ICS 451: Today's plan

- summary of IP processing
- DHCP
- IPv6: differences from IPv4

Summary: IP processing for incoming packets

- compute IP header checksum
  - discard if incorrect
- reassemble if necessary
- if destination address is one of ours
  - check protocol field
    - deliver to TCP or UDP
    - or do ICMP processing
      - including delivery to ping/traceroute
- otherwise decrement TTL, forward packet
  - if TTL==0 or not forwarding, discard packet

DHCP

- Dynamic Host Configuration Protocol
- each interface needs an IP address
- configuring each by hand is tedious and error-prone
- instead, configure them all in a DHCP server, let the server tell the machines when they boot
- can also have a “pool” of addresses
  - assigned on demand to anyone on the network
- less adminstration, less chance of people selecting an address at random

DHCP Information

- Interface IP address
- Netmask
- Default Gateway(s)
- Default Name Server(s)

and quite a bit more!

DHCP Transmission

- DHCP is carried over UDP
- but sender may not have an IP address!
  - nor know IP address of DHCP server
- DHCP packets sent from 0.0.0.0 to 255.255.255.255
  - and over the LAN broadcast address, usually ff:ff:ff:ff:ff:ff

IPv6 motivation

- needed more IP addresses
- needed more networks
  - than could fit in 32 bits
- wanted simpler header processing
  - so could be done more easily in hardware
- wanted autoconfiguration (DHCP+ARP)
- did not want to reinvent routing

IPv6 compared to IPv4

- routing, address masks, all work the same
  - one address per interface
  - network part of the address must match all other interfaces on the same network
- unicast, multicast addresses are similar
  - anycast addresses are new
- ARP+DHCP replaced by IPv6 stateless autoconfiguration
- hex:: notation instead of dotted decimal

Types of IPv6 addresses

- ::1, loopback address
- ::, unspecified address
- 2000::/3, main allocation of unicast addresses
- FC00::/7, Unique Local unicast Addresses/ULA
- FE80::/10, Link Local unicast addresses
- FFxy::/8 is a multicast address with flags x and scope y
  - every interface receives FF02::1
  - every router receives FF02::2

IPv6 extension headers

- hop-by-hop headers processed by each router
- type 0 routing header: list of routers to use as intermediate destinations
- fragmentation option
- destination options
- security options:
  - Autenthication (AH) header
  - Encryption and Authentication (ESP, Encapsulating Security Payload) header

extension header commonalities

- 8 bytes or more
  - always a multiple of 8 bytes
- generally all have next-header, type, length, and value
- type allows processing an unknown header
  - can specify **ignore** or **drop** if unknown

ICMPv6

- ping
- error reporting (and traceroute)
  - e.g. destination is beyond scope of source address
- IPv6 autoconfiguration

IPv6 autoconfiguration

- obtaining a valid IP address
  - 64-bit network part of the address
  - 64-bit host ID from MAC address
- obtaining router information
- IPv6-to-MAC address resolution: Neighbor Discovery Protocol, NDP (replaces ARP)

IPv6 NDP

- Neighbor Discovery Protocol
- all packets are valid IPv6 packets
- Neighbor Solicitation (request) is sent to FF02::1 (all hosts)
- Neighbor Advertisement (response) is unicast
- There is a secure NDP (RFC 3971)

Obtaining IPv6 addresses

- DHCPv6, or
- Stateless Address Configuration (SLAC)
  - FE80::/64+host ID gives link-local address
  - Neighbor solicitation sent to check uniqueness
  - listen for ICMPv6 Router Advertisements to find out network prefix
  - nework prefix + host ID gives global address
  - (again, Neighbor Solicitation to check uniqueness)