Topic 6: Networking

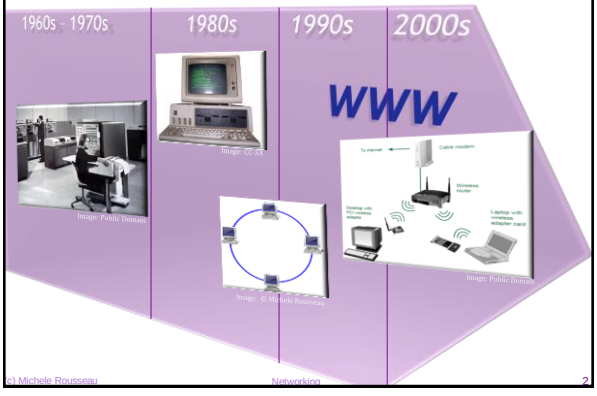
S1A

Topic 6: Networking

Computer Networks

- What are networks?
  - 2 or more computers that are linked together so that they can communicate with each other
- Why network computers?
  - To share resources
    - Software
    - Periphrials
    - Data
    - Etc..
- How are they connected?
  - Either through wires or cables
  - Wireless (radio waves, infrared signals, celluar signals)

History of Networking



Wires - Ethernet

- Developed in the 1970s at Xerox PARC
  - Was the standard by the 1980s
  - Originally used coaxial cable

- Then moved to twisted pair or 10-base-T (looks like a big telephone cable)

  - Included a protocol
    - Set of rules for transferring data
  - Most widespread wired Local Area Network(LAN) technology

Area Networks

- Different types of networks based on the geographic area it covers
- Local area networks (LANs)
  - A small group of computers (nodes)
    - Home network or small company

Wide Area Networks

- Wide area network (WANS)
  - Connects two or more LANs over a large geographical area
    - cities, states, the world
  - Small networks can communicate through each other using a gateways
- Gateway → manages communication with other LANs
  - One node on a LAN is designated as the gateway

The Internet is the worlds largest public WAN

Network Design Models

- Two basic types of high-level network design
  - Client-Server Model
    - Most commonly used in business
    - Started in the 1980s → when PCs became more prevalent
    - Different computers have different functions
    - Computers share resources
  - Peer-to-Peer Model
    - All computers tend to support the same function
    - More commonly used in home

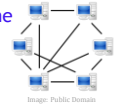
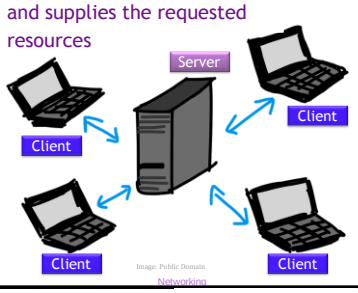


Image: Public Domain

Client-Server Model

- In this model
  - a client sends a request to the server for software, data, or a printer
  - the server processes the request and supplies the requested resources



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- Servers
  - computers attached to the network
  - manage specific resources on the network
- Network-servers
  - Manages network traffic
- File-servers
  - Primary purpose is to manage files on the network
  - Many users can access the same files
  - Eliminates the need for multiple versions of the same file
  - Dedicated to rapid storage and retrieval of shared data

Different types of servers (2)

- Print-servers
  - Manage one or more printers
  - Many users can access one printer
- Web Servers
  - Manage requests for web pages

Servers are often dedicated
→ they perform only their server specific tasks

Network Topologies

- The Topology represents the layout, structure or configuration of the network from the point of view of data flow.
  - How are things hooked up
- Many Different types of topologies – for example
  - Bus Topology
  - Star Topology
  - Ring Topology

Bus Topology

- Nodes (computers) communicate through a common conduit (line)
  - Uses a single communication backbone or all devices
- Messages are carried in both directions
- Each node checks the address on the message and retrieves it if it is necessary otherwise ignores it
- The Ethernet is a very commonly used topology that is based on the bus topology

Every thing is connected through a common line (conduit) or backbone

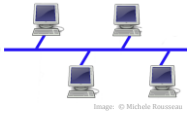
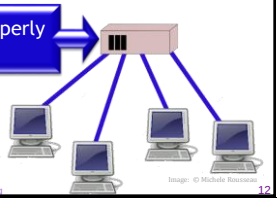


Image: © Michele Rousseau

Star Topology

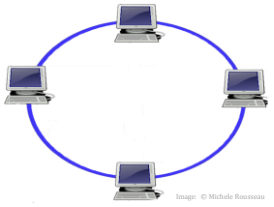
- All data flows through one centralized device (like a hub or a switch)
- Common in home networks
- All messages are sent through the centralized device

If this is not function properly → Nothing works



Ring Topology

- All nodes are connected in a loop
- Messages travel in one direction through the ring
  - Either clockwise or counter clockwise
  - Also referred to as token passing



How do computers communicate

- Need to agree upon how will they physically communicate?
  - Wires? Wireless?
- How much data will be sent at one time?
  - Ethernet → Wires
    - Blocks of data (called Packets) are sent
- Need to agree upon what each bit means
  - This is the particular "language" that must be decided upon
  - **Protocols** are a set of rules that describe how data will be formatted and processed.

The Internet

- Very large collection of smaller networks
  - A very large WAN
- Uses the Internet Backbone
  - A collection of high-speed networks that handle internet traffic
  - Companies provide this service
  - These providers have connections that provide a high transfer rate
- Agree to use the same protocols to communicate
- The protocol used on the internet is referred to as TCP/IP

TCP/IP

- Transmission Control Protocol / Internet Protocol (TCP/IP)
  - Two different protocols → TCP & IP
  - TCP/IP has become standard terminology to refer to either or both
- TCP
  - Breaks messages into packets and reassembles them at their destination
  - Takes care of transmission errors

Remember packets?
Data is transmitted over shared communication lines
Messages are divided into fixed-sized, numbered pieces → these pieces are called packets

TCP/IP (2)

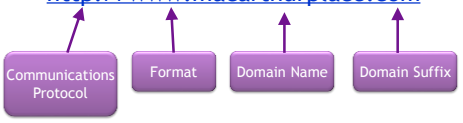
- Internet Protocol (IP)
  - Routes packets through various networks
- TCP/IP →
  - allows for low-level network communication
  - Consists of many protocols and programs
  - High-level protocols based on TCP/IP
    - SMTP (Simple Mail Transfer Protocol) - used for email
    - FTP (File Transfer Protocol) - used for file transfers between 2 systems
    - Telnet - used to log into a computer system from a remote computer (you must have an account)
    - HTTP (Hyper Text Transfer Protocol) - used for the exchange of WWW documents which are typically written using HTML

Internet Protocol Address

- IP Address
  - Like an internet phone number
  - Four-group series of numbers separated by periods
  - Represents the physical address of a server
  - Every server connected to the web can be reached by this number
- URL (Uniform Resource Locator)
  - "English like" address that corresponds to the IP Address → easier to remember

URLs

http://www.macarthurplace.com



- The domain name identifies the
  - Person
  - Organization
  - Server… etc…

  that is responsible for the web page

Domain Suffix examples

.com	→ company or commercial institution
.org	→ private or non-profit organization
.net	→ administrative site for the internet
.gov	→ government site
.edu	→ educational institution
.mil	→ military site
.ca	→ Canada → lots more of these

What is an ISP?

- Internet Service Provider (ISP)
  - An ISP is a company that provides access to the internet to individuals and other companies.
  - E.g. AOL, Time-Warner, Verizon, Cox.. etc..

How Fast is your Network?

How do we measure how fast your computer can talk?

Bandwidth aka data transfer rate

- how much data a network can transport in a given period of time.
- For digital devices
  - expressed in bits of data per second (BPS)
- For analog devices
  - expressed in cycles per second or Hertz(Hz)

How do you connect to the ISP?

- MODulator-DEModulator (Modem)
  - Converts the digital computer signals into analog signals that be transmitted over phone lines
  - Modems used to work with phone lines
  - Drawback was it was slow, takes your phone line, unreliable

Image: CC -Credit Bryan Alexander

- DSL (Digital Subscriber Line)
  - Uses phone lines to transfer digital data.
  - Can use regular phone lines
  - Phone company sets up special computers to handle digital traffic
  - Must be close to the central office to prevent signal degrade

- Cable Modem
  - Data is transferred using the same line that carries your cable television signal
- Broadband
  - Both DSL and cable modems are broadband connections
  - Wireless broadband → uses cell signals

Firewalls -
Either software or hardware or a combination that Secure a network by blocking unauthorized access.

Either software or hardware or a combination that Secure a network by blocking unauthorized access.

- Basically it is a device that filters the information coming through the Internet connection
- Either into your private network or computer system. If an incoming packet of information is flagged by the filters, it is not allowed through.

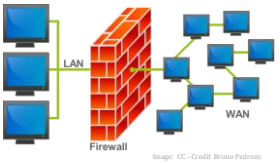


Image: CC –Credit: Bruno Pedroza

- Wireless LAN (WLAN)
  - Uses Radio Frequencies
  - First were developed in 1970s at the University of Hawaii
    - Used ham radios
    - Slow
- Other wireless networks emerged in the 1980s
  - Proprietary protocols
  - Very costly
- In 1997, IEEE (institute of Electronic and Electrical Engineers)
  - 802.11 standard protocol
  - a, b, g, i,n expanded in different ways (bandwidth, frequency, speed, security
  - Protocol is the same so they are compatible
- Now we call it Wi-Fi (Wireless Fidelity)
  - 1999, an organization called Wi-Fi Alliance (comprised of over 300 companies)
  - Certifies that products adhere to the standard

How Wi-Fi works

- Allows RF connections between a base station & a computer with a wireless card
  - Wireless card translates data into a radio signal and transmits it
  - A wireless router receives the signal and decodes it
  - Then the router sends the info through a wired Ethernet connection
  - And vice-versa
- Delivers high-bandwidth access
  - Between 200-600 ft per radio transceiver
  - Transmits at higher frequencies than cell phone & walkie-talkies
  - Watch out for noise
- Companies such as Google and MS are working on city-wide access to wi-fi

Metropolitan Area Networks (MAN)

- Connects large campuses or cities
  - High speed networks
    - Utilizes high-speed communication such as fiber optics
    - Can be wireless using radio waves
  - Larger than a LAN - Smaller than a WAN
    - Distributed Queue Dual Bus (DQDB)
      - IEEE 802.6standard
      - Can extend 20-25 miles
  - Like a WAN - consists of several smaller networks (LANS) - but is medium sized

Image: CC SA – BigBiz

Wireless MAN

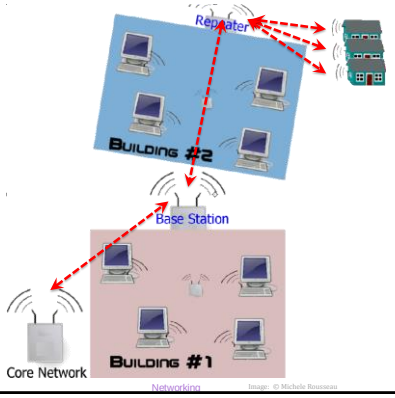


Image: © Michele Rousseau

Bluetooth is wireless too, but

Introduced in 1998

- "Bluetooth" was intended as a code name
  - Taken from 10th century Danish King united Scandinavian Europe
  - Bluetooth technology originated in Scandanavia
  - Unites different industries
- Uses a different protocol
- Low power
- Intended for short range data exchange
  - Mobile to fixed devices
- Creates a PAN (Personal Area Network)
- Used in
  - Mobile phones, telephones, laptops , PCs, GPS receivers, digital cameras,cars, video games… more to come…

Wireless Broadband

- Works off cellular signals
  - Previously we had WAP (Wireless Application Protocol)
  - WAP was slow and access limited to WAP sites – simple sites
- Broadband is close to DSL quality
  - Works with laptops, desktops, or any mobile device
- Cell signals used to transmit voice packets
- Now they can transmit data packets