Component 4: Introduction to Information and Computer Science

Unit 7: Networks & Networking
Lecture 4

Unit Objectives

- Understand the history of networks and their evolution.
- List and describe the various types of network communications.
- List and describe the various forms of network addressing, including DNS.
- List and define the different types of networks.
- Describe different network topologies.
- List and describe different network standards and protocols.
- Describe wireless communication.
- List and describe network hardware.
- Explain networking logical model concepts.

Wireless Communications

- Wireless devices communicate without cabling.
- Signals sent via:
  - Infrared light – laptop to laptop
  - Microwave – requires clear line of sight
  - Radio frequency - most common method
- Governed by IEEE 802.11 standard.
- Seems to be available everywhere!

Wireless – The Good, The Bad, & The Ugly

- Good:
  - No cables needed to connect devices to network.
  - Cleaner work environment without cables.
  - Devices can be easily moved about.
  - Easy for users to connect.
- Bad:
  - Can be slower than wired networks.
  - Limited signal range.
- Ugly:
  - Security issues.

How Does Wireless Function

- Home wireless communication is done by radio frequency.
  - Radio frequencies are mapped to channel numbers.
  - In North America, channels are 1-13 for 802.11 a/b/g
- Need the following for typical home setup:
  - Computers need wireless NICs
    – Facilitates connection to a wireless router.
  - Network needs a wireless router
    – Also known as a wireless access point (WAP).
  - Wireless router needs to connect to a wired device
    – To get Internet access, wireless router needs wired connection to the ISP device (cable modem router).

Wireless Network Setup

- WAP:
  - SSID – name for wireless network.
  - Change WAP default password since globally known.
  - IP address and subnet mask.
  - Configure WPA2 and record the code/phrase created.
  - Cable WAP so it somehow connects to ISP device.
- Each wireless client:
  - SSID configured same as WAP.
  - IP address and subnet mask in same range as WAP.
  - Configure WPA2 using code/phrase from WAP.

Wireless Network Setup (cont'd)

- Standards are backwards compatible
  - 802.11g NICs work in 802.11 a/b device-controlled WLANs.
- Wireless RF channels
  - WAPs and clients must use same channel.
  - Different channels cannot communicate.
  - Channel numbers correspond to an RF range.
  - Channels 1, 6, and 11 RF do not overlap. Use one of these!
    - Channel 5 uses the RF range of 2.421–2.443 GHz.
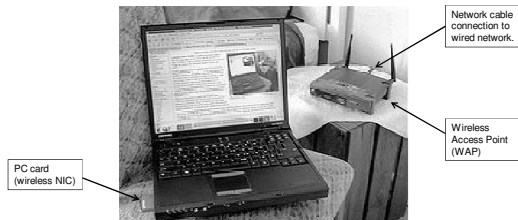   - Channel 6 uses the RF range of 2.426–2.448 GHz.

Wireless Components Example

- The notebook is connected to the wireless access point using a PC card.

Network cable connection to wired network.

Wireless Access Point (WAP)

PC card (wireless NIC)

Network Hardware

- Common components are:
  - Networked devices
  - NIC (wired and wireless)
  - Switch
  - Router
  - ISP device
  - Server
  - Surge protector
  - Uninterruptable Power System (UPS)

Network Hardware - Networked devices

- Computers / Laptops with:
  - Network-enabled operating system (OS).
  - NIC to connect to switch/router.
  - Cabling for wired network.

Network Hardware - NICs

- Required for network communication
  - Hardware uses OS services to communicate on network.
- Wired – requires cabling, jacks, switch/router.
- Wireless – requires WAP and some wired device to communicate with wired devices.

Vintage 10 Mbps Ethernet NIC for wired network.

54 Mbps Wireless LAN PCI Card (802.11g).

Network Hardware – Switch

- Very important network component.
- Devices plug into switch to communicate with each other.
- Switch plugs into ISP device to provide Internet access.

Image shows a 5-port Atlantis Ethernet switch.

If this switch connects to an ISP device, with five ports it could also accommodate a printer and three other devices.

One of the devices could be a WAP, which would allow wired and wireless clients to communicate with each other.

Network Hardware - Router

- Network boundary defined by IP address and subnet mask numbers.
- Router connects different IP networks so they can communicate with each other.
- Routers can be wired or wireless.
- ISP devices are routers.

Image shows a Cisco Linksys WRT54GL wireless router typically found in a SOHO (small office, home office) network.

The blue Ethernet cable extending out of its rear, to the right, connects this device to the wired network.
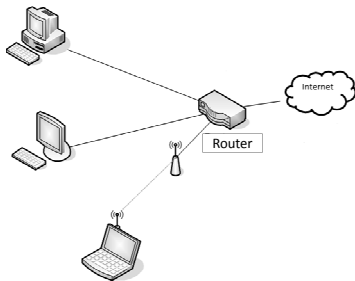
Routed Network Example

Internet

Router

Network Hardware – ISP Device

- Connects SOHO and Office networks to Internet.
- Can lease from ISP with Internet service.
  - Sometimes available for purchase too.
- Usually has one Internet port to connect to a wall port.
- Usually has one switch port to connect one device using Ethernet cable.
  - Can use that port to connect to a switch, which can connect to other devices or other switches to extend network.
  - All devices then share the one Internet connection.

ISP Device Examples
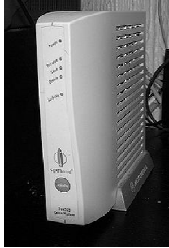
Network Hardware - Server

- Computer with specialized OS installed.
  - Windows Server 2008
  - Ubuntu Server
  - Novell Open Enterprise Server
- Creates 'gated community' of devices and users.
  - Server maintains database of objects, restricts access to authorized devices/users, and manages them.
- Can provide various functions:

✓ Domain controller	✓ DHCP server	✓ Certificate server
✓ Print server	✓ DNS server	
	✓ File server	✓ NAP server

Network Hardware – Surge Protector

- Protects devices from spikes in power usually originating with the power company.
  - Some power strips are also surge protectors – need to carefully read product information to differentiate.
- Devices need to be plugged in to gain protection.
- Power surge can destroy a devices circuitry.
- Protection measured in Joules.
  - Joules define how much electricity the surge protector can absorb without failure.
  - Should consult electrician to protect hardware.
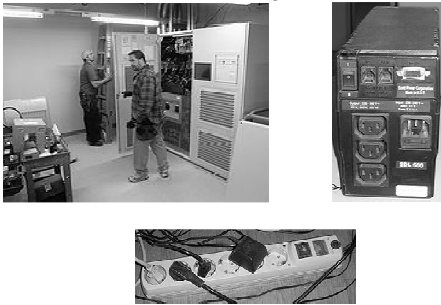
Network Hardware - UPS

- Uninterruptible power supply (UPS) provides emergency power to attached devices when power fails.
- Short battery power time (5-30 min.) depending on attached devices.
  - Computer and monitor – portable unit okay.
  - Whole building – need large (site) solution.
- Never plug laser printer into UPS.
  - Due to power requirements, will instantly drain available UPS battery power.

Surge Protector & UPS Examples