

Announcements

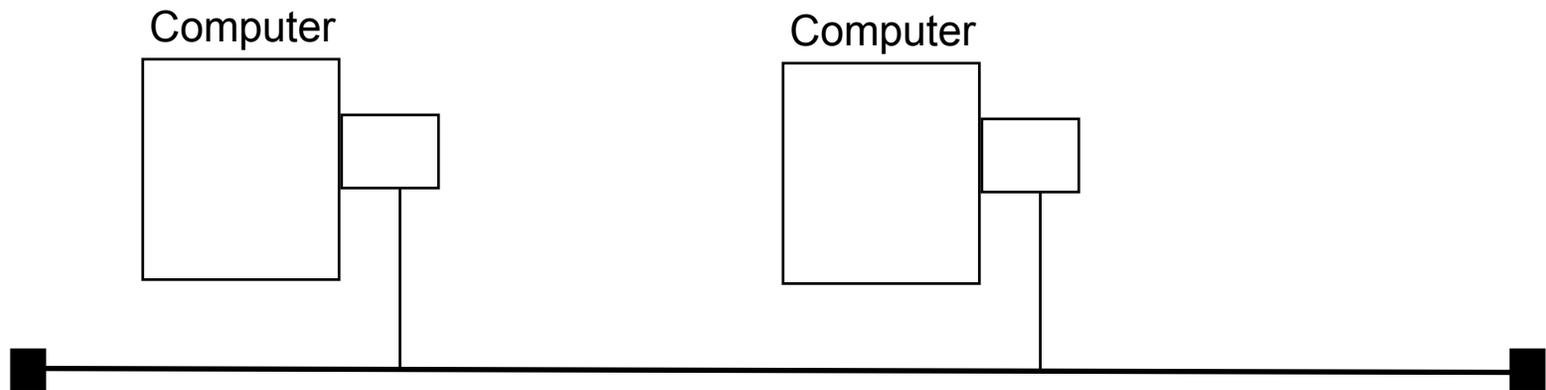
- Project #4 is due on Sunday
- Project #5 is on the web
- Midterm #2 re-grade deadline has passed

Sending Data

- Data is split into *packets*
 - limited size units of sending information
 - can be
 - fixed sized (ATM)
 - variable size (Ethernet)
- Need to provide a destination for the packet
 - need to identify two levels of information
 - machine to send data to
 - comm abstraction (e.g. process) to get data
 - address may be:
 - a globally unique destination
 - for example every host has a unique id
 - may unique between hops
 - unique id between two switches

Ethernet

- 10 Mbps (to 100 Mbps)
- milli-second latency
- limited to several kilometers in distance
- variable sized units of transmission
- bus based protocol
 - requests to use the network can collide
- addresses are 48 bits
 - unique to each interface



Hub based Ethernet

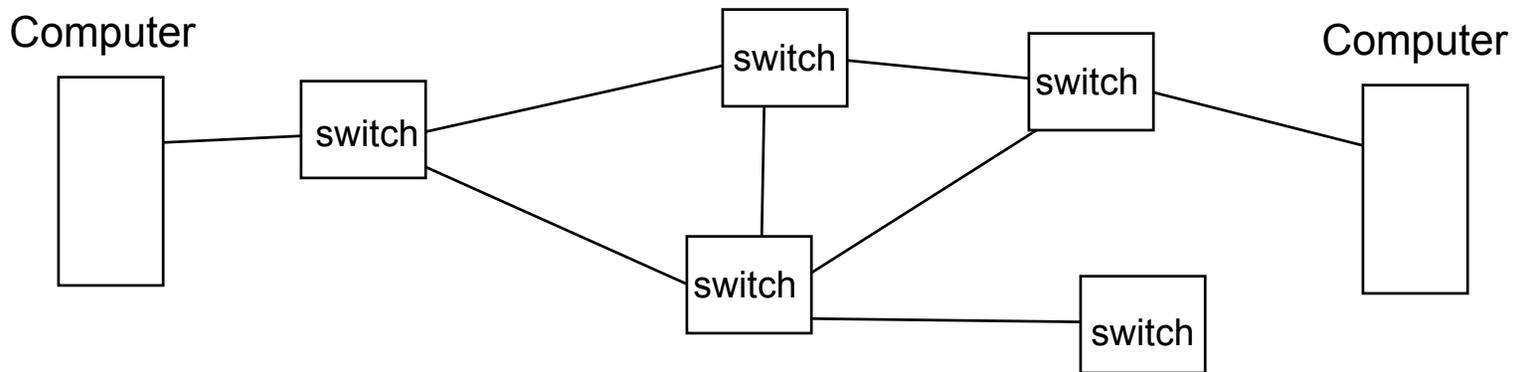
- Logically it is still a bus
- Physically, it is a star configuration
 - the hub is at the center of the network
- Hubs provide:
 - better control of hosts
 - possible to restrict traffic to only the desired target
 - can shutdown a host's connection at the hub if its Ethernet device is misbehaving
 - easier wiring
 - can use normal telephone wire to connect links (called 10 base-T)
- 100 Megabit Ethernet
 - is only available with Hubs
 - requires different hubs than 10base-T

Ethernet Collisions

- If one host is sending, other hosts must wait
 - called Carrier Sense with Multiple Access (CSMA)
- Possible for two hosts to try to send at once
 - each host can detect this event (cd- Collision Detection)
 - both hosts must re-send information
 - if they both try immediately, will collide again
 - instead each waits a random interval then tries again
- Only provides statistical guarantee of transmission
 - however, the probability of success is higher than the probability of hardware failures and other events

ATM (Asynchronous Transfer Mode)

- 155Mbps and up
- fixed sized unit of transmission called a cell
 - cells are 48 bytes plus 5 bytes header
- switch based protocol
- for both local area and wide area networking
- addresses are VCI
 - virtual circuit ids



TCP/IP Protocol

- Name for a family of Network and Transport layers
 - can run over many link layers:
 - Arpanet, Ethernet, Token Ring, SLIP/PPP, T1/T3, etc.
- IP - Internet Protocol
 - network level packet oriented protocol
 - 32 bit host addresses (dotted quad 128.8.128.84)
 - 8 bit protocol field (e.g. TCP, UDP, ICMP)
- TCP - Transmission Control Protocol
 - transport protocol
 - end-to-end reliable byte streams
 - provides ports for application specific end-points
- UDP- user datagram protocol
 - transport protocol
 - unreliable packet service
 - provides ports for application specific end-points

TCP/IP History

- Arpanet was the origin of today's Internet
 - started in 1969 to connect universities and DoD sites
 - early example of packet switched network
 - original links were 64kbps and 9.6kpbs
- Current TCP protocol
 - started in use Jan 1, 1983
 - This was a *flag day*
 - all systems had to change to the new protocol at once
 - with the modern Internet this would be **hard** to do