Building an Enterprise Web Infrastructure Using Windows 2000

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1. INTRODUCTION

From its inception more than a decade ago, the World Wide Web has evolved from a tool for the research and scientific community to what may arguably be the most accessible and broad-based communication instrument of the twentieth century. The Web has altered the way people work, recreate, communicate, and interact with each other. Commerce, marketing and publication concepts have been transformed by the Web. Corporations, public organizations, governments, educational institutions and individuals have access to a global audience through the Web. An author, artist, musician or publisher can reach millions of readers, viewers and listeners throughout the world in a matter of minutes via the distributed features of the Web.

The University of Pittsburgh's Web presence represents its current level of technology in the most visible form. The University's Web technology should reflect a modern, sophisticated University that is at the forefront of current technological trends. The University of Pittsburgh's web pages should be accessible to as many individuals as possible, compatible with as many client applications as are available, and should exploit the latest developments in web application technology.

Based on this criteria, the Enterprise Web Infrastructure Project Team was charged with the following goals:

- Provide a robust, reliable and upgradable web server hardware infrastructure.
- Provide a full-featured web server software infrastructure.
- Provide a content management software solution.
- Provide a site management software solution.

This presentation will describe and detail the design and implementation of an enterprise web infrastructure using the Microsoft Windows 2000 platform and a three-tiered approach to the system architecture. The presenter will detail the process of platform evaluation, the role of content management and site management in the implementation. Unique partnership arrangements will be described as well.

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Keywords

web, system architecture, content and site management, and partnership

2. BACKGROUND

From its inception more than a decade ago, the World Wide Web has evolved from a tool for the research and scientific community to what may arguably be the most accessible and broad-based communication instrument of the twentieth century. The Web has altered the way people work, recreate, communicate, and interact with each other. Commerce, marketing and publication concepts have been transformed by the Web. Corporations, public organizations, governments, educational institutions and individuals have access to a global audience through the Web. An author, artist, musician or publisher can reach millions of readers, viewers and listeners throughout the world in a matter of minutes via the distributed features of the Web.

The Provost's Committee on the University of Pittsburgh's Presentation on the World Wide Web was formed in 1995 to establish fundamental guidelines for the University's top level pages (http://www.pitt.edu/) and to assess the institution's use of the Web. The Committee has evaluated visual designs for the top level pages and established design criteria for departmental pages linked from those pages (http://www.pitt.edu/~provost/webrd61599.html). The Check List for University of Pittsburgh Unit Web Pages was produced by the Committee, providing guidance for links to the top level pages, accessibility for disabled users and the proper use of copyright protected material. The Committee meets periodically to examine relevant Web issues and is currently reviewing a new visual design for the University of Pittsburgh's top level pages.

The Web's impact on education has altered the paradigm, especially at colleges and universities. Nearly all of a university's activities have the potential to be transformed by the expedient and ubiquitous nature of the Web. Processes involving recruitment, application, payment and scheduling of classes can be administered in new ways. Research collaborations and instruction can occur over the Web independent of time and place. For many large research universities, a high-profile presence on

the Web represents a significant portion of an institution's marketing and public relations effort. In fact, a university's Web site has become the single most comprehensive source for information on the institution, its faculty, students, research and degree programs.

The University of Pittsburgh's long-range technology plan, "An Information Technology Foundation for the 21st Century" identified the following goal pertaining to Web infrastructure:

> It is essential that students and faculty have access to technology tools to effectively engage in teaching, learning, and research activities appropriate to their areas of study. A learning environment must be sustained that supports increased and seamless access to information resources. A robust Web infrastructure and a structured approach to utilization of the World Wide Web across student, instructional, and administrative systems will be developed.

The Plan also provides the following framework for future uses of the Web at the University of Pittsburgh:

> The ubiquitous nature of the Web, coupled with the Web literacy of students, faculty, and staff, provides a unique opportunity to create an instructional, research and working environment that exploits the Web's common tools and interface for day-to-day functions. A Web-centric environment at the University would use the Web as the basis for not only instructional applications, but for all transactional activities. Such actions would include, but not be limited to, application, registration, course scheduling, grade reporting, transcripts, procurement, and all forms of e-commerce. Instructional applications are already established with the recent adoption of CourseInfo and the ULS' extensive acquisition and deployment of digital library resources. Using the Web to unify instructional, research and administrative activities would cultivate an environment in which services and support for the University community could exist independent of time and location. Additionally, the Web's structure would allow student, faculty, and staff interactions to be integrated in a coherent and consistent manner. In such a setting, the stream of information provided by the seamless integration of all transactions and interactions would provide the basis for a more responsive IT planning and support structure.
>
> Initial implementation of a Web-centric environment would be dependent on partnerships between the more advanced users of technology and the areas for which there is nearly endless demand for service and support. This would include the Office of the Registrar, the Cashier's Office, the Office of Admissions and Financial Aid, Procurement and Accounts Payable/Receivable, and the offices of various student services such as Housing Services, Food Services, and the Book Center. The success of this integration is directly related to the University's ability to rapidly adopt and institute an enterprise-wide digital certificate solution that can serve as the basis for all transactions. The University's ability to identify, select and even require providers of goods and services who are able to operate seamlessly in such a setting will increase as the institution's deployment of a Web-based transaction environment expands.

The Enterprise Web Services Infrastructure Project will use this rationale as the principle basis for developing goals, requirements, architecture and design specifications for a new Web infrastructure.

3. PROJECT GOALS AND SCOPE

1.1 DESIGNING AN INFRASTRUCTURE FOR CURRENT AND FUTURE DEMANDS

The Enterprise Web Services Infrastructure Project must resolve a number of near-term challenges, while establishing a long-term foundation for the University's Web system architecture that supports expansion and growth. Existing functionality will be retained in the new environment. The infrastructure which supports the University's web presence will use the latest web serving software and web application technology. Additionally, the infrastructure will be designed to have the capacity to accommodate additional features or new services when such options become available and are deemed necessary. As with any enterprise service, security is of the utmost importance, as is site fault tolerance and redundancy. Provisions must be made to support e-commerce and the secure financial transactions required by that functionality. The new enterprise web infrastructure must guarantee a Quality of Service (QoS) to the University community who rely on the site for web hosting and serving. QoS is a blend of several factors, including robustness, reliability, speed, and range of services.

The University of Pittsburgh's Web presence represents its current level of technology in the most visible form. The University's Web technology should reflect a modern, sophisticated University that is at the forefront of current technological trends. The University of Pittsburgh's web pages should be accessible to as many individuals as possible, compatible with as many client applications as are available, and should exploit the latest developments in web application technology.

Based on this criteria, the Enterprise Web Infrastructure Project Team is charged with the following goals:

- Provide a robust, reliable and upgradable web server hardware infrastructure.
- Provide a full-featured web server software infrastructure.
- Provide a content management software solution.
- Provide a site management software solution.

The Enterprise Web Services Infrastructure Project scope will focus exclusively on the hardware and software infrastructure that is centric to the University of Pittsburgh's top level pages and serving student web pages. The Project's scope will not involve the process of determining the appropriate visual design for the University of Pittsburgh's top level pages.

4. CURRENT ENVIRONMENT

The University's present Enterprise web infrastructure has had no significant upgrades in the past three years. The University's main Web site provides links to schools, programs, units, and services throughout the University. The Provost's Committee on the University of Pittsburgh's Presentation on the World Wide Web oversees the University's Web site (http://www.pitt.edu), determining content and visual design of the top level pages. Individual units create and maintain their own Web sites, linking to and from the main University Web site.

The University of Pittsburgh enterprise web services currently operate on three Sun Sparc 20 computers located in the machine room at the University of Pittsburgh's R.I.D.C. Park Computer Center. Each web server has approximately 512 megabytes of RAM, two SCSI hard drives (at least two gigabytes each) and 10-megabit Ethernet cards. The University's web servers are currently running on a Parcel image (internally developed code) of Sun Solaris 2.5.1 operating system with the Sun4m architecture. The University's enterprise web servers use Netscape Enterprise Server v2.0.1 as the server software and Thunderstone Data Services' Webinator commercial search engine software version 2.13. Webinator provides for text search functionality on the University's top level pages' web content. Tracking information is obtained by routinely parsing the access log files with a program that was developed internally. This program generates formatted output for utilization by Microsoft Excel to create a graphical statistic. A fourth server is dedicated to evaluation and testing of modifications prior to moving such changes to the three production devices. Neither content nor site management tools are used to administer the University's enterprise web services. The current web architecture does not utilize true load balancing, instead relying on a DNS round-robin scheme (Appendix A).

Traffic on the University of Pittsburgh's web site has experienced rapid growth (Appendix B). Nearly every school, department, center, service and student organization has a presence linked to the main site. Students can access a variety of administrative services via the web including course schedules and grade reports. Sponsored research projects are detailed on faculty web sites, while committees report their activities to the University community using the Web. Electronic commerce is conducted using the e-Store to purchase computing hardware and peripherals.

A Web site dedicated to the provision of technology related information was developed and deployed during 1999. Presently, the site, http://technology.pitt.edu provides information concerning technology issues and services provided by Computing Services and Systems Development and Network Services, including the Help Desk, Training, Software Licensing Services, Support Services and Telecommunications. This technology-focused site also includes news items, systems announcements, a calendar of events and links to the University Library System, the Center for Instructional Development and Distance Education, and the Regional Campuses. Traffic has been heavy during the first eight months of operation (Appendix C).

A pilot program deploying University online courses and course materials using CourseInfo was initiated in 1998. During its first academic year, this program helped place nearly 150 course sections on the Web for more than 6,000 students. In less than two years, over 600 faculty have completed CourseInfo training. They have developed and offered approximately 650 courses using CourseInfo, currently impacting more than 13,000 Pitt students each term (Appendix D).

5. FUTURE ENVIRONMENT

The needs of the University of Pittsburgh community require that the institution provide a robust, flexible and yet structured, contemporary Enterprise web infrastructure. This will require rethinking the architecture and design of the University's Web infrastructure. The new solution will include support of high-end content, staging and application servers, fault tolerance, and multiple points of Internet access to ensure minimal downtime. The following factors will influence the specifications and final recommendation.

1.1 HARDWARE INFRASTRUCTURE

The hardware requirement is for the enterprise servers on which the Web services operate. The Unix-based or Intel-based system must fulfill the following criteria based on Quality of Service requirements and anticipated growth:

- Redundant Array of Independent Disks (RAID) capable hardware
- Modular hard disk space to support current demand and future growth
- Modular central processing units
- Adequate modular memory to support current demand and future growth
- Modular network connectivity with provision for future network architecture

1.2 SOFTWARE INFRASTRUCTURE

Newer versions of enterprise web service software or other more functional alternatives for the University's web service software should be evaluated. This is especially important in the interests of security, as older software versions can contains well-known, widely published bugs and exploits. The latest versions of web server software would provide access to features currently

unavailable in the older version of the software. Examples include:

- A server-side scripting language.
- Database connectivity is crucial for Web-based transactions and Content Management.
- Content Management to allow dynamic construction of web pages, simplifying the editing and updating process.

1.3 SECURITY EVALUATION

Secure connections (such as with an enterprise SSL key) are absolutely necessary to ensure private communication between the web client application and the University's enterprise web servers. Without the capability to provide a secure connection, the University's enterprise web servers will not be able to host e-commerce sites or secure transactions.

The migration from the current system to the new system will conform to all standards set by the CSSD Data Security Officer.

1.4 REDUNDANCY AND FAIL SAFE EVALUATION

University enterprise systems must be protected by a fail safe plan. The fail safe plan for the enterprise web infrastructure must address hardware failure, network failure, server failure and software failure. The following guidelines will be considered:

- The University's three production enterprise servers should be located at multiple facilities to maintain the University's web services in the event of a disaster.
- Hardware fault tolerance should be employed, typically using RAID hardware.
- Clustered load balancing to allow all servers to behave as a single IP.
- Active monitoring of the services (i.e. SNMP)

1.5 SITE MANAGEMENT

Access tracking tools and statistics are necessary in order to evaluate the traffic and destination of visitors to the University's web site. Site management software will generate data that can be employed to assess the use of the University's Web site (Appendix E). Similar statistics can provide information that can be used to develop a strategy for expansion of the site. Site management software must also adhere to specific criteria:

- Support for and integrate with the University's enterprise web service software.
- The product must provide meaningful tracking statistics, such as unique web site access counts.
- Cost and licensing issues for the product.
- Platform compatibility of the product.
- The product's statistical methodology and how it impacts the University's web services.

Several site management products will be evaluated including Webtrends Enterprise Suite and Microsoft Site Server.

1.6 CONTENT MANAGEMENT

The University of Pittsburgh's long-range technology plan, "An Information Technology Foundation for the 21st Century" identified the need for content management tools pertaining to Web infrastructure.

> The University's increased reliance on the Web for electronic publication of static and dynamic content, as well as serving as a vehicle for user interaction with a number of services, requires the addition of content management and site management software. Content management software will handle version control, content approval, testing, and deployment of content created with a wide variety of tools by a large number of people. Web site management tools are needed to provide accurate, detailed and reliable access, statistics, link management and similar functions.

A set of content management tools will simplify the process of editing and updating modifications to the University's Web site. The review and approval of new information or changes to the site will be streamlined with the addition of content management tools. Content management software must also adhere to specific criteria:

- Security of the content database
- The product's compatibility with the University's enterprise web servers
- The method used to construct dynamic web pages from the content database—what is the learning curve and can it be updated
- Cost and licensing issues for the product
- The support agreement for the product

Several content management products will be evaluated including, Halo Content Server, Interwoven TeamSite, and Broadvision One-to-One.

1.7 SEARCH ENGINES

A multitude of search engine products exist. A search engine will be selected that provides basic search functionality for the site. The enterprise web services infrastructure architecture will allow for multiple search engines and upgrades to more fully featured products as they become available.

1.8 CONVERSION AND MIGRATION

The process of cleansing the existing web site files and directories is underway. A comprehensive plan and procedure will be developed to migrate the existing files and pages to the new environment. Under the new enterprise web infrastructure, student web pages will reside and be hosted on the AFS server cluster.

6. PLATFORM ENVIRONMENT

1.1 PLATFORM CONFIGURATION

The University of Pittsburgh's enterprise web services platform must address the following factors:

- Cost – Including capital cost of the hardware and software, technical support and service agreements, and training for the web programmers and system analysts.
- Support (including hardware and software) – Availability of the skills required to operate and administer the selected platform and web serving software. Availability of products from third party software vendors that is compatible with a particular platform. Technical support from the vendor is also critical.
- Scalability –The platform's ability to function and perform as required when upgraded or expanded (CPUs, RAM, storage, etc.) in response to user demand.
- Security – The platform's susceptibility to security breaches and compromises.
- Reliability– The platform's ability to provide a service for a specified time period or some other unit of measurement without a failure.

Unix and Intel platforms were evaluated using the above mentioned factors.

1.2 INTEL-BASED

- Cost – Capital cost of an Intel-based platform solution configured to specifications is approximately $19,000. Microsoft Internet Information Server is free. Basic training for Intel-based operating environments is available at a cost of $2,000 - $5,000 per week.
- Support – Corporate support for the Windows 2000 Advanced Server Operating System and IIS is available. Windows uses the Scripting Host for writing system scripts. Active Server Pages and Visual Basic scripting are also widely supported. Individuals with the skills required to operate and administer an Intel-based server are available within the regional market or already on staff. Hardware for Intel-based systems is quite common. Vendor technical support is readily available. Software for Intel-based systems is readily available. Program source code for most Intel-based software cannot be purchased, nor does Intel-based software does not need to be compiled. Configuration time for an Intel-based system is relatively short.
- Scalability– Scalability among Intel/Windows platforms is hindered by limitations of the Intel hardware, which can only address 2 gigabytes of RAM. Once the 2 Gigabyte RAM limitation has been reached, all additional RAM must be addressed via software. Multiple individual systems may be added to an installation to provide for scalability.
- Security – Intel-based systems can be highly complex. Security on Intel-based systems is dependent on the skills of the administrator. Lack of open source reduces security exposure.
- Reliability– The reliability of Intel hardware can be considered to be the same as that of Sun hardware. The reliability of any Windows system also correlates to the skills of the System Administrator.

7. ARCHITECTURE

The enterprise web infrastructure architecture will employ a three-tiered approach—user interface tier, business rules and workflow tier, and database and content tier (Appendix F).

1.1 USER INTERFACE TIER

The User Interface Tier is comprised of servers that provide content to clients' web browsers. An implementation of multiple servers is proposed for redundancy. These servers will be load balanced for increased performance.

1.2 BUSINESS RULES & WORKFLOW TIER

The Business Rules and Workflow Tier consists of applications that will enforce the business workflow rules of the University and allow for the development of more advanced and specialized web applications. Help Desk administrative tools, Account Quota Checking tools and aspects of the CourseInfo student portal implementation are examples of such specialized web applications.

1.3 DATABASE & CONTENT SERVICES

The Database and Content Services Tier is designed to support web applications and store content and data for dynamic web pages. It includes support for legacy databases (e.g., Student Info, PittStar and ISIS) and will also allow development of new databases for more advanced web applications.

1.4 CONTENT MANAGEMENT

Content management is a set of web-based tools that support the administration of web content. Content management software establishes and enforces an approval process that allows for the staging of web pages prior to publication on the production servers. The software will allow an author or editor to use a wide variety of content editors and support storage of multiple editions of http://www.pitt.edu.

8. PARTNERSHIP OPPORTUNITY

The process of assessing our current enterprise web infrastructure, identifying potential new features and evaluating technologies took place during the past six months. The project team leader and several systems programmers were involved in this comprehensive examination of the University's present web environment and the subsequent planning for the new framework.

Although the use of Windows 2000 Advanced Server could have benefits for our proposed enterprise web infrastructure, we would clearly be entering uncharted territory in the online world of Higher Education (Appendix G). Prior to making the decision to use an Intel-based solution and Microsoft's Windows 2000 Advanced Server as the platform for our enterprise web services infrastructure, we must immediately attempt to involve Microsoft. An undertaking of this magnitude will require access to Microsoft's technical and development staff.

This effort will clearly require a commitment from Microsoft's senior management. CSSD should contact the appropriate Microsoft representatives and initiate a dialogue regarding the feasibility of a partnership between the University of Pittsburgh and Microsoft that is focused on the development and implementation of a enterprise web services infrastructure built around Windows 2000 Advanced Server and associated Microsoft products.

9. RECOMMENDATION

Recommendations regarding the choice of hardware infrastructure, server software infrastructure, site management software, content management software and the search engine will be reserved until the outcome of discussions with Microsoft and the extent to which we will be involved in a partnership with the company.

10. STAFFING RESOURCES

A CSSD Systems Programmer will lead the Enterprise Web Infrastructure project. A number of other System Programmers will support the effort. Additional technical and management staff will handle contract negotiations, support the Content Management and Site Management segments of the project and assist with project management.

11. SUSTAINABILITY

The enterprise web servers will be housed at Network Services' RIDC Park facility and be remotely administered by CSSD Tier 2 Development staff. During the initial deployment of the system (3-4 months), the Project Leader will train the eventual System Administrator. When the deployment is complete, the System Administrator is expected to spend approximately 0.5 days per week providing routine system maintenance. Crisis driven situations and outages will require additional time. Content management and site statistics will be managed by the CSSD Publications group.
Requests for resources to support future capital improvements and upgrades to the enterprise web infrastructure will be submitted to the Information Technology Steering Committee for their review.

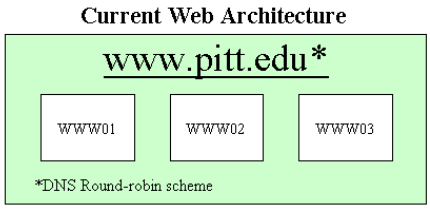
12. PROJECT PLAN

The Enterprise Web Services Infrastructure Project Plan has six major tasks:

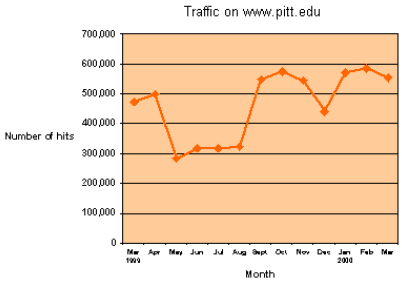
- Identify Project Goals
- Formation of the Project Team
- Architecture, Plan and Design Specification
- Identification of Resources and Requisition of Capital Items
- Development, Testing and Implementation
- Post Project Analysis and Report

Time to completion of the Architecture Plan and Design Specification Tasks is approximately 150 days. Total duration of the next phase of the project, including the Post Project Analysis and Report is projected at 277 days.

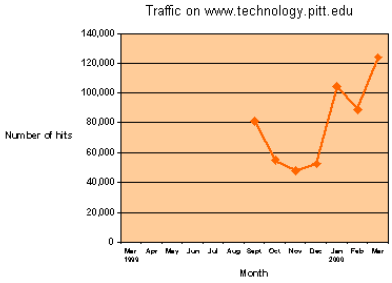
APPENDIX A



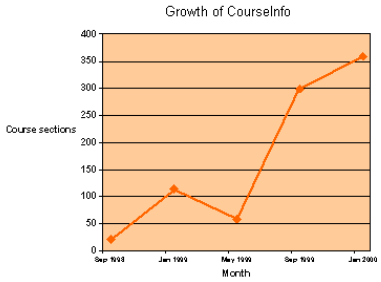
APPENDIX B

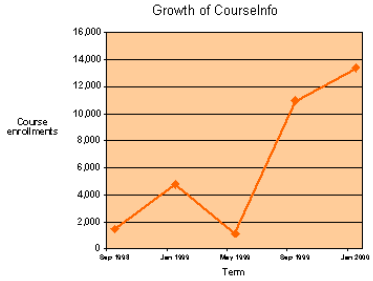


APPENDIX C

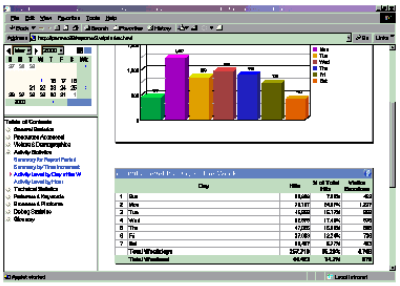


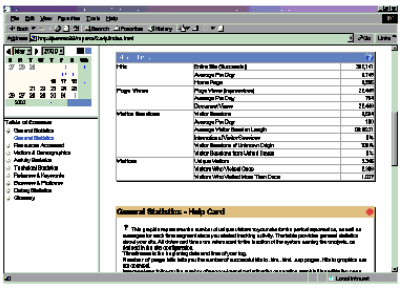
APPENDIX D



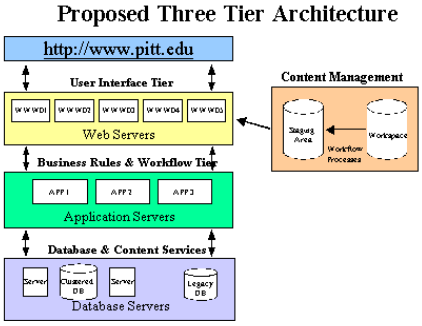


APPENDIX E





APPENDIX F



APPENDIX G

These statistics were taken from the top 50 schools in Yahoo's top 200 most wired colleges and universities. The list of corporations was chosen at random.

University	*Rank*	*Home Page*	*Web Server*	*Version*
Case Western University	1	www.cwru.edu	Netscape Enter.	4
MIT	2	www.mit.edu	Apache	1.2.6
Wake Forest University	3	www.wfu.edu	Netscape Enter.	3.6,Sp2
New Jersey Institute of Technology	4	www.njit.edu	Apache	1.3.3
Rensselaer Polytechnic Institute	5	www.rpi.edu	Apache	1.2.5
Carnegie Melon University	6	www.cmu.edu	Netscape Enter.	3
Washington State University	7	www.wsu.edu	Apache	1.3.6
Gettysburg College	8	www.gettysburg.edu	Apache	1.3.9
Indiana University, Bloomington	9	www.indiana.edu/iub	Apache	1.2.6
Dakota State University	10	www.dsu.edu	NCSA	1.5.2
University of California, Los Angeles	11	www.ucla.edu	NCSA	1.5.2
Colgate University	12	www.colgate.edu	MS IIS	4
University of Idaho	13	www.uidaho.edu	Apache	1.2.6
Harvey Mudd College	14	www.hmc.edu	Apache	1.3.6
University of Pennsylvania	15	www.upenn.edu	Apache	1.3.6
Seton Hall University	16	www.shu.edu	Lotus Domino	4.6.5
University of Texas, Austin	17	www.utexas.edu	Apache	1.3.6
Northwestern University	18	www.nsu.edu	Apache	1.3.6
Worcester Polytechnic Institute	19	www.wpi.edu	Apache	1.2.6
Georgia Institute of Technology	20	www.gatech.edu	Apache	1.3.9
Rochester Institute of Technology	21	www.rit.edu	Apache	1.3.9
Princeton University	22	www.princeton.edu	Apache	1.3.4
University of Notre Dame	23	www.nd.edu	Apache	1.3.3
Emory University	24	www.emory.edu	Netscape Enter.	3.6, SP1
University of Chicago	25	www.uchicago.edu	Apache	1.3.9
Dartmouth College	26	www.dartmouth.edu	Apache	1.3.6
Bates College	27	www.bates.edu	Apache	1.2b2
University of Michigan	28	www.umich.edu	Apache	1.3.6

Drexel University	29	www.drexel.edu	MS IIS	4
Smith College	30	www.smith.edu	Apache	1.3.3
Stanford University	31	www.stanford.edu	Apache	1.3.3
Babson College	32	www.babson.edu	MS IIS	3
Stevens Institute of Technology	33	www.stevens-tech.edu	Apache	1.2.5
Rice University	34	www.rice.edu	Apache	1.3.9
University of Delaware	35	www.udel.edu	Apache	1.2.6
Franklin and Marshal College	36	www.fandm.edu	Appleshare IP Netcloak	N/A
Connecticut College	37	www.conncoll.edu	Apache	1.3.6
Yale University	38	www.yale.edu	Netscape Enter.	3.0c
Cedarville College	39	www.cedarville.edu	Apache	1.3.9
Williams College	40	www.williams.edu	Netscape Enter.	3.5.1g
University of California, Berkley	41	www.berkley.edu	Apache	1.3.9
Oregon State University	42	osu.orst.edu	Apache	1.3.6
Middlebury College	43	www.middlebury.edu	Apache	1.3.6
Florida State University	44	www.fsu.edu	Apache	1.3.1
University of Vermont	45	www.uvm.edu	Apache	1.3.1
Texas A&M University	46	www.tamu.edu	Apache	1.2.5
SUNY, Buffalo	47	www.buffalo.edu	Apache	1.3.6
University of Virginia	48	www.virginia.edu	Apache	1.3.9
SUNY, Geneseo	49	www.geneseo.edu	Apache	1.3.0
Emerson College	50	www.emerson.edu	MS IIS	4
University of Pittsburgh	145	www.pitt.edu	Netscape Enter.	2.01

Intel	www.intel.com	MS IIS	4
Gateway 2000	www.gw2k.com	MS IIS	4
Dell	www.dell.com	MS IIS	4
Compaq	www.compaq.com	MS IIS	4
Fore Systems	www.fore.com	Apache	1.3.6
AMD	www.amd.com	Apache	1.3.6
Standard Microsystems	www.smc.com	MS IIS	4
Microsoft Corp	www.microsoft.com	MS IIS	4
Netscape	www.netscape.com	Netscape Enter.	3.6
NECX	necxdirect.necx.com	Netscape Enter.	3.5.1g
Bell Atlantic	www.bellatlantic.com	Netscape Enter.	3.5.1g
Bell Pacific	www.bellpacific.com	MS IIS	4
AT&T	www.att.com	Netscape Enter.	3.6,sp2
Pepsi Co	www.pepsi.com	Netscape Enter.	3.6,sp1
Coca Cola	www.cocacola.com	Netscape Enter.	2.01c
Pfizer	www.pfizer.com	Netscape Enter.	3.6,sp2
Saturn	www.saturn.com	Netscape Enter.	3.6,sp2
Chevrolet	www.chevy.com	Netscape Enter.	3.6 SP2
CompUSA	www.compusa.com	MS IIS	4
Best Buy	www.bestbuy.com	MS IIS	4
Nissan	www.nissan.com	Apache	1.3.6

Corporation	***Home Page***	***Web Server***	***Version***