Introduction to IPv6

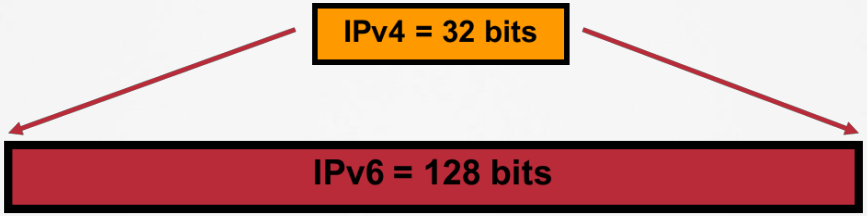
(History and Address Representation)

History of IPv6

- 1992 – an impending shortage of IPv4 address space was first recognized.
- 1994 – IETF launches work into IPv6
- 1998 – First RFC (2460) for IPv6 written
- 2006 – RFC 4291 stabilized (address structure)
- 2008 – U.S. Federal Government mandates IPv6-compatibility of all backbone devices of Federal Agencies
- 2015 – ARIN runs out of IPv4 addresses.

Introduction to IPv6

- 128-bit addressing system

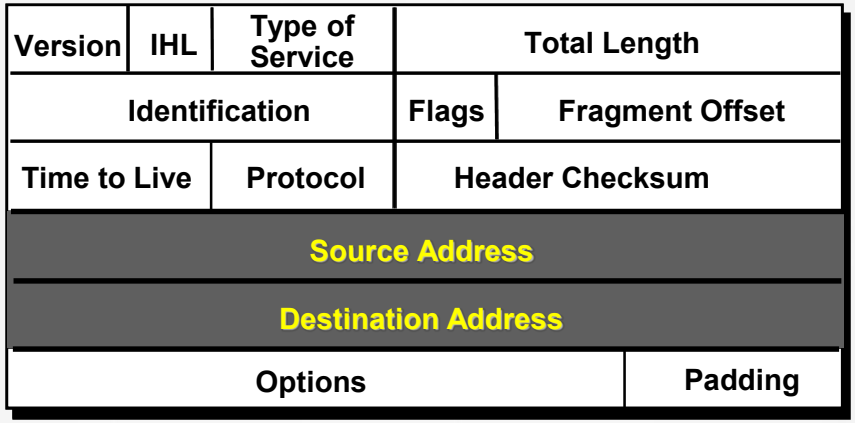


- Expressed in hexadecimal instead of decimal
- Colon ":" used to separate group of four-hex characters (a "word")
- 4 bits = 1 hex character
- Example: 2001:0000:0000:0000:0000:0001:1230:000A

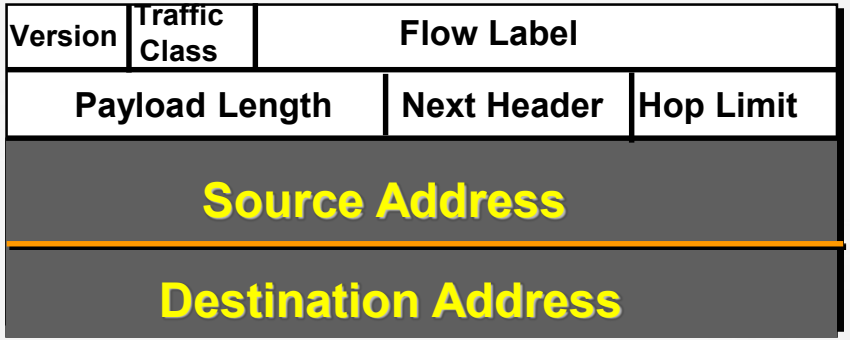
Introduction to IPv6
(v4 and v6 Header Comparisons)

IPv4 and IPv6 Header Comparison

IPv4 Header:



IPv6 Header:



Introduction to IPv6 (Interface-IDs)

IPv4/IPv6 “Host” bits

- **IPv4 host address** — 20.20.20.3 /24
  - Network/subnet portion (prefix) — 20.20.20.x
  - Host portion (host bits) — X.X.X.3 /24

- **IPv6 host addresses** — 2001:aabb:cc11::3a/64
  - Network/subnet portion (prefix) — 2001:aabb:cc11::/64
  - Interface Identifier — :0000:0000:0000:003a/64
  - Can also be dynamically-derived (EUI-64)

Introduction to IPv6 (Address Types)

Types of IPv6 Addresses

- **Link-local addresses**
  - Assigned automatically as an IPv6 host comes online
  - Similar to the 169.254.x.x address of IPv4
  - Always begin with "FE80::/10"
  - Last 64 bits is the 48-bit MAC address with "FFFE" inserted in the middle
- **Global Unicast Addresses**
  - Have their high-level 3 bits set to 001; ex: 2000::/3
  - Global routing prefix is 48 bit or less

Types of IPv6 Addresses

Unique Local Addresses

- Not globally routable
- Similar to the private addresses of IPv4
- Always begin with "FC00::/7"

Multicast Address

- FF00::/8
- As long as the first 8-bits take the form of 1111 1111, that's a multicast address.
- IPv6 nodes listen to several IPv6 Multicast Groups by default.

Types of IPv6 Addresses

- **Anycast**
  - Two-or-more nodes using the same IPv6 address
  - Used for load-balancing
  - Indistinguishable from Unicast address

Introduction to IPv6 (IPv6 Neighbor Discovery)

ICMPv6 and NDP

- NDP = Neighbor Discovery Protocol

- Makes use of new ICMPv6 message types
  - Neighbor Solicitation
  - Neighbor Advertisement
  - Router Solicitation
  - Router Advertisement

Introduction to IPv6 (Solicited Node Multicast)

Types of IPv6 Addresses

» Solicited Node Multicast Address

- FF02:0:0:0:0:1:FF/104
- Last 24-bits taken from interface-ID (next slide)
- Automatically provisioned like Link-Local addresses
- Used for L3-to-L2 address resolution

No more broadcasts!!