

# Comp 100

## Lecture Notes

### Chapter 7

#### Computer Networks

- Multiple computers, i.e., two or more, connected via hardware & software in such a way as to allow communications between the various computers, e.g., “nodes”
- Nodes
  - Computer
  - Peripheral
  - Game Console
  - Modem
  - Digital Video Recorder
  - Etc.
- Home Network (usually P2P, see below)
  - Computers
  - Printers
  - Data Storage Device common to all systems (see ■ below)
  - Internet Connection, i.e., Router
- Network Administration
  - Installing new devices
  - Monitoring network – ensure efficient performance
  - Updating & installing new network software
  - Configuring proper network security
- Network Architectures
  - Network Administration Classification
    - P2P (peer-to-peer network)
      - ★ each node administered locally
      - ★ less than 10 nodes
      - ★ possibly with a Home Network Data Server, i.e.,
        - Acer Aspire easyStore server
        - with Windows Home Server
        - ✓ Data storage across a P2P network
        - ✓ Backup facility for computers attached to server
        - ✓ Ability to share data
    - Client-Server Networks
      - ★ Server manages the network
        - ✓ Provides Information
        - ✓ Provides Resources
      - ★ Client requests information and/or resources
  - Network Span Classification
    - HAN – home area network
    - LAN – local area network – labs in ecs.csun, schools in csun.edu
    - MAN – metropolitan area network – Minneapolis, Minnesota
    - WAN – wide area network – connection of LAN’s via satellite
      - ★ UMinn at Minneapolis ↔ UMinn at StPaul ↔ UMinn at Duluth

- **Components**

- **Transmission Media – communications channel**

- ★ **Wireless networks – radio waves**
- ★ **Wired networks**
  - ✓ **Twisted-pair cable**
  - ✓ **Coaxial cable**
  - ✓ **Fiber-optic cable**

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**BANDWIDTH – data transfer rate**

**maximum data transmission speed between two nodes**

**THROUGH -- actual achievable data transmission speed**

**THROUGH  $\leq$  BANDWIDTH**

**Mbps – megabit/second, i.e., one million bits per second**

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- **Network Adapters**

- ★ **NIC (network adapter card)**
  - ✓ **Wireless – increased mobility**
  - ✓ **Wired – increased & more reliable transmission speed**

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**Magnetic & electrical interference**

**Interference from other wireless signals**

**Interference from certain building materials**

**Interference from other household appliances**

**Throughput variance caused by distance to router**

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- **Network Navigation Devices**

- ★ **Data Packets – bundle of transmitted data**
- ★ **Routers**
  - ✓ **receive packets from nodes on a network**
  - ✓ **send packets to a node on a different network**
- ★ **Switches**
  - ✓ **receive packets from nodes on network**
  - ✓ **send packets to other nodes on the same network**

- **Network Software**

- ★ **O/S support for P2P Networks**
  - ✓ **Windows**
  - ✓ **OS/X**
  - ✓ **Linux**
- ★ **O/S support for Client-Server Networks, i.e.,**  
**NOS – Network Operating System**
  - ✓ **Windows Server**
  - ✓ **SUSE Linux Enterprise Server**

**Sound Byte: Installing a Home Computer Network**

## Internet Connections

- **Internet Service Providers (IPS)**
  - **Broadband ( dedicated, high-speed data lines, i.e.,  $\geq 5$  Mbps )**
    - Digital Subscriber Line (DSL) dedicated telephone lines
    - Cable (coaxial cable)
    - Fiber-Optic (speed of light)
    - Satellite
  - **Dial-Up ( conventional telephone lines, i.e.,  $\leq 56$  Kbps )**
    - Only available service
    - Inexpensive
- **Wireless**
  - **WiFi**
    - Hotspots – “free”
    - Subscription plans
  - **WiMAX**
  - **Gogo – in-flight access (altitude 35,000 feet)**
  - **3G/4G access**
    - Cell phones
    - Tablets
    - Notebook computers
    - Wireless data card & service plan – laptop computers
- **Comparison Table Figure 7.11, page 315**

## Home Networks

- **Ethernet Home Networks**
  - **Ethernet Communication Protocol (node – node)**
  - **IEEE 802.11 wireless standard**
    - IEEE 802.11a, IEEE 802.11b, IEEE 802.11g,
    - IEEE 802.11n(WiFi)
      - ★ Multiple Input Multiple Output
      - ★ multiple data streams – multiple antennas
      - ★ 300 Mbps
    - backward compatibility
  - **IEEE 802.3 wired standard**
    - Gigabit Ethernet Standard 1 Gbps, i.e., 1,000 Mbps
    - 10 Gigabit Ethernet Standard
- **Ethernet Home Network Cabling**
  - **UTP, i.e., unshielded twisted-pair cable with RJ-45 connectors**
    - CAT-5E cable 100 Mbps
    - CAT-6 cable 1 Gbps
    - CAT-6a cable 10 Gbps

[http://en.wikipedia.org/wiki/Category\\_6\\_cable](http://en.wikipedia.org/wiki/Category_6_cable)
- **Future Standards**
  - **WiGig & WirelessHD**
    - 7 Gbps  $\leq$  Throughput  $\leq$  25 Gbps
    - 60 Ghz band

## Configuring Home Network Equipment

- Internet Cable ↔ Modem ↔ Router-Switch w/wireless & wired capabilities
- Wireless support – 253 devices – traffic limitations
- Wired support – 4 Ethernet ports
- Apple Airport Router – 50 wireless connections, 3 Ethernet wired ports (gigabit)

Router provides

- an external IP Address ↔ Internet
- and several internal IP Addresses to local devices, e.g., computers, printers

which creates a **physical firewall** to the outside world.

The router security must be modified to allow particular trusted external sites to access the system.

The internal IP Addresses may be permanently assigned to each device or may be assigned dynamically each time a device attaches to the Internet.

Each router has its own login name and password protection.

### Wireless Security

- 802.11n Networks broadcast over a large area; ease dropping from a remote location is viable.
- Piggybacking – connecting to a wireless network without the owner's consent
- Stealing personal information
- Using a piggybacked system to launch a cyberattack on a third party
- Using a piggybacked system to mask cybercrime against a third party

### Wireless Data Transmission

- Packets of information broadcast via airwaves
- Interception of packets and extraction of information

### Security Measures

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- Change the Wireless Network Name, i.e., SSID – Service Set Identifier
- Disable SSID broadcast, if possible, which makes it difficult for a
  - hacker to locate your network
  - neighbor to inadvertently connect to your network
- Change the default password on your router
- Turn on the security protocols
  - WEP – Wired Equivalent Privacy – encryption
  - WPA – WiFi Protected Access – strongest encryption
  - Security Encryption Key – passphrase
    - required for first connection to the network
    - encryption--decryption code

(continued below)

- **MAC Addresses** [http://en.wikipedia.org/wiki/MAC\\_address](http://en.wikipedia.org/wiki/MAC_address)
  - Network Adapter has unique “serial number” assigned by the manufacturer
  - Routers allow you to restrict access to certain MAC numbers
  - Controls access to specified authorized devices
- **Limit the Signal Range**
  - Possible to limit range to high, medium, or low
  - Limit to low or perhaps medium reduces the probability of signal poaching
- **Periodically Apply Firmware Upgrades**
  - ROM memory, i.e., firmware -- router software storage
  - Manufacturers issue patches to eliminate known bugs in the software
  - Periodically apply the upgrades to the router firmware

### **Network Adapters**

- Windows – Device Manager
- Other Devices – check the network adapter card

### **Network-Ready Devices**

- network adapter cards inside
- connect directly to the router
  - printers
  - game consoles
  - blu-ray players
  - television sets
  - home-security systems

### **NAS Devices, i.e., Network-Attached Storage Devices**

- **LinkStation Series from Buffalo Technologies**
  - Connects to network via switch/router
  - Special software installed on all computers to facilitate data backup
- **Time Capsule from Apple**
  - Wireless router with disk drive
  - facilitates backup of all computers on the network
  - replaces AirPort router
  - Macs connected to the network will ask the user if they want to use the Time Capsule as their source for the Time machine backups
- **Home Network Server**
  - Perform a limited set of functions
  - Acer Aspire easyStore server
    - configured with Windows Home Server
    - connected as a node in the network
  - automatically backup all computers connected to the network
  - serve as a repository for all files to be shared across the network
  - function as an access gateway to allow any computer on the network to be accessed from a remote location via the internet

## **Digital Entertainment Devices**

- **streaming data (e.g., Netflix, HBO GO, Amazon Instant Video)**
  - delivered directly to a using device
  - requires sufficient bandwidth, i.e., broadband connection
  - devices
    - network-ready television
    - home theater systems
    - smart phones
    - tablets
    - Blu-ray Disc players
  
- **downloading data**
  - saved on a hard drive, Blu-ray player, HDTV, DVR, Xbox 360
  - data is available for repeated use at a later time
  
- **portable device apps – remote control**
  - Sony Media Remote app for iPhone, iPod Touch, or iPad enables the device to control Sony Blu-ray players & Sony TVs
  - Apple Remote app for iPhone or iPad enables the device to control iTunes, Apple TV over WiFi network
  
- **Digital Video Recorders (DVRs)**
  - TiVo Premiere – connect to network
  
- **Gaming Devices**
  - PlayStation 3 (PS3) – total entertainment platform
    - contains Blu-ray drive
    - play Blu-ray Discs
    - play DVDs
    - play music
    - download movies, games, videos directly to PS3
    - import photos & videos from cameras & phones
    - share media across network
  - PS Vita [http://en.wikipedia.org/wiki/PlayStation\\_Vita](http://en.wikipedia.org/wiki/PlayStation_Vita)
    - can remotely access PS 3

- **Specialized Devices, i.e., Internet Appliances**
  - **Tablets, e.g., iPads**
  - **Sony Dash Personal Internet Viewer**
    - **Internet radio & videos**
    - **Facebook**
    - **Weather reports**
  - **Digital Picture Frames**
    - **Kodak Pulse Digital Frame**
    - **Internet address to frame**
  - **Digital Home Security**
    - **Logitech Alert System – monitor wireless cameras**
    - **View real-time images on smart phones and tablets**
    - **Motion detection can trigger e-mail or text message notifications**
    - **Lack of motion can also trigger e-mail or text message notifications**

### **Configuring Home Network Software**

- **Windows 7 on all computer systems in the network**
  - **Make sure that**
    - **each node has an appropriate network adapter**
    - **each computer has a name unique to the network**
    - **all cable connections have been made**
    - **the broadband modem is connected to both the router & internet**
    - **turn on the equipment in the following order**
      - ✓ **broadband modem**
      - ✓ **router**
      - ✓ **computers & peripherals**
    - **other devices can be added later**
  - **Open the Network & Sharing Center**  
(Control Panel >> Network & Internet Group >> Network & Sharing Center)
  - **Wired Network**
    - **automatically connected to network**
    - **network name == router's SSID name**
  - **Wireless Network**
    - **Connect to a Network**
    - **Enter security passphrase to connect to the network**
- **Windows of various versions on the computer systems in the network**
  - **1<sup>st</sup> : set up the computers running the latest version of windows**
  - **2<sup>nd</sup>: consult Microsoft website for info wrt configuring the remaining systems**

- **Windows 7 HomeGroup Feature**
  - **Connect first Windows 7 computer to the network**
  - **Click on Ready To Create Link**
  - **Once the HomeGroup is created, the originating computer is a member of that group**
  - **Choose sharing options for computers in the HomeGroup**
    - **Pictures, videos, documents, printers, etc.**
  - **Individual computers may change their sharing options with the HomeGroup**
  - **Windows 7 generates a password for all subsequent computers that want to join the HomeGroup**
  - **Connect all subsequent computers to the HomeGroup; modify the sharing options of each individual computer as desired**
  
- **Wireless Networks for Macs**
  - **Setup the router security for the network**
    - **wireless network security is independent of the type of nodes**
    - **obtain the SSID & passphrase**
  - **Startup the Mac, i.e., boot the Mac**
  - **Wireless network card should display a login screen of available networks, i.e., networks that the NIC card can detect**
  - **Closed Padlock symbol indicates a secure network – password required**
    - **Enter password, click JOIN button**
  - **Open Padlock symbol or no symbol indicates an open network**
    - **Click JOIN button**
  - **Networks that the NIC card cannot detect**
    - **Out of range; possibly intentionally set to short range**
    - **SSID broadcast intentionally turned off**
      - ✓ **Click the OTHER button**
      - ✓ **Enter SSID Name and passphrase in the appropriate boxes**
      - ✓ **Click the Remember Network box to create preferred network**
      - ✓ **System can support multiple preferred networks**
  
- **Wireless Node Configuration & Testing**
  - **TiVo, Gaming Devices, etc.**
    - **each device will have its own setup menu and configuration sequence**
    - **SSID Name & passphrase**
  - **Internet Connection Speed**
    - **Test Sites for Establishing Download & Upload File Speeds**
      - ✓ [www.speedtest.net](http://www.speedtest.net)
      - ✓ [www.broadband.gov](http://www.broadband.gov)
  
- **Troubleshooting Network Problems**
  - **Maximum Range 802.11n Standard ≈ 350 feet**
  - **Walls, Floors, Heavy Metal Objects**
  - **Wireless Range Extender**



- **Cloud Storage**
  - **Dropbox – 2GB-8GB free**
    - Windows
    - OS/X
    - Linux
    - Blackberrys
    - Android phones
    - iPhones
    - iPads
  
  - **Multimedia – 100GB yearly fee (single users)**
    - Apple iCloud
    - Amazon Cloud Drive
  
  - **Large Media Collections (shared media usage)**
    - **MediaFire – unlimited free**
      - ✓ post links directly on Facebook &/or Twitter
      - ✓ uploads limited to files  $\leq$  200MB
      - ✓ uploads limited to files  $\leq$  10GB for a fee
    - **ADrive – 50GB free**
    - **Not designed for streaming media; download required before use**
    - **Free Accounts may delete files after an interval of non-usage**
    - **Backup Policies – Investigate Carefully!!**