-info.html`

A list of World-Wide Web clients at CERN

`http://info.cern.ch/hypertext/WWW/Clients.html`

The "official" list of World-Wide Web servers at CERN

`http://info.cern.ch/hypertext/DataSources/WWW/Servers.html`

The comp.infosystems.www FAQ (Frequently Asked Questions) file

`http://siva.cshl.org/~boutell/www_faq.html`

Usenet Newsgroups

For general discussion:

`comp.infosystems.www`

For announcements:

`comp.infosystems.announce`

Other Web-related newsgroups:

`http://info.cern.ch/hypertext/WWW/Newsgroups.html`

Mailing Lists

For general discussion and announcements:

send email to `listserv@info.cern.ch`, with `subscribe www-announce your name` as the body.

For developers and technical discussion:

send email to `listserv@info.cern.ch`, with `subscribe www-talk your name` as the body. Hypertext archives are available at `http://gummo.stanford.edu/html/hypermail/archives.html`.

For HTML-related discussion:

send email to `listserv@info.cern.ch`, with `subscribe www-html your name` as the body.

Other lists at CERN:

`http://info.cern.ch/hypertext/WWW/Administration/Mailing/Overview.html`

World-Wide Web courseware:

send email to `www-courseware-request@eit.com`, with `subscribe` as the body. Hypertext archives are available at `http://www.eit.com/mailinglists/www-courseware/www-courseware.index.html`.

World-Wide Web literature:

send email to `www-literature-request@eit.com`, with `subscribe` as the body. Hypertext archives are available at `http://www.eit.com/mailinglists/www-literature/www-literature.index.html`.

World-Wide Web library resource management:

send email to `listserv@library.berkeley.edu`, with `SUB Web4Lib your name` as the body.

Local groups

The Austin, Texas World-Wide Web Users' Group (AWWWUG) – send email to `combs.quadralay.com` for information.

The World-Wide Web Special Interest Group (SIGWEB), located in California. Email `mcrae@ora.com` for information.

Lists of tools and convertors

`http://info.cern.ch/hypertext/WWW/Tools/Overview.html`

`http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/Docs/faq-software.html`

How to write Web gateways and servers

`http://info.cern.ch/hypertext/WWW/Daemon/Overview.html`

Information on HTML and HTTP

How to write HTML

`http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html`

HTML Tutorials

`http://curia.ucc.ie/info/net/htmldoc.html`

`http://fire.clarkson.edu/doc/html/htut.html`

HTML Style Guides

`http://www.willamette.edu/html-composition/strict-html.html`

`http://bookweb.cwis.uci.edu:8042/Staff/Style-Guide.html`

`http://info.cern.ch/hypertext/WWW/Provider/Style/Overview.html`

HTML FAQ

`http://www.umcc.umich.edu/~ec/www/html_faq.html`

HTML Quick Reference

`http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLQuickRef.html`

HTML official specifications

`http://info.cern.ch/pub/www/doc/html-spec.multi`

The Annotated HTML DTD (Document Type Definition)

`http://info.cern.ch/hypertext/WWW/MarkUp/HTML.dtd.html`

HTML+ DTD

`ftp://15.254.100.100/pub/htmlplus.dtd.txt`

The Latest HTML+ Draft

`ftp://ds.internic.net/internet-drafts/draft-raggett-www-html-00.*`

HTTP Specifications

`http://info.cern.ch/hypertext/WWW/Protocols/HTTP/HTTP2.html`

Information and Reports on Multimedia and Hypermedia

Index to multimedia resources

`http://cui_www.unige.ch/Chloe/MultimediaInfo/index.html`

SIGLINK Newsletter

`http://www.cs.bgsu.edu/SIGLINK/HomePage.html`

“State of the Art Review on Hypermedia Issues And Applications”, March 1994

`http://www.csi.uottowa.ca/~dduchier/misc/hypertext_review/`

“Computer Supported Cooperative Work Report”, July 1993

ftp gorgon.tft.tele.no, in directory /pub/groupware

This is a comprehensive list of all known collaborative software packages and projects currently in use or under development.

“Network Access to Multimedia Information”, June 1993

ftp ftp.ed.ac.uk, in directory /pub/mmaccess

This report summarizes the requirements of academic and research users for network access to multimedia information.

“Hypermedia and Higher Education”, April 1993

gopher lewsun.idlw.ucl.ac.be, the /digests/IPCT menu.

IPCT, Interpersonal Computing and Technology, is an excellent journal exploring the boundaries of education and high technology.

alt.hypertext Frequently Asked Questions list

This list contains dozens of pointers to mailing lists, people, Internet sites, groups, books, periodicals, bibliographies, and software related to hypertext.

The new FAQ is still under construction. For more details, email `dhirmes@hamp.hampshire.edu`.

Obtaining Web Browsers and Servers

`ftp info.cern.ch`, in directory `/pub/www`

CERN’s simple text-only browser, as well as the CERN HTTP server.

`ftp ftp2.cc.ukans.edu`, in directory `/pub/WWW/lynx`

Distribution for Lynx, a text-only browser.

`ftp ftp.ncsa.uiuc.edu`, in directory `/Mosaic`

Mosaic distribution, as well as the NCSA HTTPD server. This site contains the Mosaic browser for Macintosh, Windows, and X.

`ftp ftp.law.cornell.edu`, in `/pub/LII/Cello/`

Distribution for Cello, a Windows browser.

`ftp max.physics.sunysb.edu`, in `/pub/amosaic`

Distribution for Amiga Mosaic browser.

`ftp ftp.omnigroup.com`, in `/pub/software/`

Distribution for OmniWeb, a NeXTStep browser that does not require X Windows.

`ftp ftp.cs.unlv.edu`, in `/pub/chimera`

Distribution for Chimera, a simple browser for X Windows.

`ftp oac.hsc.uth.tmc.edu`, in `/public/mac/MacHTTP/`

Distribution for MacHTTP, a Macintosh WWW server.

`gopher hopf.math.nwu.edu`

Distribution for GN, an HTTP server that acts as a Gopher server and a World-Wide Web server simultaneously.

`ftp austin.bsdi.com`, in `/plexus`

Distribution for Plexus, a perl-based WWW server.

`ftp emwac.ed.ac.uk`, in `/pub/https`

Distribution for HTTPS, a Windows NT server.

A more extensive list of browsers can be found at `http://info.cern.ch/hypertext/WWW/Clients.html`, and a list of servers can be found at `http://info.cern.ch/hypertext/WWW/Daemon/Overview.html`.

Interesting Places on the Web

NCSA's Demonstration Page

`http://www.ncsa.uiuc.edu/demoweb/demo.html`

Internet Resources Meta-Index

`http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/MetaIndex.html`

Internet Resources List

`http://www.eit.com/web/netservices.html`

Commercial Sites

Wired Magazine

`http://wired.com/`

MTV

`http://mtv.com/`

CommerceNet

`http://www.commerce.net/`

Global Network Navigator

`http://nearnet.gnn.com/GNN-ORA.html`

Silicon Graphics

`http://www.sgi.com/`

KKSF-FM Radio
http://kksf.tbo.com/

Country Sites

Guide to Australia
http://life.anu.edu.au/education/australia.html

U.K. and Ireland Web Sites
http://www.cs.ucl.ac.uk/misc/uk/intro.html

Spain Web Sites
http://www.uji.es/spain_www.html

Educational Sites

Honolulu Community College
http://www.hcc.hawaii.edu/

La Trobe University, Australia
http://www.latrobe.edu.au/

The University of Notre Dame
http://www.nd.edu/

The Chinese University of Hong Kong
http://www.cuhk.hk/

Interactive Sites

Michigan State University Weather Movies
http://rs560.cl.msu.edu/weather

Xerox PARC (Palo Alto Research Center) Interactive Map
http://pubweb.parc.xerox.com:80/

Interactive Geographical Index
http://www.hcc.hawaii.edu/htbin/plotd

Interactive World Map Interface
http://wings.buffalo.edu/world

Live Television Sources and Games at MIT
http://tns-www.lcs.mit.edu/vs/demos.html

Legal Information and Government Sites

Legal Information at Cornell
http://www.law.cornell.edu/lii.table.html

U. S. Bureau of the Census
http://www.census.gov/

U.S. Department of Commerce
http://www.doc.gov/

National Aeronautics and Space Administration (NASA)
http://hypatia.gsfc.nasa.gov/NASA_homepage.html

The City of Palo Alto, CA
http://www.city.palo-alto.ca.us/home.html

Literature	**English Server at Carnegie-Mellon** `http://english-server.hss.cmu.edu/`
	Internet Book Information Center `http://sunsite.unc.edu/ibic/IBIC-homepage.html`
Museums and Art	**San Francisco's Exploratorium** `http://www.exploratorium.edu/`
	The Krannert Art Museum `http://www.ncsa.uiuc.edu/General/UIUC/KrannertArtMuseum/KrannertArtHome.html`
	University of California Museum of Paleontology `http://ucmp1.berkeley.edu/`
	EXPO `http://sunsite.unc.edu/expo/ticket_office.html`
	Collaborative Art `http://cui_www.unige.ch/Chloe/OtisCrosswire/`
	International Interactive Genetic Art `http://porsche.boltz.cs.cmu.edu:8001/htbin/mjwgenform`
Music and Audio	**Internet Music Resources** `http://www.music.indiana.edu/misc/music_resources.html`
	Internet Underground Music Archives `http://sunsite.unc.edu/ianc/index.html`
	Internet Talk Radio `http://www.cmf.nrl.navy.mil/radio/radio.html`
Organizations	**Electronic Frontier Foundation** `http://www.eff.org/`
	The Association for Computing Machinery `http://info.acm.org/`
	The World Health Organization `http://www.who.ch/`

Appendix A: A Hypermedia Timeline

1945 **Vannevar Bush** (The Science Advisor to President Roosevelt during World War II) proposes **MEMEX**, a conceptual machine that can store vast amounts of information, in which users have the ability to create information trails, links of related texts and illustrations, which can be stored and used for future reference.

1965 **Ted Nelson** coins the word “hypertext”.

1967 **Andy van Dam** and others build the Hypertext Editing System.

1968 **Doug Engelbart** demonstrates NLS, a hypertext system.

1975 ZOG (now **KMS**), a distributed hypermedia system, debuts at Carnegie-Mellon.

1978 The **Aspen Movie Map**, the first hypermedia videodisc, demonstrated by MIT’s Architecture Machine Group.

1981 Ted Nelson conceptualizes “**Xanadu**”, a central, pay-per-document hypertext database encompassing all written information. Read the **Xanadu FAQ** at `http://jolt.mpx.com.au:70/0h/faq.html`.

1984 **Telos** introduces Filevision, a hypermedia database for the Macintosh.

1985 **Janet Walker** creates the Symbolics Document Examiner.

1985 Intermedia, a hypermedia system, is conceived at Brown University by **Norman Meyrowitz** and others.

1986 OWL introduces **GUIDE**, a hypermedia document browser.

1987 Apple Computers introduces **HyperCard**, the first widely available personal hypermedia authoring system.

1987 The Hypertext ‘87 Workshop is held in North Carolina.

1989 **Autodesk**, a major CAD software manufacturer, takes on Xanadu as a project.

1989 **Tim Berners-Lee** proposes the **World-Wide Web** project.

1990 ECHT (European Conference on Hypertext).

1992 Autodesk drops the Xanadu project.

1993 *A Hard Day’s Night* becomes the first full-length movie to be transcribed into a hypertext format and distributed via compact disc.

April 1993 International Workshop on Hypermedia and Hypertext Standards, Amsterdam.

June 1993 **NCSA Mosaic 1.0 for X Windows** released by the **National Center for Supercomputing Applications**.

August 1993 First World-Wide Web developers' conference in Cambridge, Massachusetts.

November 1993 Hypertext Conference in Seattle, Washington. Ted Nelson speaks as the guest of honor.

March 1994 World-Wide Web byte traffic surpasses Gopher traffic on the NSFnet.

May 1994 First International World-Wide Web Conference in Geneva.

Jim Clark and **Marc Andreessen** form **Mosaic Communications Corporation**.

June 1994 World Conference on Educational Multimedia and Hypermedia in Vancouver, Canada.

For information email `aace@virginia.edu`.

September 1994 European Conference on Hypermedia Technology in Edinburgh, Scotland.

For information email `echt94@inesc.pt`.

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A network service that searches FTP sites for files.

B

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Software that provides an interface to the World-Wide Web.

C

CERN 7

The European collective of high-energy physics researchers (European Organization for Nuclear Research).

client 16

A computer or program requests a service of another computer or program.

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client-server architecture 16

A structure in which programs use and provide distributed services.

CSO 16

Central Services Organization. A service which facilitates user and address lookup in databases.

D

Doug Engelbart 29

The inventor of many common devices and ideas used in computing today, including the mouse.

F

File Transfer Protocol (FTP) 15

A common method of transferring files across networks.

finger 16

A service that responds to queries and retrieves user information remotely.

G

Gopher 8, 15, 16

A versatile menu-driven information service.

Graphics Interchange Format (GIF) 15

A commonly used graphics format which compresses the image and stores color information within the file.

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home page 13

The default document World-Wide Web users see when connecting to a Web server for the first time.

Honolulu Community College 9

HTML+ 18

The latest version of HTML.

HyperCard 15, 29

A personal hypermedia/multimedia creation system for use on Apple Computers.

hyper-g 16

A distributed hypertext system mostly popular in Europe.

hyperlink 5, 13

A connection between hypermedia or hypertext documents and other media.

hypermedia 5

Hypertext that includes or links to other forms of media.

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hypertext 4

Text that, when selected, has the ability to present connected documents.

Hypertext Markup Language (HTML) 18

The standard language used for creating hypermedia documents within the World-Wide Web.

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Hypertext Transmission Protocol (HTTP) 17

The standard language that World-Wide Web clients and servers use to communicate.

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A hypertext interface to telnet.

I

inline image 13

A graphic within a hypermedia document that is displayed on the same page as text.

Internet 6

The global collective of computer networks.

global connectivity 6

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ISO 8859 15

A character set defined by international standards that includes accented letters and symbols.

M

man page 16, 18

Manual page. Online documentation that commonly comes bundled with computers running the UNIX operating system.

MEMEX 29

A conceptual machine that could show the trails of information that its users viewed.

menu bar 12

A common element in graphic computer interfaces that allows users to select options from menus.

Mosaic 4, 14, 30

A mouse-driven interface to the World-Wide Web developed by the NCSA.

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Motion Pictures Entertainment Group (MPEG) 15

A consortium of experts in the entertainment industry that developed the MPEG standard format for digital video and audio.

N

National Center for Supercomputing Applications (NCSA) 10, 14, 30

A federally-funded organization whose mission is to develop and research high-technology resources for the scientific community.

National Science Foundation (NSF) 8

A federally-funded organization that manages the NSFnet, which connects every major research institution and campus in the United States.

navigation buttons 13

Elements within a graphic computer World-Wide Web interface that allow users to review the information they have previously seen in a number of ways.

NCSA Collage 15

Collaborative (shared whiteboard) software developed by the NCSA.

Network News Transfer Protocol (NNTP) 15

A common method by which articles over Usenet are transferred.

P

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A hypermedia document as viewed through a World-Wide Web browser.

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A digital video format developed by Apple Computer that integrates synchronized video and audio with compression techniques.

R

Rich Text Format (RTF) 18

A common interchange format for the exchange of electronic documents between computers.

S

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A graphic computer interface element that allows the user to scroll electronic documents on the computer screen.

server 16

A program which provides a service to other client programs.

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Stanford Research Institute (SRI International) 10

T

techinfo 16

A common campus-wide information system developed at MIT.

Ted Nelson 29

The inventor of many common ideas related to hypertext, including the word “hypertext” itself.

telnet 15

A program which allows users to remotely use computers across networks.

texinfo 16

A common campus-wide information system.

Tim Berners-Lee 7, 29

The inventor of the World-Wide Web.

U

Uniform Resource Locator (URL) 19

A standardized way of representing different documents, media, and network services on the World-Wide Web.

Usenet 16

The global news-reading network.

V

Vannevar Bush 29

Originator of the concept of hypertext.

Veronica 16

A network service that allows users to search Gopher systems for documents.

W

webmaster 13

The administrator responsible for the management and often design of a World-Wide Web site.

whois 16

A name lookup service.

Wide-Area Information Servers (WAIS) 15, 16

A service which allows users to intelligently search for information among databases distributed throughout the Internet.

World-Wide Web 4, 7

(World-Wide Web project) The initiative to create a universal, hypermedia-based method of access to information. Also used to refer to the Internet.

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A standard two-color bitmap image format supported by the X Windows system.

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A standard which defines electronic mail directory services. Mostly used in Europe.

Xanadu 29

A client-server system based on networked hypertext that emphasizes electronic publishing and commerce.

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XCMD 15

A program module that extends HyperCard by giving it new functionality.

About the Author

Kevin Hughes was a student systems administrator, webmaster, and World-Wide Web lecturer at Honolulu Community College when he originally wrote this paper. He now designs hypermedia products at Enterprise Integration Technologies (EIT) and has done “look and feel” work for CommerceNet, Internet Shopping Network, and other educational and corporate Web sites.