



# WEB ENGINEERING & DEVELOPMENT

## SWE 363



Spring Semester 2008-2009 (082)

### Module 1-1-1: Internet Basics for Web Development

**Dr. El-Sayed El-Alfy**

Computer Science Department  
King Fahd University of Petroleum and Minerals  
[alfy@kfupm.edu.sa](mailto:alfy@kfupm.edu.sa)

## Objectives/Outline

### Objectives

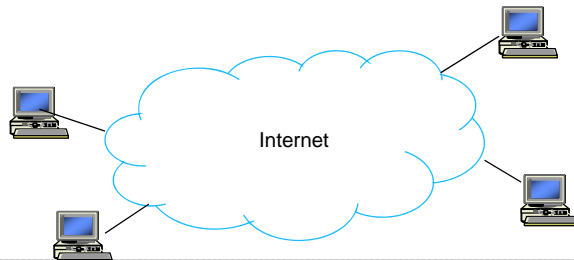
- Learn the basics of the Internet and the Web
- Identify and describe the key elements of the Internet and the Web

### Outline

- Introduction to the Internet
  - Definition
  - Hierarchical Structure
  - Internet Protocols
  - Addressing
- Introduction to the Web
  - Definition
  - Web Architecture & Operation
  - Websites & Web Documents
  - Web Browsers
- Internet and Web Growth
- Questions & Answers

## What is the Internet?

- A global heterogeneous network that connects a collection of computers all over the world
  - Using transmission media (copper, fiber, wireless, etc.), special purpose devices (routers, switches, etc.), network operating systems (NOS) and applications software (email, browsers, etc)



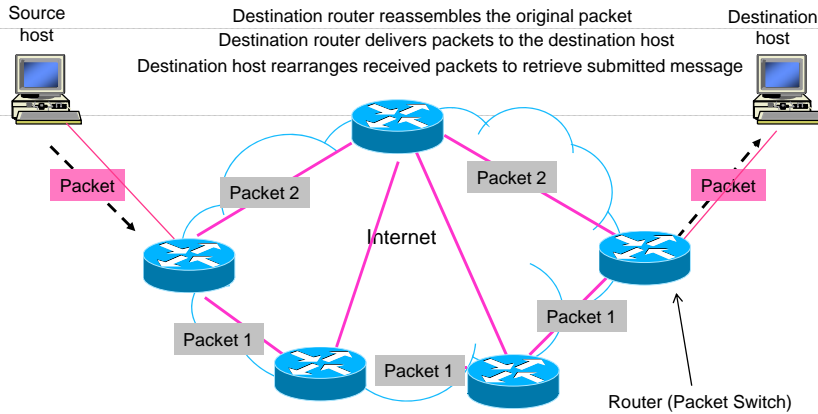
## What is the Internet? ...

- The goal is to provide connectivity between machines and between users to
  - Share resources
  - Increase reliability and availability
  - Collaborate (email, distributed computing, etc)
  - Access remote information
- Thus the Internet is a vehicle for transferring data from one machine to another.

# What is the Internet?

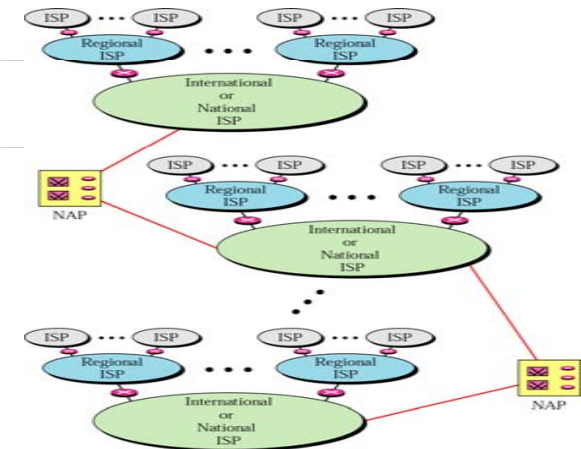
- An example of a packet-switched computer network

Source host generates a message & converts it to packets  
 Source router may fragment a packet into smaller packets (fragments)  
 Packets transferred independently across network  
 Destination router reassembles the original packet  
 Destination router delivers packets to the destination host  
 Destination host rearranges received packets to retrieve submitted message



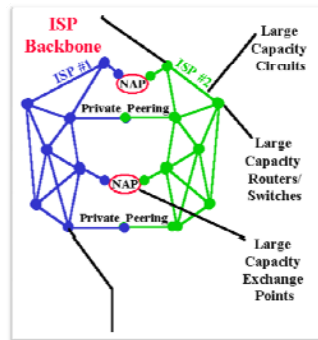
# Internet Hierarchical Structure

- To manage the growth of the Internet (scalability), it is roughly structured in a hierarchical manner



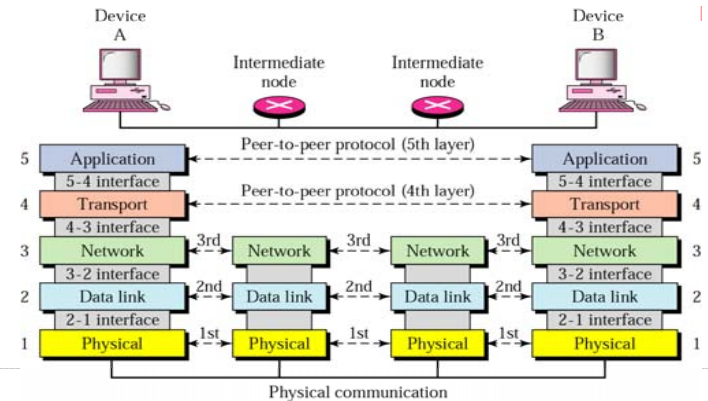
# Internet Hierarchical Structure ...

- Internet Service Provider (ISP)
  - International, National, Regional, Local
- At the lowest level are the organizations networks
  - e.g. KFUPM network
  - Which can act as ISP for lower-level user networks as well (e.g. home networks or small office networks)
- Two ISP networks can be connected to each other through network access points (NAP) or private peering.
  - NAP: data communication facilities that provide access to higher-speed links
- Routers:
  - Computer networking devices that forward data packets across a network toward their destinations



# Layered Architecture

- The Internet operating system is structured in layers called TCP/IP protocol stack
- Each has a number of protocols to facilitate the communication between different devices

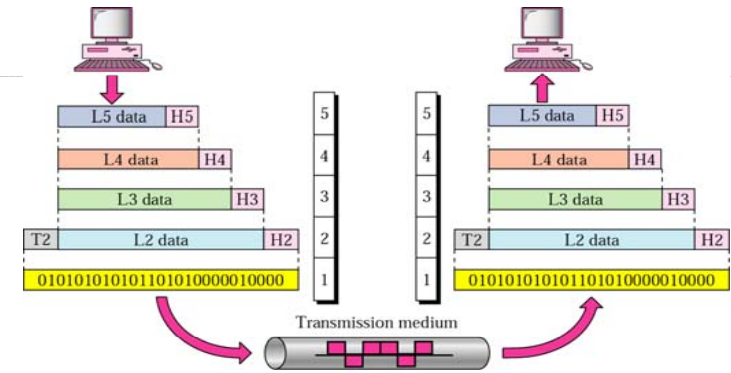


## Layered Architecture ...

- Summary of layers' roles
  - Application layer: acts as an interface to allow access to network resources. Each Internet application has its own application layer protocol.
  - Transport layer: to provide reliable process-to-process message delivery and error recovery
  - Network layer: to move packets from the source to the destination across the network
  - Data link layer: to organize bits into frames and provide hop-to-hop delivery
  - Physical layer: to transmit bits over a medium and provide mechanical and electrical specifications.

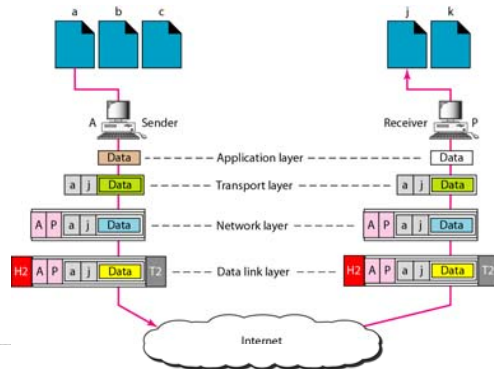
## Layered Architecture ...

- Each layer adds meta-data (control information) to facilitate communication between layers
  - E.g. source address, destination address, identification, error control information, etc.



## Addressing

- Hosts are identified using a unique global address (called IP address) or hostnames
  - DNS servers map hostnames to IP addresses
- Processes on the same host are uniquely identified using the host address (IP address) + the transport layer protocol port number (e.g. web server is running at TCP port # 80)

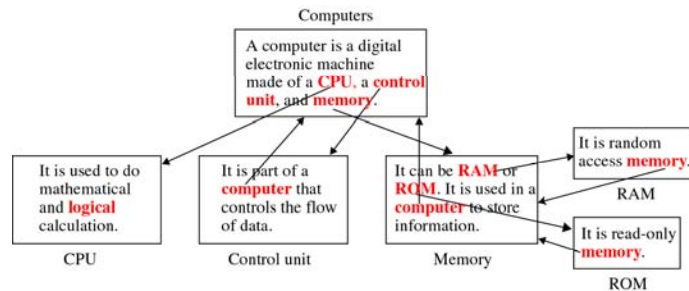


## Common Internet Applications

- The World-Wide Web (WWW)
- Electronic mail (email)
- File transfer (e.g. ftp)
- Remote login (e.g. telnet)
- Streaming multimedia (e.g. Internet feeds of live audio and video, video on demand (VoD))
- Internet telephony (VoIP)
- Chatting
- Many others ....

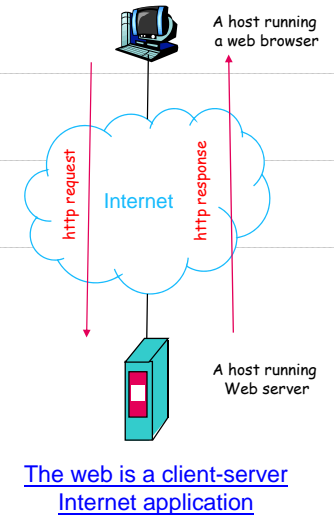
## What is the World-Wide Web?

- Also called WWW or just the Web
- A collection of web documents and other web resources uniquely identified (using URLs), can be accessed via the Internet, and are linked to each other.
  - Forms an overlay network over the Internet
  - Web documents can have different types of information (multimedia): text, images, audio and video
- Main features of the Web: Portability, Scalability, User friendly



## Web Architecture & Operation

- Web documents are hosted (stored) in machines running special software called Web servers
- Web documents can be accessed and viewed using special programs called browsers (Web clients or user agents)
- Browsers & Web servers are often running on different machines
- Browsers use HTTP protocol to communicate with the Web servers



## Web Architecture & Operation ...

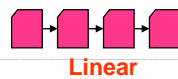
- Web documents (or web pages)
- Web browser (also called user agent, web client or HTTP client)
  - Application program that represents the user interface to the Web
  - Fetches information from Web server and displays it to the user
  - Examples: Mosaic (1993), NN (1994), IE (1995), Mozilla (1998), Firefox (2004), Opera, Safari, many others
- Web server (or HTTP server)
  - Stores a set of Web documents (web pages)
  - Responding to requests from the browser by sending a copy of the document
  - Examples: Apache, MS IIS
- Web standards
  - Transfer protocol
    - HyperText Transfer Protocol (HTTP)
  - Hypermedia links
    - Uniform Resource Locator (URL) to identify web resources
  - Document representation
    - HyperText Markup Language (HTML)
    - eXtensible Markup Language (XML)
    - etc

## Web Architecture & Operation ...

- A user starts a browser on his computer and request a web document by specifying its URL
  - E.g. <http://www.kfupm.edu.sa/>
- The browser resolve the URL to get the server IP address using the DNS server.
- Then, the browser sends a message to the server requesting the required document
- The server finds the document in its file system and sends it back to the browser
- The browser interprets the content of the document and displays (renders) it for the user
- If the document contains images,
  - Images will be on separate files and only their URLs will be embedded in the base document
  - The browser will send a different request for each image file

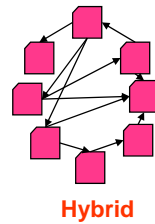
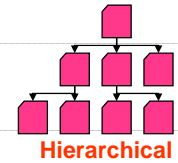
## Websites & Web Documents

- A website is made of a set of related web pages linked to each other; these pages can be on one server or distributed on different servers



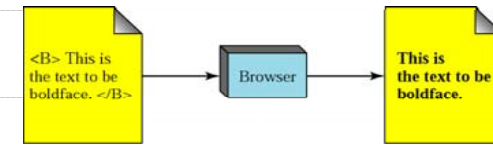
- Navigation order

- Linear
  - Web pages are linked in a strict sequence
  - Useful for guided navigation, tutorials, multi-part articles, etc.
- Hierarchical (tree)
  - Web pages are arranged hierarchically (also called tree)
  - The "root" is the website's homepage
- Hybrid (non-linear)
  - Webpage links can form sequences, trees, loops, or whatever paths are needed
  - Might this be confusing to a site visitor?



## Websites & Web Documents ...

- Web document



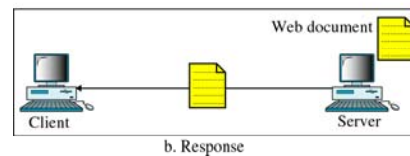
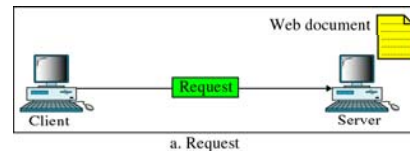
- Categories of Web documents

- Static documents
- Dynamic documents
- Active documents

## Websites & Web Documents ...

- Static documents

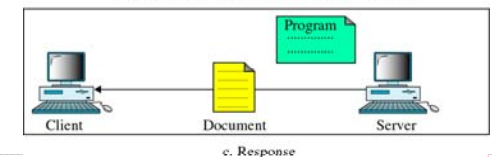
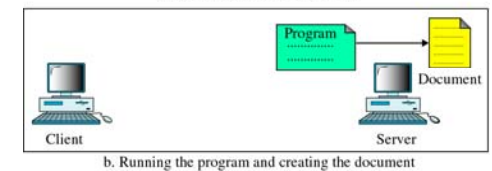
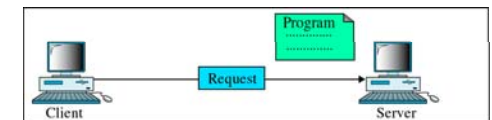
- Fixed-content document created and stored in a server
  - Content is determined when it is first created not when it is used
- The file contains text and formatting instructions
- The client can not change the content of the document
- Use HTML technology



## Websites & Web Documents ...

- Dynamic documents

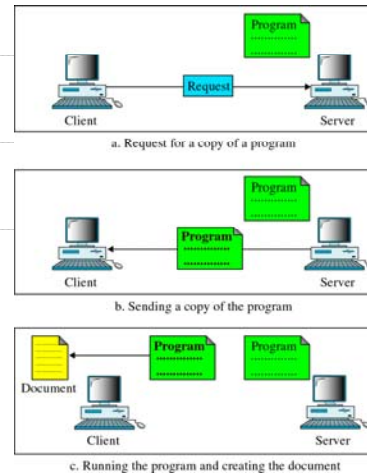
- The requested document does not exist in a predefined format but is created on demand
- The accessed document contains code (application program) that the server executes to generate the document to be submitted to the browser
- Personalized (customized) web pages
- Can access restricted resources on the server such as databases
- High load on the server
- Use Common Gateway Interface (CGI) or ASP technologies for server side programming



## Websites & Web Documents ...

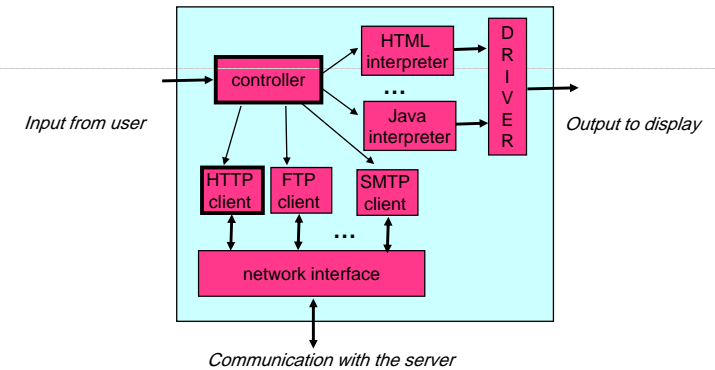
### Active documents

- The requested document contains a program; the server submits a copy of the program to the browser; the browser will run the program at the client side
- Can interact with user
- Does not create overhead for the server in the same way as dynamic documents
- The client can store the document and run it again and again without making another request
- Can save bandwidth and transmission time
- Use Java, Javascript and Vbscript technology for client side programming



## Web Browsers

- A variety of vendors offer commercial browsers that interpret and display a webpage but all use nearly the same architecture
- The browser consists mainly of three modules: **controller, client programs, and interpreters**

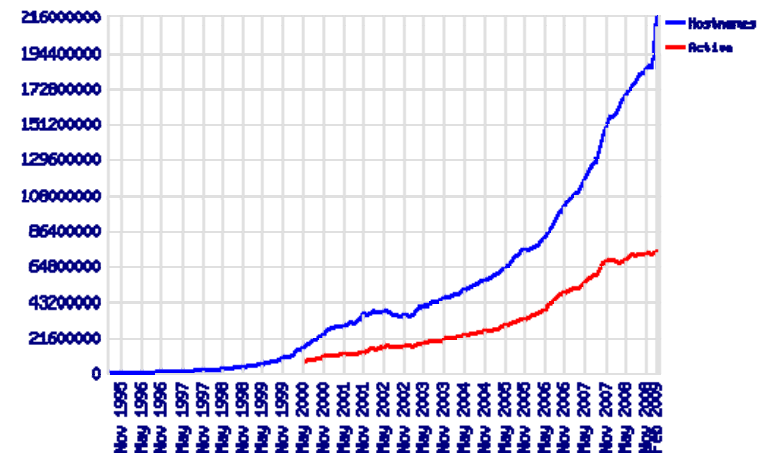


## Cross-Browser Compatibility

- There are literally hundreds of web browsers in use around the world.
- All browsers differ in functionality, performance and features
  - Implement different HTML layout engines, JavaScript and Cascading Style Sheets (CSS)
  - May make Web pages look totally different
  - Makes cross-browser compatibility difficult to achieve
- Write clean code that conforms to the www consortium (W3C) standards to get consistent results across all browser platforms
  - A cross-browser compatible Web page will look more or less the same in all of the existing Web browsers
  - Obviously, 100% compatibility with all potential browsers is impossible.
  - HTML editors are, on their part, notorious for creating non-compliant and garbage code.
  - Write your code by hand, e.g., using notepad
  - If you must use a HTML editor, the best choice for compatibility is [Dreamweaver](#) and worst is [FrontPage](#).

## Internet and Web Growth

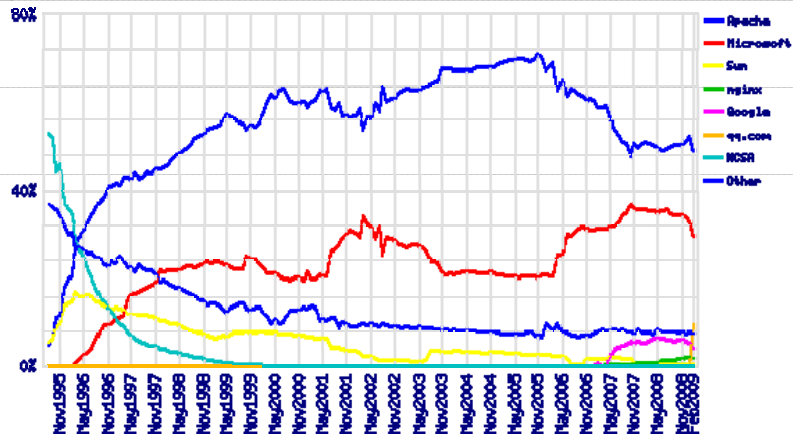
- Total sites across all domains (August 1995 – Feb 2009)



[source: <http://news.netcraft.com/> ]

# Internet and Web Growth ...

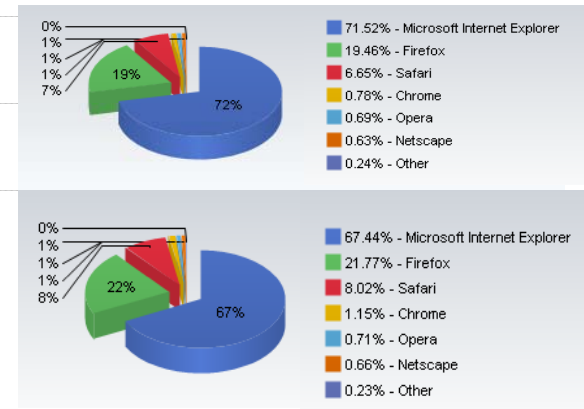
➤ Market share for top servers across all domains (August 1995 – Feb 2009)



[source: <http://news.netcraft.com/>]

# Web Browsers

➤ Total market share of web browsers



Oct. 2008

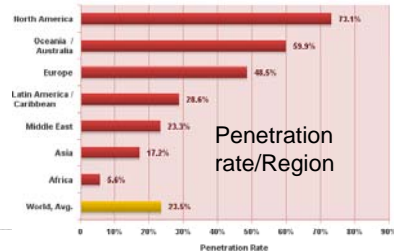
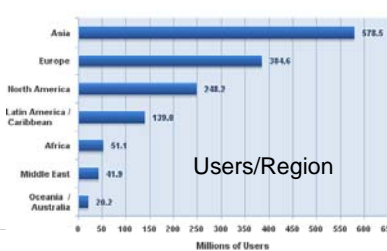
Feb 2009

[Source: [NetApplications](http://NetApplications)]

# Internet and Web Growth ...

## WORLD INTERNET USAGE AND POPULATION STATISTICS

World Regions	Population (2008 Est.)	Internet Users Dec. 31, 2000	Internet Users Latest Data	Penetration (% Population)	Users Growth 2000-2008	Users % of Table
Africa	975,330,899	4,514,400	54,171,500	5.6 %	1,100.0 %	3.4 %
Asia	3,780,819,792	114,304,000	650,361,843	17.2 %	469.0 %	41.3 %
Europe	803,903,540	105,096,093	390,141,073	48.5 %	271.2 %	24.8 %
Middle East	196,767,614	3,284,800	45,861,346	23.3 %	1,296.2 %	2.9 %
North America	337,572,949	108,096,800	246,822,936	73.1 %	128.3 %	15.7 %
Latin America/Caribbean	581,249,892	18,068,919	166,360,735	28.6 %	820.7 %	10.6 %
Oceania / Australia	34,384,384	7,620,480	20,593,751	59.9 %	170.2 %	1.3 %
<b>WORLD TOTAL</b>	<b>6,710,029,070</b>	<b>360,985,492</b>	<b>1,574,313,184</b>	<b>23.5 %</b>	<b>336.1 %</b>	<b>100.0 %</b>



[source: <http://www.internetworldstats.com>]

# Q & A



## Other Resources

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- *Data Communications and Networking, 4/e.* B.A. Forouzan, McGraw-Hill Higher Education 2007.  
<http://www.mhhe.com/forouzan>
  - [The World Wide Web Consortium \(W3C\)](#)
-