IP v6 - Version Number

- IP v 1-3 defined and replaced
- IP v4 - current version
- IP v5 - streams protocol
- IP v6 - replacement for IP v4
  - During development it was called IPng
  - Next Generation

Why Change IP?

- Address space exhaustion
  - Two level addressing (network and host) wastes space
  - Network addresses used even if not connected to Internet
    - but huge numbers are
  - explosive growth of networks and the Internet
  - Extended use of TCP/IP
  - Single address per host is limiting
- Requirements for new types of service

IPv6 RFCs

- 1752 - Recommendations for the IP Next Generation Protocol
- 2460 - Overall specification
- 2373 - addressing structure
- others (find them)

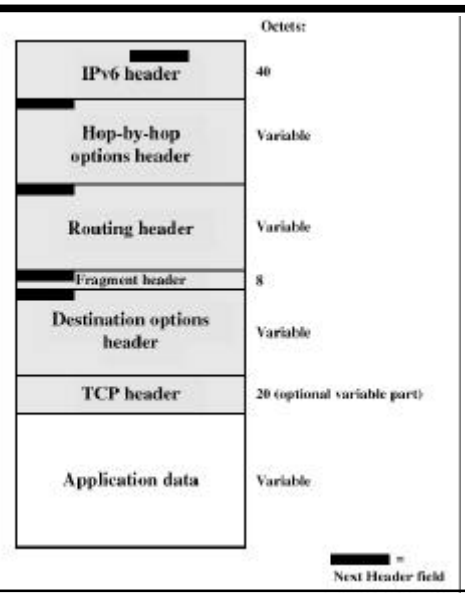
IPv6 Enhancements(1)

- Expanded address space
  - 128 bit addressing
- Improved option mechanism
  - Separate optional headers between IPv6 header and transport layer header
  - Most are not examined by intermediate routes
    - Improved speed and simplified router processing
    - Easier to extend options
- Address autoconfiguration
  - Dynamic assignment of addresses
  - Replaces DHCP

IPv6 Enhancements (2)

- Increased addressing flexibility
  - Anycast - delivered to one of a set of nodes
  - Improved scalability of multicast addresses
- Support for resource allocation
  - Replaces type of service
  - Labeling of packets to particular traffic flow
  - Allows special handling
  - e.g. real time video

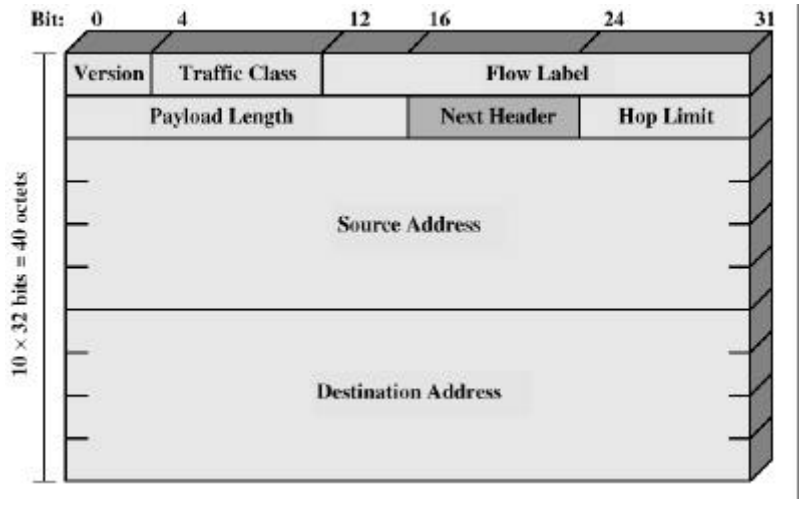
Structure



Extension Headers

- Hop-by-Hop Options
  - Require processing at each router
- Routing
  - Similar to v4 source routing
- Fragment
- Authentication
- Encapsulating security payload
- Destination options
  - For destination node

IP v6 Header



IP v6 Header Fields (1)

- Version
  - 6
- Traffic Class
  - Classes or priorities of packet
- Flow Label
  - Used by hosts requesting special handling
- Payload length
  - Includes all extension headers plus user data

IP v6 Header Fields (2)

- Next Header
  - Identifies type of header
    - Extension or next layer up
- Source Address
- Destination address

IPv6 Addresses

- 128 bits long
- Assigned to interface
  - rather than host
- Single interface may have multiple unicast addresses
- Three types of address

Ipv6 address representation

- IPv4: dotted decimal
  - 129.135.112.75
- Ipv6 : separated hexadecimal 16-bit quantities
  - FF06:0:0:0:0:1:200E:8C53
  - FF06::1:200E:8C6C
    - :: means all 0 components
- can be combined with IPv4 addressing
  - 0:0:0:0:0:0:0:129.135.112.75
  - :: 129.135.112.75

IPv6 address types

- (handwritten)

Types of address

- Unicast
  - Single interface
- Anycast
  - Set of interfaces (typically different nodes)
  - Delivered to any one interface
  - the "nearest"
- Multicast
  - Set of interfaces
  - Delivered to all interfaces identified

Hop-by-Hop Options

- Next header
- Header extension length
- Options
  - Jumbo payload
    - Over 2^{16} = 65,535 octets
  - and others

Multicasting

- Addresses that refer to group of hosts on one or more networks
- Uses
  - Multimedia "broadcast"
  - Teleconferencing
  - Database
  - Distributed computing
  - Real time workgroups

IGMP

- Internet Group Management Protocol
- RFC 1112
- Host and router exchange of multicast group info
- Use broadcast LAN to transfer info among multiple hosts and routers

IGMP Operation

- To join a group, hosts sends report message
  - Group address of group to join
  - In IP datagram to same multicast destination address
  - All hosts in group receive message
  - Routers listen to all multicast addresses to hear all reports
- Routers periodically issue request message
  - Sent to all-hosts multicast address
  - Host that want to stay in groups must read all-hosts messages and respond with report for each group it is in

Group Membership in IPv6

- Function of IGMP included in ICMP v6
- New group membership termination message to allow host to leave group