Lecture 5: Internet, Continued

Pset 4

Shopping for "computer stuff"

More about the Internet

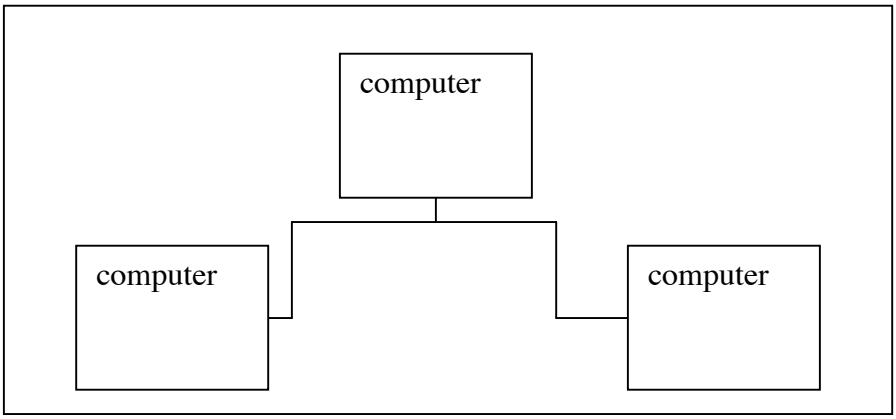
Last week was more about the application layer; tonight we take the "hood" off the Internet

- Defining the Internet
  - A global interconnection of computers
  - The network of networks
  - The World Wide Web and the Internet are not the same thing
  - Inter Net
- What is a network?
  - 2 or more computers connected
- LAN vs WAN
  - LAN - Local Area Network
  - WAN - Network of LANs
  - Peer-to-peer network
  - File sharing/Napster/Grokster
- Networking
  - Printers
  - File Server
  - Sharing data with other computers
- Network Parts
  - Hub
  - Cabling

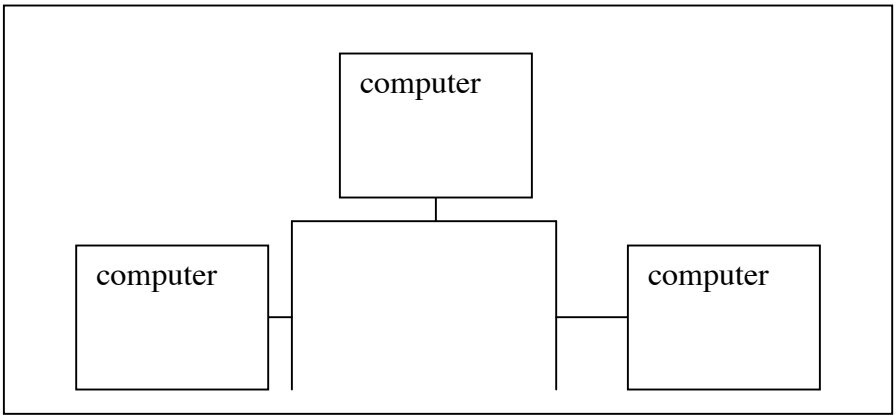
Bus network:

- String a wire that goes throughout a building
- Attach computers to that wire, and they are networked together.

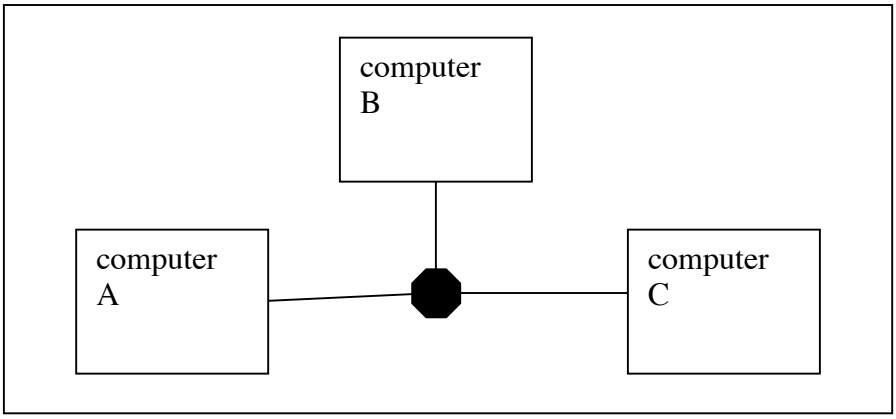
Bus network:



Ring network:



Star network:



- Star network is now the most common type of network because the center point is (usually) the only point of failure, and failure of one computer won't affect the others.
- Black Star in the center is called a 'hub'
    - Rebroadcasts data from one computer to the other computers
    - Dumb device. Rebroadcasts all data to all machines.
    - Security risk because if A sends data to B, hub rebroadcasts to all network traffic and C will receive it. (usually, an Operating System ignores data that is not meant for that computer.
- "Switches" are a smarter version of a hub.
    - It looks the same as a hub, but it has extra circuitry that allows it to rebroadcast data only to the appropriate computer.
    - Increases security and efficiency
    - How does a switch know which computer is which, if it is so simple that you only have to plug it in to work?
        - No configuration required on the part of the user

        - The first time a switch is active, it works as a hub. It blindly rebroadcasts data to every machine, and listens to see which computer responds.
        - The switch builds a table in RAM (yes, a switch has RAM!) in which it figures out which computer is plugged in to which port.
    - Router is another type.
        - They are not so much a "new" type as a combination of technologies:
        - Many modern routers include not only a switch but also an access point for wireless connections
        - Routes data from one computer to another, w/ or w/o wires
- An Ethernet card is known as a "NIC"
    - Network Interface Card
    - PCI-type or ISA-type Card (expansion card) Now-a-days, most motherboards have ethernet jacks built in so a NIC is not necessary
    - Also comes as a PCMCIA card (aka "PC Card") that slides into the side of a laptop.
- Wireless cards
    - For a laptop also come in PC Card
        - Slide it into the side of the computer
        - install drivers (software that allows computer to talk to the wireless card) and go!
        - Many modern computers have wireless built in, PC Card not necessary for them
    - Also available as a PCI card for desktops, but to make manufacturing cheaper, they use PC Card and it slides into an adapter that transforms the PC Card into a PCI expansion card.
- Cabling
    - Ethernet cables are used for networking/DSL/Internet/etc
    - Mega**bit**/second (Mbps) is how speed is measured.
        - bandwidth = how many bits can flow across a cable in a unit of time
        - 54 Mbps, max speed for wireless communication
        - 10/100 Mbps are common speeds for switches/hubs
    - Coaxial cable is an older type
        - Still in use in the home for TV
    - Ethernet cables (unshielded twisted pair) are far more popular these days
        - the connection looks like a wide phone jack
        - 4 connection in phone, 8 in UTP ethernet cable
        - unshielded so performance is affected next to strong magnetic fields
        - Only 4 of the 8 wires in Ethernet cables are being used, but the other 4 are meant for insulation against interference
        - two types:
            - straight-through ("patch"). The connections on the two ends match

                - cross-over. Crosses-over the wires, effectively changing the transmit wires to receive wires.
                - common mistake to buy the wrong kind of cable. To plug in to a hub/switch/patch, use a patch ("you want to patch into a router"). To connect two computers directly, use a cross-over.
            - Most are capable of 100 Mbps
            - Cables can go bad!
        - Fiber-optic cables.
            - Capable of 1000 Mbps
            - works fundamentally differently than a typical wire – data flows by transmission of light.
            - more expensive
- Cable modems
    - Typical cable modems often come 1.5-6 Mbps speeds
        - Neighbors often share bandwidth with each other, due to the way that the companies set it up
- DSL modems
    - Typical DSL modems come in 1.5Mbps (download) and 384 kbps (upload).
        - # of neighbors using DSL doesn't affect the speed of your connection (unlike cable)
    - use the phone line, but operate on a different frequency so it does not use preclude you from using your phone.
- Broadbandreports.com that lets you run network tests
    - Speed tests, use it a couple of times to average out your internet speed
    - Run troubleshooting tests.
- Windows command line
    - Start menu -> Run -> type "cmd" then return -> type "ipconfig" and return
    - Shows your IP address
- "Ping"
    - Very simple request to see if a computer is there
    - basically sends a "Hello?" to another machine and waits for a response
    - It can be a useful tool, but hackers will use it to find a machine for an attack
- How does all of this relate to the internet?
    - Every computer on a LAN has an Ethernet address, like a unique serial number for every Ethernet card.
    - Ethernet addresses are in hexadecimal (not decimal or binary)
    - Every computer on the internet has an IP Address (Internet Protocol Address). "ipconfig" command from before returns this
    - DHCP – Dynamic Host Configuration Protocol.
        - when connected, your computer asks the network for an IP
        - DHCP server responds with an IP address in the form #.#.#.# (where each # is 0-255)

- Routers decide what's the best route to submit data from one IP address to another.
    - Owned by big companies (AT&T)
    - Paths can change to use most available path
- TCP/IP
- DNS (Domain Name Server) translates a host name (Harvard.edu) to an IP address (140.247.x.y)
- Routers use IP addresses to figure out the best route to get data to its destination.
- traceroute is a program that traces the path that data takes from your computer to another computer over the internet. Run the command "tracert website.com" from the command line in Windows.
- You can type an IP address into your web browser instead of the appropriate host name and access the same web page.
    - Use "nslookup cnn.com" in Command line to find the IP address of CNN: 64.236.16.20
    - you can type http://64.236.16.20 and access the CNN website.
    - cnn.com points to several IP address for redundancy
- Bluetooth
    - wireless technology
    - used for wireless headsets with cell phones
    - transfer small data between computers or cell phone/computer
    - very small range and bandwidth
- Wi-Fi
    - wireless technology in which we most usually associate with wireless internet
    - longer range than Bluetooth, and up to 54Mbps (for 802.11g)