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)
- mili-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 if 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 9.6kbps

● **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