Technology Briefing

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The Internet and the World Wide Web

Information Systems Today: Managing in the Digital World
Learning Objectives

1. Describe the Internet and how it works.
2. Describe the basic Internet services and the use of the World Wide Web.
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How Did the Internet Get Started?

- **Internet** – derived from internetworking
- 1960s – U.S. Defense Advanced Research Project (**DARPA**)
  - **ARPANET** – WAN that linked universities and research centers
- 1986 – U.S. National Science Foundation
  - **NSFNET** – became major component of the Internet
- Other networks ultimately connected
  - **BITNET, CSNET, NSINET, ESNET, NORDUNET**
Packet-Switching Technology

- Problem: Concurrent data transmission
  - One wire and several users
- Solution: Turn-taking
- Messages divided into packets and sent
- Packets travel independently
- Reassembled by receiver
- Header contains address of source and destination
TCP/IP

• Protocol of the Internet

• TCP (Transmission Control Protocol)
  o Breaks information into packets
  o Manages transfer of packets between computers

• IP (Internet Protocol)
  o Defines how the packet must be formed
  o Contains destination address
IP Datagram

• Data packet that conforms to the IP specifications

• Relies on IP address
  - Unique address assigned to computers and routers

• TCP helps IP deliver packets:
  - Checks for lost datagrams
  - Puts received datagrams in correct order
  - Discards duplicate datagrams
Connecting Independent Networks

- Routers interconnect independent networks
- Fundamental building blocks of Internet
- Router:
  - Special-purpose computer
  - Only jobs:
    - Interconnect networks
    - Forward data packets
Backbone Networks

- Manage bulk of network traffic, high speed
Web Domain Names and Addresses

• Uniform Resource Locator (URL) used to locate a Web page
• URL consists of three parts

www.google.com
Domain Name

- Represents company or person
  - Anyone can register domain name

[Diagram showing domain name structure with examples like www.google.com]
Top-Level Domain

- Domain name suffix
  - “com” – reserved for commercial organizations
  - “edu” – educational institutions
  - “org” – nonprofit organizations

- Top-Level Domain have to be approved by ICANN
**Host Name**

- Web server or group of servers
- “www” usually the default (Can be anything)
  - spreadsheets.google.com – server responsible for serving Google’s spreadsheet application

Some of Google’s host names
- mail.google.com
- labs.google.com
- maps.google.com
More on IP Addresses

• Domain names associated with IP addresses
• google.com – about dozen underlying IP addresses
• Destination address for a computer
• 32-bit numeric address
  o 4 numbers separated by periods
  o Each number is 0 – 255
• To use the Internet, IP address needs to be registered
Who Manages the Internet?

• National and international committees
• Coordinating Committee for Intercontinental Research Networks
• The Internet Society
  o 150 organizational members
  o 16,000 individual members
  o Internet Engineering Task Force
  o Internet Architecture Board
• Groups help manage Internet standards
Internet Registry

- Central repository for Internet-related information
- Central maintenance of Domain Name System (DNS)
  - Match domain names with IP addresses
  - www.apple.com = 17.254.0.91
- Starting in 1993, InterNIC managed directory and database services
- Late 1990s – ICANN
- IPv6 created to meet growing demand for Internet addresses
How to Connect to the Internet

- Internet service provider (ISP)
- ISPs connect to each other through Network access points (NAPs)
  - Determine how traffic is routed
  - Key component of the Internet backbone
  - Hierarchical structure
Home Internet Connectivity

- Dial-Up
  - Uses telephone lines
  - Plain old telephone service (POTS)
  - Public switched telephone network (PSTN)
  - 52 Kbps (52,000 bits per second)
ISDN

- **Integrated Services Digital Network** (ISDN)
  - Standard for worldwide digital communication
  - Designed in 1980s to replace analog systems
  - Uses existing twisted pair telephone wires
- Transmits voice, video, and data
- Computers can connect without a modem
- "ISDN modem"
- Popular in some parts of the world (e.g., Germany)
- Mostly replaced by DSL and cable modems
DSL

• Popular “last mile” solution
  o Connection from home to switching station

• Two main types
  o Asymmetric digital subscriber line (ADSL)
    • 1.5 – 9 Mbps downstream, 16 – 40 Kbps upstream
    • Mostly in North America
  o Symmetric digital subscriber line (SDSL)
    • Up to 3 Mbps both ways – symmetric
    • Mostly in Europe

• Uses high-frequency area of telephone wires
• Special modem-like device
Cable Modems

- Provided by cable TV service providers
- Special cable modem
  - Data transmitted over cable TV lines
- Coaxial cable used
  - Greater bandwidth than phone lines
- Fast, popular method
  - Speeds up to 30 Mbps
Satellite Connections

- Internet over satellite (IoS)
- Satellites in fixed positions - Geostationary (geosynchronous) orbit
- PC connected to satellite dish
- Excellent for remote locations
- Slower than high-speed terrestrial connections
Broadband Wireless

- Increasingly popular
- Speeds comparable to DSL and cable modem
- Mostly found in rural areas
- Line of sight necessary
- Distance from antenna up to 50 km
Mobile Wireless Access

• Cellular network
  - Internet-enabled cellular phones
  - Network adapter cards
    - Laptops, tablets, PDAs connect to cellular networks
  - User can move within cellular coverage area

• WLAN
  - Ethernet network adapter card
  - User can move within range of WLAN
Fiber to the Home (FTTH)

- A.k.a. Fiber to the premises (FTTP)
- Very high bandwidth
- Fiber optic cabling running directly into homes
Business Internet Connectivity

• Increased needs for bandwidth
• High-speed options
  o T1 Lines
  o Asynchronous transfer mode (ATM)
T1 Lines

- Dedicated line for digital transmission
- Developed by AT&T – 1.544 Mbps
- Interexchange carriers (IXC)
- As low as $400 a month
- Faster option: T3 line
  - 45 Mbps
Capacity of Telecommunication Lines

- **OC – Optical Carrier**
  - Synchronous optical network standard (SONET)

<table>
<thead>
<tr>
<th>Type of Line</th>
<th>Data Rate</th>
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</thead>
<tbody>
<tr>
<td>T1</td>
<td>1.544 Mbps</td>
</tr>
<tr>
<td>T3</td>
<td>44.736 Mbps</td>
</tr>
<tr>
<td>OC-1</td>
<td>51.85 Mbps</td>
</tr>
<tr>
<td>OC-3</td>
<td>155.52 Mbps</td>
</tr>
<tr>
<td>OC-12</td>
<td>622.08 Mbps</td>
</tr>
<tr>
<td>OC-24</td>
<td>1.244 Gbps</td>
</tr>
<tr>
<td>OC-48</td>
<td>2.488 Gbps</td>
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</table>
Asynchronous Transfer Mode (ATM)

- Transmission of voice, video and data
- Up to 2.2 Gbps
- Used for LANs and WANs
- Integration of disparate networks
- Packet-switched transmission
  - Fixed length cells (53 bytes)
- Potential to use without routers
The Future of Connectivity

- New innovations
  - Broadband over power lines
    - Use of power distribution wires
    - Current rates: 1 Mbps
    - Availability of infrastructure
  - WiMax
    - “Last mile” wireless
    - High-speed stationary wireless
    - Does not require line-of-sight
    - Currently expensive
Current State of Internet Usage

• The most prominent global network
• 1 billion people
  o 15% of world’s population have access at home
  o 183% increase since 2000
  o Asia – most users
  o North America - largest percentage of population are users (68.6%)
  o Africa – smallest percentage (2.6%)
    • Rapid growth – 423%
Internet Growth

Growth in Internet hosts (Internet servers)
Learning Objectives

1. Describe the Internet and how it works.
2. Describe the basic Internet services and the use of the World Wide Web.
## Popular Internet Uses and Tools

<table>
<thead>
<tr>
<th>Internet Use</th>
<th>Description</th>
<th>Popular Free Applications</th>
</tr>
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<tbody>
<tr>
<td>E-mail</td>
<td>Enables users to send and receive messages</td>
<td>Apple Mail, Mozilla</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thunderbird, Outlook Express</td>
</tr>
<tr>
<td>File sharing</td>
<td>Making files available for users to download; files can be provided by a server or peer to peer (P2P) based.</td>
<td>Bittorrent, FreeNET, WSFTP</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>Uses a client application to have real-time messaging</td>
<td>AIM, GTalk, Jabber, Windows Live Messenger, Yahoo! Messenger</td>
</tr>
<tr>
<td>Search engine</td>
<td>Uses Internet applications to provide a list of documents stored on other computers connected to the Web</td>
<td>Google, Windows Live, Yahoo!, Dogpile</td>
</tr>
<tr>
<td>Web browsing</td>
<td>View documents (usually Web pages) on computers connected to the Web</td>
<td>Opera, Internet Explorer, Firefox</td>
</tr>
<tr>
<td>Voice communication</td>
<td>Enables users to transmit and receive voice conversations</td>
<td>Skype, GTalk, Windows Live Messenger</td>
</tr>
</tbody>
</table>
World Wide Web

• World Wide Web (WWW)
  o Graphical user interface to the Internet
  o One of the most powerful uses of the Internet

• Web browser
  o Software application used to locate and display Web pages
    • Netscape Navigator, Internet Explorer, Firefox
History of the World Wide Web

• Gopher – early menu driven tool
• Web invented by Tim Berners-Lee in 1991
  o Introduced hypertext – web page
  o Hyperlinks – links to other related documents
  o HTML – standard method for specifying Web pages
    • Tags specify formatting
  o Web pages stored on Web servers
    • HTTP – used for processing requests
    • Web pages have unique URL address
Three Important “Web” Events

1. Invention of the Web
2. Information Infrastructure Act (1992)
   • Opened Web for commercial use
3. Mosaic – first Web browser
   • Addition of graphical front end to the Web
   • Enabled multimedia delivery
   • Predecessor of Netscape Navigator
World Wide Web Architecture

- Web uses
  - Web browser
  - Web server
  - TCP/IP

Diagram showing the architecture of the World Wide Web, including web servers, web pages, and internet users.
Web: Accessing Information

1. User enters URL into Web browser
2. TCP/IP breaks request into packets
3. Packets are sent over the Internet to the Web server
4. TCP/IP reassembles packets at destination
5. Request passed on to Web server
6. Web server retrieves the specified Web page
Web: Accessing Information

7. Web page is converted into packets by TCP/IP
8. Page packets are sent over the Internet to the Web browser
9. TCP/IP reassembles the packets and delivers Web page to Web browser
10. Web browser translates HTML and displays the Web page