Facts Related to IPv6

- TCP/IP has worked well for over 25 years

- Design is flexible and powerful

- Has adapted to

  – New computer and communication technologies

  – New applications

  – Increases in size and load

- Address space will eventually run out

IPv6 History

- In the early 1990's, the IETF began development of a new version

- Three main proposals

- Eventually new version emerged

- Assigned version number 6,

- Final documents/specifications finished in 1994

- Defined over 15 years ago, where is it?

Major Changes from IPv4

- Larger addresses

- Extended address hierarchy

- Variable header format

- Facilities for many options

- Provision for protocol extension

- Support for autoconfiguration and renumbering

- Support for resource allocation

IPv6 Addresses

- 128 bits per address

- Large increase in capacity

- IPv6 has 10^{24} addresses per square meter of the Earth's surface

- Uses Colon Hexadecimal Notation

  – Replaces dotted decimal

  – Example: dotted decimal value

  104.230.140.100.255.255.255.255.0.0.17.128.150.10.255.255

  – Becomes

  68E6:8C64:FFFF:FFFF:0:1180:96A:FFFF

Zero Compression

- The new notation tends to have large blocks of zeros

- To compensate, we use zero compression

- Successive zeroes are indicated by a pair of colons

- Example

$$FF05:0:0:0:0:0:0:B3$$

- Becomes

$$FF05::B3$$

- Of course, you can only do that once in an address!

IPv6 Destination Addresses

- Three types

  - Unicast (single host receives copy)

  - Multicast (set of hosts each receive a copy)

  - Anycast (set of hosts, one of which receives a copy)

    - Later removed from the specifications

- Note: no broadcast (but special multicast addresses (e.g., all hosts on local wire)

IPv6 Address Semantics

- An IPv6 address consists of:

  - N bits of "Global Routing Prefix"

    - This comes from your ISP and is a subset of **their** prefix

  - 64-N bits of Subnet ID

    - An end user is supposed to get at least 8 bits of this

  - 64 bits of Interface ID

    - For example, ethernet address (with 8 extra bits defined)

Special IPv6 Addresses

- Link Local

  - Only address computers on the same physical network

  - That's `FE80::/10`

- Site Local

  - Only address computers at the "same site"

  - Not globally routable

  - That's `FEC0::/10`

  - Made obsolete in RFC3484

- Multicast

  - `FF00::/8`

Example IPv6 Multicast Addresses

- Node-Local
  - `FF01:0:0:0:0:0:0:1` All Nodes [RFC4291]
  - `FF01:0:0:0:0:0:0:2` All Routers [RFC4291]

- Link-Local
  - `FF02:0:0:0:0:0:0:1` All Nodes [RFC4291]
  - `FF02:0:0:0:0:0:0:2` All Routers [RFC4291]
  - `FF02:0:0:0:0:1:FFXX:XXXX` Solicited-Node [RFC4291]

- Variable Scope
  - `FF0X:0:0:0:0:0:0:101` Network Time Protocol (NTP) [RFC1119][DLM1][RFC-ietf-ntp-ntpv4-proto-13.txt]
  - `FF0X:0:0:0:0:0:0:10B` IETF-1-AUDIO [SC3]

IPv4 Address Space Exhaustion Speculations

- IANA gave the last of its /8 address blocks to the RIR (Regional Registries) on Jan 31, 2011
  - APNIC
  - AFRINIC
  - ARIN
  - LACNIC
  - RIPE NCC

- APNIC gave out their last addresses on April 15, 2011

- RIPE is expected to go next

- An 2008 IETF meeting firewalled everything except ipv6