ICS 351: Today's plan

• IPv6 addresses
• IPv6 packets
• IPv6 over Ethernet
IPv4 vs. IPv6

- IPv4 does not have enough addresses:
  - CIDR (netmasks) developed to deal with a shortage of IPv4 addresses
  - NAT developed to deal with a shortage of IPv4 addresses
- what if we had a very large number of IP addresses?
- what if we could assign these addresses automatically without using DHCP?
IPv6 addresses

- IPv6 uses 128-bit addresses instead of the 32-bit IPv4 addresses.
- These are written as 8 groups of 4 hex digits separated by colons:
  \[1234:5678:0000:0000:0000:0008:9ABC:DEF0\]
- Leading zeros may be omitted: \[1234:5678:0:0:0:8:9ABC:DEF0\]
- A single sequence of all-zero groups can be omitted: \[1234:5678::8:9ABC:DEF0\]
- Networks are followed by a slash to indicate the number of bits in the network number:
  \[1234:5678/32\]
- The loopback address is \[::1\].
- An interface with a MAC address automatically has a non-routable IPv6 address:
  \[fe80::\] 48 bits of MAC address +16 inserted bits
- For example, with a hardware address of \[00:01:03:a0:31:51\], my non-routable IPv6 address will be \[fe80::201:3ff:fe90:3151\] -- note the "u" bit is set to one to indicate universal scope.
- Globally routable unicast addresses have a network and subnetwork number in the most significant 64 bits.
- \[ffff::/8\] addresses are multicast addresses.
IPv6 header

* the IPv6 header is twice as big as the (minimal) IPv4 header, but simpler (from RFC 2460):

```
+-----------------------------------------------+                   
| Version | Traffic Class | Flow Label |                   |
|---------|---------------+------------|-----------|
|---------|---------------+------------|-----------|
|         | Payload Length| Next Header| Hop Limit       |
|         | Source Address | Destination |           |
```

(from RFC 2460)
IPv6 details

- instead of IP header options, there may be extension headers
- fragmentation is only done by the sender, and path MTU discovery is required
- upper layer is now required to checksum.
- IPv6 routing is essentially the same as IPv4 routing (perhaps minus netmasks)
- when sent over Ethernet, the Ethertype field is 0x86DD instead of 0x800. (RFC 2464)
- Neighbor Discovery Protocol (NDP, RFC 2461) replaces both ARP and DHCP, uses IPv6 packets