

## Technology Infrastructure:

The Internet and the  
World Wide Web

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## Technology Overview

- Computer networks and the Internet form the basic technology structure for electronic commerce.
- The computers in these networks run such software as:
  - Operating systems, database managers, encryption software, multimedia creation and viewing software, and the graphical user interface
- Rapid change in these technologies requires businesses to be flexible.

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## Packet-Switched Networks

- A local area network (LAN) is a network of computers close together.
- A wide area network (WAN) is a network of computers connected over a great distance.
- Circuit switching is used in telephone communication
  - Single electronic path between sender and receiver
  - Temporary
- The Internet uses packet switching

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## Packet Switching

- Data broken into smaller packets
- Labeled with:
  - Origin
  - Sequence #
  - Destination
- Packets have standard format
- Each sent separately
- Reassembled at destination

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## Routing Packets

- Router
  - decides how best to forward each packet
  - use 'routing algorithms' with 'routing tables' to determine the best path to send each packet
  - if path fails, router gives an alternate
  - routers and the telecommunication lines connecting them are referred to as 'the Internet backbone'.

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## Routing Packets

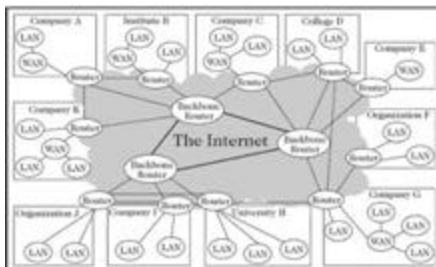


Figure 2-1 Router-based architecture of the Internet

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## Data Transmission Protocols

- Protocol
  - Rules for data sent across a network
    - Formatting
    - Ordering
    - Error-checking.
- ARPANET is the earliest packet-switched network.

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## Protocols

- TCP – Transmission Control Protocol
- IP – Internet Protocol
- HTTP – HyperText Transfer Protocol
  - Hyperlinks
  - Files contain references which elicit transfer requests
  - URL – Uniform Resource Locators
    - <http://www.adobe.com/products/golive/main.html>
      - Protocol
      - Domain Name
      - Directory Path
      - Retrieved file
- FTP - File Transfer Protocol – Upload/Download files
- Telnet – gives user access on network
- SMTP- Simple Mail Transfer Protocol
- POP3 – Post Office Protocol & IMAP – Internet Message Access Protocol

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## Data Transmission Protocols (cont.)

- This open architecture has four key rules that have contributed to the success of the Internet.
  1. Independent networks should not require any internal changes to be connected to the network.
  2. Packets that do not arrive at their destinations must be retransmitted from their source network.
  3. Router computers act as receive-and-forward devices; they do not retain information about the packets that they handle.
  4. No global control exists over the network.

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## Internet Protocols

- The Transmission Control Protocol (TCP) and the Internet Protocol (IP) are the two protocols that support the Internet operation (commonly referred to as TCP/IP).
- TCP controls
  - disassembly of a message into packets before it is transmitted
  - reassembly of those packets when they reach their destination.
- The IP protocol
  - specifies the addressing details for each packet being transmitted. (origin, destination)

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## IP Addresses

- IP addresses
  - based on a 32-bit binary number (0 -255)
  - allows over 4 billion unique addresses for computers to connect to the Internet.
- IP addresses appear in 'dotted decimal' notation (four numbers separated by periods).  
212.120.016.108
- They are assigned by three not-for-profit organizations (ARIN, RIPE and APNIC).

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## IP Addresses

- Approximately two billion IP addresses are either in use or unavailable for use.
- Private IP addresses are a series of IP numbers that have been set aside for subnet use and are not permitted on the Internet.
- IPv6 is a possible solution that uses a 128-bit hexadecimal number for addresses.
  - 0-F (hex) for symbols
  - Millions more IP addresses available

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## Domain Names

- To make the numbering system easier to use, an alternative addressing method that uses words was created.
- An address, such as `www.course.com`, is called a domain name.
- The last part of a domain name (i.e., `.com`) is the most general identifier in the name and is called a 'top-level domain' (TLD).

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## Top-level Domain Names

Original General TLDs		Country TLDs		New (2000) General TLDs	
TLD	Use	TLD	Country	TLD	Use
.com	Commercial	.au	Australia	.aero	Air-transport industry
.edu	Four-year educational institution	.ca	Canada	.biz	Businesses
.gov	U.S. Federal government	.de	Germany	.coop	Cooperatives
.mil	U.S. Military	.fi	Finland	.info	General use
.net	General use	.fr	France	.museum	Museums
.org	Not-for-profit organization	.jp	Japan	.name	Individual persons
		.se	Sweden	.pro	Professionals (accountants, lawyers, physicians)
		.uk	United Kingdom		

Figure 2-2 Top-level domain names

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## Web Page Delivery

- Hypertext Transfer Protocol (HTTP) is the set of rules for delivering Web pages over the Internet.
- HTTP uses the client/server model
  - A user's Web browser opens an HTTP session and sends a request for a Web page to a remote server.
  - In response, the sever creates an HTTP response message that is sent back to the client's Web browser.
- Uniform Resource Locator (URL).
  - combination of the protocol name (`http://`) and the domain name (`www.wright.edu`)

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## SMTP, POP, MIME, and IMAP

- E-mail sent across the Internet
  - Must be formatted to a common set of rules
  - Read by anyone using same rules
  - Protocol specifies exact message format and how to administer
- Simple Mail Transfer Protocol (SMTP)
- Post Office Protocol (POP)
- Multipurpose Internet Mail Extensions (MIME)
- Interactive Mail Access Protocol (IMAP)
  - newer

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## SMTP, POP, MIME, and IMAP (cont.)

- An e-mail program running on a user's computer can request mail from the company's main e-mail computer using the Post Office Protocol (POP).
- Multipurpose Internet Mail Extensions (MIME) allow the user to attach binary files to e-mail.
- The Interactive Mail Access Protocol (IMAP) performs the same basic functions as POP, but includes additional features.

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## Internet Applications

### FTP

- File Transfer Protocol (FTP) defines the formats used to transfer files between TCP/IP-connected computers.
- FTP transfers both binary data and ASCII text.
- Full privilege FTP allows remote uploading and downloading of files.
- Anonymous FTP allows you to log on to a remote computer as a guest.

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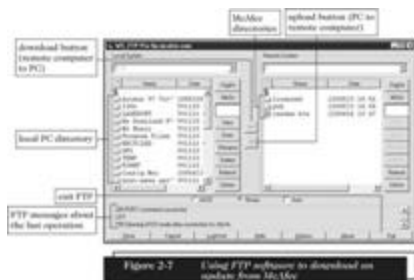
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## Internet Applications



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## Markup Languages and the Web

- Web pages are marked with tags to indicate the display and formatting of page elements.
- HTML now includes tags for tables, frames, and other features that help Web designers create more complex page layouts.

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## Extensible Markup Language

- XML uses markup tags to describe the *meaning of the text* rather than its display characteristics.
- XML uses paired start and stop tags.
- An XML document can be embedded within an HTML document.
- XML allows a user to 'extend' the language by creating their own tags.

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## HTML Tags

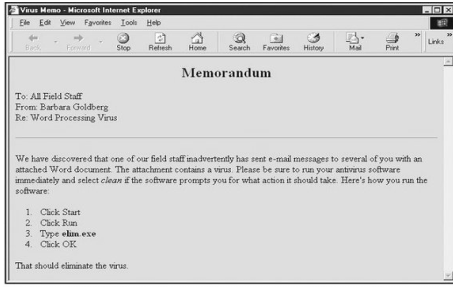


Figure 2-13 Internet Explorer display of the HTML-formatted memo

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## HTML Links

- Hyperlinks are bits of text that connect the current document to:
  - another location in the same document
  - another document on the same host machine
  - another document on the Internet
- Hyperlinks are created using the HTML anchor tag.
- Two popular link structures are:
  - Linear hyperlink structure ("next" button)
  - Hierarchical hyperlink structure (navigation bar)

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## Web Clients and Web Servers

- Your PC is a Web client
- Web software is platform-neutral
  - Doesn't matter if it is a MAC/PC/LINUX
- Web servers.
  - Computers that are connected to the Internet and that contain documents made publicly available
  - Servers usually have more memory and larger, faster disk drives than the client computers they serve

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## Web Clients and Web Servers

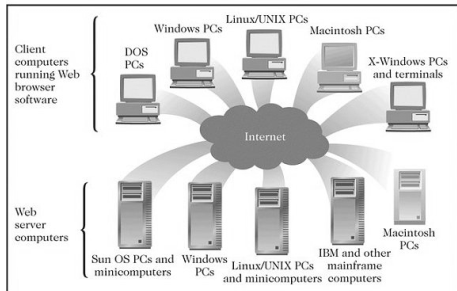


Figure 2-16 The client-server architecture of the Web

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## Two-Tier Client-Server Architecture

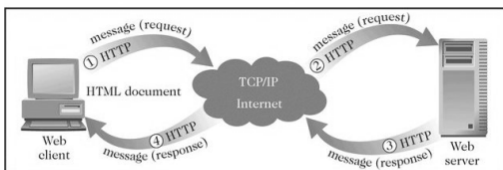


Figure 2-17 Message flow in a two-tier client-server architecture

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## Three-Tier and Client-Server Architectures

- A three-tier architecture extends the two-tier architecture to allow additional processing to occur before responding to the client's request.
- The third tier usually includes software applications that supply information to the Web server.
  - Often involve a database server
- Higher-order architectures (those with more than three tiers), are called 'n-tier' architectures.

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## Three-Tier and N-Tier Client-Server Architectures

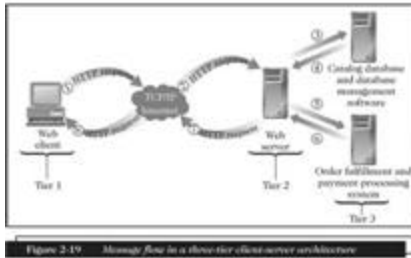


Figure 2.19: Message flow in a three-tier client-server architecture

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## Intranets

### Intranets

- An intranet is an interconnected network that does not extend beyond the organization that created it.
- IADT is on an Intranet called ACADEMY or RAIDZONE
- An intranet uses Web browsers and Internet-based protocols (including TCP/IP, FTP, Telnet, HTML, and HTTP) and often includes a firewall.

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## Internet Connection Options and Trade-Offs

- Internet Service Providers (ISPs)
  - Large firms that provide Internet access to other businesses
- Ways to connect
  - Dial-up telephone
  - Broadband (Cable, DSL)
  - Leased (T1, T3)
  - Wireless (802.11b)

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## Connection Options

Service	Upstream speed (Kbps)	Downstream speed (Kbps)	Capacity (number of simultaneous users)	One-time startup costs	Continuing Monthly Costs
<b>Residential and small business services</b>					
Modem (POTS)	28 - 56	28 - 56	1	\$0 - \$20	\$12 - \$20
ISDN	128 - 256	128 - 256	1 - 3	\$60 - \$300	\$50 - \$90
ADSL	100 - 640	4,500 - 9,000	1 - 4	\$50 - \$100	\$40 - \$90
Cable modem	300 - 1,000	1,000 - 10,000	1 - 4	\$0 - \$100	\$40 - \$70
Satellite	125 - 150	400 - 500	1 - 3	\$600 - \$1,200	\$60 - \$70
<b>Business Services</b>					
Leased digital line (DS0)	64	64	1 - 10	\$50 - \$200	\$40 - \$150
Fractional T1 leased line	128 - 1,544	128 - 1,544	5 - 180	\$50 - \$800	\$100 - \$1,000
HDSL	768	768	50 - 100	\$300 - \$1,500	\$400 - \$900
T1 leased line	1,544	1,544	100 - 200	\$100 - \$2,000	\$900 - \$1,600
T3 leased line	44,700	44,700	1,000 - 10,000	\$1,000 - \$9,000	\$5,000 - \$12,000
<b>Large Business, ISP, NAP, and Internet 2 Services</b>					
OC3 leased line	156,000	156,000	1,000 - 50,000	\$3,000 - \$12,000	\$9,000 - \$22,000
OC12 leased line	622,000	622,000	Backbone	Negotiated	\$25,000 - \$100,000
OC48 leased line	2,500,000	2,500,000	Backbone	Negotiated	Negotiated
OC192 leased line	10,000,000	10,000,000	Backbone	Negotiated	Negotiated

Figure 2-21 Internet connection options

## Internet 2

- Internet 2 is an experimental test bed for new networking technologies that is separate from the original Internet.
- 200 universities and a number of corporations joined together to create this network.
- It has achieved bandwidths of 10 Gbps.
- Internet 2 promises to be the proving ground for new technologies and applications of those technologies that will eventually find their way to the Internet.