NOTES

Chapter 22
IPv6

Future of IP

- Current version of IP - version 4 - is old and showing its age.
- IPv4 has shown remarkable ability to move to new technologies
- IETF has proposed entirely new version to address some specific problems

Short History of IPv6

- IETF has been working on this since 1991
- So what was the big issue?
  - There weren't enough IP addresses to give out – The Internet was growing very fast
  - Class B's in high demand. Called *the Gold-i-locks syndrome* (one's too hot, one's too cold, middle one is just right)
  - Also called ROADs (running out of address space) problem
  - Routers don't have enough memory to hold routing tables
  - Older routing protocols could not carry all the routes that needed to be exchanged
  - Expected they would run out of class B addresses sometime in 1994.
- Bottom Line: A new IP was needed – and fast!

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History of IPv6: (continued)

- They decided to:
  1. Stop giving out class B addresses
  2. Instead, give out class C addresses
  3. Employ CIDR immediately
- This had a big impact and bought some time. Shrunk routing table sizes significantly.
- Gave time to develop IPv6
- IPv6 exists today, but it is still not widely deployed. Why?

IPv6 New features

- Bigger Addresses:
- Header format:
- Extension headers:
- Flows:
- Extensible:
- Multicasting?:

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IPv6 Addresses

- 128 bit addresses = 340,282,366,920,938,463,463,374,607,431,768,211,456 potential hosts
- theoretically 665,570,793,348,866,943,898,599 addresses per square meter of the earth's surface
- practically (from telephone estimates) there are 1564 addresses per square meter

Types of Addresses

- There are several different types of IPv6 addresses (not called classes anymore), where each type has its own unique prefix

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Provider-Based Addresses

- Just advertise the prefix to other routers!

010	Registry ID	Provider ID	Subscriber ID	Subnet ID	Node ID

Figure 1: Provider-Based Address Structure

IPv6 address notation

- 128-bit addresses unwieldy in dotted decimal; requires 16 numbers

  `105.220.136.100.255.255.255.255.0.0.18.128.140.10.255.255`

- Groups of 16-bit numbers in hex separated by colons - colon hexadecimal (or colon hex)

  `69DC:8864:FFFF:FFFF:0:1280:8C0A:FFFF`

- Zero-compression - series of zeroes indicated by two colons

  `FF0C:0:0:0:0:0:0:B1`

  `FF0C::B1`

- IPv4 Notation

  `::128.163.146.100`

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IPv6 Frame Layout

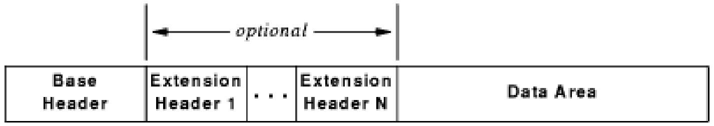

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Figure 2: Logical Packet Structure

IPv6 base header format

- Contains less information than IPv4 header
- NEXT HEADER points to first extension header
- FLOW LABEL used to associate datagrams belonging to a flow or communication between two applications

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IPv6 Base Header Format: (continued)

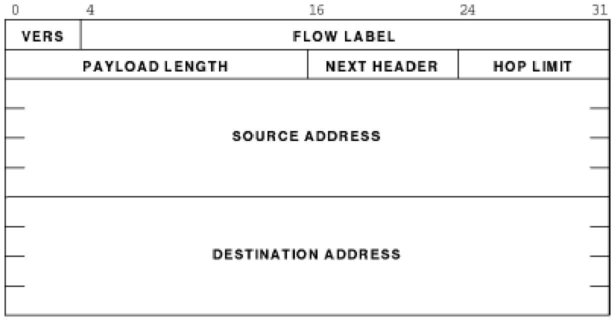

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Figure 3: IP Base Header

IPv6 Next Header

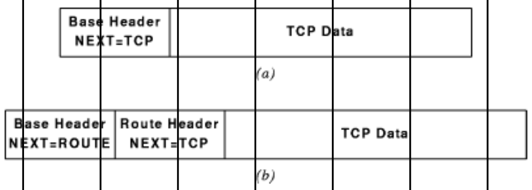

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Figure 4: IP Next Header

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Parsing IPv6 headers

- Base header is fixed size - 40 octets
  - NEXT HEADER field in base header defines type of header
  - Appears at end of fixed-size base header
- Some extensions headers are variable sized
  - NEXT HEADER field in extension header defines type
  - HEADER LEN field gives size of extension header

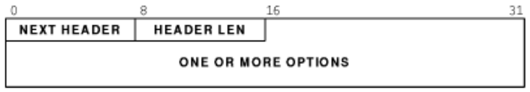

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Figure 5: Variable Size Next Headers

Fragmentation

- Fragmentation information kept in separate extension header
- Each fragment has base header and (inserted) fragmentation header
- Entire datagram, including original header may be fragmented

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Fragmentation: (continued)

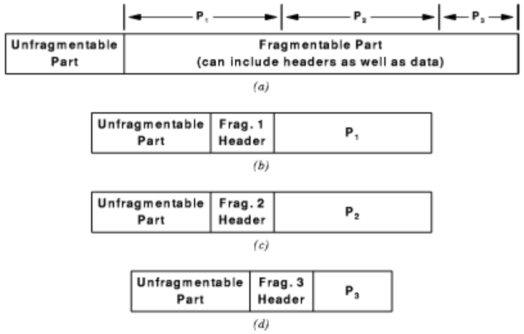

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Figure 6: IPv6 Fragmentation

Fragmentation and path MTU

- IPv6 source (not intermediate routers) responsible for fragmentation
  - Routers simply drop datagrams larger than network MTU
  - Source must fragment datagram to reach destination
- Source determines path MTU
  - Smallest MTU on any network between source and destination
  - Fragments datagram to fit within that MTU
- Uses path MTU discovery
  - Source sends probe message of various sizes until destination reached
  - Must be dynamic - path may change during transmission of datagrams