

- Version** (4 bits) · Always set to 6
- Traffic Class** (8 bits) · A DSCP value for QoS
- Flow Label** (20 bits) · Identifies unique flows (optional)
- Payload Length** (16 bits) · Length of the payload in bytes
- Next Header** (8 bits) · Header or protocol which follows
- Hop Limit** (8 bits) · Similar to IPv4's time to live field
- Source Address** (128 bits) · Source IP address
- Destination Address** (128 bits) · Destination IP address

Address Types

- Unicast** · One-to-one communication
- Multicast** · One-to-many communication
- Anycast** · An address configured in multiple locations

Multicast Scopes

- | | |
|--------------------------|---------------------|
| 1 Interface-local | 5 Site-local |
| 2 Link-local | 8 Org-local |
| 4 Admin-local | E Global |

Special-Use Ranges

- | | |
|----------------------|---------------------|
| ::/0 | Default route |
| ::/128 | Unspecified |
| ::1/128 | Loopback |
| ::/96 | IPv4-compatible* |
| ::FFFF:0:0/96 | IPv4-mapped |
| 2001::/32 | Teredo |
| 2001:DB8::/32 | Documentation |
| 2002::/16 | 6to4 |
| FC00::/7 | Unique local |
| FE80::/10 | Link-local unicast |
| FEC0::/10 | Site-local unicast* |
| FF00::/8 | Multicast |
- * Deprecated

Address Notation

- Eliminate leading zeros from all two-byte sets
- Replace up to one string of consecutive zeros with a double-colon (::)

Address Formats

Global unicast



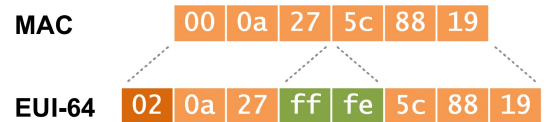
Link-local unicast



Multicast



EUI-64 Formation



- Insert 0xfffe between the two halves of the MAC
- Flip the seventh bit (universal/local flag) to 1

Extension Headers

- Hop-by-hop Options (0)**
Carries additional information which must be examined by every router in the path
- Routing (43)**
Provides source routing functionality
- Fragment (44)**
Included when a packet has been fragmented by its source
- Encapsulating Security Payload (50)**
Provides payload encryption (IPsec)
- Authentication Header (51)**
Provides packet authentication (IPsec)
- Destination Options (60)**
Carries additional information which pertains only to the recipient

Transition Mechanisms

- Dual Stack**
Transporting IPv4 and IPv6 across an infrastructure simultaneously
- Tunneling**
IPv6 traffic is encapsulated into IPv4 using IPv6-in-IP, UDP (Teredo), or Intra-Site Automatic Tunnel Addressing Protocol (ISATAP)
- Translation**
Stateless IP/ICMP Translation (SIIT) translates IP header fields, NAT Protocol Translation (NAT-PT) maps between IPv6 and IPv4 addresses

IPv6 Cheat Sheet

IPv6 Header

Version (4)	Traffic Class (8)	Flow Label (20)	
Payload Length (16)		Next Header (8)	Hop Limit (8)
Source Address (128 bits) [16 bytes]			
Destination Address (128 bits) [16 bytes]			

Version : IP version number (6).
Traffic class : Used by originating nodes and/or forwarding routers to identify and distinguish between different classes or priorities of IPv6 packets.
Flow label : Used by a source to label sequences of packets for which it requests special handling by the IPv6 routers.
Payload Length : Length of the IPv6 payload (also the extension headers).
Next Header : Identifies the type of header following the IPv6 header.
Hop Limit : Decrement by 1 by each node that forwards the packet.
Source Address : Address of the originator of the packet
Destination Address : Address of the intended recipient of the packet (possibly not the ultimate recipient, if a Routing header is present)

General Format for IPv6 Global Unicast Addresses

Global routing prefix (n bits) | Subnet ID (m) | Interface ID (128-n-m)

IPv6 Global Unicast Addresses (not starting with binary value 000)

! 000 | Global routing prefix (n) | Subnet ID (64-1) | Interface ID (64)

IPv6 Global Unicast Addresses (2000::/3 prefix, IANA delegated)

001 | Global routing prefix (45) | Subnet ID (16) | Interface ID (64)

IPv4-compatible IPv6 address

0 (80 bits) | 0 (16 bits) | IPv4 address (32 bits)

IPv4-mapped IPv6 Address

0 (80 bits) | FFFF (16 bits) | IPv4 address (32 bits)

Link-Local IPv6 Unicast Address (FE80::/10)

111111010 (10 bits) | 0 (54 bits) | Interface ID (64 bits)

Site-Local IPv6 Unicast Address (FEC0::/10)

111111011 (10 bits) | Subnet ID (54) | Interface ID (64 bits)

Subnet-Router Anycast Address

Subnet Prefix (n bits) | 0 (128-n)

Ethernet Types

0800 IPv4
 0806 ARP
 8035 Reverse ARP
 86DD IPv6
 8847 MPLS Unicast
 8848 MPLS Multicast
 8863 PPoE (Discovery stage)
 8864 PPoE (PPP sess stage)

IPv6 Option Types (8 bits, 3 fields) act - 2 bits

00 skip over option
 01 silently discard
 10 discard and send ICMP
 11 discard and send ICMP, if unicast
chg - 1 bit
 0 = option data does not change en-route
 1 = option data may change en-route
rest - 5 bits, the rest of the Option Type

IPv6 Next Header Fields

041	IPv6
000	IPv6 Hop-by-Hop Option
060	Destination Options for IPv6
043	Routing Header for IPv6
044	Fragment Header for IPv6
051	Authentication Header (AH)
050	Encap Security Payload (ESP)
059	No Next Header for IPv6
002	Internet Group Management (IGMP)
006	Transmission Control (TCP)
017	User Datagram (UDP)
046	Reservation Protocol (RSVP)
047	General Routing Encapsulation (GRE)
055	IP Mobility (MOBILE)
058	ICMP for IPv6 (ICMPv6)
089	OSPFv6
094	IP-within-IP Encapsulation Protocol (IPIP)
103	Protocol Independent Multicast (PIM)
135	Mobility Header

ICMPv6 Informational Messages

128	Echo Request
129	Echo Reply
130	Multicast Listener Query
131	Multicast Listener Report
132	Multicast Listener Done
133	Router Solicitation
134	Router Advertisement
135	Neighbor Solicitation
136	Neighbor Advertisement
137	Redirect Message
138	Router Renumbering
139	ICMP Node Information Query
140	ICMP Node Information Response
143	Version 2 Multicast Listener Report
144	Home Agent Address Discovery Request
145	Home Agent Address Discovery Reply
146	Mobile Prefix Solicitation
147	Mobile Prefix Advertisement
128 - 255	Informational Messages

Flags (000T)

T = 0 Well-known
 T = 1 Transient

ICMPv6 Error Messages (Type/Code)

1	Destination Unreachable
0	no route to destination
1	communication with destination administratively prohibited
2	(not assigned)
3	address unreachable
4	port unreachable
2	Packet Too Big
3	Time Exceeded
0	hop limit exceeded in transit
1	fragment reassembly time exceeded
4	Parameter Problem
0	erroneous header field
1	unrecognized Next Header type
2	unrecognized IPv6 option
0-127	Error Messages

IPv6 Extension Headers (NH = Next Header)

	IPv6 Header NH = TCP	TCP Header + Data
	IPv6 Header NH = Routing	Routing Header NH = TCP
	Routing Header NH = Fragment	Fragment Header NH = TCP
	IPv6 Header NH = Routing	TCP Header + Data

IPv6 Addressing

** Deprecated*

Address Type	Binary Prefix	IPv6 Notation
Unspecified	00...0 (128 bits)	::/128
Loopback	00...1 (128 bits)	::1/128
Multicast	11111111	FF00::/8
Link-local unicast	1111111010	FE80::/10
Site-local unicast*	1111111011	FEC0::/10
Unique local unicast	1111110000	FC00::/7
Global unicast	(everything else)	
Anycast	Unicast address assigned to multiple interfaces.	
IPv4-Compatible IPv6*	0:0:0:0:0:A.B.C.D	
IPv4-Mapped IPv6	0:0:0:0:0:FFFF:A.B.C.D	
6to4	2002::/16	

Well Known Multicast Addresses

FF01:0:0:0:0:0:1	All Nodes Addresses	Interface-local
FF02:0:0:0:0:0:1	All Nodes Addresses	Link-local
FF01:0:0:0:0:0:2	All Routers Addresses	Interface-local
FF02:0:0:0:0:0:2	All Routers Addresses	Link-local
FF05:0:0:0:0:0:2	All Routers Addresses	Site-local
FF02:0:0:0:0:1:FFXX:XXXX	Solicited-Node Address	Link-local
FF02:0:0:0:0:0:4	DVMRP Routers	Link-local
FF02:0:0:0:0:0:5	OSPFv2	Link-local
FF02:0:0:0:0:0:6	OSPFv3 DRs	Link-local
FF02:0:0:0:0:0:9	RIP Routers	Link-local
FF02:0:0:0:0:0:D	All PIM Routers	Link-local
FF02:0:0:0:0:0:16	All MLDv2 Routers	Link-local
FF02:0:0:0:0:0:1:2	All DHCP Agents	Link-local
FF05:0:0:0:0:0:1:3	All DHCP Servers	Site-local
FF0X:0:0:0:0:0:101	Network Time Protocol	Variable Scope

Multicast Address

FF (8 bits)	Flags (4)	Scope (4)	Group ID (112)	Scope
				1 Interface-local
				2 Link-local
				4 Admin-local
				5 Site-local
				8 Organization-local
				E Global