CSE 451: Operating Systems
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Module 20
461 in 9 slides

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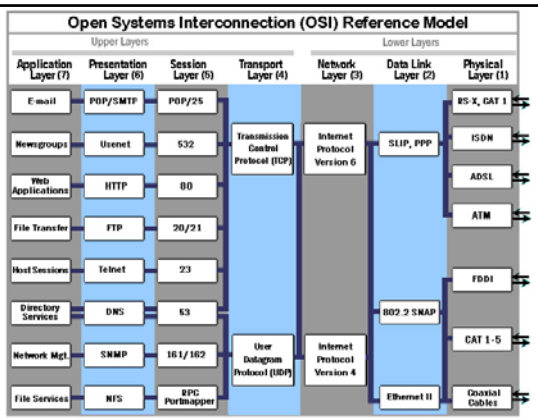
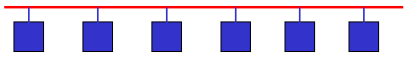


Data link layer: Ethernet

- Broadcast network



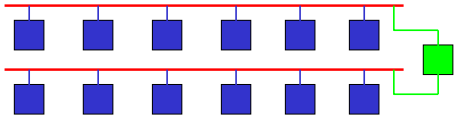
- CSMA-CD: Carrier Sense Multiple Access with Collision Detection
  - recall the "standing in a circle, drinking beer and telling stories" analogy
- Packetized – fixed
- Every computer has a unique physical address
  - 00-08-74-C9-C8-7E

- Packet format

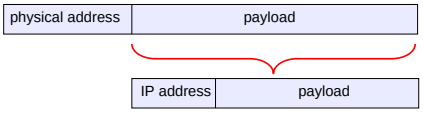
- Interface listens for its address, interrupts OS when a packet is received

Network layer: IP

- Internet Protocol (IP)
  - routes packets across multiple networks, from source to destination
- Every computer has a unique Internet address
  - 172.30.192.251
- Individual networks are connected by routers that have physical addresses (and interfaces) on each network



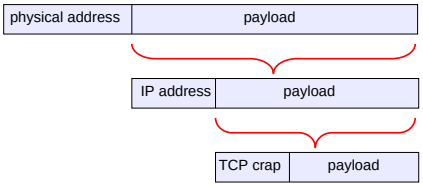
- A really hairy protocol lets any node on a network find the physical address on that network of a router that can get a packet one step closer to its destination
- Packet format



- A separate really hairy protocol, DNS (the Domain Name Service), maps from intelligible names (lazowska.org) to IP addresses (209.180.207.60)
- So to send a packet to a destination
  - use DNS to convert domain name to IP address
  - prepare IP packet, with payload prefixed by IP address
  - determine physical address of appropriate router
  - encapsulate IP packet in Ethernet packet with appropriate physical address
  - blast away!
- Detail: port number gets you to a specific address space on a system
  - a process can "register" for a port, and some are always used: 25=SMTP, 80=web server, 20=FTP, 22=ssh, etc.

Transport layer: TCP

- TCP: Transmission Control Protocol
  - manages to fabricate reliable multi-packet messages out of unreliable single-packet datagrams
  - analogy: sending a book via postcards – **what's required?**



Summary

- Using TCP/IP and lower layers, we can get multi-packet messages delivered reliably from address space A on machine B to address space C on machine D, where machines B and D are many heterogeneous network hops apart, without knowing any of the underlying details
- Higher protocol layers facilitate specific services
  - email: smtp
  - web: http
  - file transfer: ftp
  - remote login: telnet