NAVAL POSTGRADUATE SCHOOL

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THESIS

WEB SERVER CONFIGURATION FOR AN

ACADEMIC INTRANET

by

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September 2000

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WEB SERVER CONFIGURATION FOR AN ACADEMIC INTRANET

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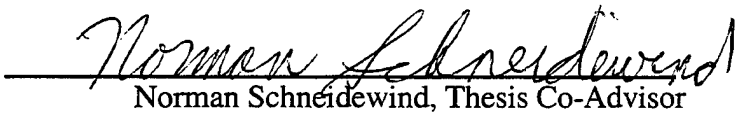
Approved by: 

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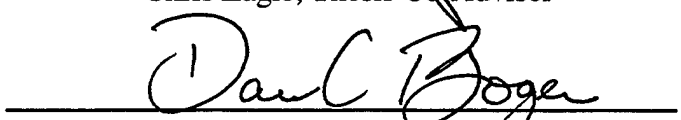

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Group

ABSTRACT

The Internet has undergone a tremendous growth in the past decade. After the evolution of Personal Computers and the radical decrease of their prices, people have the ability to access all the massive information that only the Internet and the World Wide Web can provide. One of the factors that boosted this ability was the evolution of the Web Servers. Using the web server technology man can be connected and exchange information with the most remote places all over the world. So, the web can be thought as a mass medium. This study will provide the necessary information required to configure a Web Server within the boundaries of an academic Intranet. It will also serve as an example for both Greek and US DoDs or other organizations seeking to implement a Web Server as an improvement to their existing Servers.

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I. INTRODUCTION

The World Wide Web (www) and the Internet generally are not inventions of the last decade. Their history dated from the early 70's when it started as ARPANET (Advanced Research Projects Agency Network), a military wide area network for the US DOD. During the ARPANET projects, packet switching and a new communications protocol suite were developed: The Transmission Control Protocol/ Internet Protocol, widely known as TCP/IP.

During those years, only Government facilities, University campuses and large corporations used mainframes, minicomputers, or supercomputers to run their applications. However, the evolution of Personal Computers (PC's) in the early eighty's has boosted web activities to the business and public sectors. This development combined with the significant reduction of PC prices provided people with greatly enhanced computing power. This fact was combined with a tremendous increase in computer performance, which started primarily in the past decade. In addition, the evolution of land-based and satellite telecommunication provided access to this increased computing power through the Internet on a worldwide basis.

One of the crucial factors that supported this ability was the evolution of web servers. Through this technology, people can connect to and exchange information with most remote locations. Today, computers and the Internet can be thought of as a mass medium for communication among the people; in few years in will be as necessary as the

telephone is today. One current use of the Internet is for IP Telephony, which can deliver voice, fax, or video packets in a dependable flow to the user. So, the replacement of conventional telephony with IP may occur in the near future.

Furthermore, web technology is now radically transforming the traditional way of doing business. E-commerce is the present and the future way of doing business, selling any kind of items from software to agricultural products. "Friction Free economy theory" as described by Naval Postgraduate School (NPS) Professor Ted Lewis [Ref.1], resets Adam Smith's and Maynard Keynes' economic theories, at the speed of the Internet. So, the Internet is pervasive and whoever ignores this fact, will soon fall behind and eventually disappear from the "business decision chessboard".

Web technology is used by many organizations, institutions and business corporations. Among them is the Naval Postgraduate School. The use of the Internet is necessary for both faculty and students. Classes, notes, assignments, presentations, and other sources of information about a course or an academic issue can be placed on a web site. Everyone who has a connection to the Internet can access, browse, copy or print anything that the user needs. E-mail is widely used and is one of the primary means of exchanging ideas and assignments.

The implementation of public web sites requires configuration of a program, called a web server, which has to be installed on a publicly accessible computer. A web server is a program that runs under a designated machine and operating system for

making documents available to Internet visitors through a web browser. A web browser is a client program that provides a way to view and interact with information on a web server. By visiting a web site, we can see a large variety of web pages. Some of the most well-known and widely used browsers are Microsoft's Internet Explorer and Sun's Netscape Navigator.

Thus, through a thorough study of web server technology, and after considering the advantages and the disadvantages of each case, this thesis will define which solution is most appropriate in configuring a web server of an academic intranet.

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II. WEB SERVER TECHNOLOGY

A web server is a system that combines hardware and software with the mission to provide information to clients. This system receives requests for information from a client via the Internet and after processing these requests and checking their validity, retrieves or generates the desired information and transmits it back to the client. A web server utilizes the client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP) provides web pages to users. Every computer on the Internet that contains a web site must have a web server or alternatively the web site files must be uploaded to a computer that has a web server.

The factors that have significant impact on a web site performance are the hardware that hosts the server, the operating system under which it runs, and the web server software. After thorough research on the Naval Postgraduate School campus, forty web servers were found to be in operation. Appendix A, contains information about them and Appendix B contains a web server baseline assessment.

A. NETWORK PROTOCOLS

A necessary part of the technology required to setup an Internet or Intranet environment in a company is to select a specific protocol for use on the corporate network. The protocol that is widely used for Internet technologies is known as the Transmission Control Protocol /Internet Protocol or TCP/IP. This protocol can operate on Ethernet or Token Ring Local Area Networks (LANs), on various Wide Area Networks (WANs), and even over standard telephone lines that are connected to a modem. UNIX

systems have implemented TCP/IP as a standard feature. Smaller systems like Windows 9x and NT have TCP/IP built into their operating system.

Mainframes also use TCP/IP in conjunction with proprietary networking protocols. Some examples are IBM's SNA and DEC's DECnet.

B. HARDWARE PLATFORMS FOR WEB SERVERS

Regarding hardware, there are three main categories in which web servers "reside". These include: **1) UNIX** systems like Sun, Silicon Graphics, IBM, and or HP **2) Windows based** systems that can utilize Intel, RISC technology, Alpha, AMD or Cyrix processors, and **3) Apple's Macintosh** systems that use Motorola 68x, or PowerPC processors. The UNIX operating systems, such as LINUX, Sun OS, Solaris, HP/UX, IBM/AIX and IRIX are primarily used in large systems, while smaller systems like PCs run under Microsoft's Windows 9x, NT or Windows 2000 operating systems. In Appendix C, there is a suggested configuration for a PC/Windows 9x-NT platform.

For web server software, it was observed that larger systems use Apache and Netscape's Enterprise Server while the smaller systems primarily used Microsoft's Internet Information Server (IIS) web server. Of course, there are some other combinations of hardware platforms, operating systems and web server software.

Web servers often come as part of a larger package of Internet- and intranet-related programs for serving e-mail (e-mail servers), files (ftp servers), and building and publishing web pages (web publishers). Considerations in choosing a web server include:

how well it works with the operating system (that runs in a specific computer) and other servers, its ability to handle server-side programming and publishing, search capabilities, and web site construction tools that may be included.

C. WEB SERVER SOFTWARE SOLUTIONS

The software to be used for a web server is closely related with the hardware platform that will host the web server. We can divide this software in two main categories: UNIX/LINUX based machines and the Windows 9x-NT machines.

1. Unix-Linux Based Web Servers

Web servers with heavy traffic require machines that are usually running under Unix-Linux operating Systems. The most popular web server is Apache, an open source web server that is free [Ref.2]. Apache is available for both 32-bit Windows and UNIX-LINUX based operating systems. (see Figure 1)

Figure 1: Apache Web Server Logo

2. Pc/Windows 9x-NT Based Web Servers

For relatively light to medium traffic on a web site, Microsoft provides Internet Information Server (IIS). IIS is bundled with Windows NT server. For PC's that use

Windows 9x/2000 as their operating systems, there is a special version of IIS called Personal Web Server (PWS) [Ref.3] (see Figure 2.). Netscape offers, its Fast Track and Enterprise servers. If the web site is expecting to have heavy traffic, O'Reilly's WebSite [Ref.4] (see Figure 3), Smart desk Personal Web Server, Imatix Xitami [Ref.5] and Sun's Java web Server are some of the solutions that can handle the load effectively. All of these web servers can be downloaded for free from the Internet.

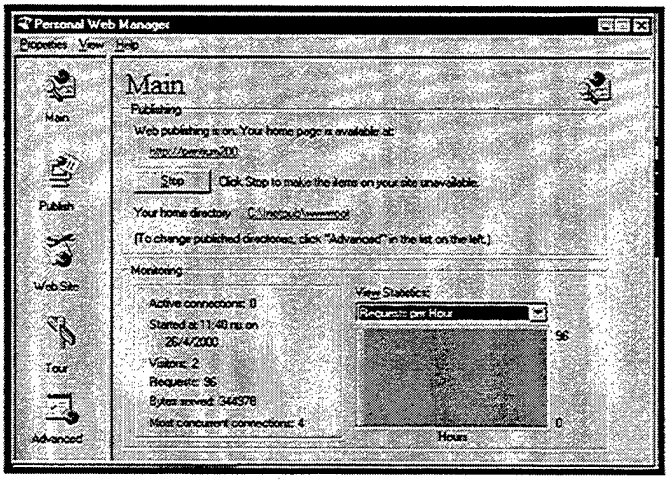


Figure 2: Microsoft's Personal Web Server (PWS) Main Window

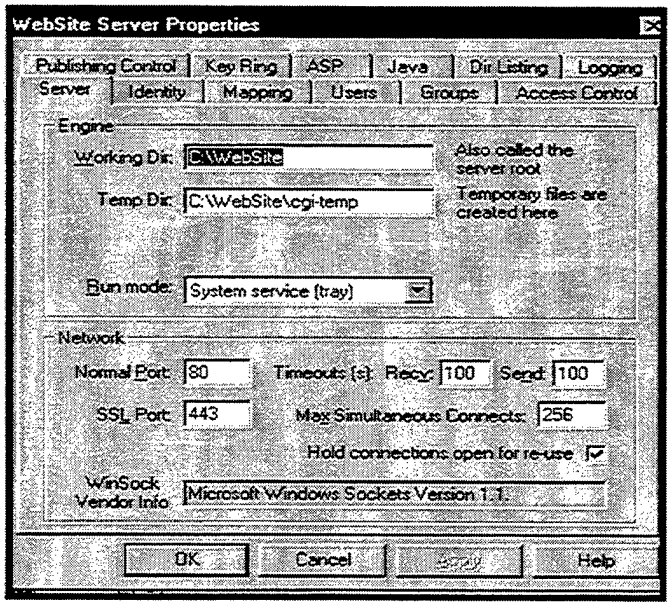


Figure 3: O'Reilly's Website Professional Server Properties Page

3. Windows 2000 Based Web Servers

Another solution for the enterprises that wish to upgrade from Windows NT based Internet Information Server (IIS) version 4.0, is the latest version IIS V.5.0. This version is included with Microsoft 2000 Server editions. IIS 5.0 is a high performance web server containing many improvements compared with the previous IIS versions. Its first characteristic is the smaller size (about 30 MB) of the files. In addition, IIS v 5.0 provides performance application protection, security enhancements. Furthermore, it supports many standards such as Fortezza (a new D.O.D security standard), Transport Layer security (using SSL v 3.0), Digest Authentication (a method of hashing authentication information introduced in Internet explorer 5.0) and Kerberos v 5.0 authentication protocols that are used in Windows 2000. Finally, IIS v5.0 features Web based Distributed Authoring and Versioning (WebDAV), which is a standard designed to simplify the construction of intranets and provide the ability for multiple users to publish documents to a common Web server.

On the other hand, there are some cons such as the lack of a Unix version, and the lack of documentation on the newest features. In addition, IIS runs only on the Server edition of Windows 2000 and the remote Web-based administration is still somewhat lacking. [Ref.6]

D. WEB BROWSER SOFTWARE

A web browser is a program that is used to view the web pages that exist on various web sites. The types of computing platforms we use can influence the selection of an appropriate browser. So, first we have to check the operating systems that run under

the respective hardware platforms and the versions we need. Another characteristic to consider is the browsers' Java-capability. The most widely used web browsers are Sun's Netscape Navigator (see Figure 4), and Microsoft's' Internet Explorer (see Figure 5).

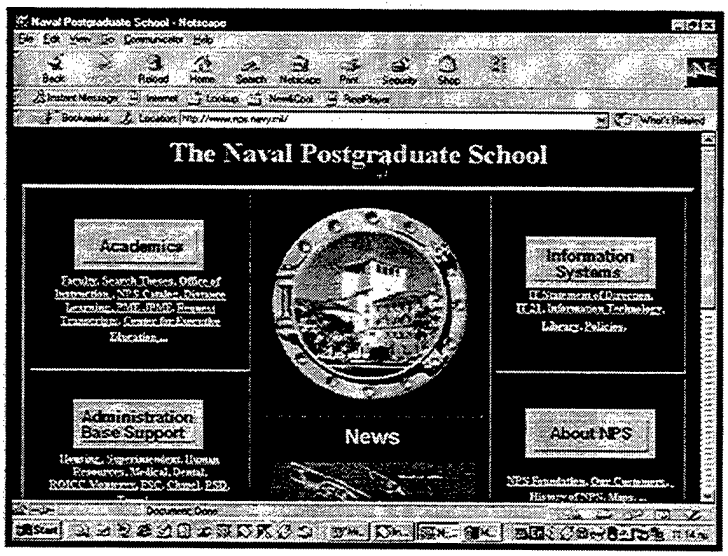


Figure 4: Netscape Navigator

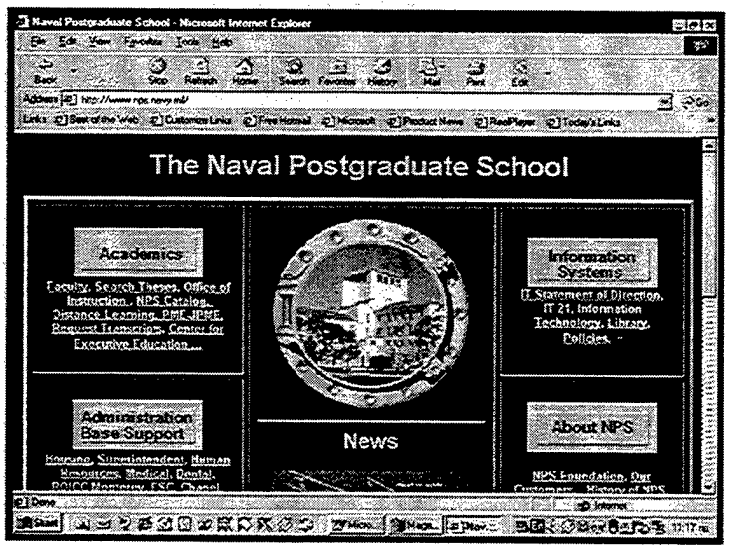


Figure 5: Internet Explorer

E. OTHER WEB SERVERS

Novell's offers a web server for users of its NetWare operating system and IBM's family of Lotus Domino servers are used primarily for IBM's OS/390 and AS/400 mainframe computer customers. These web servers are used to handle high volume needs.

In the world of unique, there is the Matchbox web server, which is the smallest web server, ever created. This server runs on a single-board AMD 486-SX computer with a 66 MHz CPU, utilizes 16 MB RAM, and 16 MB flash ROM, which is big enough to hold an adequate amount of the Red Hat 5.2 Linux operating system, including the HTTP daemon that runs the web server. It communicates with the outside world via two serial ports, a printer port, and a connector for a floppy drive. It measures 2.8" x 1.8" for an area of 5 square inches. Being 0.2" thick, this makes the volume one cubic inch (16 cc's). It weighs 3/4 oz (20 grams). This server was constructed in the Wearable Computing Laboratory at Stanford University [Ref.7] (see Figure 6).

Figure 6: The Matchbox Web Server

F. HOW A WEB SERVER WORKS

Generally speaking, a server is a computer program that provides services to other computer(s) (see Figure 7).

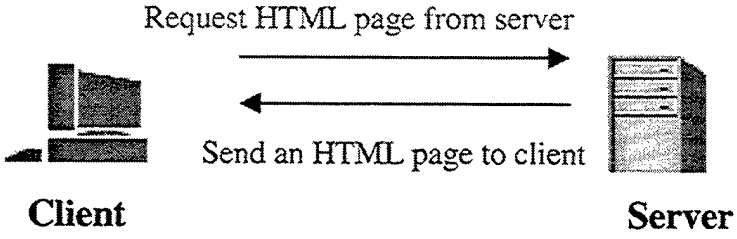


Figure 7: Client/Server Programming Model

In the client/server programming model, a server is a program that awaits and fulfills requests from client programs in the same or other computers. A given program (application) in a computer may run as a client which requests services from other programs and as a server of requests from other programs.

For our purposes, a web server responds to requests for HTML pages. A page is the basic unit of information transfer on the web, although, the user can request a download of a file. A web client is the requesting program associated with the user. The web browser (i.e. Netscape Navigator or Internet Explorer) in our computer is a client that requests HTML pages from web servers.

III. OVERVIEW OF A WEB SERVER

A. WEB SERVER CHARACTERISTICS

1. Factors that Affect the Choice of a Web Server

Generally, all web servers perform the function of delivering a document to a client(s) when the document's web address (or to be more specific, the Uniform Resource Locator (URL)) is requested.

Web servers have many capabilities. Common features include the ability to log accesses to files or databases, execute applets that may be written in languages like Java or JavaScript, execute server side scripts and process "clickable" image maps. Security features typically allow a web site administrator to restrict a portion of the document tree to authorized users. Since, most sites are usually limited by the speed of their network connection, the performance of a web server (with only few exceptions) should not be a major factor in the choice of our web server. Of course, a crucial factor is the size of the documents, images or other files that we'll be serving.

Another critical issue in the choice of a web server is the operating system that the hardware platform will use. Some of the options offered, include the Unix family of operating systems, Windows 9x or NT or 2000 and Apple's OS. All of these have advantages and disadvantages, but they all support the TCP/IP protocol, which is essential for the operation of a web server.

2. Overview of a Personal Web Server

As previously mentioned, a personal web server is a program that can turn a personal computer into a web server. Generally speaking, what ever is personal is something not in large scale or size. So, a personal web server covers the needs of an individual or a small business. The use of such kind of web server, provides us with some advantages and but there is also some limitations that we must keep in mind.

3. Advantages of Using Personal Web Servers

The first advantage is the ability to maintain our own log files. This feature gives us information about our web site traffic and data of each visitor. In addition, our site can function as a simple FTP server by allowing users " browse directory". This method helps the visitors of our site to browse folders and access publicized files faster than if we put them in web pages. Finally, ease of use and simplicity is very essential for non-experienced developers in order to develop an entry-level web server.

4. Limitations of Personal Web Servers

Personal web servers are made for serving a limited volume of web traffic. This primarily means that they can efficiently handle only five to ten visitors simultaneous connections. So, if we expect higher traffic, more robust web server will be required. Microsoft's Internet Information Server (IIS) or Apache's web server are common solutions in high traffic cases.

B. WEB CLIENT CHARACTERISTICS

Recall from Chapter II that a web browser (i.e. Netscape Navigator or Internet Explorer) plays the role of a client that requests HTML pages from web servers. There are a wide variety of web browsers available for use today. Some Internet Service Providers (ISP's) such as America on Line (AOL) offer web browsers along with their connection software package. Nevertheless, the largest slice of the web browser market belongs primarily to two: Microsoft Internet Explorer and the Netscape Navigator.

Internet Explorer (IE) is the web browser that Microsoft offers with Windows 95 or 98. The latest version of IE is 5.5, is bundled with Windows 2000 Professional, but can also be downloaded for free from the Microsoft's web site. Sun Microsystems, offers Netscape Navigator. Navigator is the browser component of th`e Netscape Communicator software package that contains several other tools, such as Messenger (email) and Composer (web page editing). The latest version is 4.77 can also be downloaded for free from Sun's web site.

Both IE 5.5 and Netscape Navigator are excellent browsers and offer many tools to their users. They have a lot in common and do almost the same job using different methods. The evaluation of these two web browsers is beyond of the scope of this thesis. Nevertheless, the major difference is the way they handle email. Because, IE 5.5 does not incorporate any mailing program, Microsoft offers (together with Windows 9x or 2000) a specialized email handling program called Outlook Express (see Figure 8). On the other hand, Netscape Messenger is an email client included in the Netscape Communicator package (see Figure 9).

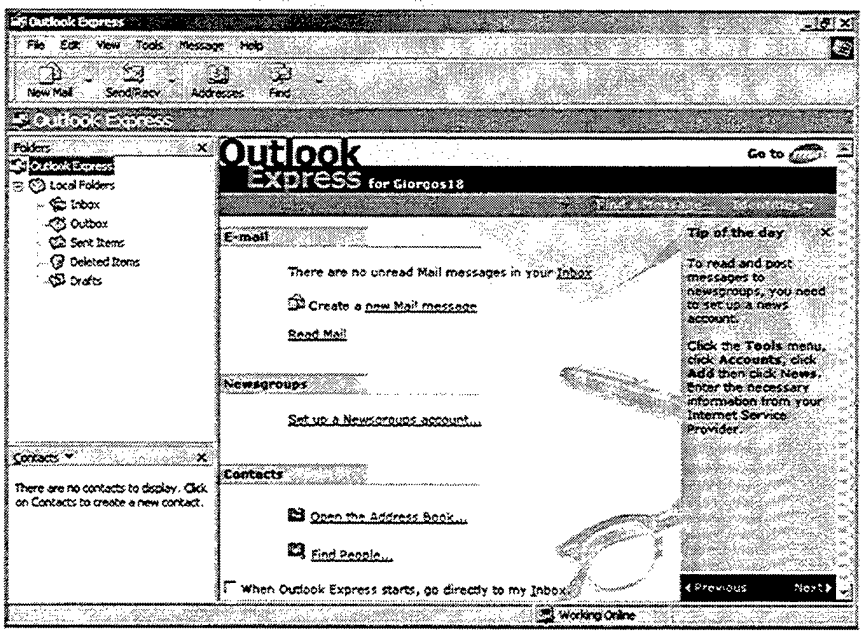


Figure 8: Microsoft Outlook Express 5.0

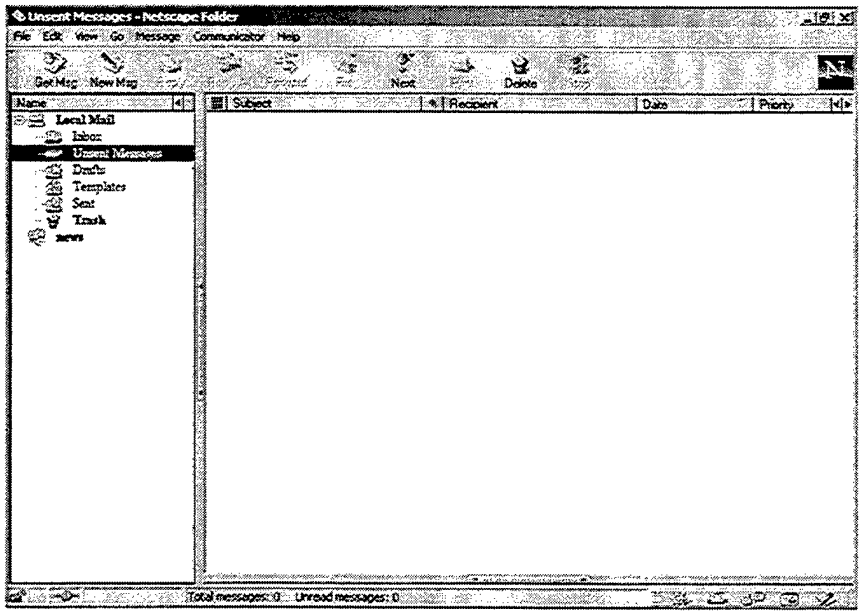


Figure 9: Netscape Messenger

C. WEB SITE DEVELOPER TOOL CHARACTERISTICS

A web server can manage one or more web sites. Every web site consists of one or more web pages. For the educational purposes of this thesis, I developed a web site named NPS Student Information Center (NPSSIC). This web site has a welcome page that offers two choices: An English site and a Greek one. The welcome pages of this site are shown on Appendix D.

Microsoft Front Page 2000 was used to develop the necessary web pages (see Figure 10). This software tool, which provides flexibility and multiple features, proved to be very handy and useful. The resemblance with the other Microsoft applications such as Microsoft Word and the user-friendly environment gives Front Page 2000 an advantage over the other web page developing tools. Recently, Microsoft's Front Page 2000 was rated as an editor's choice for novice users who want to design simple web sites [Ref.8]. For the advanced users who wish to design an advanced site editor's choice went to Macromedia's Dreamweaver 3 [Ref.8].

Front Page 2000 has the ability to edit different kinds of web pages like HTML format (**.htm**), Cascading Style Sheet (**.css**) format or Active Sever Pages (**.asp**) format. ASP is a server-side scripting language. This means that ASP code is first processed at the server and then it is sent to the web, while HTML pages are processed by the client (web browser). This ASP characteristic gives additional security to our web pages, because we can write code that will never be viewed from a web browser.

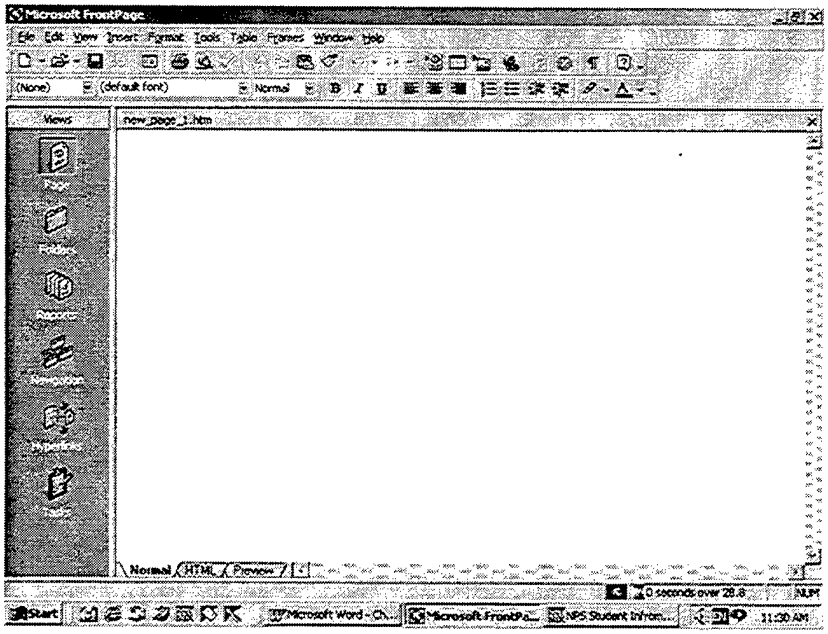


Figure 10: Microsoft Front Page 2000

In addition, Microsoft FrontPage provides the following support that let us take the advantage of advanced Web browser technology [Ref.9]:

1. ActiveX controls

ActiveX controls are software components that we can reuse and insert in our web pages in order to produce multimedia effects, pop-up menus, interactive menus, and other sophisticated applications. These controls can be written in a variety of modern programming languages such as Java, C++ and Visual Basic.

2. Java Applets

Java applets are like the ActiveX controls that are written in Java programming language. These applets can provide dynamic elements and interactive characteristics on

Web pages. Thus, when we browse a web page that contains a Java applet, its components are downloaded and executed at a run time, only for that browsing session.

3. Web Browser Plug-ins

Plug-ins are small software pieces that can extend the functionality of a web browser. Using plug-ins we can make our browser capable of handling specific file types like image files, sound files or animation files. Plug-ins are supported by Internet Explorer 4.0 or later.

4. Scripts

Scripts are pieces of programming code that we can add to web pages for Web-based solutions development. Using scripts we can handle page elements without knowing the details of HTML code.

5. Secure Socket Layer

Another useful feature of Microsoft FrontPage 2000, that is not only useful but also necessary for the electronic commerce, is **Secure Socket Layer (SSL)**. SSL is an open standard that was designed to prevent hackers to intercept private or sensitive information (such as bank account numbers, credit card numbers or social security numbers) sent over a network or through the Internet. Using SSL our web browser encrypt its communication with a web server.

FrontPage can take advantage of SSL in the following ways:

- Communicate securely between the client and the web server.

- Create secure hyperlinks in our web pages. Secure hyperlinks are indicated by **https://** instead of the **http://** before the URL or the Internet address of the web server and the target page.

Web servers that support the SSL standard include Microsoft IIS, Netscape Enterprise Server, O'Reilly WebSite Professional and Stronghold Web Server. Since SSL feature is not enabled by default, we have to check it in order to activate it.

IV. WEB SITE DEVELOPMENT

A. INTERNET CONNECTION

When we consider the construction of our web site the first problem to be resolved is the Internet connection that this site will utilize. First, we could install it on a web server provided by an Internet Service Provider (ISP). Second, we could host a web server on an ISP site. Finally, we could install a high-speed Internet connection (i.e. DSL) that will be dedicated for use from our web server. Each of the previously mentioned solutions has advantages and disadvantages. The factors that must be taken into consideration, in order to achieve the highest performance with the lowest budget, include:

- The type and the source of information that our web site will be serving,
- The amount of traffic, which will be generated.
- The Internet connectivity that is in place within the organization.

B. LOCATION OF THE WEB SERVER

In choosing the location of our web server, we must consider the following four main connecting options:

- The first is to connect it on an Intranet or a LAN without a firewall,
- The next is our server will be connected to stubnet,
- The third is it inside an Intranet or a LAN and inside a firewall,
- The last is to connect it outside an Intranet or a LAN and out side a firewall.

All the above options have their pros and cons and we have to decide having as criteria, the above-described factors. Firewalls are systems that protect our servers from outer attacks. They are described in more detail below in the paragraph named "WEB SERVER SECURITY".

1. Connecting the Server on a LAN or Intranet

Putting our web server inside a local area network or an Intranet (see Figure 11) could provide us with some advantages, but we would have some limitations too.

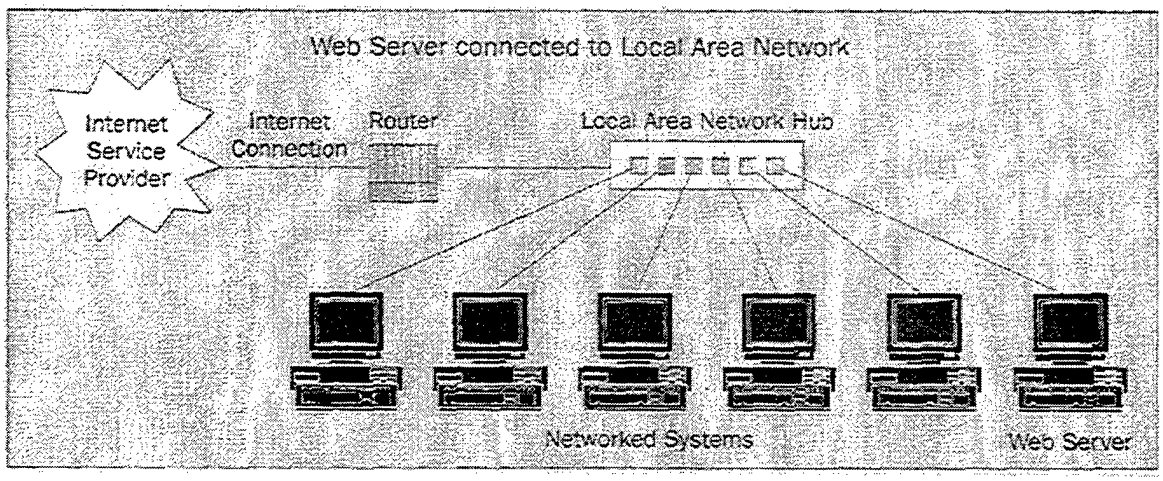


Figure11: A Web Server Inside a Local Area Network (LAN) [Ref.13]

In this case we connect our server (as the rest of the LAN computers), directly to the hub, the hub is connected to the router, which in turn is directly connected to the Internet Service provider.

a. Positives

Installing our web server inside a Local Area Network could provide us higher security. Security can be provided by a proxy server (firewall), which protects all

the LAN computers from possible attacks. Furthermore, we will have faster access to the Internet using the high-speed routers that the network utilizes.

b. Negatives

First, we are not fully independent to do what we like and we have to comply with the security or other regulations of the LAN administrator. Second, any problem that shuts down the LAN will bring down our web server while the problem exists. Finally, we may be obligated to choose the same hardware and software used by the other LAN computers.

2. Connecting the Server to a Stubnet

A stubnet is actually a subnet with few connected computers. The rest of the LAN can be connected to the Internet, as previously mentioned (see Figure 12).

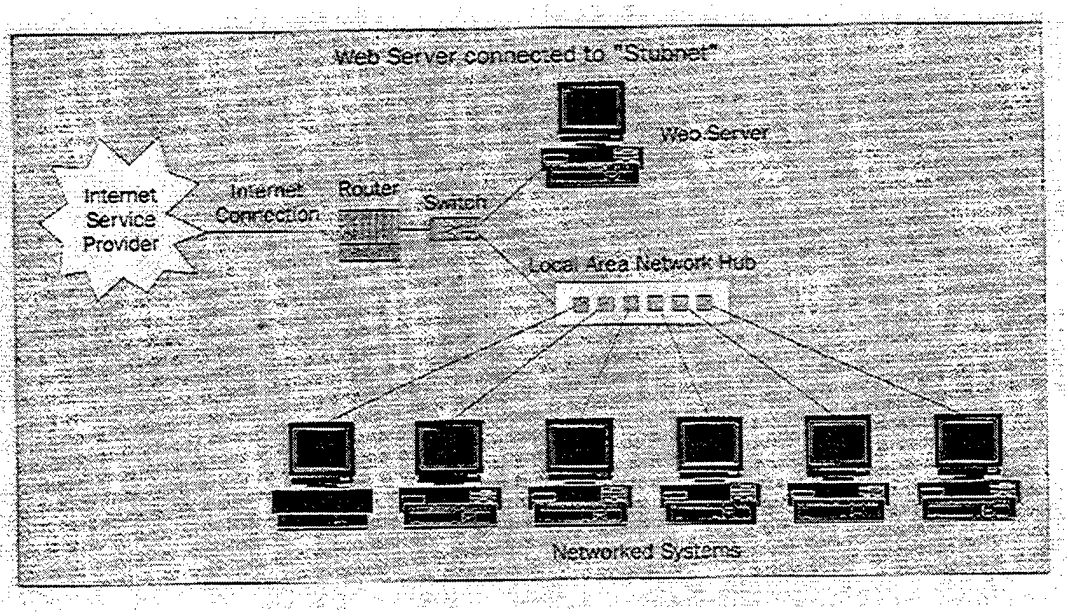


Figure12: A Web Server Connected to a Subnet [Ref.13]

The device that appears in Figure 12, used to join individual subnets to the Internet (via a router) is a switch but it can also be a bridge. A bridge is used to separate two or more local networks. It can pass traffic between the networks, based on knowledge about which hosts are on which interface on the bridge.

a. Positives

Since the web server is isolated from the other LAN(s), the performance of both the web server and the LAN(s) can be improved.

b. Negatives

Installing our web server outside a Local Area Network security environment is more vulnerable to possible attacks.

3. The Server is Inside an Intranet or a LAN and Inside a Firewall

When we put our web server inside a LAN (see Figure 13), which is connected to a firewall system, we have to configure the firewall in order to allow the HTTP traffic that is forwarded to and from our server.

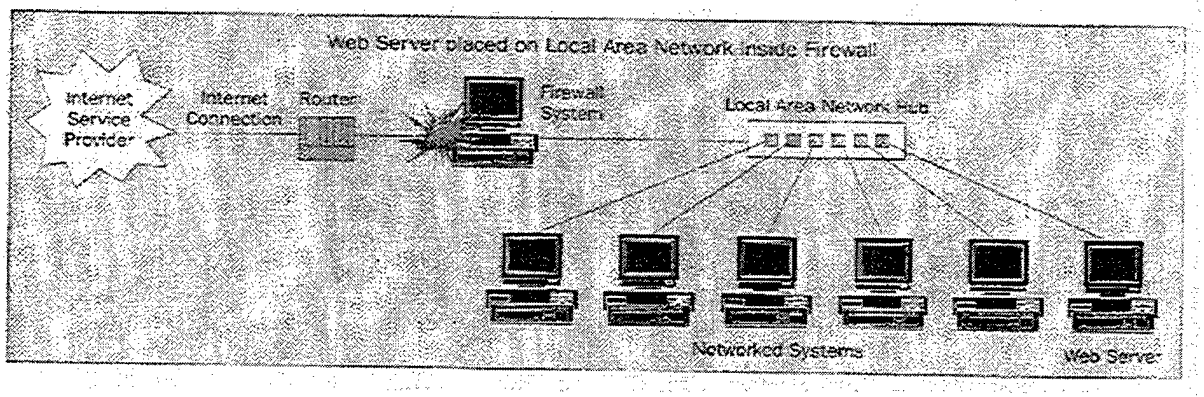


Figure 13: A Web Server Connected Inside an Intranet or a LAN and Inside a Firewall

Of course, using this topology can be a considerable security risk. The solution to this issue is to use a proxy HTTP server in our firewall system. The proxy server blocks the direct access to the LAN and our server. When a proxy server receives a request from the Internet, it contacts the web server and retrieves the requested web page. Since, most of proxy servers provide caching, then the web pages that have been recently accessed are stored on the proxy server and proxy's sole responsibility is to check if the file that in cache and the file that is in the server are identical. If they are different, it retrieves a copy, it places it to its cache and sends it to the user who requested it otherwise it sends the cached copy.

a. Positives

Using caching techniques, the performance of our server can be high. In addition, possible attacks can reach only the cached web pages and files located on our web server or on LAN computers remain untouched.

b. Negatives

This solution is more complex and simultaneously more expensive, because it demands more hardware and software.

4. Server is Placed Outside a LAN and Outside of a Firewall

The final alternative is to connect our web server directly to the Internet and outside a firewall (see Figure 14). This topology allows bypassing the complexity of the previous solution and provides us with higher level of freedom and functionality. So, we

have absolute control of the web server. Furthermore, we avoid the traffic that leads to and from the LAN.

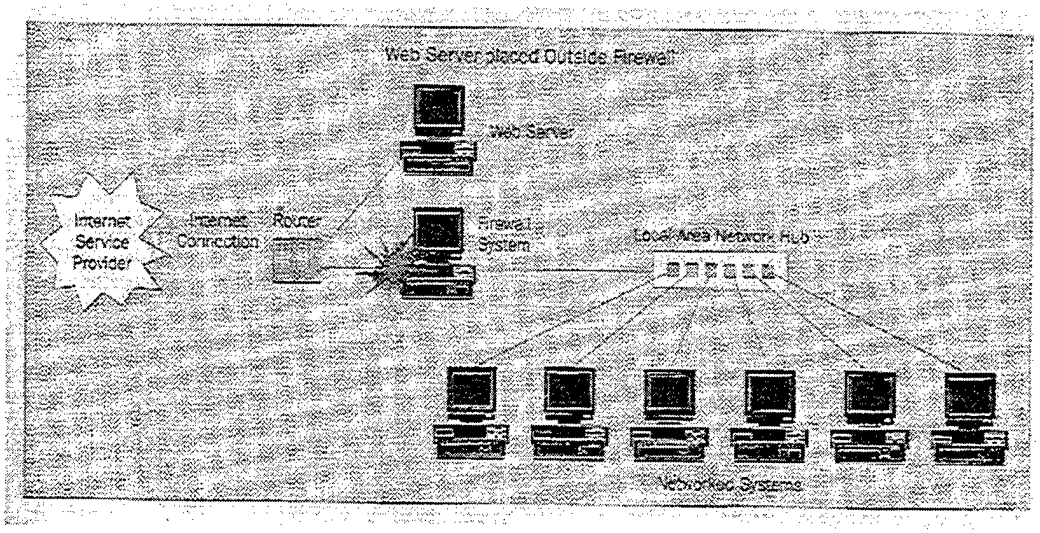


Figure14: A Web Server Connected Outside the Internet or a LAN and outside a Firewall

a. Positives

Installing our web server outside inside a Local Area Network we can have complete control over the server. In this case we connect our PC directly to the Internet. You can choose the combination of hardware and software that provides the features that you want. Set up access control and security restriction

b. Negatives

The price of independence is balanced by security problems that can be encountered by possible attacks of some hackers.

C. CHOOSING THE RIGHT HARDWARE AND SOFTWARE

1. Hardware

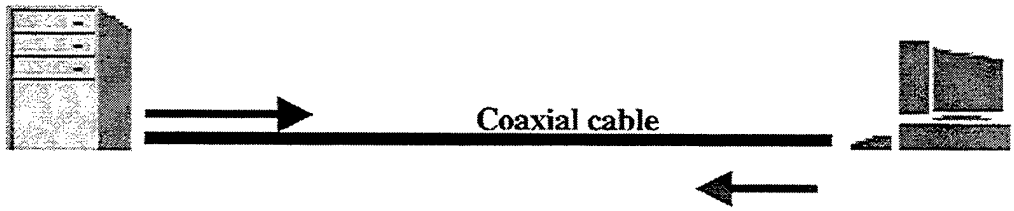
The platform that will be used is a crucial factor that will also influence the

software to be used. The higher the performance of our machine is the better the results of our web server will be. Of course, we have to bear in mind that the crucial factor that will affect our decision in choosing the right hardware is the level of our business or organization. This means that if our business is relatively small, it would be waste of money to purchase very expensive, high-end machines in order to cover a low traffic web server needs.

For the purpose of this thesis, we will experiment with two web servers and install one server in a personal computer with a Pentium 200 MMX CPU and 82 MB of RAM and a second in a personal computer with a Pentium 233 MMX CPU and 64 MB. The operating systems will be Windows 2000 Professional and Windows 95 respectively. In the Pentium 200 PC we will install and use the **Internet Information Services (IIS)** version 5.0-web server and in the Pentium 233 PC will utilize **Microsoft Personal Web Server (PWS)** version 4.0.

2. Network Models

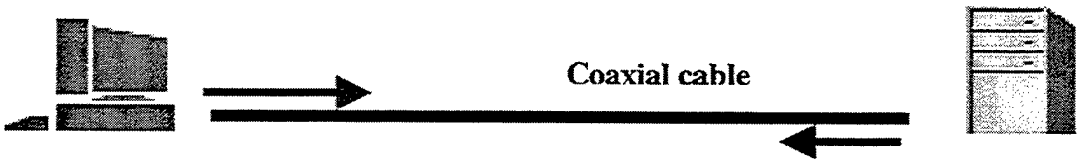
By-passing the previously mentioned topologies, we will work on a two computer LAN. Initially Pentium 200 MHZ PC will play the role of a server and the Pentium 233 PC the role of a client (see Figure 15). Later the roles will be reversed and the Pentium 233 will play the role of the server and the Pentium 200 PC the role of a client (see Figure 16). Both PC's will form a small peer- to-peer LAN connected by coaxial cable using two Ethernet Cards.



Pentium200 as a web server (IIS web server), sends a web page

Pentium233mhz as a web client, requests a web page

Figure 15: First Web Server/Client Model



Pentium200 as a web client requests a web page

Pentium233 as a web server (Personal web server), sends a web page

Figure 16: Second Web Server/Client Model

3. Personal Web Server

a. Installation

Personal Web Server is packaged with Microsoft IIS as part of NT 4.0 option pack. PWS is characterized as a desktop entry-level web server specifically suited for Windows 9x-or NT Workstation operating system users. The necessary software is 74.6

MB and can be downloaded at no charge from Microsoft's web site (see Figure 17). Once PWS is installed, it will run automatically each time the computer starts. The only sign that shows PWS' activation is a small tray icon that appears at the right side of the taskbar (see Figure 18).

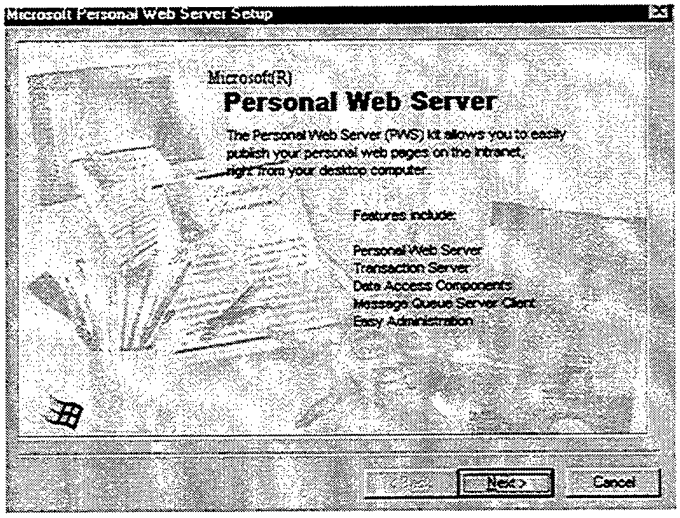


Figure 17: Setup Page of Personal Web Server

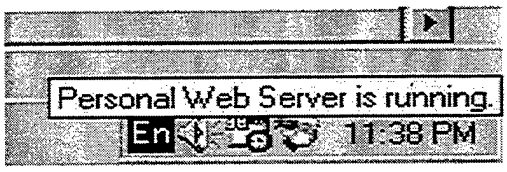


Figure 18: Icon Activation of PWS

b. Features

In addition to web server capabilities, Personal Web Server kit includes the following:

- Transaction Server
- Data Access Components

- Message Queue Server Client
- Easy Administration

We can run the PWS by accessing the default web page and checking the main page of the server, which controls the function of the server. A snapshot with some statistics about the log activity (visitors per hour) that pentium233mhz web server had, is shown on Figure 19.

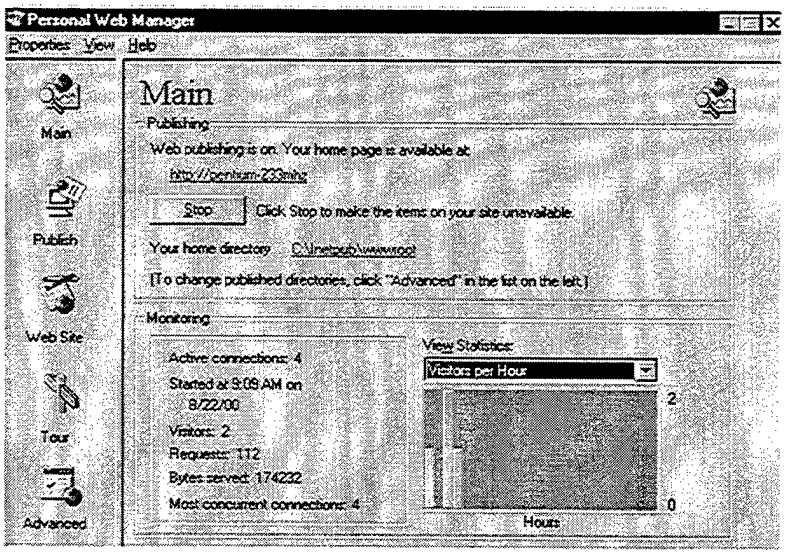


Figure 19: Main Page of Personal Web Server (PWS) Installed in the Pentium233mhz PC

Another alternative for users running Windows 2000 Professional, is to activate Personal Web Manager (PWM) which was the interface of Personal Web server for the users of Win 9x or NT Workstation. Personal Web Manager occupies 1.4 Mbytes and is one of the nine components of IIS v 5.0 (see Figure 20). Both PWM and IIS can be activated and installed following the sequence: Control Panel - Add/Remove Programs-Add/Remove Windows Components.

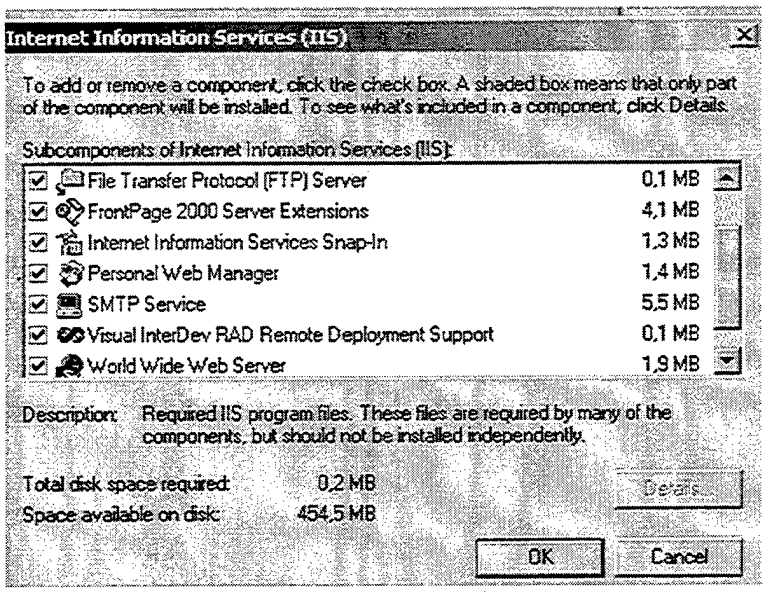


Figure 20: Internet Information Services (IIS) Version. 5.0 Components

The advantages and disadvantages of the Microsoft's Personal Web Server are similar to Personal web server's and are listed as follows:

c. Advantages

(1) Using PWS we have the ability to create a welcome page (home page). The welcome page is the first page that a user sees when accessing our web site and provides navigation (links) to the rest of our site. Nevertheless, in our web site development, we used the Microsoft's Front Page 2000 for designing not only the welcome, but the entire set of necessary web pages as well.

(2) PWS includes a wizard that walks you through setting up a home page and sharing files. Personal Web Server administrator **reduces the complexity** of running a Web server. Using the Personal Web Manager, we can start and stop the server,

view statistics using bar charts, and easily share additional directories or the Windows Explorer.

(3) Personal Web Server on Microsoft Windows NT Workstation is also ideal for developing Web applications for IIS. Furthermore, PWS on Windows NT Workstation includes support for features such as **Active Server Pages** (.asp), script debugging, and the Internet Service Manager, the comprehensive administration tool for IIS integrated into Microsoft Management Console.

(4) We can also develop transactional Web applications for Microsoft Transaction Server (MTS), another part of Windows NT Server. Personal Web Server is a great platform for testing a site before hosting it on a company's server, or on an Internet service provider (ISP). So, we can test the web links, forms, scripts, and applications to be sure they will be displaying and working properly on the web. Moreover, we can use Microsoft's FrontPage to easily copy a web site developed on PWS and switch to a higher performance web server such as the IIS.

d. Limitations

Because Personal Web Server was not designed to support high volume Web sites, it does not include all the features found in Internet Information Server, such as Microsoft Site Server Express, Index Server, and Certificate Server. Due to its limited capabilities it's ideal for testing our web site inside a relatively small Intranet, before we publish it to the Internet. PWS traffic capabilities are limited on handling 8-10 clients simultaneously.

4. Internet Information Service (IIS) 5.0

a. Installation

Internet Information Services 5.0 is not installed on Windows 2000 Professional by default. Before we install it, we have to install the TCP/IP Protocol and Connectivity Utilities. For security purposes, Microsoft recommends that all drives used with IIS be formatted with NTFS.

We start the installation by using the **Add/Remove Programs** application in Control Panel and then to choose **Add /remove Windows Components.** IIS v5.0 consists of about 30 MB of files that need approximately 10 minutes to be installed and configured. When we upgrade from Windows 95/98 to Windows 2000, IIS 5.0 will be installed by default only if PWS was installed on your previous version of Windows. Some other improvements are that we don't have to install service packs and reboot our PC once we finish the installation.

b. Features

IIS web server is designed for heavy traffic. However, if we know in advance the numbers of the expected visitors per day we can tune the server properly (see Figure 21). If we don't have this information, the best solution is to install a hit counter in our welcome web page and together with the log activity that we have for a certain period in our web server we'll adjust it for the optimal performance.

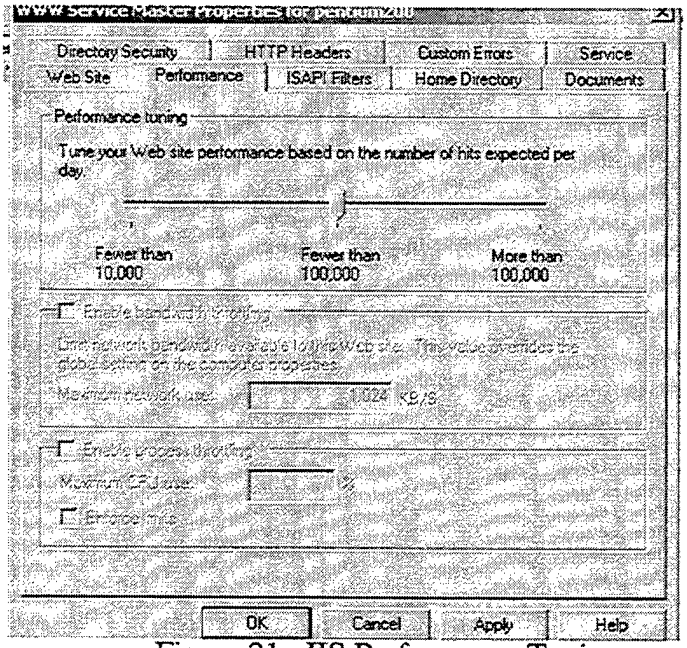


Figure 21: IIS Performance Tuning

Using IIS, we can watch log activities by hour, day, week or month, and can limit the maximum number of connections permitted. We can also set the length of time in seconds before the server disconnects an inactive user. This ensures that all connections are closed if the HTTP protocol fails to close a connection. Another feature is "HTTP Keep-Alives" property. If we enable this property, we allow a client to maintain on open connection with our server, rather than re-opening the client connection with each new request. In case that we decide to disable "Keep-Alives" we may degrade our web server performance.

c. Advantages

The IIS package is designed to cover high web traffic needs that PWS cannot meet. Furthermore, IIS provides to the users not only web server services, but some additional ones such as File transfer Protocol Services (FTP), Simple Mail Transfer Protocol (SMTP) services and News Services. The 5.0 version provides the users some

extra security enhancements such as restricting guest accounts and setting appropriate file permissions.

Moreover, as we already mentioned in Chapter II, IIS supports the Fortezza security standard), Transport Layer security, Digest Authentication and Kerberos v 5.0 authentication protocols used in Windows 2000. Finally, IIS v5.0 features Web based Distributed Authoring and Versioning (WebDAV), which is a standard designed to simplify the construction of intranets and give the ability to multiple users to publish documents to a common Web server.

d. Limitations

Some hardware limitations are the high demand of RAM memory (in order to work efficiently it needs at least 128 MB and the hardware platform must be at least a Pentium 200MHZ). In our case, we run the IIS server on a 200 MHZ platform using only 82 MB of RAM. In addition, the lack of a Unix version, and documentation on the newest features is a serious problem. Finally, IIS runs only on Server editions of Windows 2000 and the remote Web-based administration still needs to be improved.

e. Web Server Management

In addition to managing IIS from its own window, Windows 2000 Professional gives us the ability to reach and manage IIS from a remote location. From Control panel, Administrative Tools we can open a Computer Management window and have the ability to control our computer with IIS included (see Figure 22).

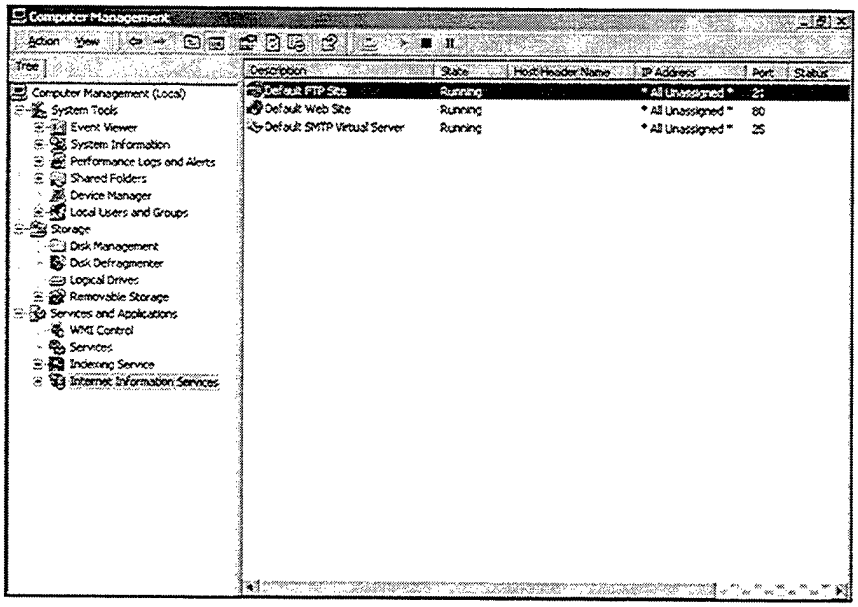


Figure 22: IIS Control from Computer Management of Win2000

D. NAMING OUR COMPUTER.

Naming, is giving a name to the computer that will host the web server. After we install the web server software in our computer, people can access our web server and specifically our site. In some instances providing access to our site requires knowing our computer IP address, rather than just the computer's name. Every computer has a name and a unique 12-digit IP address. The default name for a computer is usually "***default***" (unless we change it) and in Windows 2000 Professional it can be seen if we click the Network icon in Control Panel and select identification (see Figure 23). In this instance the computer name is Pentium200.

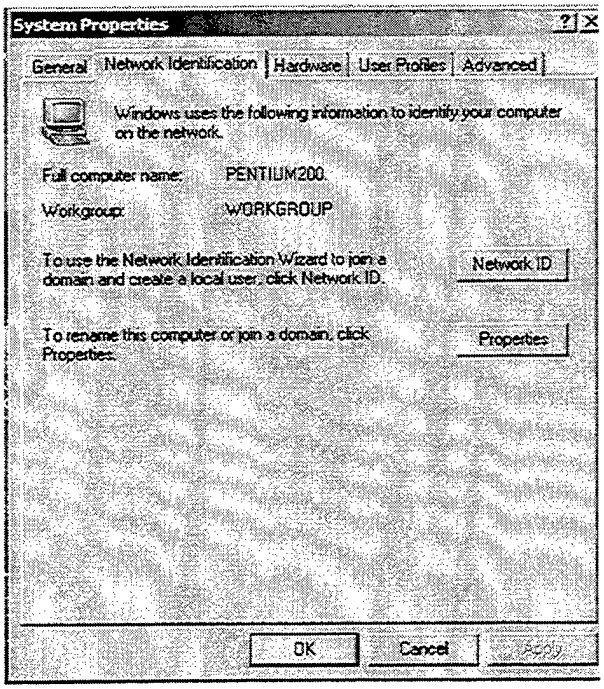


Figure 23: Identification of a Computer in Windows 2000 Professional

1. Providing a Web Site Domain Names

While an IP address is something that we cannot easily remember, its more practical to have and use a name that can be memorized. For this purpose, we can utilize a domain name that identifies uniquely a computer (or host) that is connected on the Internet. The domain name consists of a actual domain and a suffix that is a Top Level Domain (TLD) name (e.g in www.myweb.com , myweb is the actual domain and .com is the TLD. More details about TLDs are provided in Appendix E. In order to obtain a unique domain name, we must register it with a company that provides such services. Among them, are Internic [Ref.14], Network solutions, register.com, and NameSecure, which with a relatively small amount of money can provide a registered unique domain name for a certain period of time. In addition there are some web sites that offer free domain names like www.namezero.net, under some restrictions of course.

2. IP Addresses of the Two PCs

Concerning the local IP address assigned to our machines, we chose one of the three groups of IP's that are valid for use on a machine connected to a private LAN (that won't collide with other machines). So, we used Class C IP addresses (ranging from 192.168.0.0 to 192.168.255.255). The other two Classes are: Class A (10.0.0.0 to 10.255.255.255) and Class B (172.16.0.0 to 172.31.255.255). Finally, Pentium200 machine IP address is 192.168.0.1 and Pentium233 is 192.168.0.2.

E. CREATING AND MANAGING THE DIRECTORIES OF OUR WEB SITE

Files and directories (folders) that will be publicized must be organized before we install the web server. Our personal web server cannot publish pages that are stored outside the specific directories related with our web site.

1. Physical Directories

The directory structure that can be seen by using the Windows Explorer is the physical directory. In our case, the files (web pages) of our web site are stored in C:\Inetpub\wwwroot directory.

2. Virtual Directories

Virtual directories are the structure that reflects the web site. This consists a hierarchy of virtual directories. There are three main reasons for using the virtual directories on web servers:

a. Make the URL web pages shorter and easier to remember, because it reduces the typing time. In order to do this the web master can assign a virtual directory name (or alias) to the specific directory. For example, instead of typing: www.mynews.com/sports/carraces/formula1/lagunaseca/index.htm We can make the URL shorter using a virtual directory that takes us directly to the web page that we wish.: www.mynews.com/lagunaraces/index.htm

b. This provides the computer with extra security, because it hides the physical directory structure on this hard disk drive, from all the web site visitors.

c. Finally, it allows the Webmaster's web site structure to remain independent of the directory structure on the hard drive. So, he can move files on the disk between different physical folders without having to change the structure of the web pages.

3. Publishing a Virtual Directory

In order to create virtual directories, we use the web server. In addition, we can specify the relationships between the virtual directory and the physical directory. For this purpose, IIS have has a very handy Wizard which is called Virtual Directory Creation wizard (see Figure 24). After following the directions in this wizard we end up with the creation of a virtual directory. An example is shown on Figure 25.

Figure 24: Virtual Directory Creation Wizard in IIS

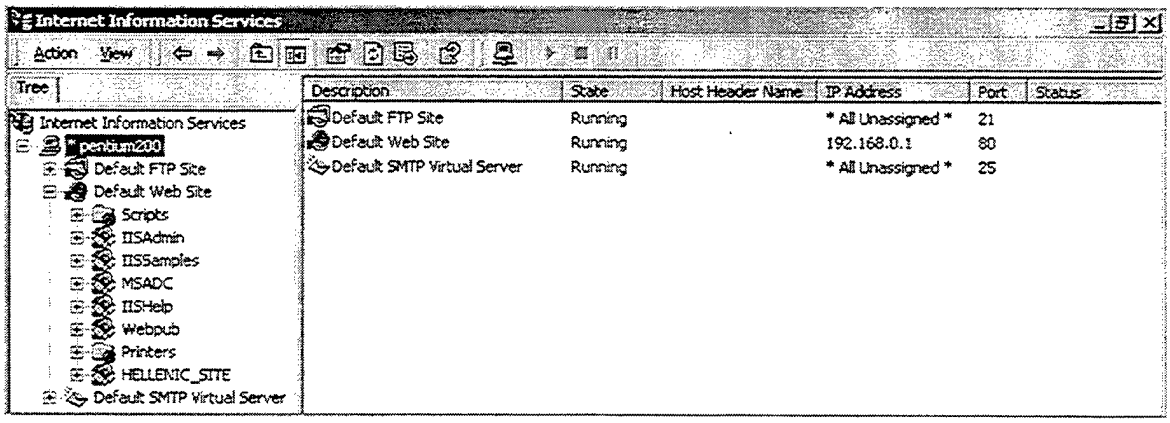


Figure 25: Virtual Directory (**HELLENIC_SITE**) Created in IIS

Using PWS we have the same ability. So, if we click the Advanced Options icon (see Figure 26). We can create a virtual directory. An example is shown on Figure 27.

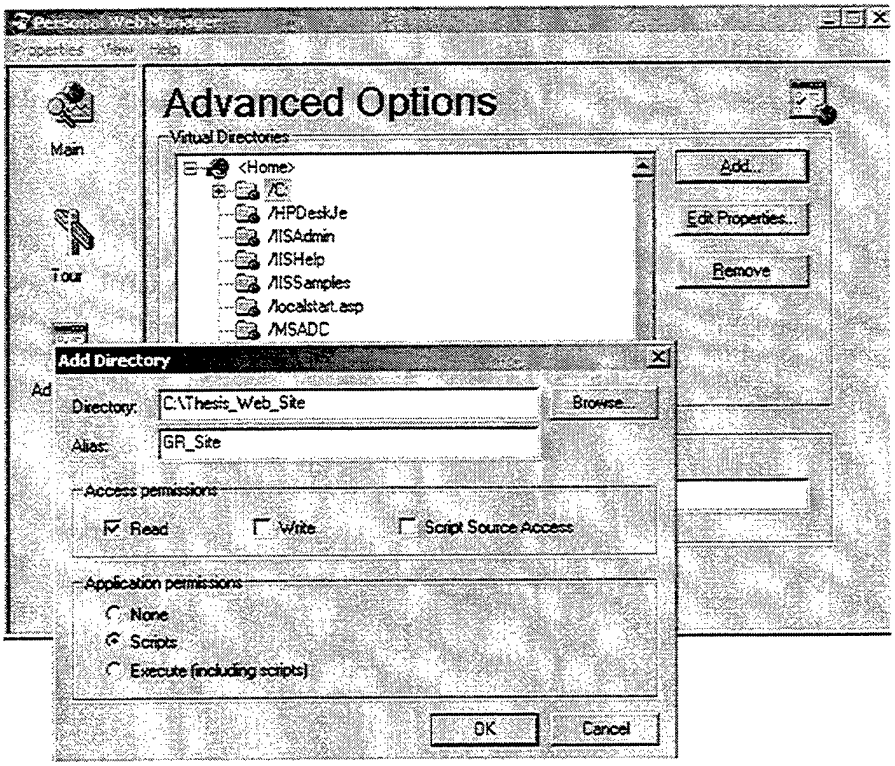


Figure 26: Virtual Directory Handling in PWS

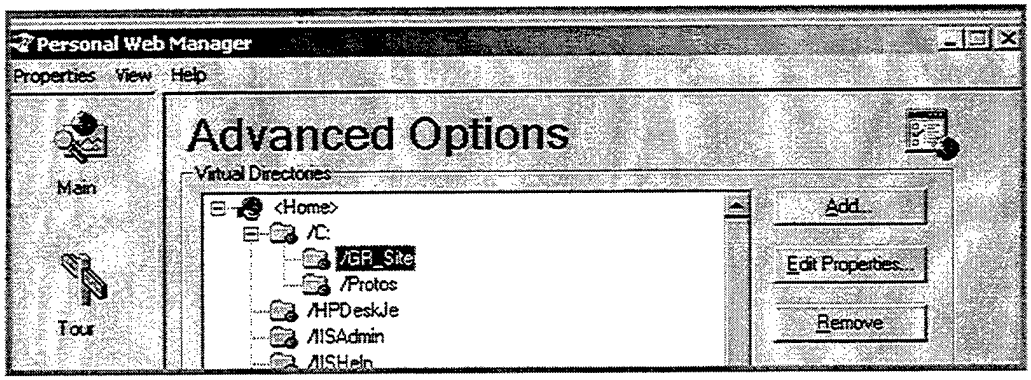


Figure 27: Virtual Directory (**GR Site**) Created in PWS

F. WEB BROWSERS

The web browser in our model plays the role of the client. The necessary feature in the selection of a modern web browser is to be Java language capable. Most modern web browsers support Java. For LAN environments we have to select the same web

browser for all computers. Doing this, we reduce the training and support time for the users.

In our implementation, we used both, Netscape and Microsoft Internet Explorer, each of which are Java capable browsers.

G. CONSTRUCTING THE WEB SITE TO BE HOSTED IN THE WEB SERVER

1. Web Page Authoring Tools/ HTML Editors

HTML stands for Hypertext Markup Language, which is the source language for documents that used as web pages. HTML has the ability to embed commands that determine formatting along with the text to be displayed [Ref.14]. There are two main categories of HTML editors. The first category can generate simple and raw HTML pages and the second provides a WYSIWYG (What You See Is What You Get) environment. The second category is the one that offers all the modern authoring features, such as sophisticated menus, automated wizards and macros. The interface of WYSIWYG web page tools is usually similar to that of a modern Word Processor and the user does not generally need to know how HTML works in order to use it.

For the purpose of this thesis, I used Microsoft's FrontPage 2000, which is a WYSIWYG web-authoring tool that provides a friendly, graphical interface for tasks such as inserting tables, graphics, and scripts.

2. Front Page Extension Tools

The FrontPage Server Extensions are a set of three programs that support features such as collaborative authoring, hit counters, e-mail form handling, and editing a Web site directly on a server computer. FrontPage MMC snap-in is a program that you use to administer the FrontPage Server Extensions and FrontPage-extended webs. You can use it to extend virtual servers, create sub webs, upgrade the server extensions on a web, convert folders into sub webs and vice versa or recalculate hyperlinks in a web.

The Microsoft FrontPage MMC snap-in has a complete help system providing FrontPage server extensions overviews and descriptions of server extensions administrative techniques. [Ref.15]

H. WEB SITE PERFORMANCE

Some of the main factors affecting web site performance are:

1. **Large Graphics Richness.** The more graphics a web page has, the more time the web browser needs to download the page.

2. **Sound-Video-Animation Files.** The rule of large graphics also applies here.

3. **Network Connection Speed.** The faster the network connection is the faster the web page will appear on the user's screen.

In addition, the user's hardware configuration, such as processor and RAM, may affect the final performance.

In our application (the NPS Student Information web site), I used only text with few images. The background was almost white. No animation, video graphics or sound files were used. The connection speed was the highest possible, because the two PC's were interconnected in a LAN.

I. WEB SERVER SECURITY

The most crucial chapter of the web server construction is the one that refers to security measures. No matter where we decide to place our web server, some security measures must be taken in order to avoid futures catastrophes. The security policy must cover not only outside "enemies" but "insiders" as well. Security mechanisms that protect the valuable data from outside intruders are called firewalls. A firewall is a combination of hardware and software, which sits between an Internal network and the Internet. Its primary objective is to limit the access in and out of our network, based upon an established security policy. Firewalls can also be used to reduce the outgoing traffic of our network by restricting users access to the Internet. The most common categories of firewall filtering mechanism are the following [Ref.16]:

- **Proxy Servers.**
- **Packet Filters**
- **Application Gateways**
- **Circuit-Level Gateways**
- **Stateful Inspection**

The above firewalls use different filtering techniques in order to achieve similar goals: the elimination of possible attacks. There are also firewalls that use combination of

these techniques, which can improve the security level. "Firewall scanners" are tools that allow you to check your corporate network and detect potential security holes in both the application and the operating system levels. Some of the most well-known firewall vendors are TIS Gauntlet, BorderWare, Raptor, CyberGuard and IBM SecureWay.

J. INSTALLING A PROXY SERVER

In order to implement the dual web server evaluation test while we use one Internet connection and two PCs, we had to install a program called proxy server. A Proxy server is a program that allows any machine on our local network to route its requests through a central machine that act as a gateway to the Internet. In addition, it offers some security (firewall) that protects the computers on the LAN from outside attacks. In our implementation, we chose to install a proxy server program in the Pentium200 PC in order to share the same Internet connection with the LAN. Thus, using only one connection to the Internet with one modem in the Pentium200 PC we enable Internet access for the Pentium233 PC and protection of this PC as well.

We downloaded **AnalogX Proxy v 5.0** from its web site [Ref.10]. Its file size is very small (just 188.1Kbytes). In order to install this proxy server, we run the downloaded file on the machine with the Internet connection and configure the other machine to use a proxy. The procedures of install and configure take only few minutes (see Figure 28).

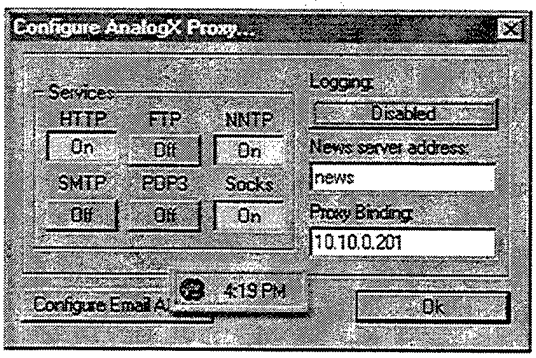


Figure 28: Configuring the AnalogX Proxy Server

AnalogX Protocols

AnalogX supports the following protocols:

- HTTP (for web browsers-port # 6588),
- HTTPS (for secure web browsers-port # 6588),
- POP3 (for receiving mail, port #110),
- SMTP (for sending mail, port # 25) NNTP (usenet newsgroups, port#119),
- FTP (file transferring, port# 21),
- SOCKS4 (TCP proxying, port # 1080),
- SOCKS4a (TCP proxying with DNS lookups, port # 1080)
- And partially (does not support UDP) Socks5, port # 1080)

Moreover, AnalogX works with many web browsers like Internet Explorer, Netscape, AOL, AOL Instant Messenger or Microsoft Messenger. We can see if it is running by a round shaped red or green icon that appears at the lower right part of the screen on the toolbar (see Figure 29).

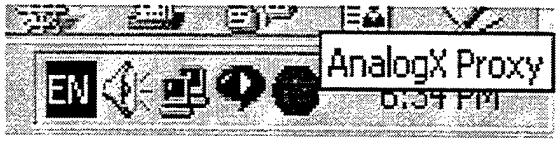


Figure 29: Indicator Icon of AnalogX Proxy Server

V. POST-IMPLEMENTATION REQUIREMENTS

Creating the web server and its necessary components is not the difficult part of the job. The remaining job, which is the management and the maintenance, is the most difficult and simultaneously most critical. The role of a web manager proved to be very important and decisive for the viability of the web site. So, he or she must be properly qualified in order to carry out his or her mission successfully. Required skills include knowledge of management, statistical analysis, business, computers science and experience in project management and the Internet.

Additional responsibilities include defining server standards, monitoring users, training others in web document design, policy formation and enforcement, and data owner support services. Successful web masters will bring a mix of skills and talents appropriate to the needs of the organization in building effective web systems [Ref.21]. Below are listed some of the duties are usually assigned to a web manager [Ref.22]:

- Hosting account administration
- Disk space monitoring and management
- CPU resource monitoring
- Web application performance monitoring
- Review of Web site access statistics
- Installing software upgrades
- Domain name and digital server certificate status monitoring
- Safekeeping of digital certificates and private keys

- Downloading and archiving log files
- Policing of data files, permission settings, and logs
- Periodic testing and preventive maintenance of security features
- Database performance monitoring
- Data archiving

After installation of the web server and the development of the web site, crucial questions, concerning the administration of our web site, will arise. Some of them are listed below:

A. HOW MANY WEB SITES WILL BE HOSTED ON THIS SERVER?

If we host only one site on our web server, it's no problem to monitor or maintain it. Putting more than one web site on a web server requires shared hosting. So, in a single web server computer it is possible to host dozens or even hundreds of independent web sites. In this case, we must assign the duty of their maintenance to more than one person since it's impossible for a single person to keep track of many web sites.

B. WHO WILL BE THE WEB ADMINISTRATOR, THE WEB MASTER AND THE ACCOUNT MANAGER?

This will depend upon the range of the Web server. In a high-end web server with a high volume of web traffic, we need highly experienced persons for each of these duties. Of course the more complex the system the more people will be needed for the

above positions. Below is a description of each duty and the qualifications that the assigned person should have.

1. Web Administrator

This is the person that usually controls everything that is involved in the web jobs of an organization or a business. In large enterprises this may be the Chief Information Officer (CIO) of the company. He or she must be a highly experienced person specialized in Information Technology (IT) management.

2. Account manager

This person controls the people who are eligible to have access to the web server files. An experienced and professional technician, specialized in computers can do this job.

3. Web master.

The web master is the person who accepts the feedback of all the users of the web site and evaluates which updates or improvements should be done in the web site. This is a job for a computer programmer, who knows html, web site development tools and Internet networking generally.

C. WEB ADMINISTRATOR. RULES TO REMEMBER

Below are listed some rules and tips that a web administrator should bear in mind in order to improve the quality of a web site [Ref.21]:

1. Knowledge of our Clients

The first precept of building any information system is to know our clientele and their information needs. The knowledge of these needs aids us in the improvement of our services.

2. Boosting the Data Owners

Those who have responsibility for the content being served on our web server are the "***owners***" of the information and therefore should be involved in how it is presented. This involvement could be as trivial as advising the person who marks it up in HTML or as substantive as doing it themselves. Those falling into the latter category should be supported in several ways such as:

a. Personnel Training

Training is crucial in the IT business. Everybody who deals with computers needs to be up-to-date in order to take advantage of new technologies and make best use of them. Since, no one is born knowing HTML, markup training is certainly a beginning requirement. But beyond that our data owners may require training in using FTP, format conversion (e.g., Adobe Acrobat files (.pdf), word processing to HTML conversion utilities), image acquisition and handling hardware (e.g., scanners, digital cameras) and respective software (e.g., Corel Draw), Internet searching techniques (e.g., search engines), and effective use of web browsers.

b. Providing Templates

Providing basic HTML templates for common structure types of web pages is a very helpful way to save time creating new files. The simplest way to do this is to write an HTML "***shell***" that data owners can fill in with their own information. For some types of files that do not require sophisticated markup we may want to write a small program (i.e. script) that will create a web document with the appropriate basic markup for our server simply by filling in a few blanks on a form. This method can be particularly important to allow those who do not have the time or capacity to learn HTML to contribute information to our web server.

c. Sharing Information

Chances are we do more HTML as a web manager than anyone else in our organization. Therefore we have likely learned a few things along the way. Share those tips and tricks with our data owners. Another idea is to create a mailing list of our data owners so that sharing information with them as a group could be an easy job.

d. Providing Assistance

Although we may not have the time to hold everyone's hand, sometimes there is simply no substitute for sitting down with someone and showing him or her how to do something or even doing it for them while they are there to tell us how they want it.

3. Formulation of Policies

Sooner or later we will need to write policies that govern appropriate uses of our web server. With a written policy that has been reviewed by appropriate groups within your organization, we will be authorized to refuse requests that fall outside of this policy.

4. Enforcement of Standards

Maintaining a web server without setting and enforcing some standards could lead to disaster. If we allow our data owners to do anything they like they often will, and this will lead to "web disorder". We must determine the essential limits on creativity to protect usability and user friendliness and stick to them. On the other hand, we must be careful not to set limits when none need exist. So, a good policy is to reevaluate our standards periodically. If they are too strict, we should loosen them up. If we are facing problems where no standards exist or where they are too loose, then it's time to be more strict.

5. Encouragement of Creativity

Within the framework provided to the data owners, we can promote and encourage the creativity. The issue is to keep a reasonable balance. One way in which this can be done is to specify the presence of some simple graphic element or text that will place the page in context (such as a button bar that identifies the institution) and leave the rest to be filled in by the data owner. In addition, when we encourage creativity it is possible that those who are the most creative set examples that inspire and challenge the others. Applying this method can be a much more effective motivation than mandating participation.

6. User Monitoring

It is usual for the majority of web servers to keep statistics on client requests. Logs include data that specifies the type of client software used, the kinds of errors they are experiencing, and what pages they are looking at. All of these logs are typically available in a specific directory.

7. Studying the Competition

A good web manager should be on the web as much as possible every day. The purpose is to see what others are doing and how they are doing it, and to get new graphic design ideas. Doing so, we can decide what we don't like by seeing the mistakes of others.

8. Checking the Links

A common problem that all web managers face, is keeping the links on their server updated. Documents are moved every day, thereby making links that lead users nowhere. It is the responsibility of the web managers to help his data owners identify these links so they can be fixed.

9. Striving for the Best

No matter how good we are doing as web managers, there is always room for improvement. Below are some ways that we can be sure we are doing as well as possible, since they tend to be things that are overlooked by many web managers:

a. Error Message Replacement page

Most web server error messages are cryptic at best and user hostile at worst. The default "**file not found**" error message is a nice example (see Figure 30).

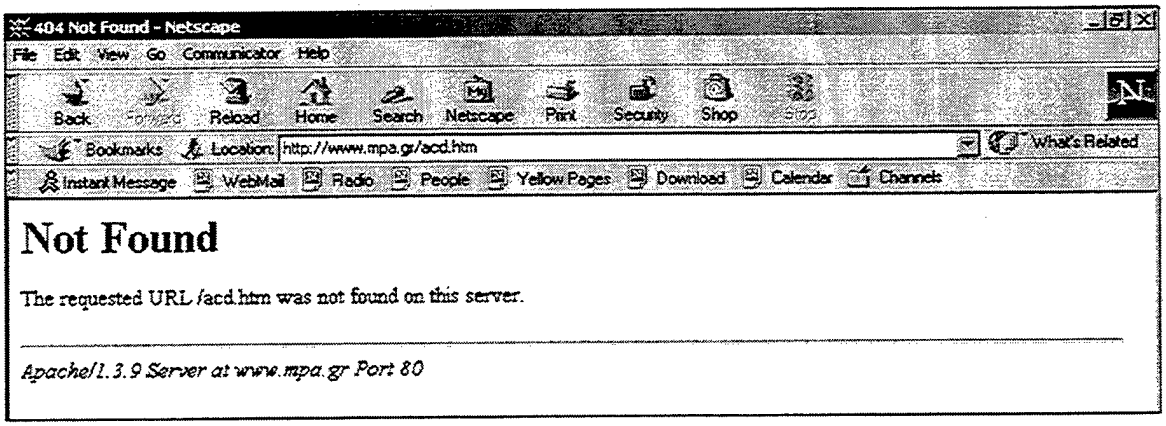


Figure 30: Default Screen for a "404 Not Found" error

This error message tells the user nothing about finding the page they are looking for. Using the built-in ability of most web servers, we can replace the standard error messages with something that is more useful and descriptive (see Figure 31).

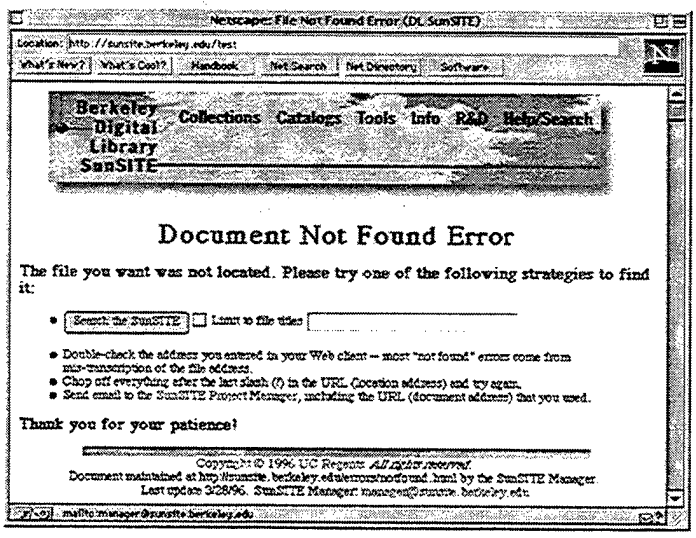


Figure 31: Screen of a replacement error message for a "404 Not Found" error [Ref.21].

b. Referrals

One of the most direct ways to prevent users from losing our information when we move some pages is to create a new page pointing to the new location. On such a page we will typically request that the user update any bookmarks or links that they have to the old location (see Figure 32).

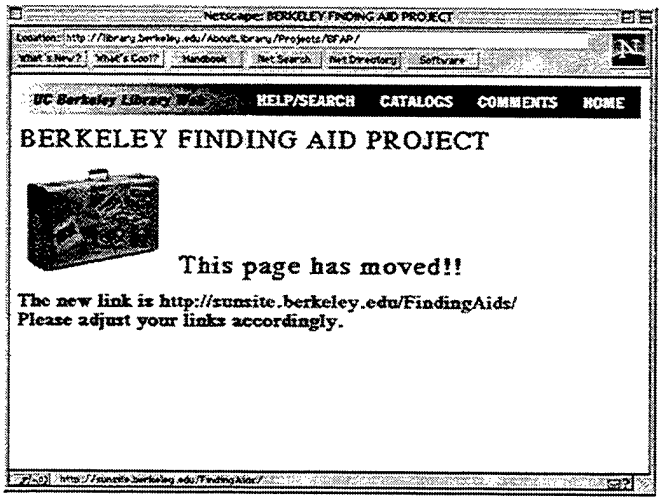


Figure 32. Screen of a Referral to a New Web Address [Ref.21].

c. Redirecting a Web Page Address

Redirection is the procedure whereby we can specify the new location of a document behind the scenes. Then, when a user requests the document at the old location they are automatically redirected to the new location. Doing this we avoid the appearance of "***404 File Not Found***" error message as well as the need to put up an explicit referral.

10. Question Everything

It is all too easy to assume that our first decisions on the design of our server are the best. So, we should periodically question all of our decisions and search if there is a better way to organize our information or design a particular page. We also have to ask for critical evaluations from our users and other staff in our organization.

Finally, we have to look critically at each web page for accuracy, usability, good visual design, and proper display in different browsers.

D. MAINTENANCE

1. Backup

A frequent backup and an installed UPS can provide us with a high level of assurance against any accidental loss of data.

2. Troubleshooting

A FAQ can be installed and utilized each time someone needs assistance resolving possible problems that may occur.

E. WEB SITE ADMINISTRATIVE TOOLS

Large scale or mission-critical websites usually require some automated tools to optimize performance and provide effective management. These tools are software programs that can help us to manage and maintain a web site. There are four main categories of web management tools [Ref.23]:

1. **Web Site Change and Configuration Management Tools.**
2. **Web Site Integrity and Accuracy Tools.**
3. **Tools that Gather Analyze the Traffic and Usage Patterns.**
4. **Tools that Help Examine and Manage Web Site Content.**

F. AN EXAMPLE OF WEB SITE CHANGE MANAGEMENT PROGRAM

[Ref.24]

1. Description

Stage2Live is a web site change management program. It assists with incremental site updates by copying and recording files that have changed on our web servers. A site rebuild feature lets us restore our web site to any earlier version that was placed into the library. A complete Version 3.2 can be downloaded for free from the Internet.

All monitored files are synchronized into a system library, where we can later examine and/or restore multiple revisions of the same file. This is an excellent method for keeping a historical reference of our web site.

Stage2Live can be used to create an automated one-to-many or many-to-many site release strategy for html, asp, text, graphic, and other web files. The program also

supports FTP uploads to your destination sites. Restore previous versions of the files on our web site.

2. Prerequisites

In order to run Stage2Live with Windows 9x/NT/2000, we must have Microsoft Access 97 or 2000 installed in our computer.

Below are some snapshots of the Stage2Live program (see Figures 33-34).

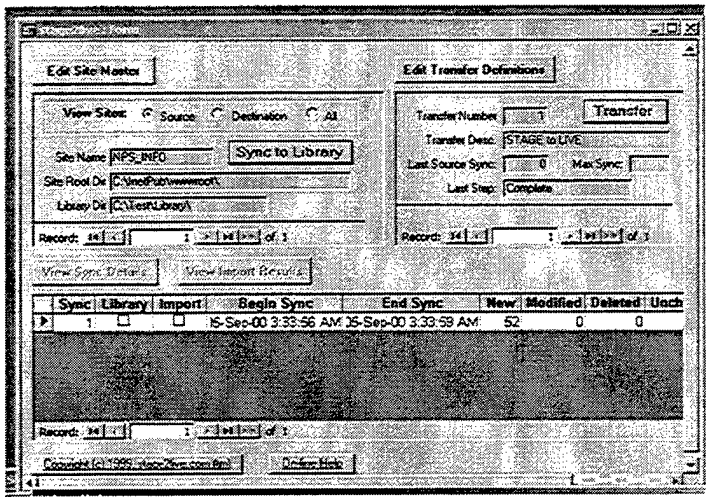


Figure 33: Main Page of Stage2Live Program

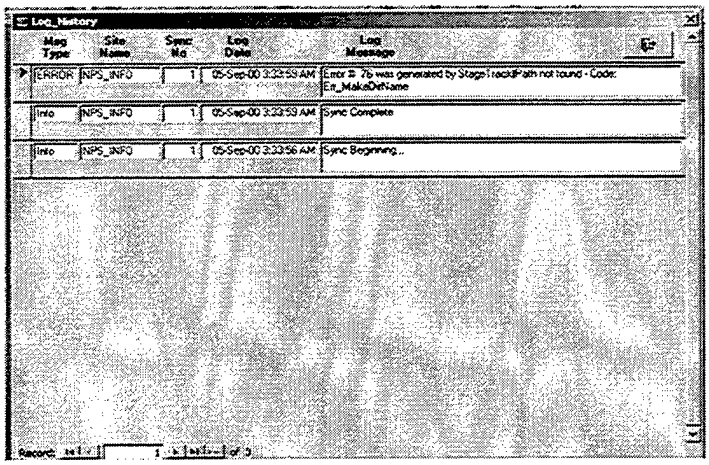


Figure 34: Log History of our Web Site using Stage2Live Program

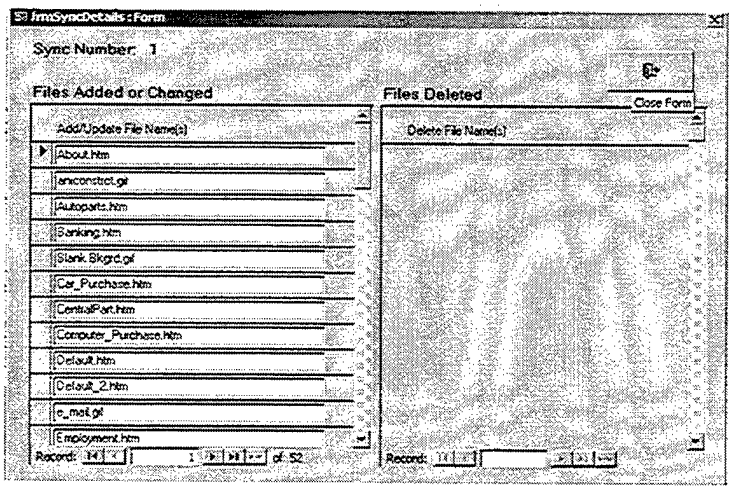


Figure 35. Web Pages or Files that Added, Changed Or Deleted Using Stage2Live Program

G. FINALS NOTES ABOUT WEB MANAGEMENT

A good manager must always be proactive and prevent problems before they arise. This is the best policy to implement in order for an organization or a business to run effectively.

VI. CONCLUSIONS AND RECOMENDATIONS

A. CONCLUSIONS

1. Topology

In chapter IV, we noticed that each LAN configuration has cons and pros. If we want functionality and simplicity, we should place our web server out side of a LAN or a firewall. In the case that our server provides confidential or restricted information and we need increased security, we have to be oriented to the firewall and proxy solutions.

2. Security Issues

The Internet has never been a secure place nor will it be in the near future. Problems with possible hackers will continue to exist and as people become more educated especially in the technical fields the number of "intruders" will continue to rise. The remedy for this situation is to design more secure systems that will prevent possible attacks. In addition, web server administrators have to check and to restrict the publication of any kind of information such as names, addresses, phone numbers, credit card and social security numbers of individuals that will be utilized by possible hackers for frauds or any other criminal actions.

Finally, because a system will never become 100% secure, we must be sure when we are requested to send any sensitive information via the Internet. For this reason, the Security Information alert window can provide a warning message, if we requested a

secure document or if we are going to submit any kind of information via our web browser (See figures 36 and 37).

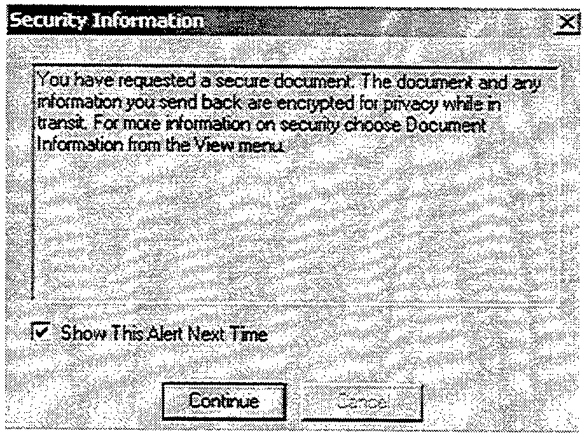


Figure 36: Security Information Alert Window for Secure Documents

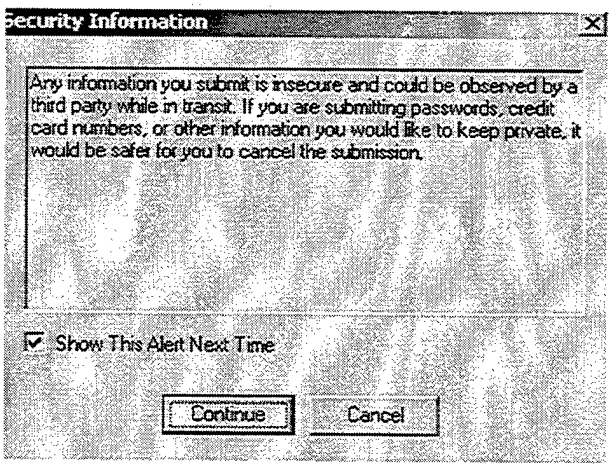


Figure 37: Security Information Alert Window about Insecure Site

The use of a proxy server proved very valuable, because it can filter whatever we chose to prohibit from our computer. Moreover, it was very easy to use and didn't consume a lot of resources.

3. Personal Web Server

PWS proved to be a very handy and useful web server. Regardless of its limited capacity, PWS has handling capabilities that some of the high-end counterparts have. Using the main menu you can monitor many activities such as the number of active connections, the visitors, the requests and the even the number of bytes served, You can also view some statistics in a graphical mode (bar charts) such as the requests per day or per hour, or the visitors per day or per hour.

4. Internet Information Services Web Server

Using IIS under Windows 2000 Professional, and utilizing ASP technology, increased security is possible, because Windows 2000 authentication can be used. With only 82 MB RAM, instead of the best-suggested 128 MB, we encountered no problems, probably because the web traffic was just one client (the Pentium 233 PC). However, we cannot estimate the efficiency of our web server in a high traffic situation, since it wasn't possible to check it in such conditions. In addition, the operation of IIS compared with PWS is more complex, because of its additional capabilities and it should be administered by an expert.

5. Access Control

One of the problems that we faced during the implementation phase was the configuration of the Ethernet cards that this small LAN used. In order to make them work, we decided to swap the two cards and install the necessary drivers from the start. Another issue was the increased security that Windows 2000 Professional provides (comparing with the Win95.) So, every time that we tried to connect the Win95 PC with the Win2000 PC, we were asked for a valid password (See Figure 38).

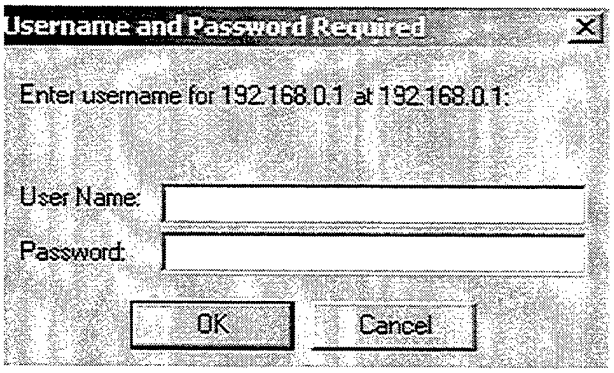


Figure 38: Username and Password Check for a LAN

While logged in Win95 PC (in our case in Pentium233hmz PC) as a "userX" using as a password "passwordY", in order to be connected to the Win2000 PC (in our case Pentium200 PC), userX must have an established account on the Windows 2000 server. We overcame this obstacle by opening a new account in Win2000 PC that was identical to the Win95 PC one.

6. Web Site Performance

When the client requested web pages from the web server, the server responded instantly. And that's because the connection speed between the two PC's was the highest

possible due to the fact that the two PC's were interconnected in a LAN and there was no other network traffic to interfere.

Both Netscape and Microsoft Internet Explorer proved to be very efficient as web clients. Netscape has proved more practical especially concerning the issue of handling the e-mailing, because a separate program is not required to see your e-mail, like Microsoft Outlook.

The use of Microsoft FrontPage 2000 as a web site development tool was proved very efficient and easy to use. It is a very capable tool for the novice and intermediate level web developers. Restricting the use of graphics proved to be very efficient in reducing the downloading time.

7. Web Site Security

a. In Web Server

Since we experimented with unclassified subjects, we were not obliged to use any kind of security measures, such as encryption or security certificate) in order to protect our web site. But for practice purposes we activated SSL, which can give us a kind of security, provided that we activated SSL feature also in FrontPage, in the Web browsers, and web servers (See Figure 39).

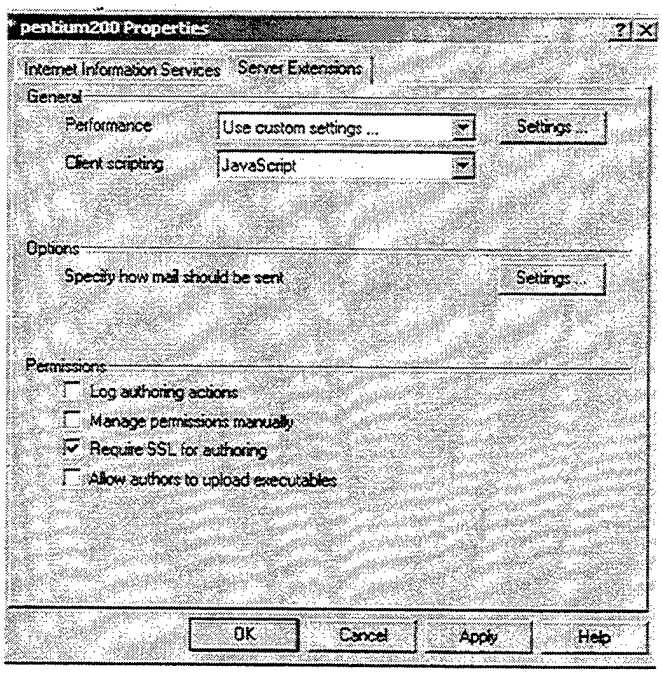


Figure 39: SSL Setting In IIS Web Server

b. FrontPage 2000

FrontPage provides administrative tools that let us set permissions and limit access to our web site. FrontPage security is based on the security mechanism used by the Web server and its operating system. In FrontPage we can specify the type of access that each user has. Users can have one of the following types of permission [Ref.19]:

- **Browse** — the user can browse the files in the web.
- **Author** — the user can browse and change the files in a web.
- **Administer** — the user can browse and change the files in the web, and can also administer the web by adding and removing users. On systems running IIS, FrontPage grants administrator access by default

to all members of the Windows NT Administrators group and the system account.

c. Web Browsers

From the web browser point of view specifically IE 5.0 provides us with two different types of security certificates [Ref.20]:

(1) A ***"personal certificate"*** is a kind of guarantee that you are who you say you are. This information is used when you send personal information over the Internet to a Web site that requires a certificate verifying your identity.

(2) A ***"Web site certificate"*** states that a specific Web site is secure and genuine. It ensures that no other Web site can assume the identity of the original secure site.

Netscape 4.77 provides various types of security settings two different types of certificates, from the most simple to the most advanced SSL v3 (See Figure 40).

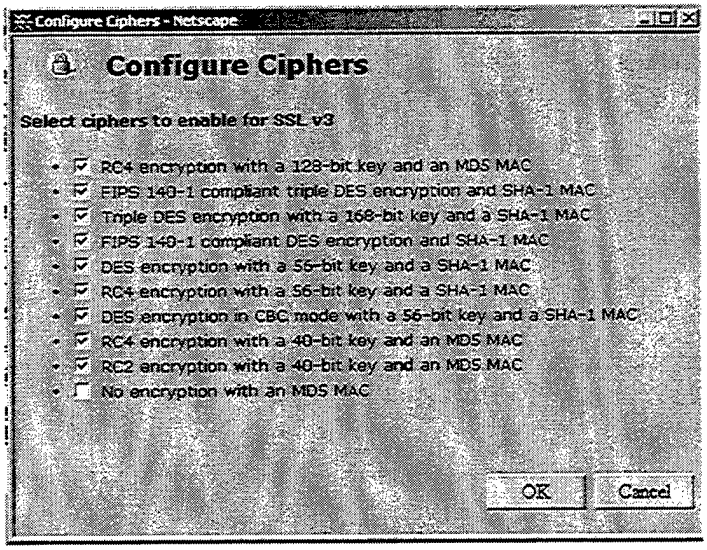


Figure 40: Encryption Setting In Netscape Navigator v4.77

The Internet is a place that everyone can do almost what ever he or she wishes. The possibility of "cyber anarchy" with no restrictions at all is very high. The positive of this situation is that knowledge and information is freely distributed all over the world and the Internet is a rapidly evolving entity. Every day a lot of web business companies offer free Internet connection, free web space to host your web site and even DNS. Offering these free services, the companies advertise their products, and utilize your mail or e-mail address in order to promote their products. This situation gives e-commerce a tremendous boost and the traditional way of buying things tends to be changed in the near future. The negative side of this story is that crime is also distributed freely via the Internet and it is very difficult to stop.

Web server technology helps the situation. Big corporations with high web traffic can use high-end hardware and high-end web servers and improve their business. Small web servers running on popular operating systems installed on affordable hardware platforms are designed in such way that almost everybody can utilize them. In conclusion, almost everybody can obtain and run a web server and publicize his or her web site to the Internet.

B. RECOMMENDATIONS

For the small businesses with low traffic or for home web servers, Microsoft's Personal web server proved very efficient. Since, PWS has limited capabilities it's ideal for testing our web site inside a relatively small Intranet, before we publish our pages on the Internet.

By monitoring traffic on our web sites using the log capabilities, we can see if the traffic is getting higher. This may give us an indication that we need a software upgrade, or both in order to effectively handle the increased traffic.

If we stay in Windows OS and especially Win NT or Win2000, one of the best solutions would be Internet Information Services v5.0, which is the second most popular web server in the world market following Apache server (see Appendix F for more details). In addition, there are other editions of Win2000, like Windows2000 Server or Advanced Server that cover the needs of very large enterprises, but is relatively expensive.

If the operating system does not meet our needs and we intend to switch to UNIX-LINUX like machines, we have to consider seriously using the most popular freeware web server, which is the Apache server. Of course in this case, we have to take under consideration the acquisition cost of the necessary hardware that may be higher than the PC/NT platforms.

Software scientists are continuously working to construct web servers that will run faster, provide higher security, have a better interface and will be easy to handle. Nowadays there is tendency to the freeware and this is one of the reasons that has made the Apache web server so popular (it currently claims the 60% of the installed web servers worldwide). If this trend persists, in few years we may see that the majority of the servers (web servers included) in use are based on open source software.

Both Internet Explorer 5.0 and Netscape Communicator 4.77 proved very efficient web browsers. So, ultimately the decision boils down to personal choice. Concerning the web site development tool, FrontPage 2000 proved a very handy program with many capabilities for novice and intermediate developers. Finally, I think that the combination of the IIS as a webs server, FrontPage as the developer tool and the IE 5.0 as a web browser could be one of the best choices that someone could have in order to set up, operate and maintain a professional looking web site.

APPENDIX A

Naval Postgraduate School Campus Web Servers in Operation

(http://adpsec.nps.navy.mil/webservers.htm)

S/N	Server Name	VLAN Support	Platform/OS	Web Server
1	web.nps.navy.mil	Extranet/O5	Sun/Solaris	Apache
2	hopper.nps.navy.mil	Extranet/O5	Sun/Solaris	Apache
3	itwarrior.nps.navy.mil	Extranet/O5	PC/NT	IIS
4	bulkhead.nps.navy.mil	Extranet/O5	PC/NT	IIS
5	wildcat.nps.navy.mil	Extranet/O5	PC/NT	IIS
6	spitfire.nps.navy.mil	Extranet/10	PC/NT	IIS
7	data.lib.nps.navy.mil	Extranet/13	PC/NT	IIS
8	marines.nps.navy.mil	Extranet/37	PC/NT	IIS
9	research.nps.navy.mil	Extranet/AA	N/A	N/A
10	aa.nps.navy.mil	Extranet/AA	N/A	N/A
11	luqipc.cs.nps.navy.mil	Extranet/CS	PC/Win95	Ms PWS
12	caps.nps.navy.mil	Extranet/CS	Sun/SunOS	Netscape
13	cisr.nps.navy.mil	Extranet/CS	SGI/IRIX	Netscape
14	interact.nps.navy.mil	Extranet/CS	SGI/IRIX	Netscape
15	moves.nps.navy.mil	Extranet/CS	SGI/IRIX	Netscape
16	npsnet.nps.navy.mil	Extranet/CS	SGI/IRIX	Netscape
17	cs.nps.navy.mil	Extranet/CS	Sun/SunOS	Netscape
18	iscas.nps.navy.mil	Extranet/EC	PC/NT	Ms PWS
19	fear.nps.navy.mil	Extranet/EC	SGI/IRIX	Netscape

S/N	Server Name	VLAN Support	Platform/OS	Web Server
20	pc427b3.ece.nps.navy.mil	Extranet/EC	PC/NT	Netscape
21	oapiweb01.nps.navy.mil	Extranet/OI	PC/NT	IIS
22	OAPIWEBD1	Extranet/OI	PC/NT	IIS
23	Oapiwebd1.nps.navy.mil	Extranet/OI	PC/NT	IIS
24	Ideatest.nps.navy.mil 131.120..70.121	Extranet/OI	PC/NT	IIS
25	Ideatest.nps.navy.mil 131.120..70.122	Extranet/OI	PC/NT	IIS
26	jvle.nps.navy.mil	Extranet/OI	PC/NT	IIS
27	diana.or.nps.navy.mil	Extranet/OR	Linux	Apache
28	spica.or.nps.navy.mil	Extranet/OR	MAC/MacOS	Apache
29	magog.sm.nps.navy.mil	Extranet/SM	PC/NT	IIS
30	wings.sm.nps.navy.mil	Extranet/SM	PC/NT	Apache
31	satcom.sp.nps.navy.mil	Extranet/SP	PC/Linux	Apache
32	gs-control.sp.nps.navy.mil	Extranet/SP	PC/Linux	Apache
33	sp.nps.navy.mil	Extranet/SP	PC/Linux	Apache
34	devo.stl.nps.navy.mil	Extranet/STL	SGI/IRIX	Apache
35	compaq204.trac.nps.navy. mil	Extranet/TRAC	PC/NT	IIS
36	dellsvr.trac.nps.navy.mil	Extranet/Trac	PC/NT	Apache
37	met.nps.navy.mil	Intranet/MR	SGI/IRIX	Apache
38	ptsur.nps.navy.mil	Unknown	SGI/IRIX	Apache

39	usw.nps.navy.mil	Unknown	SGI/IRIX	Apache
40.	Metricssrv.nps.navy.mil	DNA	PC/NT	IIS

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APPENDIX B

Web Server Baseline Assessment

The following data was collected from a survey of operational web servers at the Naval Postgraduate School:

A. GENERAL INFORMATION

1. NPS has 40 web servers installed. 45 % of them use Win NT, 22.5% use SGI/IRIX and 7.5 % PC/LINUX. The rest use Sun/Solaris, Sun/Sun OS, Linux, Mac/MacOS, PC/Win 95 and 3 of 40 provided no data.

2. A break down of web servers shows 35% use Microsoft IIS web server, 32.5% use open source Apache web server, 20% Netscape, 5% use MS PWS and 7.5 provided no data.

B. WEB SERVER AVAILABLE SOFTWARE

1. Apache web server (for Sun-Linux -IRIX platforms mainly).
2. Windows IIS (for NT/PC).
3. Netscape web server (for SGI/IRIX mainly).

C. HARDWARE PLATFORMS

1. Unix/SUN like platform.
2. PC like platform.
3. Macintosh platform.

D. SECURITY CONCERNS

1. Proxy servers.
2. Gateways (Bastion).
3. Windows NT security features.
4. Routers.

E. WEB SITE DEVELOPMENT SOFTWARE TOOLS AVAILABLE

1. Microsoft Front Page for Windows.
2. Netscape Composer.
3. Adobe Pagemil (old version).
4. HoTMetal.
5. Macromedia Dreamweaver.
6. Net objects Fusion version 4.0 or 5.0 and Team Fusion Client 2000.

F. PROTOCOLS USED

1. HTTP.
2. FTP.
3. TCP/IP.

G. CONCLUSION

I think that a PC/NT platform and Microsoft IIS as web server S/W would be the best solution, because it is more user-friendly and NPS is already licensed to use it. Furthermore it is easier to maintain. Microsoft Personal Web Server that runs on

Windows 9x or 2000 Professional edition would also be good choice. For web page construction Microsoft FrontPage 2000 would be a good choice, because it is more user friendly and has more capabilities compared with other editors.

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APPENDIX C

Suggested Configuration (Optimal) for a Web Server that Uses PC/Windows 9x-NT-2000 Platform.

I consider that the following requirements would be the most appropriate to implement a suitable web server:

A. PHYSICAL WEB SERVER REQUIREMENTS

1. Type of server: PC-based
2. Server station internal architectural characteristics
   a. Motherboard: Any motherboard that supports Intel Pentium II or III CPU
   b. Microprocessor: Pentium II or III /450 - 700 MHz
   c. RAM: At least 128 MB SDRAM DIMM/PC 100 MHz expandable at least up to 256 MB.
   d. Ports: At least 1 serial, 1 parallel free port.
3. Number of expansion slots: At least 4 empty PCI expansion slots.
4. Type of Network Interface Card (NIC): 10 Base T /100 Mbps Ethernet.
5. Permanent Storage Devices: Hard disk drive at least 12 GB Ultra DMA at 5400 RPM or higher.
6. Removable Storage media: FDD, Zip drive at least 100 MB, CD-ROM device at least 40 X speed.
7. Backup Unit: Tape streamer or CD-RW unit.
8. Video Graphics card: S-VGA with at least 4MB memory.
9. Case: ATX case with at least 6 bays and power supply > 200 Watts.
10. Monitor: At least 15" color monitor with dot pitch at most .27mm and at least 1024 X 768 pixels maximum resolution.
11. UPS: any system that supports at least 600 KVA power devices

B. NETWORK REQUIREMENTS

Since, it will be installed in a Personal computer that is a stand alone one, no firewall required. In addition, there is no need for transaction or message servers. Of course there are other alternatives for the web server connectivity that could be considered, with respective pros and cons.

C. Communication Protocol Requirements

TCP/IP

D. Software requirements

1. Windows Personal Web Server or Windows NT/IIS
2. Microsoft Front Page 2000 or Net Objects Fusion 5.0
3. Windows 2000 Professional would be the optimal solution with Windows 9x or NT (in the case that we will implement the IIS web server)

APPENDIX D

Main Pages of the NPS Student Information Center Web Site

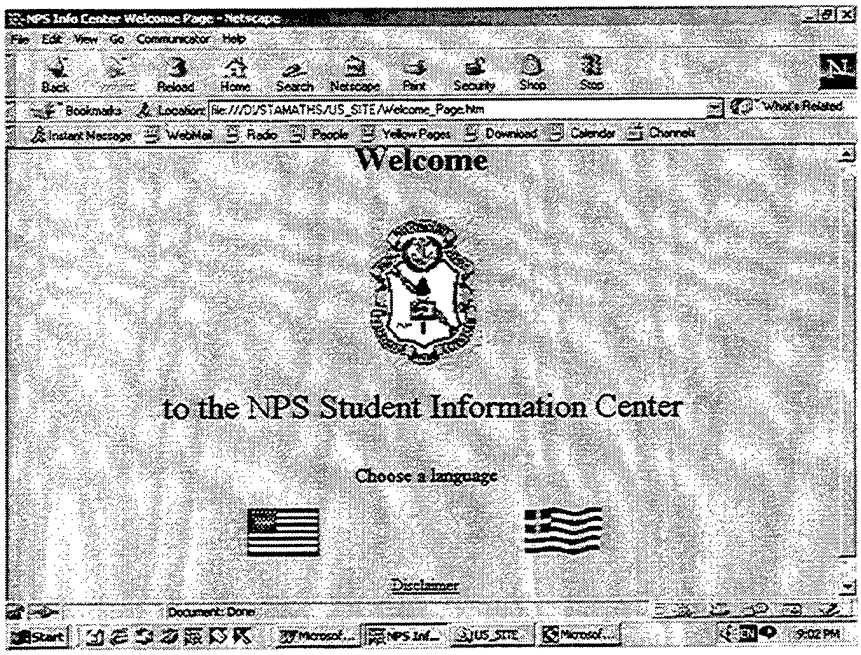

Figure 41: Main Welcome Page of the NPS Student Information Center Web Site

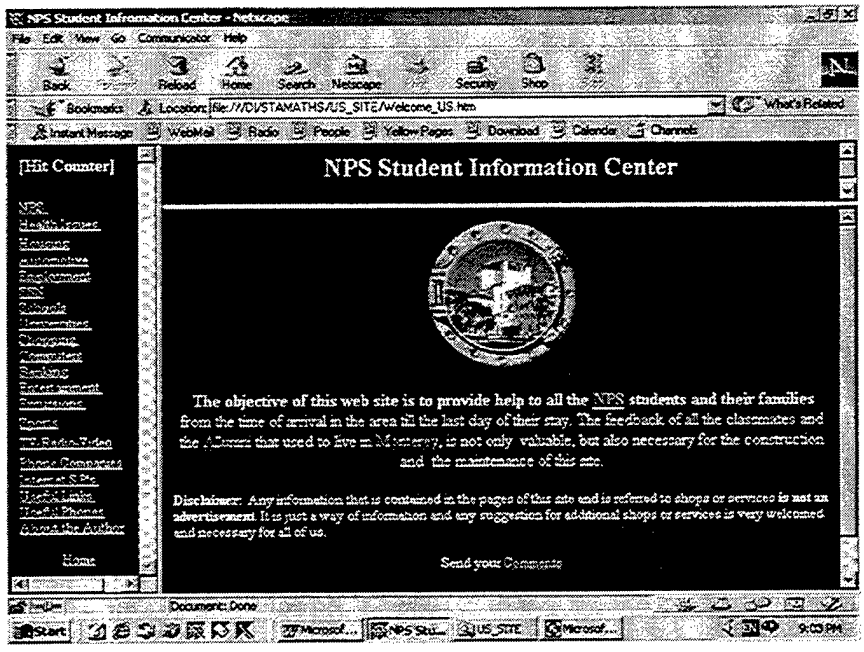

Figure 42: English Main Page of the NPS Student Information Center Web Site

Figure 43: Greek Main Page of the NPS Student Information Center Web Site

APPENDIX E

List of Generic Top level Domains (gTLD)

.com	For commercial business
.gov	For government organizations
.mil	For military organizations
.edu	For educational institutions
.org	For non-profit organisations
.arts	For arts or culture-oriented organizations
.info	For information services
.net	For computer networks
.nom	For individuals
.store	For online merchants
.rec	For recreation or entertainment resource
.web	For web-oriented organizations

The first five TLD that listed above, established and used , while the rest remain inactive. There are also other TLDs that identify each different country that the web site belongs, like **.uk** for United Kingdom, **.gr** for Greece or **.de** for Germany. In addition, there are combinations like **.uk.com**.

The responsible organization for defining TLDs is ICANN (Internet Corporation for Assigned Names and Numbers). ICANN is a non-profit corporation that was formed to oversee IP address space allocation, protocol parameter assignment, domain name system management, and root server system management functions previously performed

under U.S. Government contract by IANA and other entities. The last meeting of ICANN was held in 16 July 2000 in Yokohama-Japan. In 1 November 2000, the ICANN will announce their decision about the new top-level domains. [Ref.11]

APPENDIX F

Netcraft Web Server Survey

The latest Netcraft Web Server Survey was held in the July 2000 and received responses from 18,169,498 sites. The following graphs depict the market share of various web servers. [Ref.18]

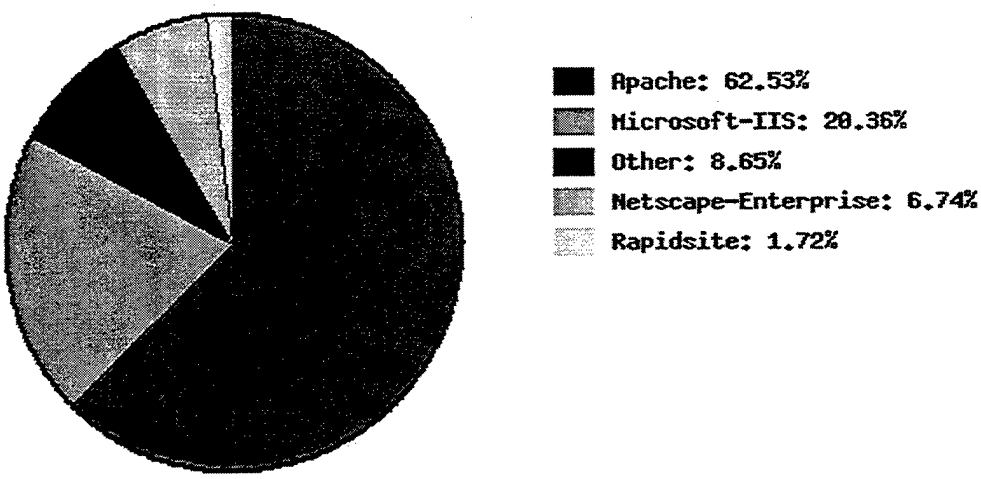

Figure 44: Web Server Count by Sites

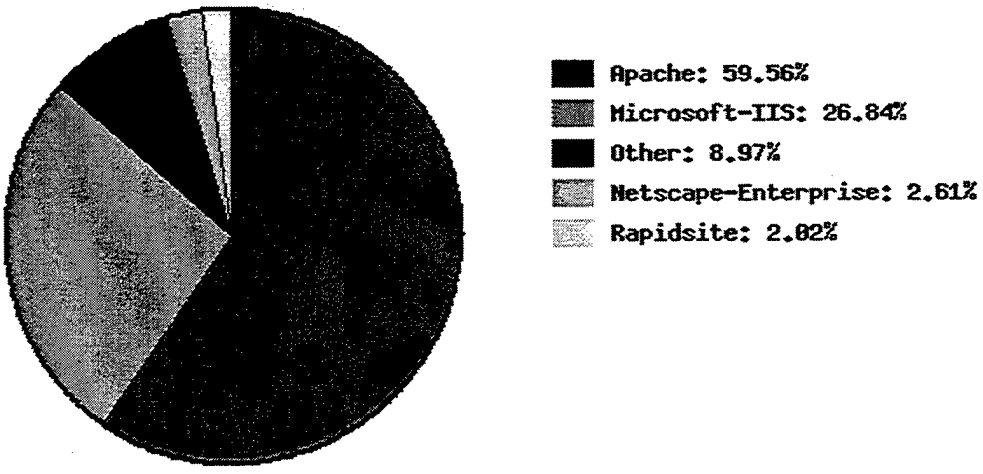

Figure 45: Web server Count by Active Sites

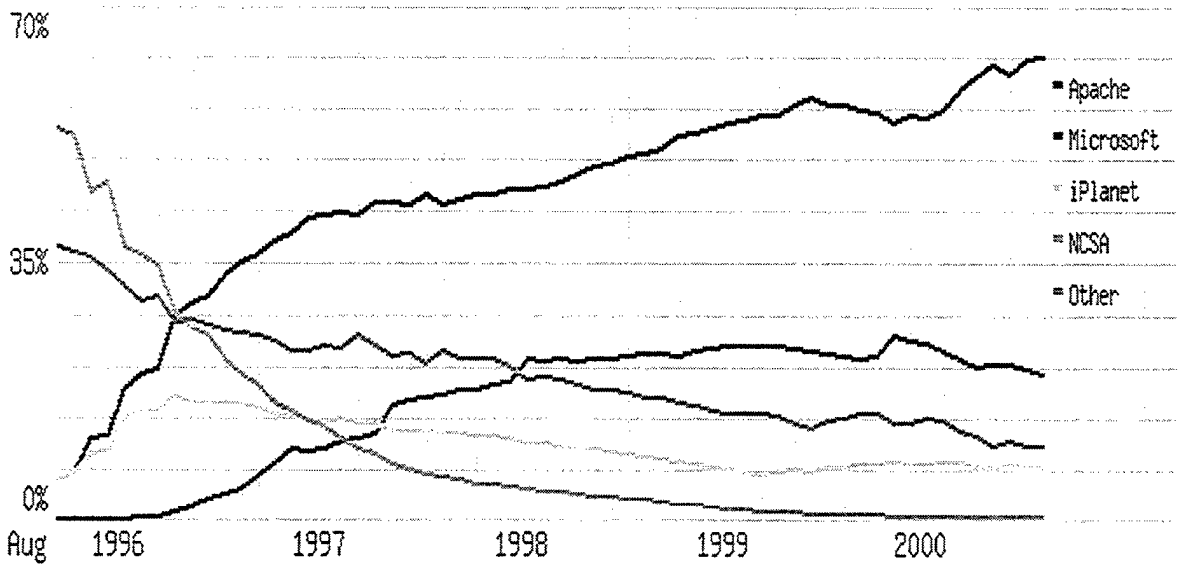

Figure 46: Market Share for Top Servers Across All Domains August 1995 - July 2000

GLOSSARY OF TERMS AND ACRONYMS

ADMD: Administration Management Domain

CCITT: Consultative Committee for International Telegraphy and Telephony

DSL: Digital Subscriber Line

FAQ: Frequently Asked Questions

FTP: File Transfer Protocol

GIF: Graphics Interchange Format

HTML: Hypertext Mark-up Language

HTTP: Hypertext Transfer Protocol

HTTPS: Hypertext Transfer Protocol Secure

IE 5.0: Internet Explorer version 5.0

IIS: Internet Information Services

ISP: Internet Service Provider

IT: Information Technology

JPEG: Joint Photographic Experts Group

MHS: Message Handling System

NTFS: Network File System

NNTP: News Network Transfer Protocol

PWS: Personal Web Server

PNG: Portable Network Graphics. A recently invented graphics format that can be 10 to 30% more compressed than in a GIF format.

SSL: Secure Socket Layer is a protocol, which is used to transmit encrypted data between a client and a server.

TCP/IP: Transaction Control Protocol/Internet Protocol

UDP: User Datagram Protocol, which is the TCP/IP protocol that provides application programs with connectionless communication service.

URL: Unified Resource Locator, which consists of three parts: the protocol, the domain name and the path.

WYSIWYG: What You See Is What You Get. This function of a program describes that what you see in your monitor is what you'll finally have printed in your hard copy.

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