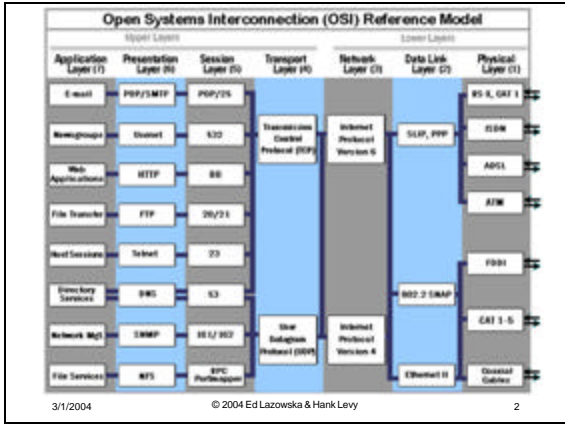


## CSE 451: Operating Systems Winter 2004

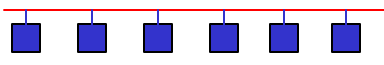
**Module 18**  
**461 in 7 slides**

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Allen Center 570



### Data link layer: Ethernet

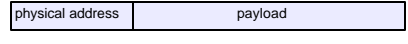
- Broadcast network



- 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

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- Packet format

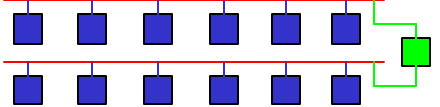


- Interface listens for its address, interrupts OS when a packet is received

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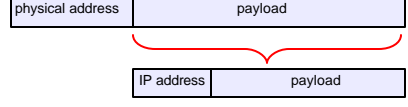
### Network layer: IP

- 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



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- 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



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- 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

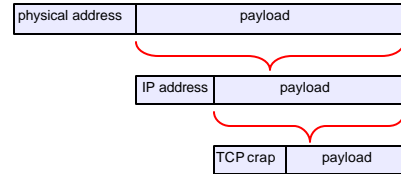
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## Transport layer: TCP

- TCP: Transmission Control Protocol
  - manages to fabricate reliable multi-packet messages out of unreliable single-packet datagrams
  - analogy: sending a book via postcards



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