The Internet and Network Technologies

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“Inside” vs. “Outside”

Inside the Box
What the computer owner actually has possession of

- Computer’s hard drive and other memory
  - Documents
  - Pictures
  - Outlook Emails
  - Internet Cache
- CD’s and floppy disks
- iPods
- Cell Phones
- External Hard Drives
Inside the Box
What the computer owner actually has possession of

Outside the Box
What is not stored on the owner’s computer
- Online Email Accounts (Gmail and Yahoo)
- Internet Shopping Accounts
- Social Networking Accounts
- Backups of text messages
- Cell Site Location Data
- Using Pen/Trap for Internet “DRAS” information
- Subscriber account records
- Contents of Websites
Networks may take two basic forms:

- Wired – each computer connects to a router with a cable
  - Speeds of 100 Mbps
- Wireless – computers connect through a signal that is broadcasted by a router
  - Home wireless networks allow sharing of a connection as far as 750 feet
  - Unauthorized access is much easier
  - Speeds up to 54 Mbps
What is the Internet?

- A network of computers?
- A network of networks?
  - It is a network of millions of networks
- World Wide Web
  - Plus lots more. WWW is the most obvious part of the Internet, but it isn't all of it
- Each computer on the Internet uses TCP/IP to communicate

The Internet

- World Wide Web (the Web)
- E-mail
- Instant messaging (IM)
- Webcam / Internet Telephone (VoIP)
- Peer-to-peer (P2P) networks
- Legacy Systems
  - USENET Newsgroups
  - Telnet and File transfer (FTP) sites
  - Internet Relay Chat (IRC)
  - Bulletin boards
What Kinds of Computers Can Be on the Internet?

Mainframes  Laptops  Vehicles  Cell Phones
↑ Personal computers

Internet Connectivity

Home PCs  Internet Service Provider (ISP)
  Telephone  DSL line  Cable modem connection
  Network  Network

Internet Connections

At one time, dial-up was the predominant way to connect to the Internet. Today, dial-up has been replaced so the user is constantly connected and receives higher speeds
- Dial-up – 56 Kbps
- DSL – 245 Kbps to 20 Mbps
- T-3 – 44 Mbps
- 3G – 200 Kbps; 4G – 6.4 Mbps
**Internet Connections**

- Many businesses utilize the same connection types as home users, but often subscribe to a higher connection speed.
- Larger businesses use a T1 or T3 connection
  - Requires direct fiber optic connection
  - May cost more than $10,000 per month
- Even faster networks are available
  - Cost can exceed $5 million per month

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**What is TCP/IP?**

- A set of rules governing the communication of computers online
- TCP (Transmission Control Protocol)
  - Converts data into packets and reassembles them into files for the user to read
- IP (Internet Protocol)
  - Handles addressing so that information is sent to the correct computer

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**IP Addressing**

- Each device on the Internet has a unique IP address, such as this one: 317.23.90.134
- Computers, servers, and even printers have an IP address
- Addresses are usually temporary
  - “Dynamic”
  - In some cases, “static” addresses are assigned more or less permanently
IP Addressing

If a network utilizes a router, there are two IP addresses involved:
- **Internal**: each computer has an internal IP address that distinguishes the computers on the network.
- **External**: the unique IP address assigned to the router by the ISP.

Data is received at the external IP address by the router, and then the router sends the information to the correct internally-addressed computer.

### IP Addressing

<table>
<thead>
<tr>
<th>Computer 1</th>
<th>Internal: 172.168.1.1</th>
<th>External: 190.56.892.002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer 2</td>
<td>Internal: 172.168.1.2</td>
<td>External: 190.56.892.002</td>
</tr>
<tr>
<td>Computer 3</td>
<td>Internal: 172.168.1.3</td>
<td>External: 190.56.892.002</td>
</tr>
<tr>
<td>Router</td>
<td>Internal: 172.168.1.4</td>
<td>External: 190.56.892.002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coffee Shop</th>
<th>Internal: 172.168.1.102</th>
<th>External: 235.71.90.123</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Office</td>
<td>Internal: 172.168.1.195</td>
<td>External: 190.56.892.002</td>
</tr>
<tr>
<td>Home</td>
<td>External: 753.23.234.901</td>
<td></td>
</tr>
</tbody>
</table>
Note

MAC vs. IP

- While an IP address is assigned by a network, each computer also has a unique MAC address which is assigned by the computer’s manufacturer
  - IP = software
  - MAC = hardware
- Example:
  - 70-F3-95-38-1F-06

Why Addressing Matters

- The Internet is a packet-switched network
- The component parts of a communication (i.e., the packets) sent to another host may travel by different paths
- Each packet makes one or more “hops” along the network on the way to its destination

TCP – Packet Switching

Sending File from Computer A to Computer B
TCP – Packet Switching

File is broken into smaller pieces called “packets”

TCP – Packet Switching

The packets are labeled with addressing information

TCP – Packet Switching

The packets are not sent through the same path. There are billions of paths they may take.
When the packets arrive, they must be put back together.

TCP – Packet Switching

The Path

Domains & URLs

Domain names are used to help a browser locate a website. For example:

http://www.ncjrl.org
Domain names provide information about the corresponding computer:
- .com, .gov, .edu, .net, .mil are *generic* top-level domains for types of organizations
- .xxx added in 2011
- New TLDs like .hotel expected in the near future
- Other top-level domains are geography-based (e.g., .de for Germany, .fr for France, etc.)

Domain names often serve as an alias for an IP address. For some websites, the IP address is interchangeable with the domain name.
- For example, you can visit Google by entering either:
  - http://www.google.com
  - http://74.125.159.99/

Immense amount of digital data created, transmitted, stored
- Some created by humans
- A lot necessarily created by machines “in the background”
Digital Evidence

- **User-created**
  - Text (documents, e-mail, chats, IM’s)
  - Address books
  - Bookmarks
  - Databases
  - Images (photos, drawings, diagrams)
  - Video and sound files
  - Web pages
  - Service provider account subscriber records

- **Computer/Network-created**
  - Email headers
  - Metadata
  - Activity logs
  - Browser cache, history, cookies
  - Backup and registry files
  - Configuration files
  - Printer spool files
  - Swap files and other “transient” data
  - Surveillance tapes, recordings

Web Browsers

- A browser is a computer application that retrieves and displays content from the web
- This content may include web pages, videos, pictures, and more
- Popular browsers include Firefox, Internet Explorer, Chrome, and Safari
Browser Functions

Web browsers also collect a variety of information about a user’s online actions and save this information on the computer:
- History
- Cache / Temporary Internet Files
- Cookies

Browser Functions

History
- Records each page visited within the browser
- Tags each visit with a time and date

Browser Functions

Internet History
Cache (Temporary Internet Files)

- Stores data so that future requests for the same website can be served faster
- Cache is most obvious when you click the "back" button. The webpage appears almost immediately because the content is retrieved from your computer, not the server
- Cache may remain on a computer for weeks at a time – or longer

Browser Functions

Cache (continued)

- Usually consists only of images and text
- May allow viewing of an entire website even if the computer is not connected to the Internet

Browser Functions

Temporary Internet Files Folder

<table>
<thead>
<tr>
<th>Filename</th>
<th>Size</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>00095001</td>
<td>132B</td>
<td>11/11/2010 12:00 AM</td>
</tr>
<tr>
<td>00095002</td>
<td>145B</td>
<td>11/11/2010 12:00 PM</td>
</tr>
<tr>
<td>00095003</td>
<td>150B</td>
<td>11/11/2010 12:30 PM</td>
</tr>
<tr>
<td>00095004</td>
<td>155B</td>
<td>11/11/2010 13:00 PM</td>
</tr>
<tr>
<td>00095005</td>
<td>160B</td>
<td>11/11/2010 13:30 PM</td>
</tr>
</tbody>
</table>
The Internet:
It’s more than just email
“Web 2.0”

- Interactive Internet communities
- Social networks
- Blogs
- "Wikis"
- Video or photo sharing sites
- Online role-playing games
- Virtual worlds

Virtual Worlds

- User chooses name, job, body type, lifestyle, personality
- Exchange of USD for Second Life currency
- Money is used to buy clothing, cars, and buildings, and to pay for services

Avatars in Second Life
Some Social Networking features:
- Posting Messages (public or private)
- Personal Profile
- Picture Sharing
- Interactive Games
- Instant Messaging
- “Classified” Advertising
Social Networking

Consider

“Cloud Computing” (“Web 3.0”?)
“Cloud Computing”
- Basically, obtaining computing resources from someplace outside your own four walls
  - Processing
  - Storage
  - Messaging
  - Databases
  - etc.
- Entrusting data to third-party providers

The “Cloud”
- Everything we currently do.
  - Email
  - Online Storage
  - Social Networking
  - Peer-Peer File Sharing
  - Chat and IM
  - Virtual worlds and online games

What Is a Web App?
- A program similar to those on your computer, but different because it does not need to be installed
- Accessed entirely online
  - No need to update
  - Less chance of getting viruses and spyware from installing them
  - Works on any computer with a browser – Macs, PCs, cell phones
Peer-to-Peer Networking

Peer-to-Peer Networking is used to download files from the Internet including:
- Music
- Movies
- Books & Magazines
- Documents
- Pornography

While not always illegal, it often is.

Client-Server vs. Peer-to-Peer

Step 1: User downloads the software
Peer-to-Peer Networking

Step 2: User searches for the movie and downloads a torrent file

Peer-to-Peer Networking

Step 3: User begins to download the file

Peer-to-Peer Networking

Step 4: User is able to play the movie and his computer often continues to share it with other users on BitTorrent
Peer-to-Peer Networking

Considerations
- By default, BitTorrent and other P2P programs share downloaded files
- Broadband use turned home computers into distributed super-networks for sharing files
- Design of networks fault tolerant and load balancing

Considerations
- Users on Internet voluntarily
- Users can decide, through settings in the software, how much or how little of their computers will be open to viewing by others on the Internet
Considerations

- Every download is exact duplicate of the original image
- Internet Protocol (IP) Address of individual user can be ascertained (identifying unique computer)
- Successful tracking of IP address reveals computer that had the file available for distribution

Cellular Phones

- SMS (short message service)
- MMS (multimedia message service)
- Phone Calls
- Cameras
- File Storage
- Internet Access
Cellular Phones

SMS (short message service)

- 160 characters or less
- Sent from cell phone to cell phone by way of towers and servers
- If recipient phone is off, a message will be saved until the phone is turned on

Cellular Phones

Sender types message and sends it

The message travels through the nearest cell towers

The phone company directs the message to the recipient through its servers

The message travels through the nearest cell towers to the recipient

The recipient receives the message
Sample Tower/Sector

Questions?

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