

MBEYA UNIVERSITY OF SCIENCE AND TECHNOLOGY



INFORMATION SYSTEMS AND TECHNOLOGY DEPARTMENT

INTERNET TECHNOLOGIES

Web Programming Language

2020

Web programming

- The Web is no longer just presenting information on a computer screen.
- The Web is a collection of software and protocols that has been installed on most, if not all, of the computers on the Internet
 - Many commercial sites include some methods of getting information from a browser to web servers.
 - How do you program your web site such that it can interact with people?
 - With XML, data from spreadsheets, reports or other applications can be easily displayed on the Web.
 - Can we learn XML without the understanding of HTML and other Web language?

Web Languages

- There are many languages used for *representing information* on the Web.
 - HTML
 - XML
 - XHTML (*the "XML version" of HTML*)
 - JSON (*more concise representation for data*)
 - CSS
- *Programming languages* used on the Web, such as
 - Javascript (*used in the browser and Server*)
 - PHP (*used on the server*)

The Web Programmer's Toolbox

- The most common tools used in web programming are:
- **XHTML**, a markup language, along with a few high-level markup document-editing systems;
- **XML**, a meta-markup language; JavaScript, PHP, and Ruby, which are programming languages;
- **JSF**, **ASP.NET**, and **Rails**, which are development frameworks for Web-based systems;
- **Flash**, a technology for creating and displaying graphics and animation in XHTML documents;
- **Ajax**, a Web technology that uses JavaScript and XML.

The Web Programmer's Toolbox

cont.

- Web programs and scripts are divided into two categories—client side and server side—according to where they are interpreted or executed.
- XHTML and XML are client-side languages; PHP and Ruby are server-side languages; JavaScript is most often a client-side language, although it can be used for both.

XML

- Extensible Markup Language (XML)
- It provides a standard way to represent information so as to allow information to be stored and interchanged among any Internet-connected devices.
 - It is not a markup language.
 - It is a meta-markup language that specifies rules for creating markup languages.
 - Browsers use XML parsers to isolate and extract the information from XML documents.

XHTML

- **The extensible Hypertext Markup Language**
 - A Reformulation of HTML 4 in XML 1.0
 - Consists all HTML 4.0.1 predefined components combined with XML standards
- A way of making XML documents that look and act like HTML documents.
- Using XHTML helps you strengthen the structure and syntax of your markup.

HTML – OK, XHTML - !OK

<HTML>

<HEAD>

<TITLE>My Title</TITLE>

<body></HEAD>

<td>It is an acceptable HTML, but an unacceptable XHTML

</BODY>

...

<table WIDTH=80%> ← Incorrect [Test](#)

<table width="80%"> ← Correct

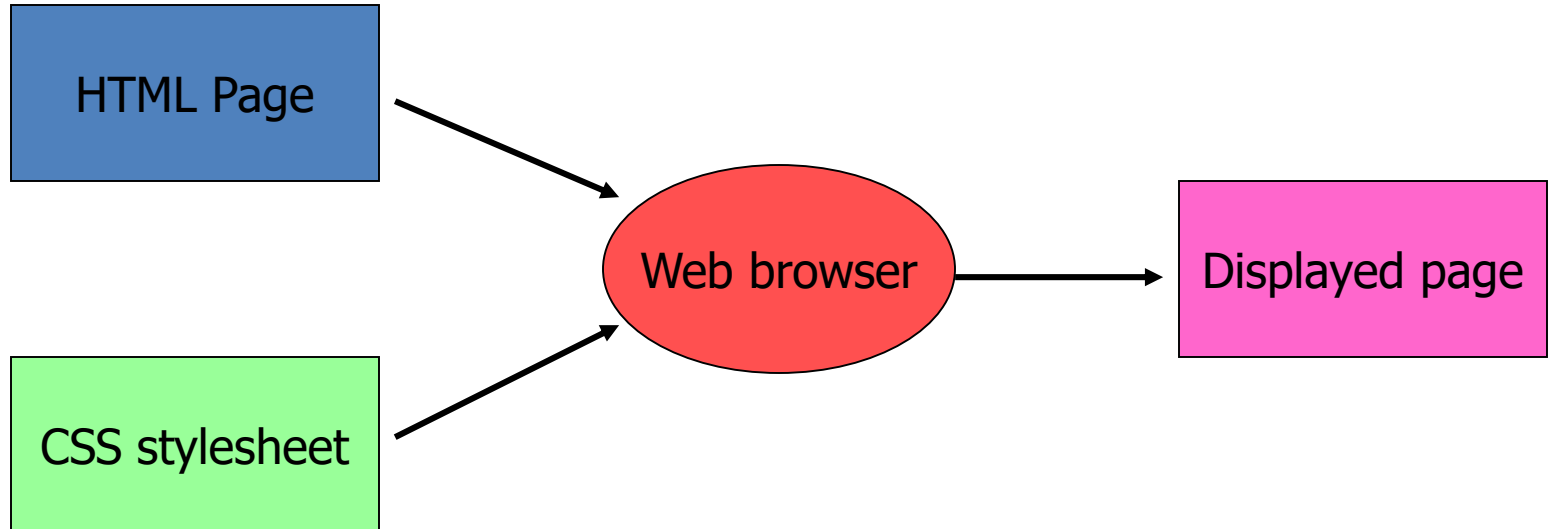
Cascading Style Sheets (CSS)

- Provides a powerful and flexible way to control the details of web documents.
- HTML is more concerned about the content, CSS is used to impose a particular style on the document.
- they apply typographic styles and layout instructions to elements on a page
- Named cascading style sheets because they can be defined at three different levels to specify the style of a document.
 - Inline, document level, external.

PHP

- Hypertext Preprocessor (PHP).
 - An open source web scripting language.
 - A PHP page is always interpreted by the server when it is requested.
 - PHP 5 provides an object-oriented approach
 - Server needs to have PHP installed
 - Have to learn an entirely new language.
 - Delimiters differentiate PHP code from static HTML
 - Reference: <http://www.php.net/>

Using Stylesheets to add presentation



JAVA

- Java
 - An object-oriented programming language
 - Developed by Sun Microsystems
 - Based on C++
 - Allows small programs -- applets -- to be embedded within an HTML document

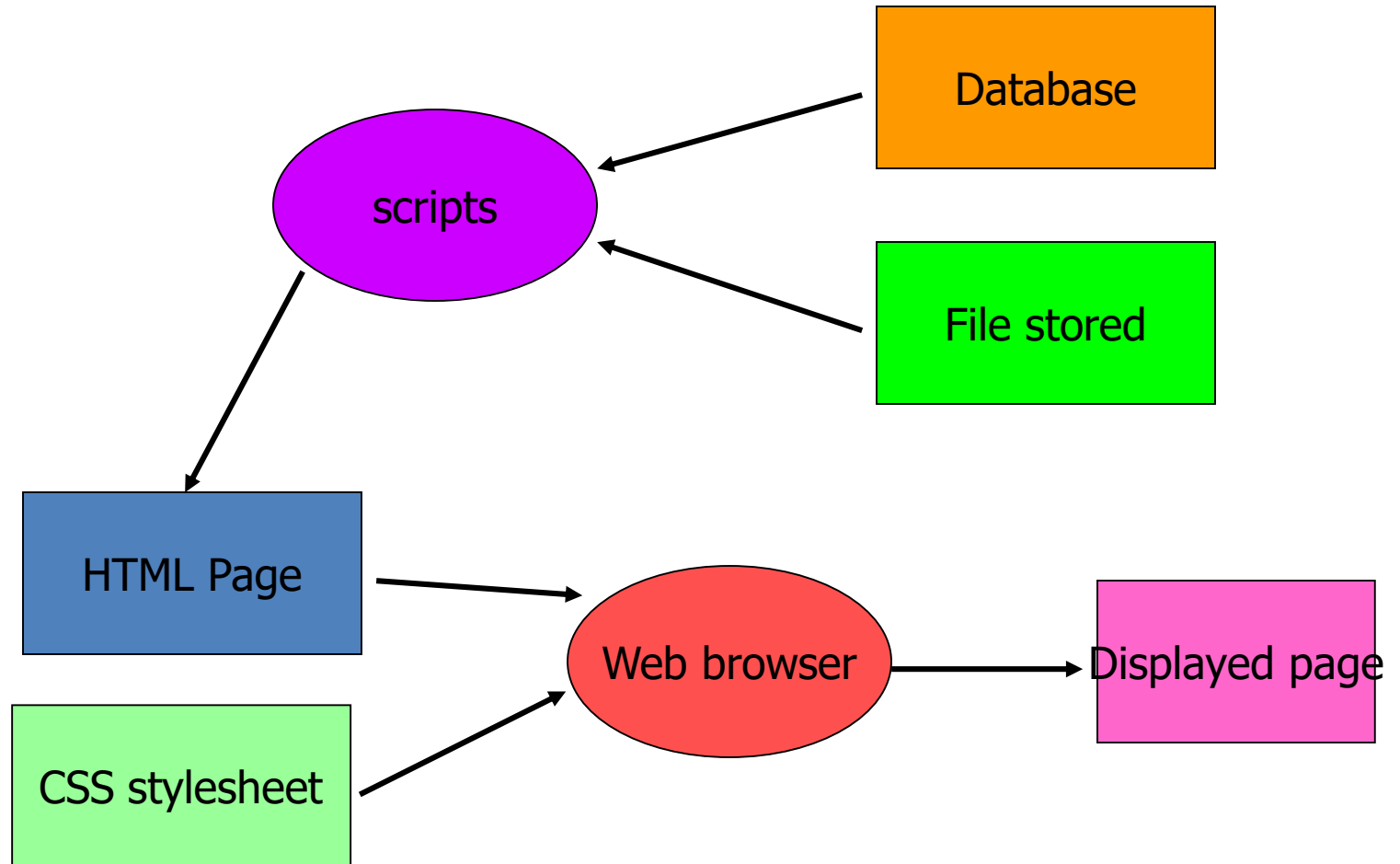
JavaScripts

- interpreted, scripting language for the web
- loosely typed
 - *variables do not have to be declared*
 - *the same variable can store values of different types at different times*
- specified using the attribute and value `type="text/javascript"` in the `<script>` start tag
- can generate HTML dynamically
- can respond to user actions and input
- can be used in client or server
- syntax is a mixture of C and Java (and functional programming)

What can JavaScript do?

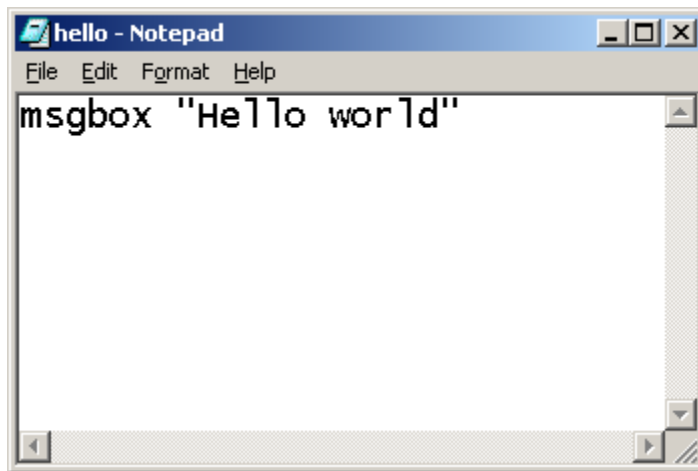
- Control document appearance and content
- Control the browser
- Interact with the user
- Read and Write Client State with Cookies
 - my.yahoo.com
- Interact with Applets
- What it cannot do?
 - Read/write files

Using Scripts



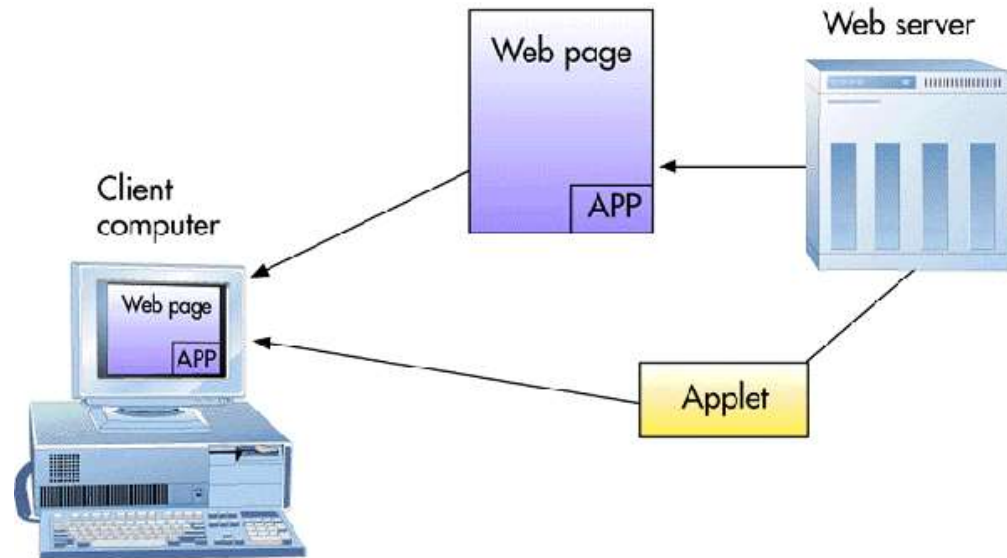
VBScript

- VBScript is the short form for Visual Basic Scripting from Microsoft.
- Try to edit a file “hello.vbs”
 - MsgBox “Hello world”



Applets

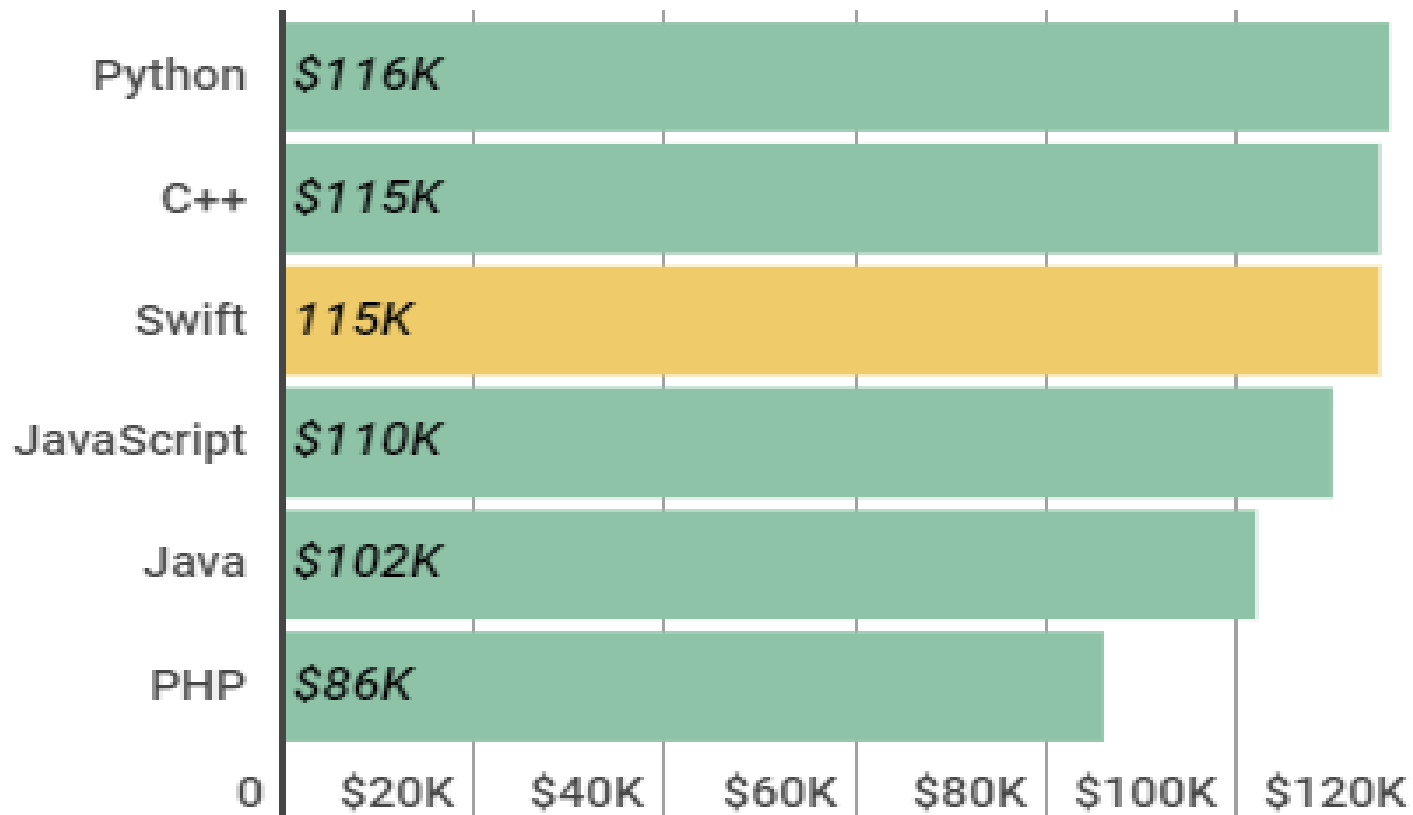
- Applets are small java programs that are downloaded from the server to the local machine



Top ten languages

- JavaScript
- Python - dJANGO
- C#
- Java
- PHP
- Go
- Swift - apple IOS
- Kotlin – Android
- C & C++
- Rust – mozilla
compare c
- Elixir – erlang --
ruby
- Scala .. JVM
- R programming

USA salary – www.indeed.com



Client-Side Processing

- client program (e.g. web browser) can be used to
 - *customize interaction with the user*
 - *validate user input (although HTML5 now provides this)*
 - *generate (part of) document dynamically*
 - this can be done using
 - *programming language (e.g. Java applets)*
 - *XSL (for XML)*
 - *scripting language (e.g. JavaScript)*
- since these are built into browsers

Client-server Model

- A client is a process that is requesting services from the server
- A server is a process that offers services requested by a client.
- Client-server is a standard for networks application
- A client and server may run from different machines
- A client and server processing is asymmetric

Types of Server

- A. Iterative servers** – These are servers which knows in advance how long it takes to execute each request(short time). One request at a time (single copy of server runs all the times) thus A client may have to wait if the server is occupied.
- B. Concurrent server** – Unknown amount of time to handle a request and each request require a different process. A server (multiple servers) will make as many copies of server as there are client requests. The connection between a client and server is in a dedicated fashion.

TCP vs UDP connectivity

- In order for a communication to start, a connection between two clients/hosts has to be established.
- Connection components : Association
 - ☐ **Protocol used**
 - ☐ **Source IP address**
 - ☐ **Source port number**
 - ☐ **Destination IP address**
 - ☐ **Destination port number**

Berkeley Socket Interface

- An API standard called a half association
- If information for both side is known before connection is established i.e. Telephone line is called a socket.
- Component of Socket:
 - ☐ **Protocol, Local IP address, Local Port Number**
 - ☐ **Protocol, Remote IP address, Remote Port Number**

Domain Name System - DNS

- The international database system for internet addressing.
- Management of Domain is distributed
- Main function of DNS server is to translate domain names to IP address
- International domains : .COM, ORG, NET, GOV, GO, AU, CA, FR, IN, DE, JP, KR, UK, ES,EDU, MIL, IT, US, TZ, KE, UG.

TELNET

- Used for remote connections
- Can start a remote session on another machine
- Requires login name and password to access a machine.
- Used to access software's from a remote machine
- Printer interconnection
- Telnet port is 23 THOUGH other port can also be used.

Client Server programming

Server-side Programming

Uses

- Process user input.
- Display pages.
- Structure web applications.
- Interact with permanent storage (SQL, files).

Example Languages

- PHP
- Python
- ASP.Net in C#, C++, or Visual Basic.

Client-side programming

Uses

- Make interactive webpages.
- dynamically on the web page.
- Interact with temporary storage
- Send requests to the server, and retrieve data from it.

Example languages

- JavaScript (primarily)
- HTML*
- CSS*

Document Type Definitions (DTDs)

- DTD defines a *class* of documents
- specified using an *extended context-free grammar*
- defines
 - *element names and their allowed contents*
 - *attribute names and their allowed values*
 - *entity names and their allowed values*
- a *document type* is defined by specifying the constraints which any document which is an *instance* of the type must satisfy

Document Object Model (DOM)

- DOM is a W3C recommendation (levels 1, 2, 3 and 4)
- Defines *API* for HTML and XML documents
- Defines *logical* structure (model) of documents
- Document modeled as a *tree* (or *forest*) of nodes
- Using DOM, programmers can
 - *build documents*
 - *navigate their structure*
 - *add, modify, delete elements and content*
- Purpose is to provide *portability* across web browsers
- DOM is *platform-neutral* and *language-neutral*
- Language bindings for *JavaScript*, among others

Web Server

- Web servers are programs that provide documents to requesting browsers. Servers are slave programs: They act only when requests are made to them by browsers running on other computers on the Internet.
- The most commonly used Web servers are Apache, which has been implemented for a variety of computer platforms, and Microsoft's Internet Information Server (IIS), which runs under Windows operating systems.

HTTP & Server Side

- Application-layer transfer protocol used by browsers to interact with web servers.
- normally runs over TCP
- based on client/server architecture, HTTP is *stateless*: servers retain no information about past requests
- Interaction between client and server has 4 phases:
 - *client connects to server*
 - *client sends request to server*
 - *server sends response to client*
 - *server closes connection (although persistent connections are possible)*

HTTP Interaction

- assume we enter the URL `http://www.mustnet.ac.tz/How_to_Apply.php` into the address bar of a browser
- the browser (HTTP client) initiates a TCP connection to the server `http://www.mustnet.ac.tz/` on port 80
- the browser sends an HTTP request message to the server asking for resource `/How_to_Apply.php`
- the HTTP server retrieves the resource, encapsulates it in an HTTP response message, and sends this to the browser
- the HTTP server tells TCP to close the connection
- the browser receives the response
- if the HTML in the response includes images, the process has to repeat

HTTP Persistent Connections

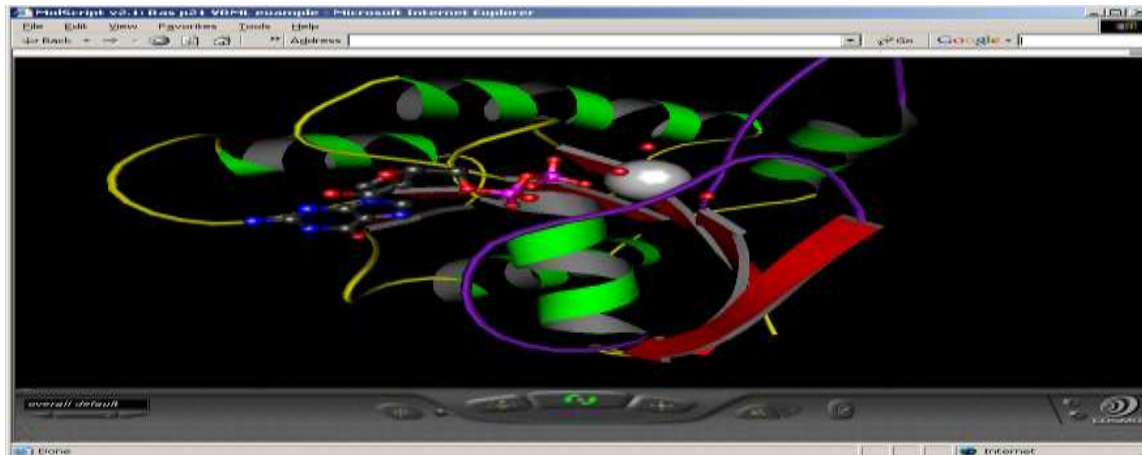
- Poor performance of HTTP connection is due to a separate connection for each request
- *Persistent* connections send multiple request and response interactions over a single TCP connection
- This results in improved performance
- Persistent connections are the default

Pipelining HTTP

- *Pipelining* can be used over an HTTP persistent connection
- Allows a client to make multiple requests without waiting for each response
- This results in better utilisation of connection
- The server processes requests concurrently
- In principle, server could send responses in the order requests complete which would minimise waiting times
- But HTTP has no way of identifying a response with a request (it is *stateless*)
- So the specification states that the server must send responses in the *same* order as requests

VRML

- Virtual Reality Modeling Language (VRML) is a language for the animation and 3D modeling on the Internet.
- The user can connect the online VRML website and move around the “3D world”.



CGI / Perl

- When the page is loaded by a browser, the tag of the webpage call the script and then execute by the server.
- It is different from the Java applets or JavaScript which are executed by the client's system.
- CGI defines an *interface* between servers and external programs
- **Common Gateway Interface (CGI)** is a standard way in which a browser communicate to run a program on the server and return the output to the browser.
 - It can be written in any programming language, e.g., Perl, python, Visual Basic, C/C++
 - It is a powerful string pattern-matching language.

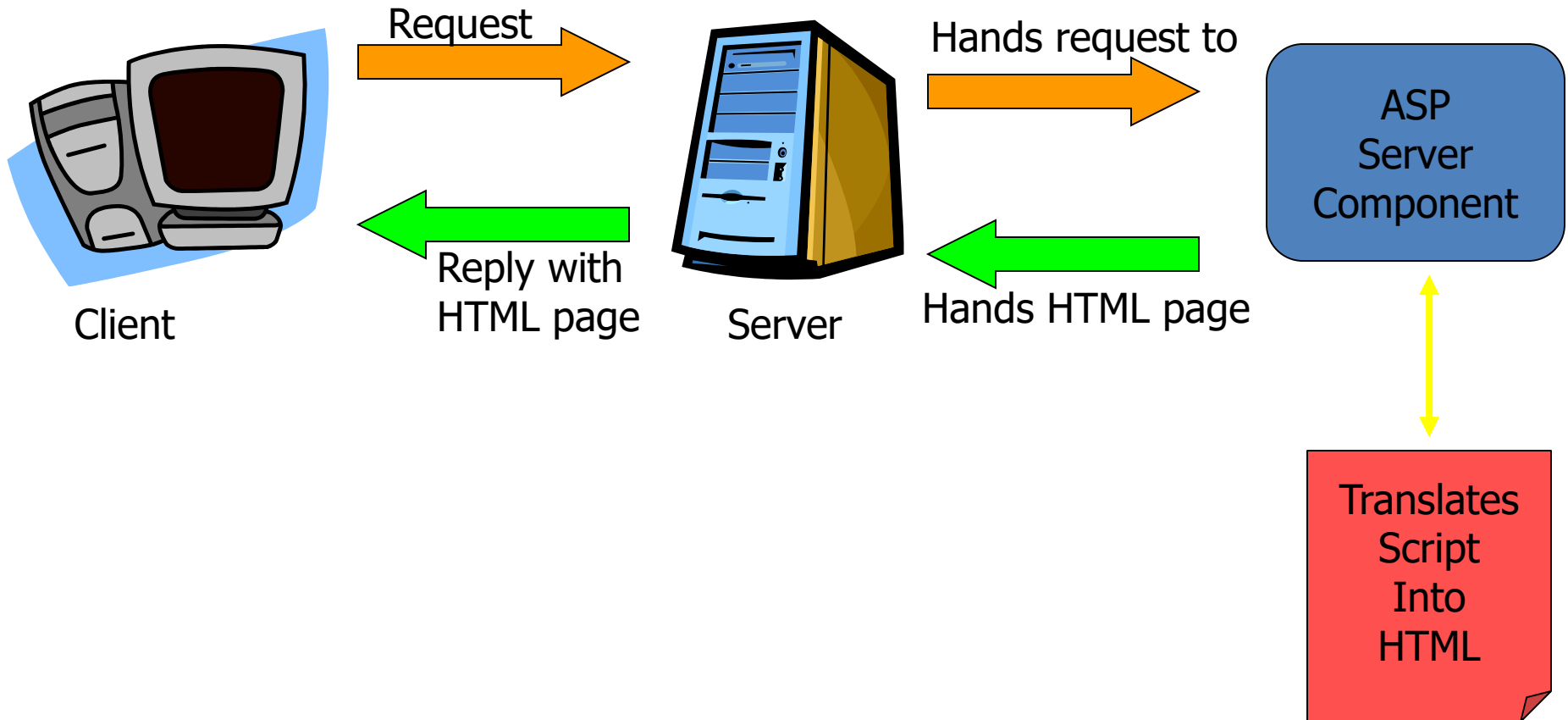
Server-side processing technologies

- *Common gateway interface* (CGI) programs (already covered)
- *Java servlets*
- *Server-side include* (SSI) pages
- *Java server pages* (JSP)
- Java Server Face (JSF) technology
- *active server pages .NET* (ASP.NET)
- *PHP*

Active Server Page -ASP

- **Active Server Page** was developed by Microsoft and it is a popular technology for developing dynamic web sites.
 - It allows the author includes scripting code (VBScript or JScript) in regular web pages.
 - In complex code, COM (ActiveX) components are used.
 - Must run on an active server pages server
 - IIS, Personal Web Server, ...
 - The latest version is ASP.NET

How to load an ASP page?



ColdFusion

- Designed to make it easier to connect simple HTML pages to a database.
- One of the distinguishing features of ColdFusion is its associated scripting language, ColdFusion Markup Language (CFML). CFML compares to the scripting components of ASP, JSP, and PHP in purpose and features, but its tag syntax more closely resembles HTML, while its script syntax resembles JavaScript.
- ColdFusion is most often used for data driven websites or intranets, but can also be used to generate remote services such as SOAP -Simple Object Access Protocol web services or Flash remoting.
- ColdFusion can also handle asynchronous events such as SMS and instant messaging via its gateway interface, available in ColdFusion MX 7 Enterprise Edition.

Java Servlets

- They are Java application programs that are resident on the server and are alternatives to CGI programs.
- Java Servlets allow you to build
 - Web page based on the user's input data
 - Web page that changes frequently
- More efficient, easier to use, more powerful and portable.

Servlets Advantages

- Platform and vendor independence
 - Supported by all the major web servers
- Integration
 - Take advantages of all the Java technologies, JDBC, Enterprise JavaBeans (EJB).
- Efficiency
 - A single process that runs until the servlet-based application is shut down.
- Scalability – extremely scalable.
- Robustness and security
 - A strongly typed programming language.
- Portability: because it uses java language

JSP vs. ASP

	ASP Technology	JSP Technology
Web Server	IIS or Personal Web Server	Any Web Server
Platforms	Microsoft Windows	Most popular platforms
Reusable components	No	JavaBeans, JSP tags
Security against System crashes	No	Yes
Scripting Language	VBScript, Jscript	Java

- JSP is platform and server independent.
- ASP relies on Microsoft Platforms and Servers.

Objectives

- Web server basics
- Software for Web servers
- Internet utility programs
- Web server hardware

Web Server Basics

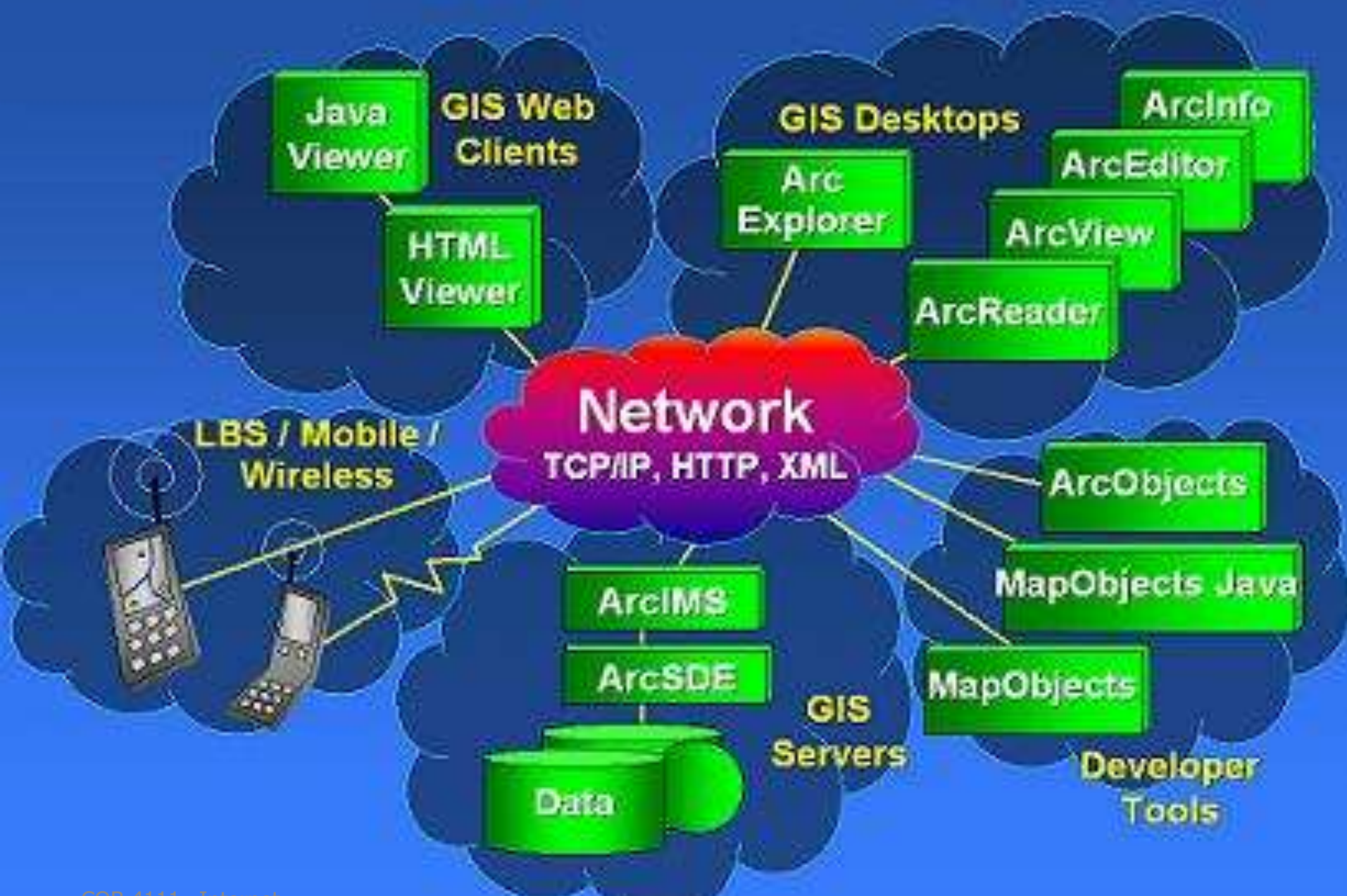
- Main job of a Web server computer
 - To respond to requests from Web client computers
- Three main elements of a Web server
 - Hardware
 - Operating system software
 - Web server software

Roles of a server

- Data Storage
 - NAS (network attached storage)
 - SAN (storage area network)
 - DAS (direct attached storage)
- Application Host
 - GIS software-host server (application server)
 - GIS software license server
- GeoProcessing
 - Spatial Data Management
 - SDE=Spatial Database Engine
 - Requires DBMS
 - ArcSDE
 - Spatial library organized with a RDBMS
- Website Host

SUM CRUD Model

- ☐ Software
- ☐ Users
- ☐ Machines
- ☐ Create
- ☐ Read
- ☐ Update
- ☐ Delete



Types of Web Sites

- Development sites
 - Used to evaluate different Web designs
- Intranets
 - Corporate networks that house internal memos, corporate policy handbooks
- Extranets
 - Intranets that allow authorized parties outside the company to access information stored in the system

Types of Web Sites (Continued)

- Transaction-processing sites
 - Commerce sites that must be available 24 hours a day, seven days a week
- Content-delivery sites
 - Deliver content such as news, histories, summaries, and other digital information

Tools for building websites – Frontend

- AngularJS – developed by google 2009 / 2016 for single page applications
- Ember-Javascript web dev frameworks- 2011 for advanced management systems
- Iflutter - JS-free written in Dart, a programming language by Google for developing server-side and web applications for both desktop and mobile platforms.
- React.js a JavaScript library, client facebook
- Vue.js
- MeteorJS
- Node.js
- Asp.net
- **Bootstrap**
- **web2py**
- Cake PHP
- Yii Framework

Tools for building websites – Backend

- Django – 12,000 web projects are built since 2005
- ExpressJs is a Node.js API and web app development framework
- Ruby on Rails framework (RoR), 826,000 live websites such as Airbnb, YellowPages, Groupon
- Spring – web application based on JAVA
- Symphony for PHP developers
- Laravel is an open source PHP framework
- CodeIgniter
- Drupal

Web Clients and Web Servers

- Client/server architectures
 - Client computers typically request services
 - Server processes clients' requests
- Web software
 - Lets different types of computers, running different operating systems, communicate

Platform Neutrality of the Web

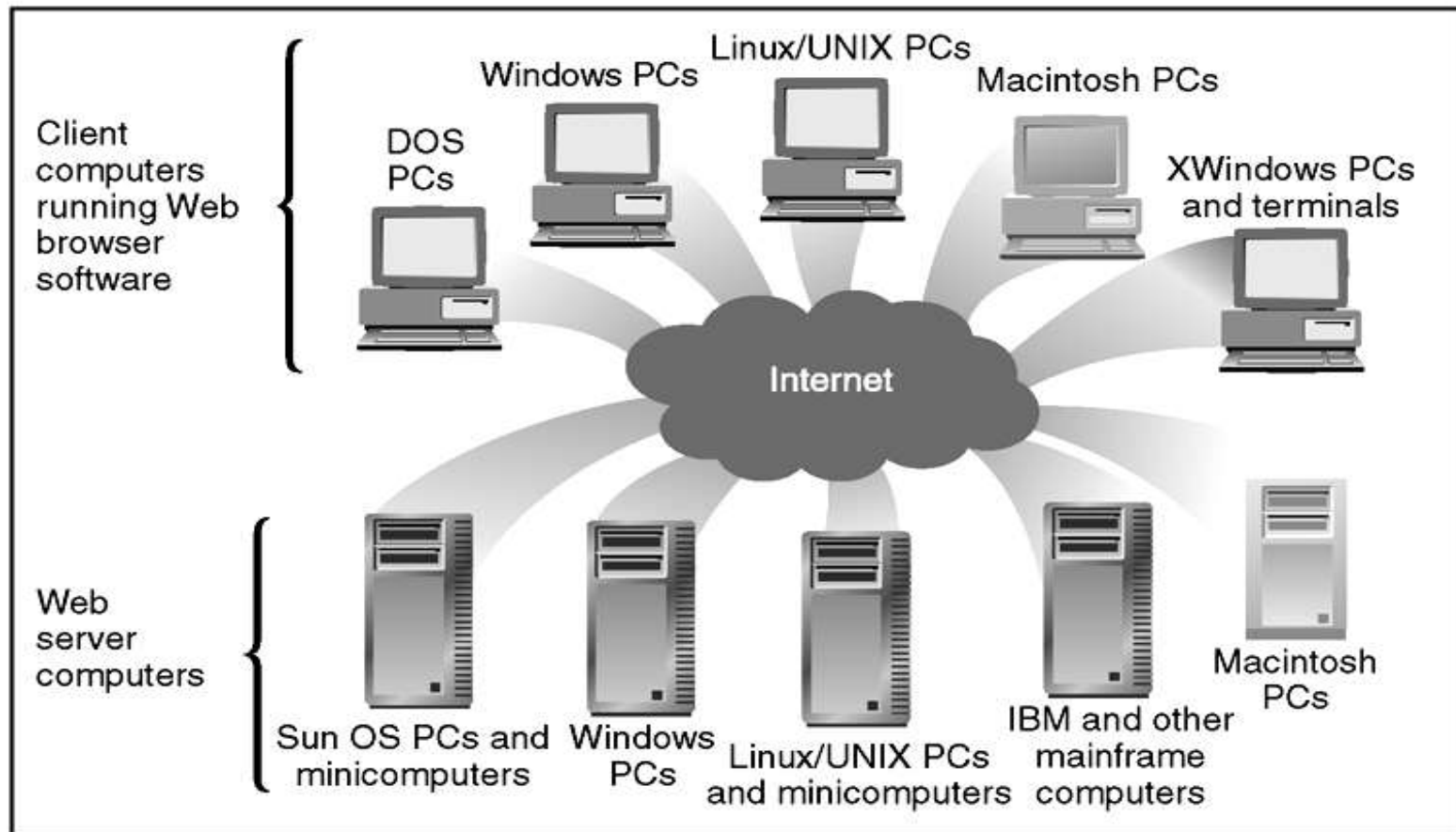


Figure S-1 *Platform neutrality of the Web*

Dynamic Content

- Nonstatic information constructed in response to a Web client's request
- Dynamic page
 - Web page whose content is shaped by a program in response to user requests
- Static page
 - An unchanging page retrieved from disk

Dynamic Content (Continued)

- Server-side scripting
 - Programs running on Web server create Web pages before sending them back to the requesting Web clients
- Dynamic page-generation technologies
 - Active Server Pages (ASP)
 - JavaServer Pages (JSP)
 - PHP: Hypertext Preprocessor (PHP)

Two-Tier Client/Server Architecture

- Has only one client and one server
- Request message
 - Message that a Web client sends to request a file or files from a Web server
- Typical request message
 - Request line
 - Optional request headers
 - Optional entity body

Message Flows in a Two-tier Client/Server Network

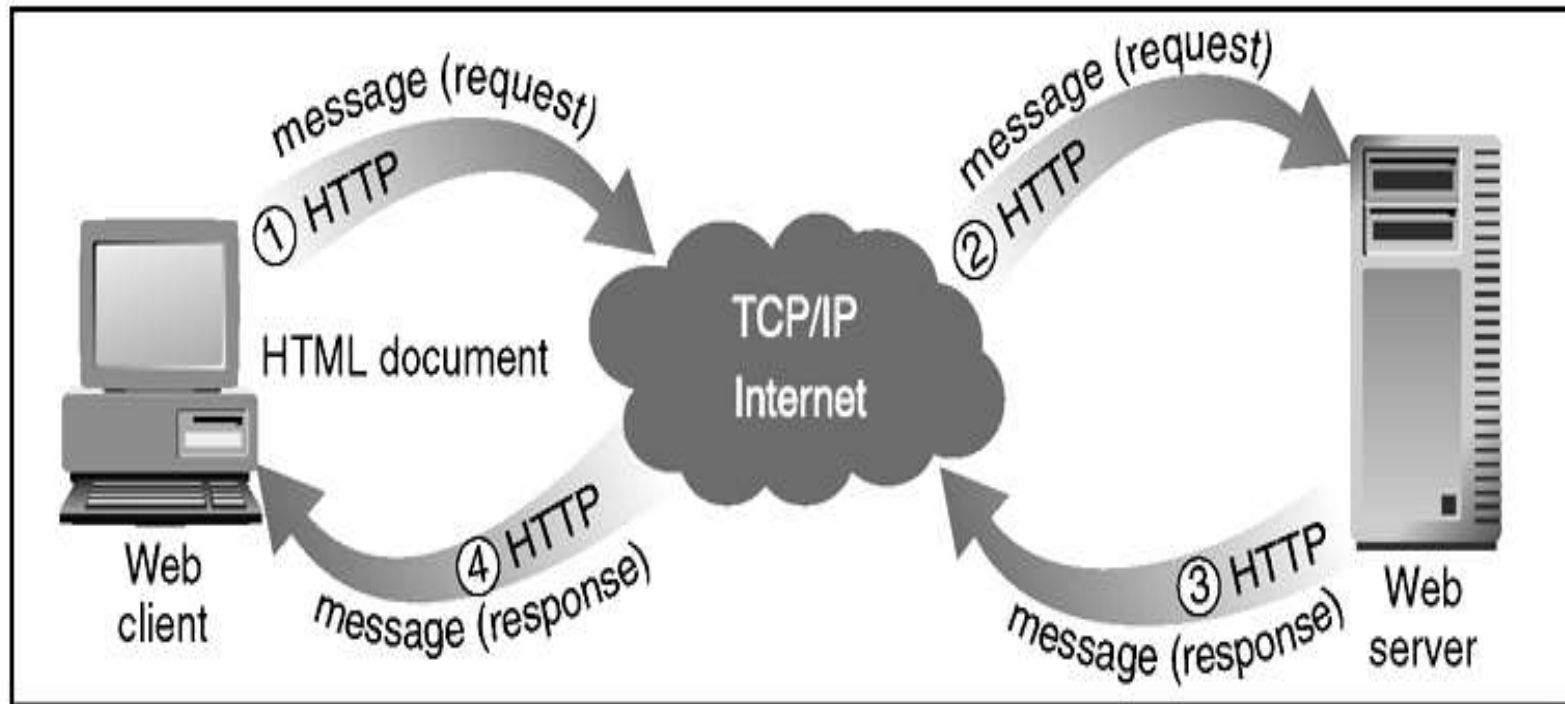


Figure 8-2

Message flows in a two-tier client/server network

Two-Tier Client/Server Architecture (Continued)

- Request line
 - Contains command, name of target resource, and protocol name and version number
- Request headers
 - Can contain information about types of files that client will accept in response to request
- Entity body
 - Used to pass bulk information to the server

Two-Tier Client/Server Architecture (Continued)

- Three-tier architecture
 - Extends two-tier architecture to allow additional processing
- N-tier architectures
 - Higher-order architectures
 - Third tier includes software applications that supply information to Web server

Message Flows in a Three-tier Client/Server Network

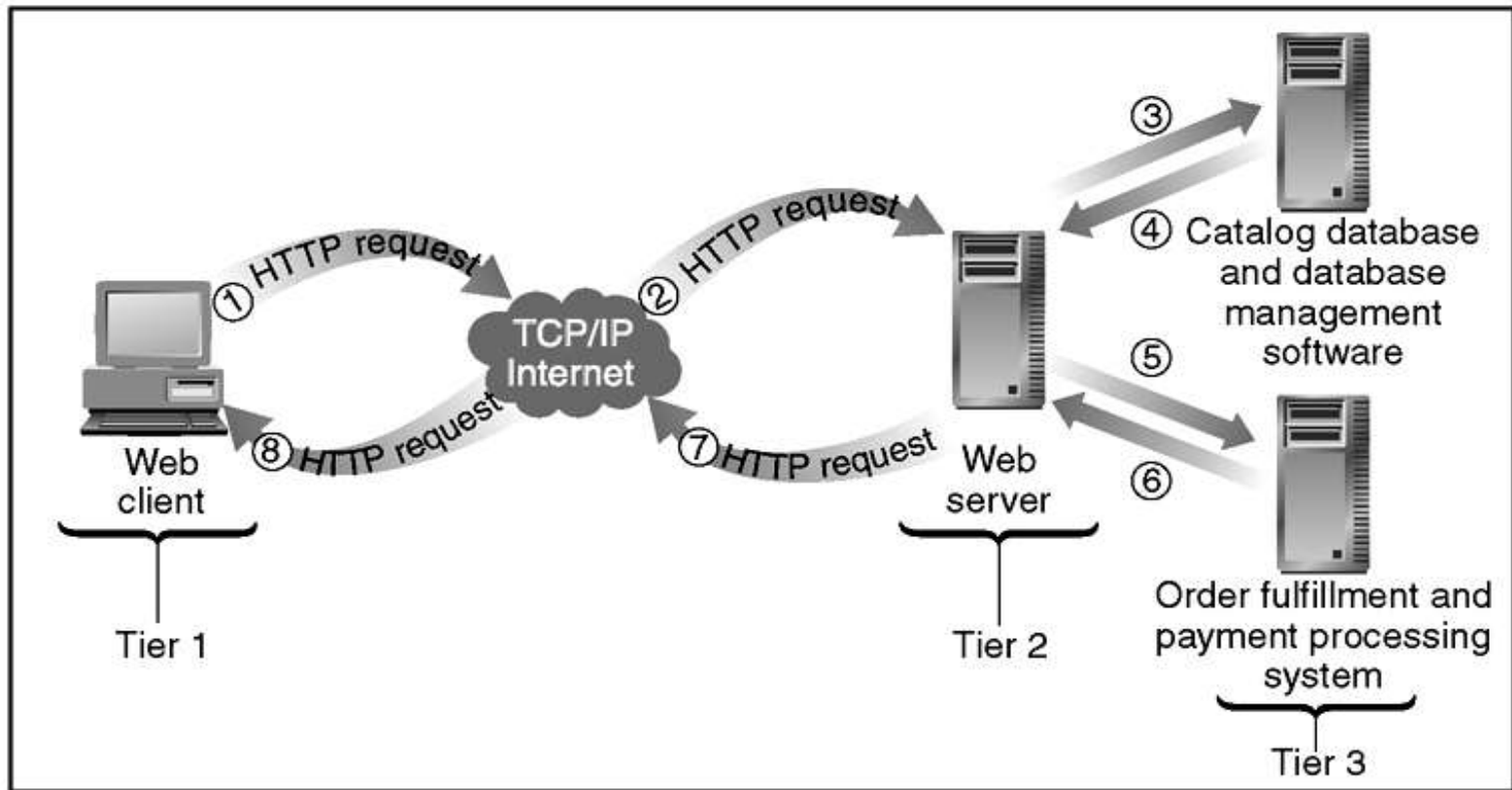


Figure 8-3

Message flows in a three-tier client/server network

Software for Web Servers

- Operating system tasks
 - Running programs and allocating computer resources
- Linux
 - Open-source operating system that is easy to install, fast, and efficient
- Open-source software
 - Developed by community of programmers who make it available for download at no cost

Web Server Software

- Most popular Web server programs
 - Apache HTTP Server
 - Microsoft Internet Information Server (IIS)
 - Sun Java System Web Server (JSWS)
- Netcraft
 - A networking consulting company in Bath, England
 - Accumulated popularity rankings

Market Shares for Top Web Server Software

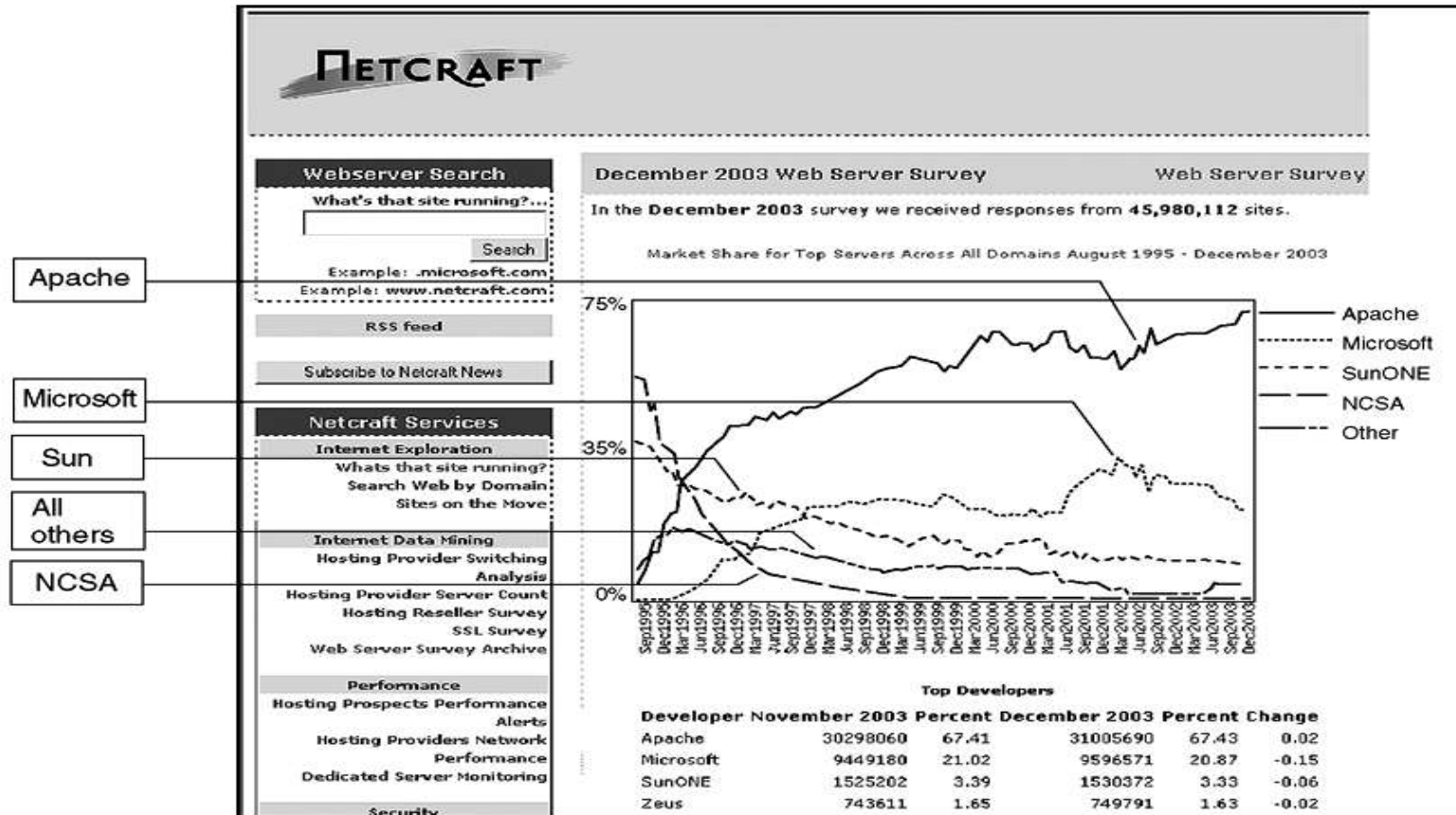


Figure 8-4

Market shares for top Web server software

Apache HTTP Server

- Ongoing group software development effort
- Dominated Web since 1996 because it is free and performs efficiently
- Apache
 - Developed by Rob McCool at University of Illinois in 1994 at the NCSA
 - Currently available on the Web at no cost as open-source software

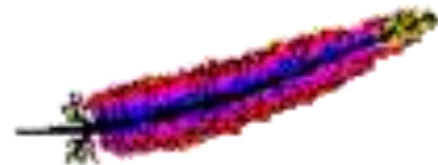
Apache Web Server

“...63% of the web sites on the Internet are using Apache, thus making it more widely used than all other web servers combined”

Apache.org

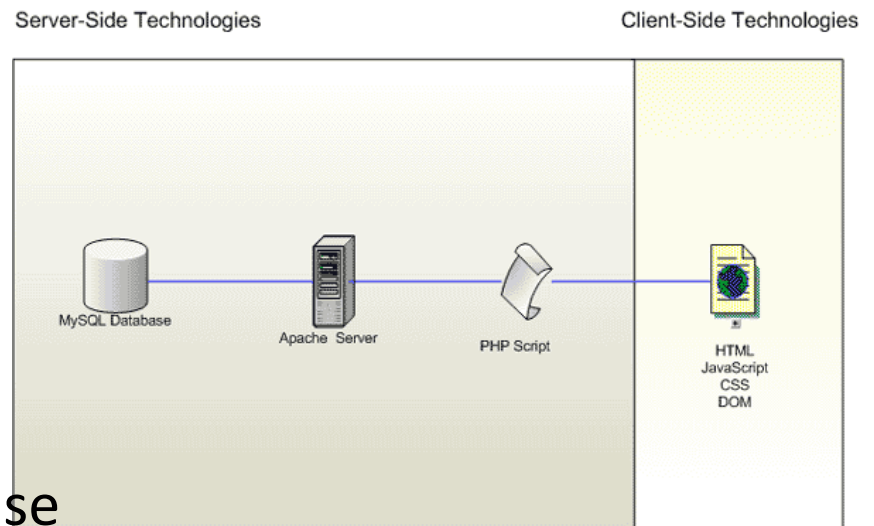
- Install server before any other technologies
 - PHP
 - MySQL

- Configure themselves for the server



Using Apache Web Server Software

- Database and PHP hosted on Server
- PHP executed on Server
- Install
 - Web Server Software
 - MySQL Database
 - PHP
- Front end for MySQL database (optional)
 - MySQL Control Centre
 - MySQL Administrator



Microsoft Internet Information Server

- Comes bundled with current versions of Microsoft Windows Server operating systems
- Used on many corporate intranets
- Supports the use of
 - ASP
 - ActiveX Data Objects
 - SQL database queries

Using Internet Information Server (IIS)

- Installed on Windows 2000 server by default
- Use Add/Remove to install components
- Use Inetpub root directory to store files
- To access files
 - ***http://servername/filename***

Sun Java System Web Server (Sun ONE, iPlanet, Netscape)

- Descendant of original NCSA Web server program
- Formerly sold under the names
 - Sun ONE
 - Netscape Enterprise Serve
 - iPlanet Enterprise Server
- Charges a \$1500-per-CPU licensing fee

Types of servers

- System logging server (e.g. rsyslog service)
- Print server (e.g. cups)
- Web server (e.g. apache2 / httpd and nginx)
- FTP server (e.g. vsftpd)
- Windows file server (e.g. Samba)
- NFS (Network File System) server (e.g. nfs-utils package)
- Mail server (e.g. sendmail, Postfix, Exim)
- Directory server (e.g. LDAP, Kerberos and NIS)
- DNS server (e.g. BIND)
- SQL server (e.g. PostgreSQL and MySQL/DB)

How secure is your web server?

- Public websites are hacked on a daily basis
- Hackers may be seeking to:
 - Embarrass an organisation
 - Placement of illegitimate material
- Can your files be easily accessed?
- How will you protect your server?
 - Firewall Security

Firewall Security

- Protect using
 - Software Firewalls
 - Hardware Routers
 - Wireless Routers
- Protects against unauthorised access and viruses
- Windows in-built firewall

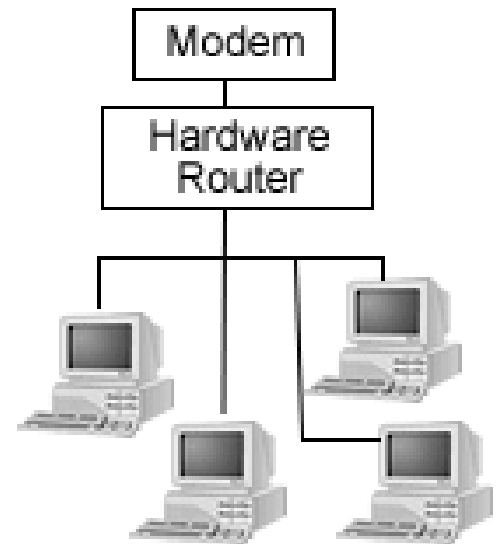


Software Firewalls

- Good for single computers
- Pro's
 - No requirement for additional software
 - No requirement for additional computer wiring
- Cons
 - Speed – uses system resources

Hardware Routers

- Provide protection for multiple computers
 - If they have a hardware firewall
- At least 4 network ports
- Requires wiring



Wireless Routers

- Allows wireless connection

- Excellent for laptops, PD/ etc

- Unauthorised access

- Encryption

- Wired Equivalent Privacy (WEP)
- Wi-Fi Protected Access (WPA and WPA2)

- Neighbours

- People outside home



Not always available with built-in firewall

Importance of a Firewall

- Hackers with malicious intent
 - Delete information
 - Crash machine
 - Steal personal information
 - Passwords
 - Credit Card Numbers

Web Site and Internet Utility Programs

- Finger
 - Runs on UNIX operating systems
 - Allows users to obtain information about other network users
 - Command yields list of users who are logged on to network
- Ping (Packet Internet Groper)
 - Tests connectivity between two computers connected to the Internet

Tracert and Other Route-Tracing Programs

- Tracert (TRACE RouTe)
 - Sends data packets to every computer on the path between one computer and another
 - Clocks packets' roundtrip times
 - Calculate and display number of hops between computers
 - Calculate time it takes to traverse entire one-way path between machines

Tracing a Path Between Two Computers on the Internet

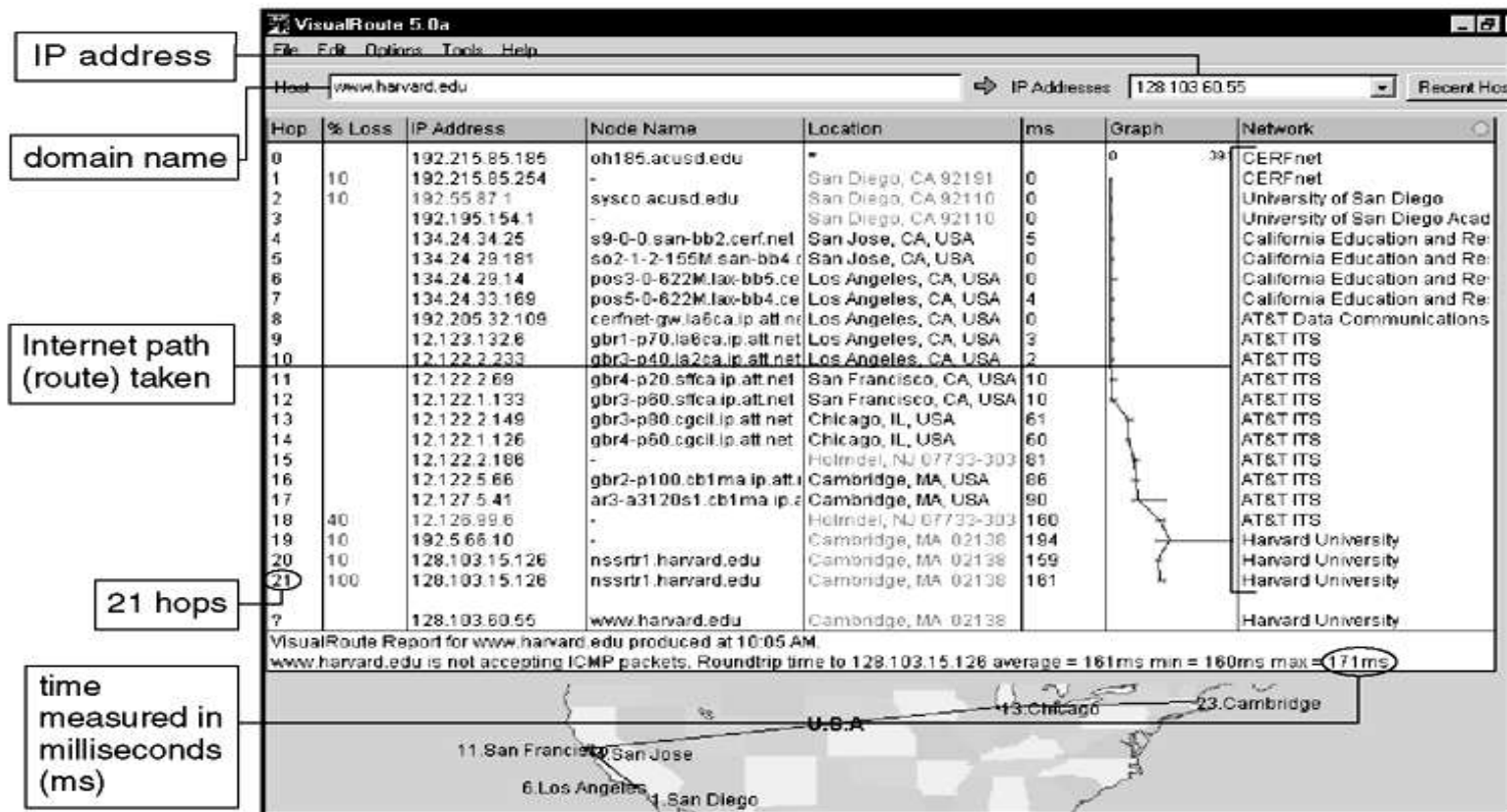


Figure 8-5

Tracing a path between two computers on the Internet

Electronic Mail

- Useful feature
 - Attachments
- Drawbacks
 - Time spent by business people responding to e-mail
 - Computer virus
 - Program that attaches itself to another program
 - Can cause damage when host program is activated

Unsolicited Commercial E-Mail (UCE, Spam)

- Electronic junk mail that can include
 - Solicitations, advertisements, or e-mail chain letters
- Can consume large amounts of Internet capacity
- Companies

COB 4111 – Internet Technology

– Now offer software to limit amount of spam

MOST

Growth of Spam as a Proportion of all Business E-mail

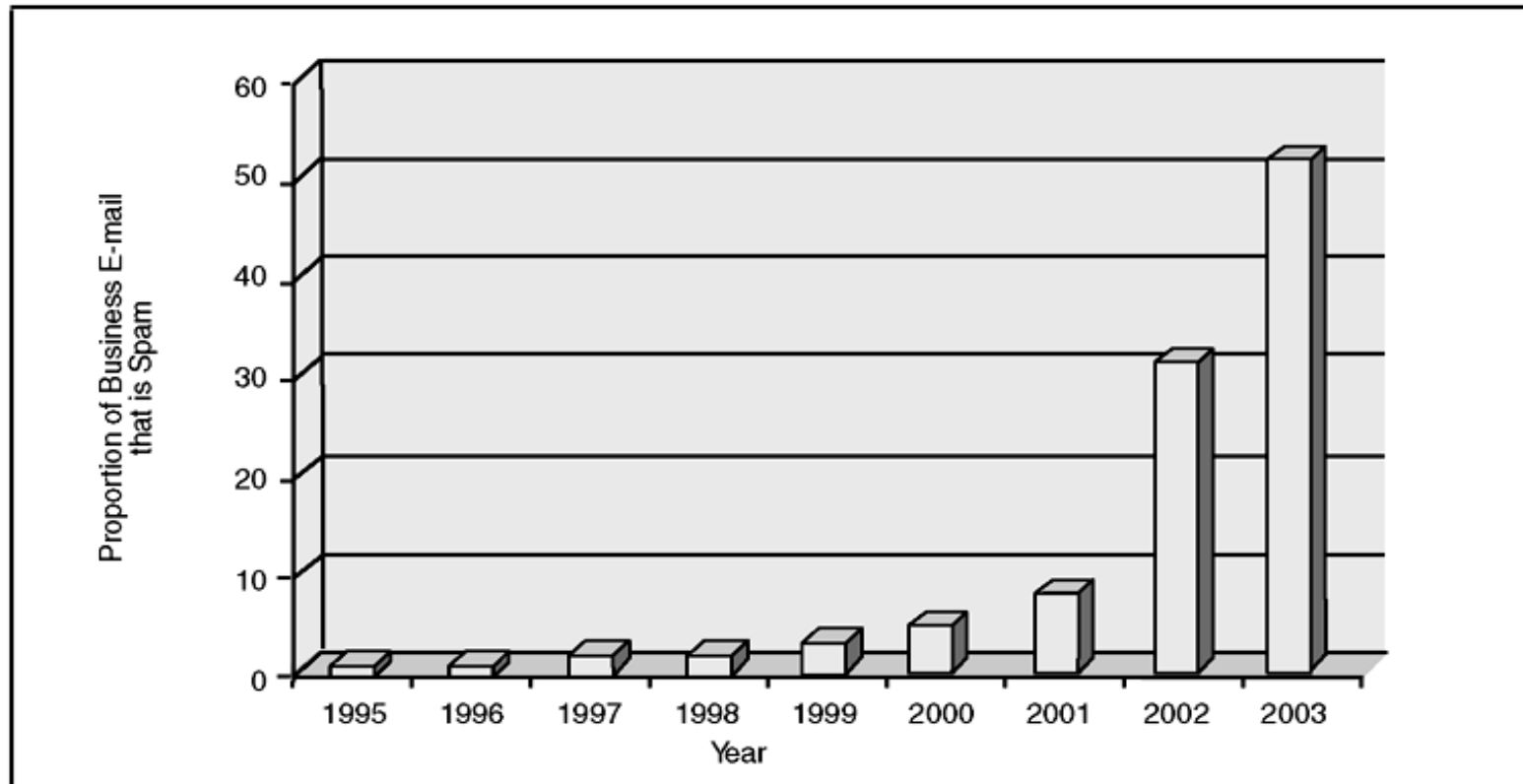


Figure S-6

Growth of spam as a proportion of all business e-mail

Solutions to the Spam Problem

- Reduce likelihood that a spammer can automatically generate e-mail addresses
- Control exposure of an e-mail address
- Use multiple e-mail addresses
- Content filtering strategy
 - Require software that identifies content elements that indicate if message is (or is not) spam

Solutions to the Spam Problem (Continued)

- Content-filtering techniques
 - Black list spam filter
 - Looks for known spammer From addresses in incoming messages
 - White list spam filter
 - Examines From addresses and compares them to list of known good sender addresses
 - Challenge-response
 - Compares all incoming messages to a white list

Telnet and FTP Utilities

- Telnet
 - Program that allows users to log on to a computer connected to the Internet
- Telnet protocol
 - Set of rules used by Telnet programs
- File Transfer Protocol (FTP)
 - Defines formats used to transfer files between TCP/IP-connected computers

Indexing and Searching Utility Programs

- Search engines or search tools
 - Search either a specific site or the entire Web for requested documents
- Indexing program
 - Can provide full-text indexing that generates an index for all documents stored on server
 - Can often index documents stored in many different file formats

Data Analysis Software

- Web servers can capture
 - Data about who is visiting a Web site
 - How long the visitor's Web browser viewed site
 - Date and time of each visit
 - Which pages visitor viewed
- Data captured by Web servers
 - Stored in a log file

WebTrends Log File Analysis

wide variety
of detailed
reports
available

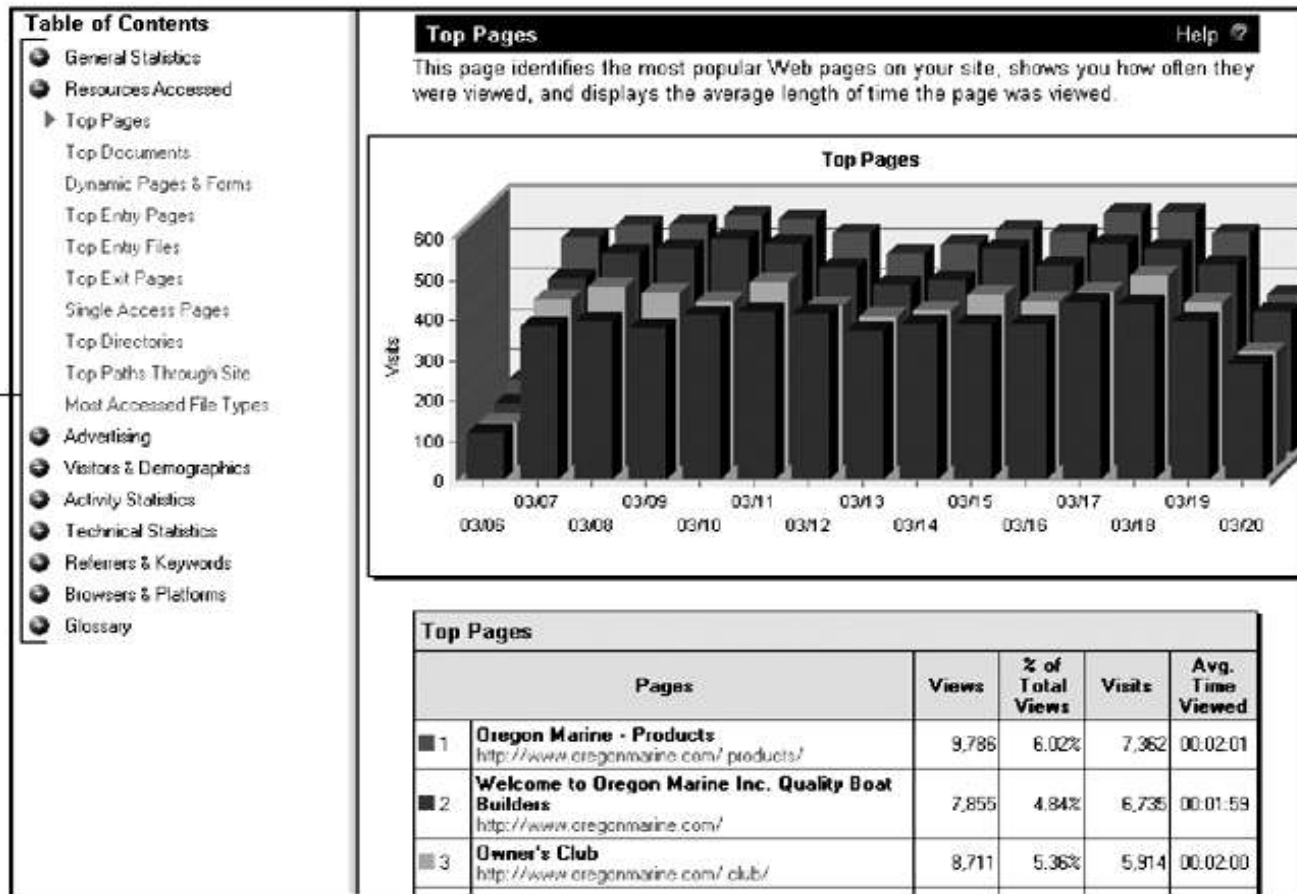


Figure 8-7

WebTrends log file analysis

Link-Checking Utilities

- Link checker
 - Examines each Web page and reports on URLs that are
 - Broken, seem broken, or are in some way incorrect
- Orphan file
 - File on Web site not linked to any Page
- Dead link
 - When clicked, displays error message rather than a Web page

Watchfire Link Report



Figure 8-8

Watchfire link report

Remote Server Administration

- Web site administrator can control Web site from any Internet-connected computer
- NetMechanic
 - Offers variety of link-checking, HTML troubleshooting, site-monitoring, and other programs

Web Server Hardware

- Web server computers
 - More memory, larger hard disk drives, and faster processors
- Blade servers
 - Placing small server computers on a single computer board, then installing boards into a rack-mounted frame
- Virtual server (virtual host)
 - Maintains more than one server on one machine

Web Server Performance Evaluation

- Benchmarking
 - Testing used to compare the performance of hardware and software
- Throughput
 - Number of HTTP requests that hardware and software combination can process in a unit of time
- Response time
 - Time required by server to process one request

Web Server Hardware Architectures

- Server farms
 - Large collections of servers
- Centralized architecture
 - Uses a few very large and fast computers
- Distributed/decentralized architecture
 - Uses large number of less powerful computers
 - Divides the workload among them

Load-Balancing Systems

- Load-balancing switch
 - Piece of network hardware that monitors the workloads of servers attached to it
 - Assigns incoming Web traffic to server that has the most available capacity at that instant in time

A Load-Balancing System in a Decentralized Architecture

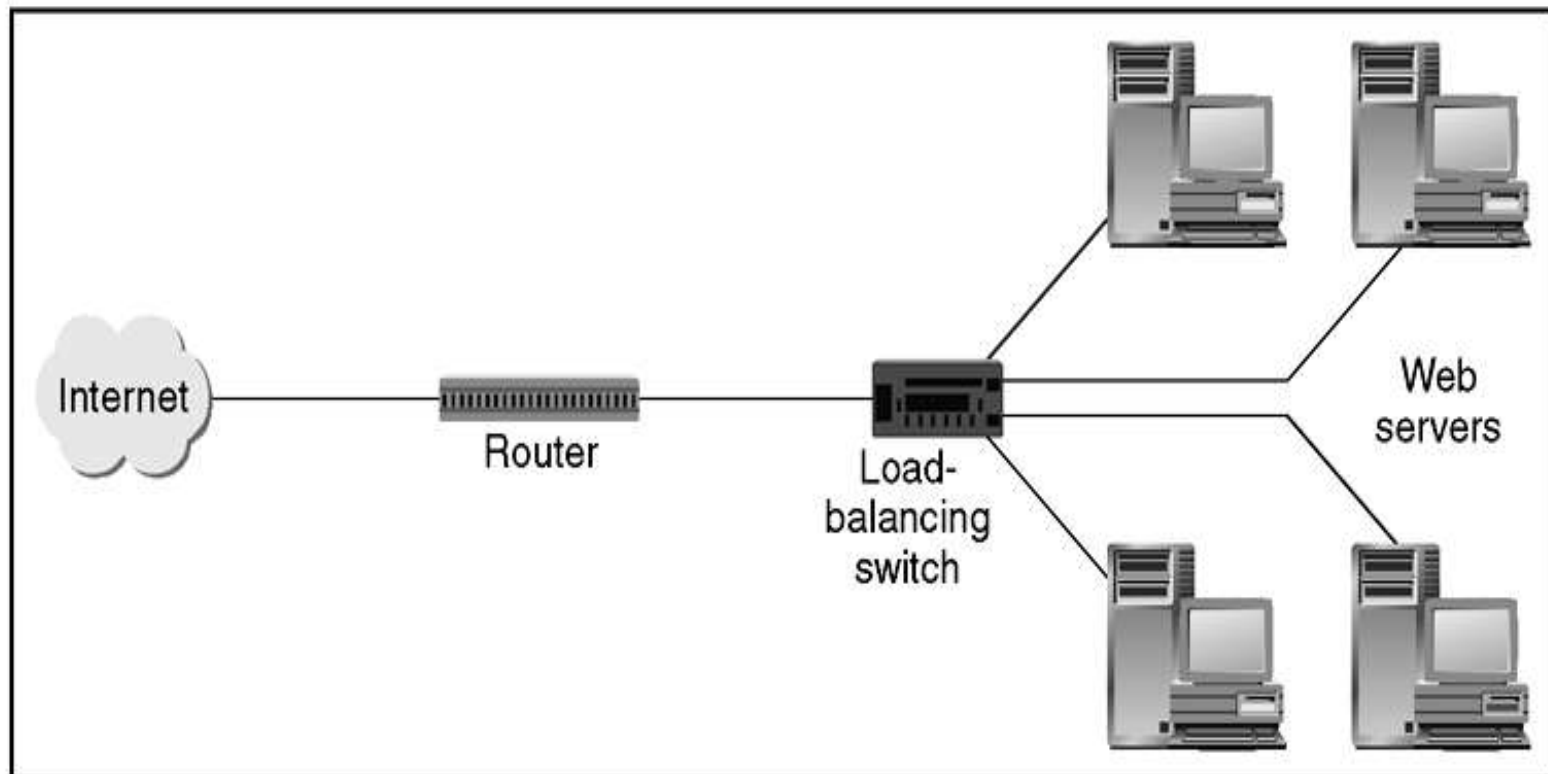


Figure 8-10 *A load-balancing system in a decentralized architecture*

Complex Load Balancing

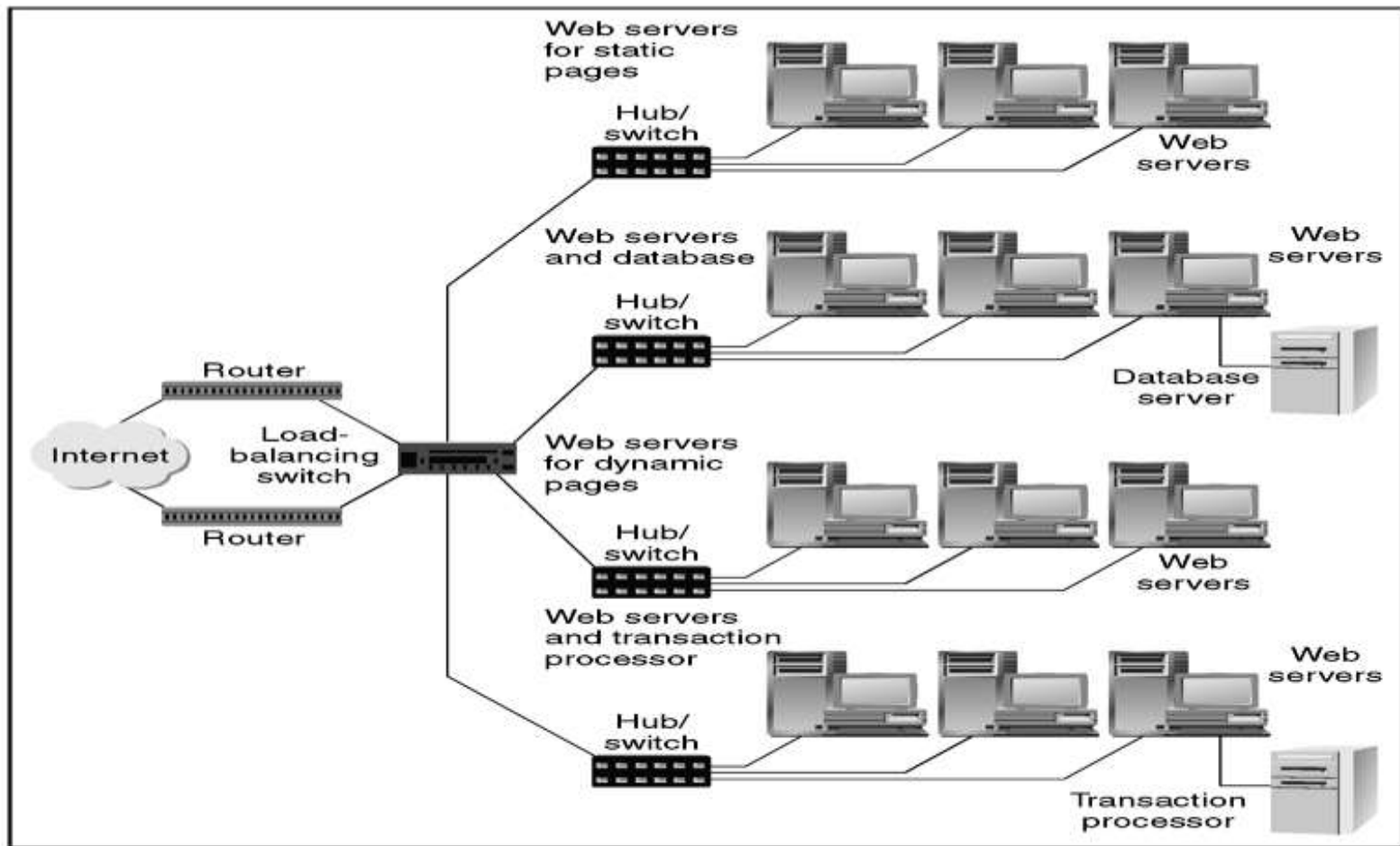


Figure S-11 Complex load balancing

Summary

- Web uses
 - Client/server architecture
- For simple HTTP requests
 - Two-tier architecture works well
- Operating systems commonly used on Web server computers
 - Microsoft server operating systems
 - UNIX-based operating systems

Summary

- Utility programs running on Web server computers
 - Finger, Ping, Tracert, email server software, Telnet, and FTP
- Web server hardware
 - Server computer must have enough memory and disk space
- Factors that affect Web server performance
 - Operating system
 - Connection speed
 - User capacity

Links for more information

- www.w3.org/MarkUp/historical
some history relating to hypertext and HTML
- www.w3.org/TR/webarch/
Architecture of the World Wide Web, Volume One (W3C Recommendation)
- www.w3schools.com/html/default.asp
HTML tutorial
- www.w3.org/TR/REC-xml.html
the XML 1.0 specification
- www.w3.org/TR/xhtml1
the XHTML 1.0 specification
- www.w3.org/International/tutorials/tutorial-char-enc/#choosing
W3C tutorial on Character sets & encodings in XHTML, HTML and CSS

Reference

- Data Communications and Computer Networks **for Computer Scientists and Engineers BY** Michael Duck and Richard Read
SECOND EDITION
- Computer Networks and Internets by Douglas E. Comer. Fifth edition
- **Data and Computer Communications BY William Stallings**