ICS 351: Today's plan

- review of packet forwarding: switching and Internet routing
data is divided into units of finite size, called packets or frames, datagrams, PDUs, etc.

the finite size limits the delay when multiplexing data from different sources

to accommodate packets, longer data must be split up into smaller units: fragmentation (IP), segmentation (TCP)

each packet has one or more headers, and possibly one or more trailers
network structure

- networks include point-to-point links (most of today's Internet, including the lab), or physical broadcast media (older technologies)
- networks are interconnected by a variety of switching technologies: hubs, ethernet bridges or switches, routers (IP switches), NAT
- a switch implies hardware forwarding
Ethernet switching

- every packet on an Ethernet has an Ethernet header
- a hub works on the physical layer, and rebroadcasts the packet without regard to the header
- an Ethernet switch works on the data-link layer, and rebroadcasts the packet unless it has better information:
  - o a learning switch that has seen this destination address as the source address of previous packets, only forwards on the interface the prior packet came from
  - o a switch that implements the Spanning Tree Protocol (STP), only forwards on interfaces that are part of the spanning tree
- data-link forwarding does not scale to really large networks, since it requires broadcasting at least some of the time
- special provisions (e.g. STP) are needed to prevent forwarding loops in Ethernet networks, and redundant links cannot be used for load balancing
Internet addresses

- for scaling, it is important that network addresses be assigned based on their point of connection to the Internet (MAC addresses are encoded in the hardware)
- in IP, there is a network part of the address, and a host part of the address: all hosts on the same network should have the same network part of the address
- IP addresses and netmasks must be configured (perhaps automatically, via DHCP) for every interface on the Internet!
- the netmask determines the number of bits in the IPv4 address that are in the network part of the address
- different netmasks can be used in different parts of a network, allowing for subnetting
Internet Routing

- where there is broadcasting, it is limited, e.g. to routers within an OSPF network
- each router processes the data it receives, updates its routing table accordingly
- Distance-Vector (RIP): the data is essentially the neighbor's routing table, better routes are added to the routing table, and worse routes from that neighbor may be discarded or time out
- Path-Vector (BGP) is similar, but the entire path (the list of each AS in the path) is distributed, rather than just the cost
- Link-State (OSPF): the data is the router's neighborhood information. This is integrated in a graph representation of the network, and Dijkstra's shortest path algorithm gives the actual routes