

CS 149D, slide set 3

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M. Overstreet  
Old Dominion University  
Spring 2006

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Chapter 4

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Networking and  
the Internet

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Chapter 4: Networking and  
the Internet

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- 4.1 Network Fundamentals
- 4.2 The Internet
- 4.3 The World Wide Web
- 4.4 Network Protocols
- 4.5 Security

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## Network classifications

- Local area network (LAN)
- Wide area network (WAN)
- Closed, or proprietary
- Open

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## Network topologies

- Ring
- Bus
- Star
- Irregular

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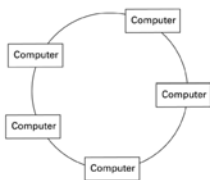
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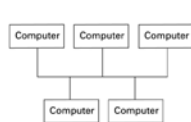
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## Figure 4.1 Network topologies

a. Ring



b. Bus



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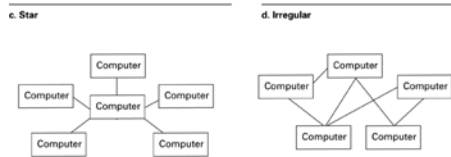
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## Figure 4.1 Network topologies (cont'd)



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## Connecting networks

- Bridge: connects two compatible networks
- Router: connects two incompatible networks
  - Resulting "network" is called an internet

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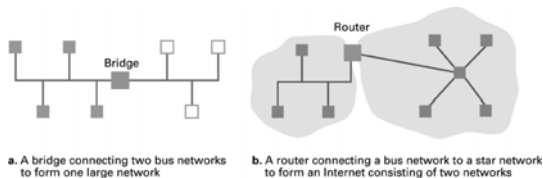
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## Figure 4.2 The distinction between a bridge and a router



a. A bridge connecting two bus networks to form one large network

b. A router connecting a bus network to a star network to form an Internet consisting of two networks

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## Inter-process communication

- Client-server
  - One server, many clients
  - Server must execute continuously
  - Client initiates communication
- Peer-to-peer
  - Two processes communicating as equals
  - Peer processes can be short-lived

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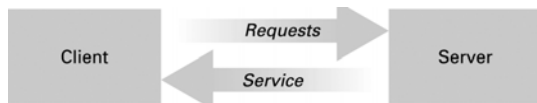
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## Figure 4.3 The client/server model



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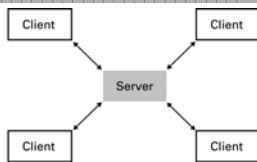
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## Figure 4.4 The client/server model compared to the peer-to-peer-model



a. Server must be prepared to serve multiple clients at any time.

b. Peers communicate as equals on a one-to-one basis.

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## Distributed systems

- Systems with parts that run on different computers
  - Infrastructure usually provided by standardized toolkits
    - Example: Enterprise Java Beans from Sun Microsystems
    - Example: .NET framework from Microsoft

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## The Internet

- The Internet: one internet spanning the world
  - Started by DARPA in 1973
    - Idea was to have two supercomputers share a BIG computation
    - This was so hard to do that the programmers at the two locations needed to talk to each other a lot!
      - Figured out they could use the same connection that was set up for the 2 computers to talk
        - They typed messages back and forth
    - Turns out that the ability to send messages back and forth easily and instantly was the best part!
    - Pretty soon, all of the geeks wanted the ability to do this
    - E-mail existed before this
    - Until this, most common approach was to have one computer at each location connected to a phone line. It would dial a more central computer once a day to deliver and pick up e-mail messages.
      - All of our mail used to go through Washington, DC
  - Today involves millions of machines

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## Internet Architecture

- Domain = network or internet controlled by one organization
- Gateway = router connecting a domain to the "cloud"
  - cloud = the rest of the internet
- Domains must be registered by their owners
  - Internet Corporation for Assigned Names & Numbers (ICANN) serves as registrar

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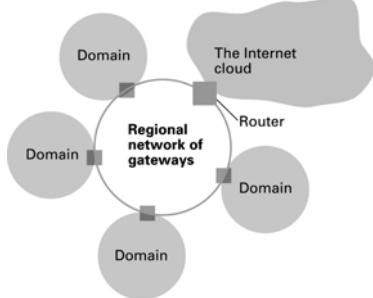
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**Figure 4.5** A typical approach to connecting to the Internet



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### Strategies for connecting to the Internet

- Large organization: buy a direct connection
- Small organization or individual: link domain to the domain of an ISP
  - ISP = Internet Service Provider
- Individual: temporarily link computer into ISP's domain

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### Internet Addressing: IP Addresses

- IP address = 32 bit identifier for a machine
  - Network identifier = part assigned by ICANN
  - Host address = part assigned by domain owner
- Dotted decimal notation = standard for displaying IP addresses
  - Example: 192.207.177.133

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## Internet addressing: host names

- Host name = mnemonic name
  - Example: mymachine.aw.com
- Domain name = part assigned by a registrar
  - Example: aw.com
  - Top level domain = classification of domain owner
    - By usage – Example: .com = commercial
    - By country – Example: .au = Australia
    - Original idea: divide sites up by type of organization
      - .mil—for military
      - .gov—for government (nonmilitary)
      - .edu—for education
      - .com—for business
      - .org—for nonprofits
- Subdomains and individual machine names
  - Assigned by domain owner
  - Domain owner must run a name server

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## Internet applications

- Early internet applications; all of these existed before the world-wide-web
  - Electronic main (e-mail)
  - File Transfer Protocol (FTP)
    - To copy files between distant machines (with error checking)
  - Remote login: telnet, etc.
- World Wide Web

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## Electronic mail

- Mail server: set up by domain owner
  - Mail sent from domain members goes through mail server
  - Mail sent to domain members is collected by mail server
  - Mail delivered to clients on demand
    - POP3
    - IMAP

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## World Wide Web

- Server disseminates hypertext (or hypermedia) documents
  - Web site = all hypertext documents controlled by one organization or individual
    - Usually all at same internet address
  - HTML = language of hypertext documents
  - Other content can also be disseminated
    - Example: images

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## World Wide Web implementation

- Web server: provides access to documents on its machine as requested
- Browser: allows user to access web pages
- Hypertext Transfer Protocol (HTTP): communication protocol used by browsers and web servers
- Uniform Resource Locator (URL): unique address of a document on the web

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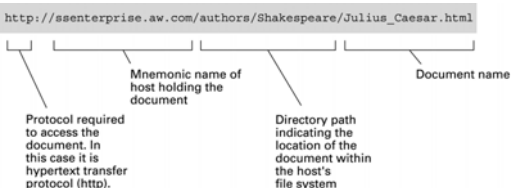
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## Figure 4.6 A typical URL



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## Hypertext document format

- Entire document is printable characters
- Contains tags to control display
  - Display appearance
  - Links to other documents and content
  - Dynamic functions

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## Figure 4.7 A simple Web page

a. The page encoded using HTML.

```
Tag indicating beginning of document <html>
Preliminaries <head>
<title>demonstration page</title>
</head>
Part of the page that will be displayed by browser <body>
<h1>My Web Page</h1>
<p>Click here for another page.</p>
</body>
Tag indicating end of document </html>
```

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## Figure 4.7 A simple Web page (cont'd)

b. The page as it would appear on a computer screen.



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## Figure 4.8 An enhanced simple Web page

a. The page encoded using HTML.

```
<html>
<head>
<title>demonstration page</title>
</head>
<body>
<h1>My Web Page</h1>
<p>Click
  <a href="http://crafty.com/demo.html">
    here
  </a>
  for another page.</p>
</body>
</html>
```

Anchor tag containing parameter

Closing anchor tag

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## Figure 4.8 An enhanced simple Web page (cont'd)

b. The page as it would appear on a computer screen.



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## Extensible Markup Language (XML)

- XML: a language for constructing markup languages similar to HTML
  - A descendant of SGML

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**Figure 4.9** The first two bars of Beethoven's Fifth Symphony



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## Dynamic web pages

- Client-side
  - Examples: java applets, javascript, Macromedia Flash
- Server-side
  - Common Gateway Interface (CGI)
  - Servlets
  - PHP

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## Network protocols: transmission control

- Token ring: one-way communication around ring network
- Ethernet:
  - Uses carrier sense, multiple access with collision detection (CSMA/CD)
  - Popular for bus networks
  - Like a conversation in small group

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## Internet software layers

- Application layer:
  - Example: browser
- Transport layer: TCP/IP, UDP
- Network layer: handles routing through the internet
- Link layer: handles actual transmission of packets
  - Token ring or Ethernet

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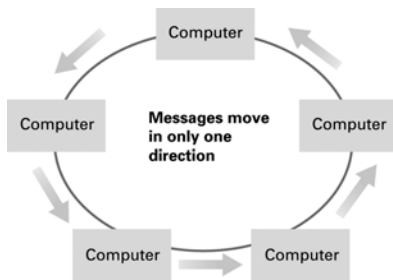
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**Figure 4.10** Communication over a ring network



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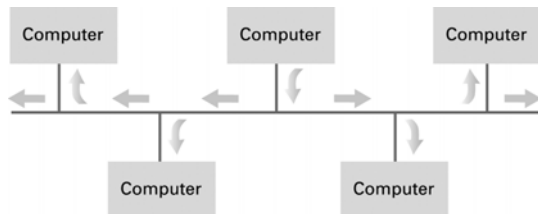
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**Figure 4.11** Communication over a bus network



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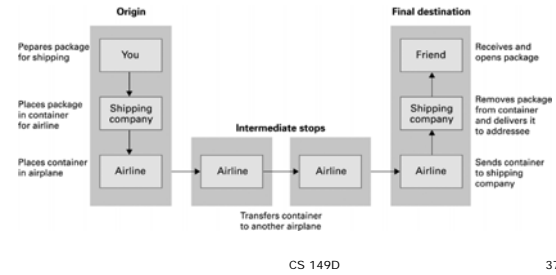
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### Figure 4.12 Package-shipping example




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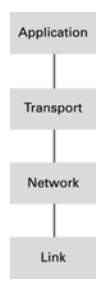
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### Figure 4.13 The Internet software layers




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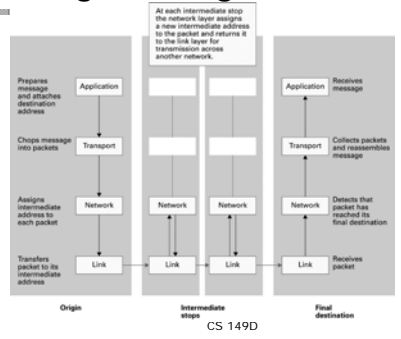
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### Figure 4.14 Following a message through the Internet




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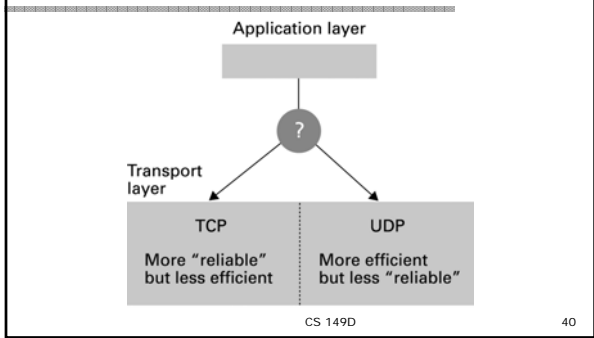
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**Figure 4.15** Choosing between TCP and UDP



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## Network security

- Privacy of communication
  - Public-key encryption
- Integrity of machine exposed to internet
  - Attacks: viruses and worms
  - Defense: firewall

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