

CprE 530

Lecture 12

Topics

- IPv6
 - Overview
 - Packet Format
 - ICMP V6

Reasons for IPv6

- IPv4 uses 32 bits for addresses
- Real time/streaming traffic (voice, audio)
- Security issues with IPv4

IPv6 – Larger Address Space

- Header format – separates state information from dynamic routing info to simplify router actions
- New Options
- Quality of Service
- Added Security

IPv6 Address Space

- 128 bits (16 bytes)
- 4 hex digits: xx:xx:xx:xx:xx:xx:xx:xx
- Can abbreviate by removing leading zeros
 - :0F: \Rightarrow :F:
 - xx:0:0:0:AD64:0:0:xx \Rightarrow xx::AD64:0:0:xx
- CIDR Rules also supported (/ nbr of bits)

IPv6 Address Types

- Address types:
 - Unicast: A \Rightarrow B
 - Anycast: same first part; subnet broadcast
 - Multicast
- IPv6 Address Format:


Type Prefix	Address
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IPv6 Address Format

- Common Type Prefixes
 - 010 = Provider based Unicast
 - 100 = Geographic Unicast
 - 1111 1110 10 = Link Local
 - 1111 1110 11 = Site Local
 - 1111 1111 = Multicast
 - 0000 010 = IPX
 - 0000 001 = NSAP

Provider Based Unicast

3	5	16	24	32	48
010	Registry	Provider	Subscriber	Subnet	Node



11000	INTERNIC
01000	RIPNIC
10100	APNIC

- A = 8 bits = 010 + Registry
- B = variable (16 bits recommended) = Provider
- C = 24 bits = Subscriber
- D = variable (32 bits recommended) = Subnet
- E = variable (48 bits recommended) = Node
 - If Ethernet, Ethernet MAC address recommended

Reserved Addresses

- Starts with: 0000 0000
- Unspecified Address= ::
- Loopback= ::1
- IPv4 Address:
 - 0000 0000 | 88 0's | 32 bit IPv4 Address

Local Address

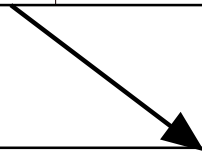
- Starts with: 1111 1110
- Link Local:
 - 10 | 70 0's | 48 bit node address |
- Site Local:
 - 11 | 38 0's | 32 bit subnet | 48 bit node |

Multicast

- Starts with: 1111 1111
- 4 bits = flag
- 4 bits = scope (node local, link local, site local, organization, global)
- 112 bits = Group ID

IPv6 Header

Base Header 40 bytes	Payload (65,535 bytes max)	
	Optional Extension Header	Upper Layer Payload



Version	Priority	Flow Label		
Payload Length		Next Header	Hop Limit	
Source IP address				
Destination IP address				

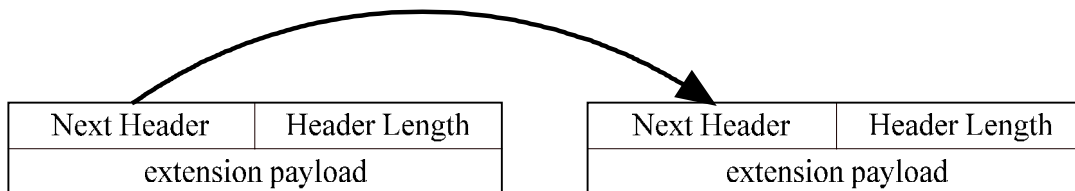
IPv6 Header

Priority Codes

0	None	
1	Background	News
2	Unattended	email
3	reserved	
4	attended bulk	Web
5	Reserved	
6	Interactive	Telnet
7	Control Traffic	routing

Next header Codes

Code	Next Header
0	hop by hop
2	ICMP
6	TCP
17	UDP
44	Fragmentation
50	Encrypted
51	Authenticated
53	None



Packet Format

- 40 byte base header; N byte Extension Headers
 - 4 bits = 6 (IP version)
 - 4 bits = Priority
 - 24 bits = Flow label
 - 16 bits = Length
 - 8 bits = Next Header
 - 8 bits = Hop Limit
 - 128 bits = Source Address
 - 128 bits = Destination Header

Next Header Codes

- 2 = ICMP
- 6 = TCP
- 17 = UDP
- 43 = Source Routing
- 44 = Fragmentation
- 50 = Encrypted
- 51 = Authentication

Priority (Part 0-7)

- Congestion Controlled
 - 0 = None
 - 1 = background (news)
 - 2 = unattended (email)
 - 3 = reserved
 - 4 = Attended bulk (HTTP/FTP)
 - 5 = Reserved
 - 6 = Interactive
 - 7 = Control traffic (routing)

Priority (8-15)

- Noncongestion Controlled
 - 8 = Most redundancy
 - :
 - 15 = Least redundancy

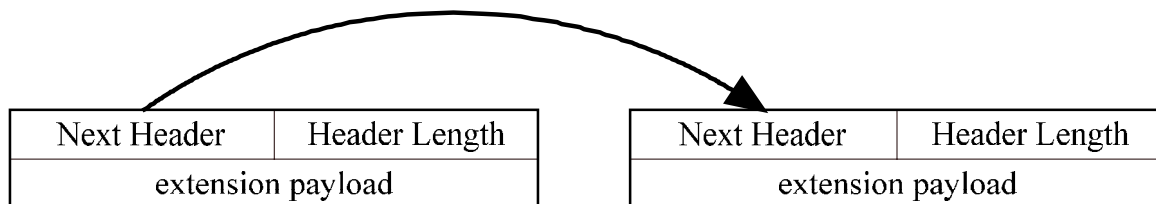
Flow Label

- Flow Label + Source Address is unique
- Router can cache “Flow Label + Source Address” to speed up routing
- TCP routing can take up to 70% of the processing with IPv4

Items not in IPv6 Headers

- ID/Offset = only needed if handling fragmentation/reassembly (not needed by routers)
- No checksum = minimal value

Extension Headers



- Can be chained
- If Next Header = 59, last header

Extension Header Types

- 1 = Hop by Hop Option
- 2 = Jumbo Payload (if payload > 65535 bytes)
 - up to $2^{32}-1$
- 3 = Source Routing
- 4 = Fragmentation (use Path MTU Discovery)
- 5 = Authentication (Authenticates sender)
- 6 = Encrypted

ICMPv6

- ICMPv6: Internet Control Messaging Protocol
- Many of the TCP/IP protocols (ARP, etc) are covered by ICMPv6 so are no longer needed

Error Reporting Packet Format

A	B	C
D		
E		

- A = Type
- B = Code
- C = Checksum
- D = Other Information
- E = Data

Error Reporting Types

- 1 = Destination Unreachable
- 2 = Packet too big
- 3 = Time exceeded
- 4 = Parameter problem
- 137 = Redirection

Type 1 Codes

- 0 = No path
- 1 = Communications is prohibited
- 2 = Source routing is impossible
- 3 = Destination address is unreachable
- 4 = Port

Type 2 & 3 Codes

- Type 2 Codes
 - 0 = MTU exceeded
- Type 3 Codes
 - 0 = Hop Count
 - 1 = Fragment timeout

Type 4 & 5 Codes

- Type 4 Codes
 - 0 = Header
 - 1 = Extension Header
- Type 5 Codes
 - 0 = Router finds better path