IPv6/TCP Header Cheat Sheet

6	0	0	0	0 0	0 0	0 0	3 4	0 6	4 0
Ver	**Traffic Class**		**Flow Label**			**Payload Length**		**Next Header**	**Hop Limit**

f f	2 1	5 0	a 0	8 0	f 0	7 f	d e
0 d	b 0	c 0	2 1	0 0	9 0	a 1	1 2
Source IP Address							

f f	1 8	0 8	0 8	0 8	0 0	0 0	0 0
0 0	0 0	0 0	0 0	0 0	0 0	0 0	9 f
Destination IP address							

a 3	e 0	0 5	0 c	F 6	f 9	d 9	c 0
Src Port	**Dest Port**	**Sequence Number**				**Acknowledgement Num**	

0 0	0 0	5 0	1 1	f 0	2 1	6 f	f 5
Ack Num Cont....		**TCP/HL**	**Flags**	**Window Size**		**Checksum**	

0 0	0 0	a f	c 0	2 1	6 f	f 5	9 c
Urgent Pointer		**TCP Options or Payload**		**Payload**			

<-----1 byte-----|-------1 byte------|----------------2 bytes---------------|-------------------------------------4 bytes----------------------------->

Developed By Christopher Davis

1. IP Version
2. Traffic Class
3. Flow Label
4. Payload Length
5. Next Header
6. hop Limit
7. Source IP Address - ff21:50a0:80f0:7fde:db0:c021:90:a112
8. Destination IP Address - ff18:808:8::9f
11. Source Port

12. Destination Port

13. The TCP Sequence number used by the transport layer to order data.

14. The Acknowledgment field is used to acknowledge receipt of data.

15. The TCP/HL is the TCP header length and "50" in hex would just be "5" as we ignore the 0 in this instance. So a value of "5" means the TCP header length is 5x4=20   bytes.

16. TCP Flags Field. This has 2 hex (8 bits). Depending on the bits that are turned on, it represents either CWR,ECN-Echo, URG, ACK, PSH, RST, SYN, or FIN. This bits are aligned as follows: | C | E | U | A | P | R | S | F | In this instance, the Hex characters are "11" which would equate to 17 in decimal and would have the following bits in this order: | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | We can deduce that the ACK, FIN flags are set.

17. The TCP windows size field is used to show the number of bytes that can be transferred to the dest before an ACK should be sent.

18. The TCP header Checksum is used to validate the integrity of the TCP header field.

19. Urgent pointer field is used to identify the location of urgent data within the packet. In most cases it will be 00 00.

20. The TCP options Field represented in the graph is 4 bytes but can actually be 0-40 bytes. This field will often not exist and depends on the TCP/HL (refer to 15). Since the TCP header length was only 20, the TCP header ended after the urgent pointer and there is no TCP options in this example. This starts the payload if no options are present.

IPv6

Protocol Header

8	16	24	32

Ver	Traffic Class	Flow Label	
Payload Length		Next Header	Hop Limit

Source Address

Destination Address
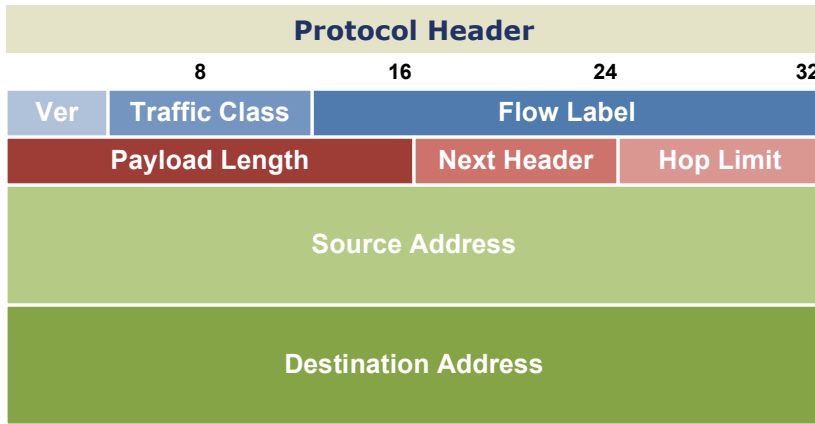
Version (4 bits) · Always set to 6

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 (::)
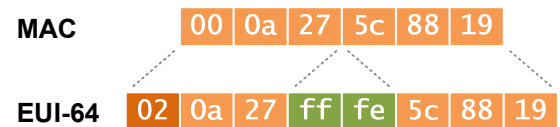
Address Formats

Global unicast

Global Prefix	Subnet	Interface ID
48	16	64

Link-local unicast

FE80::/64	Interface ID
64	64

Multicast

FF	Flags	Scope	Group ID
8	4	4	112

EUI-64 Formation

MAC

00	0a	27	5c	88	19

EUI-64

02	0a	27	ff	fe	5c	88	19
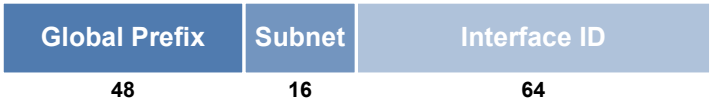
· Insert 0xfffe between the two halves of the MAC

· 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 : Decremented 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)

1111111010 (10 bits)	0 (54 bits)	Interface ID (64 bits)

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

1111111011 (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 OSPFIGP
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

IPv6 Extension Headers (NH = Next Header)

IPv6 Header NH = TCP		TCP Header + Data
IPv6 Header NH = Routing	Routing Header NH = TCP	TCP Header + Data
IPv6 Header NH = Routing	Routing Header NH = Fragment	Fragment Header NH = TCP	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*	0:0:0:0:0:0:A.B.C.D	
IPv4-Mapped IPv6	0:0:0:0:0:FFFF:A.B.C.D	
6to4	2002::/16	

Well Known Multicast Addresses

FF01:0:0:0:0:0:0:1	All Nodes Addresses	Interface-local
FF02:0:0:0:0:0:0:1	All Nodes Addresses	Link-local
FF01:0:0:0:0:0:0:2	All Routers Addresses	Interface-local
FF02:0:0:0:0:0:0:2	All Routers Addresses	Link-local
FF05:0:0:0:0:0:0:2	All Routers Addresses	Site-local
FF02:0:0:0:0:1:FFXX:XXXX	Solicited-Node Address	Link-local
FF02:0:0:0:0:0:0:4	DVMRP Routers	Link-local
FF02:0:0:0:0:0:0:5	OSPFIGP	Link-local
FF02:0:0:0:0:0:0:6	OSPFIGP DRs	Link-local
FF02:0:0:0:0:0:0:9	RIP Routers	Link-local
FF02:0:0:0:0:0:0:D	All PIM Routers	Link-local
FF02:0:0:0:0:0:0:16	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:0:0:0:0:0:0:101	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**

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