TCP/IP Cheat Sheet

Ethernet Frame

Destination Address	Source Address	Type	Payload	CRC
48 bits	48 bits	16 bits	46-1500 bytes	16 bits
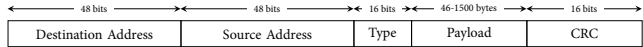
Type field values : 0x0806 | ARP   0x0800 | IPv4   0x86DD | IPv6

ARP Requests and Responses

32 bits

Hardware Type (Ethernet : 1, HDLC : 17)		Protocol Type (IPv4 : 0x0800)	
8 bits	8 bits	16 bits	
Hardware Address Length (m)	Protocol Address Length (n)	OpCode (1 : ARP Request, 2 : ARP Reply)	
Sender Hardware Address (m bits)			
Sender Protocol Address (n bits)			
Target Hardware Address (m bits)			
Target Protocol Address (n bits)			
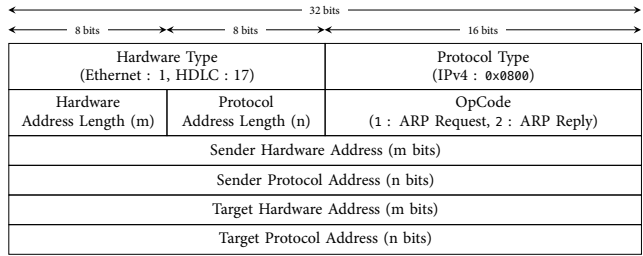
IPv4 Addresses

Class	First byte	Netid	Hostid	Start	End
A	0b1XXXXXXX	8 bits	24 bits	0.0.0.0	127.255.255.255
B	0b10XXXXXX	16 bits	16 bits	128.0.0.0	191.255.255.255
C	0b110XXXXX	24 bits	8 bits	192.0.0.0	223.255.255.255
D	0b1110XXXX	-	-	224.0.0.0	239.255.255.255

Special-purpose IPv4 Addresses

0.0.0.0/32	Unspecified address		
255.255.255.255/32	Limited Broadcast		
0.0.0.0/8	'This' network	169.254.0.0/16	Link-local
10.0.0.0/8	Private network	172.16.0.0/12	Private network
127.0.0.0/8	Loopback	192.168.0.0/16	Private network

IPv4 Packet Header

32 bits

4	IHL	ToS		Total Length	
4 bits	4 bits	8 bits		16 bits	
Identifier			0 D F M F	Fragment Offset	
TTL		Protocol		Header Checksum	
Source Address					
Destination Address					
Options + Padding					
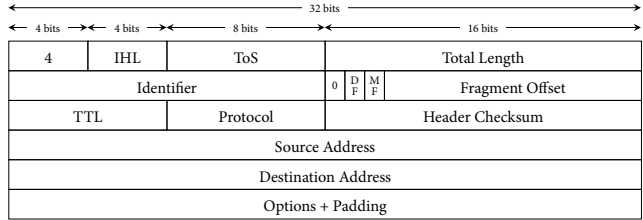
IHL	Internet Header Length (× 4 bytes)		
ToS	Type of Service	MF	More Fragment
TTL	Time To Live	DF	Don't Fragment

Protocol field values

0x01	ICMP	0x06	TCP
0x02	IGMP	0x11	UDP

IPv4 Options

0x00	EOL	0x83	Loose Routing
0x01	NOP	0x89	Strict Routing

ICMP Messages

ICMP Message Format

Type	Code	Checksum
8 bits	8 bits	16 bits
Message-specific data		

Destination Unreachable (Type 3)

Type = 3	Code = 0-5	Checksum
8 bits	8 bits	16 bits
Reserved		
IP Header + 64 bits of Original IP Packet		

Code 0	Net unreachable	Code 1	Host unreachable
Code 2	Protocol unreachable	Code 3	Port unreachable
Code 4	Fragmentation needed and DF set	Code 5	Source route failed

Time Exceeded (Type 11)

Type = 11	Code = 0,1	Checksum
8 bits	8 bits	16 bits
Reserved		
IP Header + 64 bits of dicarded IP Packet		
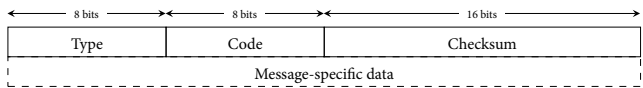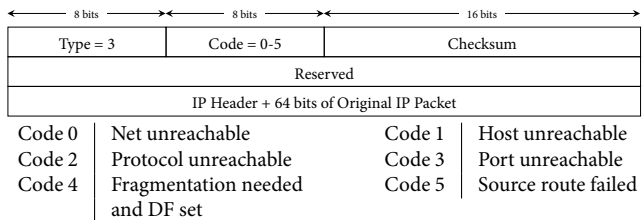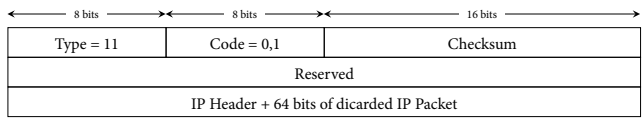
Code 0	Time to live exceeded in transit
Code 1	Fragment reassembly time exceeded

Parameter Problem (Type 12)

Type = 12	Code = 0	Checksum
8 bits	8 bits	16 bits
Reserved		
IP Header + 64 bits of dicarded IP Packet		

Redirect Message (Type 5)

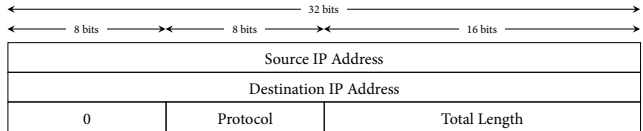| Type = 5	Code = 0	Checksum
8 bits	8 bits	16 bits
Gateway Internet Address (32 bits)		
IP Header + 64 bits of dicarded IP Packet		
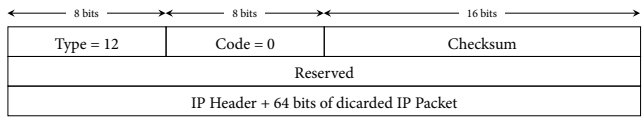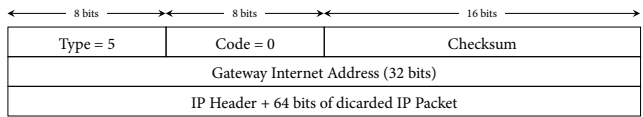
Code 0	Redirect datagrams for the Network
Code 1	Redirect datagrams for the Host
Code 2	Redirect datagrams for the Type of Service and Network
Code 3	Redirect datagrams for the Type of Service and Host

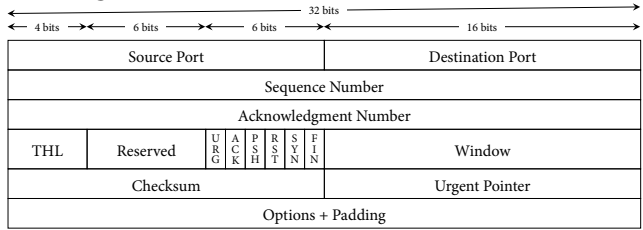*Echo Request and Reply Message (Type 8/0)*

Type = 8/0	Code = 0	Checksum
8 bits	8 bits	16 bits
Identifier		Sequence number
Data		
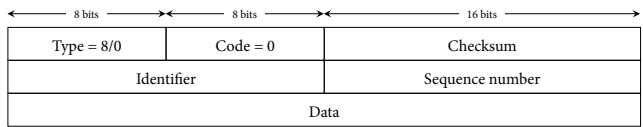
Type 0	Echo Reply
Type 8	Echo Request

IPv4 Pseudo-Header

32 bits

Source IP Address		
8 bits	8 bits	16 bits
Destination IP Address		
0	Protocol	Total Length

TCP Segment Header

32 bits

Source Port			Destination Port	
4 bits	6 bits	6 bits	16 bits	
Sequence Number				
Acknowledgment Number				
THL	Reserved	U R G A C K P S H R S T S Y N F I N	Window	
Checksum			Urgent Pointer	
Options + Padding				

THL	Transport Header Length (× 4 bytes)

TCP Flags

URG	Urgent data	RST	Reset
ACK	Acknowledgement	SYN	Synchronisation
PSH	Push	FIN	Fin

TCP Options

Type	Length	Option Value
8 bits	8 bits	(8 × Length) - 16 bits

Type	Length	
0x00	–	End of Options List (EOL)
0x01	–	No Operation (NOP)
0x02	0x04	Maximum Segment Size (MSS)
0x03	0x03	Window Scale (WScale)
0x08	0x0A	Timestamp (TS)

UDP Datagram Header

Source Port	Destination Port
16 bits	16 bits
Length	Checksum
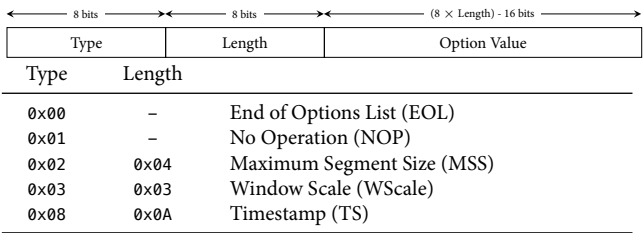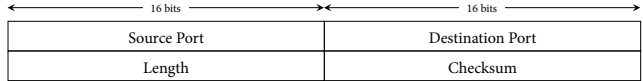
Well-known Port Numbers

ftp	20/21/tcp	ssh	22/tcp/udp	telnet	23/tcp
smtp	25/tcp	dns	53/tcp/udp	dhcp	67/68/udp
http	80/tcp	pop3	110/tcp	ntp	123/tcp/udp
imap4	143/tcp	snmp	161/upd	https	443/udp

DNS Messages

Identification		Q R	Opcode (4 bits)	A A	T C	R D	R A	0	rCode (4 bits)
16 bits		16 bits							
Number of Questions		Number of Answers RR							
Number of Authority RR		Number of Additional RR							
Questions									
Answers									
Authority									
Additional Informations									

Question Section

QNAME	QTYPE 1: A, 2: NS, 5: CNAME, 15: MX	QCLASS 1: IN (Internet)
n bytes	2 bytes	2 bytes

Answer Section

QNAME	QTYPE 1: A, 2: NS, 5: CNAME, 15: MX	QCLASS 1: IN (Internet)
n bytes	2 bytes	2 bytes
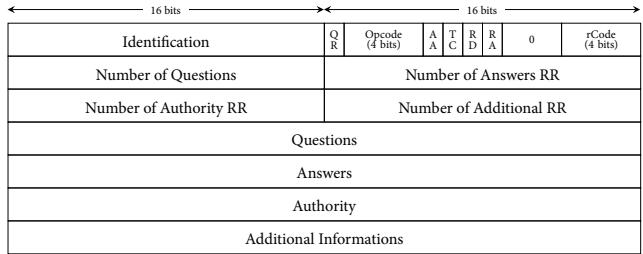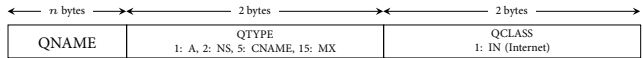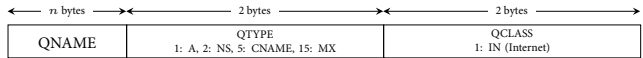
IPv6 Cheat Sheet

IPv6 Addresses

`2000::/3`	Global unicast		`fc00::/7`	Unique local
`fe80::/64`	Link-local		`ff00::/8`	Multicast[(*,**)]

(*) Mapped to Ethernet multicast MAC addressed 33–33–XX–XX–XX–XX
(**) Solicited-node multicast address: `ff02::1:ff00:0/104`

Special Purpose Addresses

`::/128`	Unspecified address		`::/0`	Default route
`::1/128`	Loopback			

IPv6 Packet Header

4 bits	8 bits	20 bits		
	16 bits		8 bits	8 bits
6	Traffic Class	Flow Label		
Playload Length		Next Header		Hop Limit
Source Address (16 bytes)				
Destination Address (16 bytes)				

Next Header field values

Header Extensions		Upper Layer Protocols	
`0x00`	Hop-by-hop	`0x06`	TCP
`0x2B`	Routing	`0x11`	UDP
`0x2C`	Fragment	`0x3A`	ICMPv6
`0x33`	Authentication	`0x3B`	No Next Header

Header Extensions

Routing Extension Header

8 bits	8 bits	8 bits	8 bits
Next Header	Length	Routing Type = 4	Segments Left
Last Entry	Flags	Tag	
Segment List[0] (16 bytes)			
...			
Segment List[N] (16 bytes)			
Optional Type Length Value objects (variable)			

Fragment Extension Header

8 bits	8 bits	13 bits	3 bits
Next Header	Reserved	Fragment Offset	R R M
Identification			

M = 1	More fragments	M = 0 Last fragment	R Reserved

IPv6 Pseudo-header

24 bits	8 bits
Source IPv6 Address (16 bytes)	
Destination IPv6 Address (16 bytes)	
Payload Length	
Reserved	Next Header

ICMPv6 Header & Messages

8 bits	8 bits	16 bits
Type	Code	Checksum
Message-specific data		

Destination Unreachable (Type 1)

8 bits	8 bits	16 bits
Type = 1	Code = 0-6	Checksum
Reserved		
Portion of the discarded packet (1280 bytes max.)		

Packet Too Big (Type 2)

8 bits	8 bits	16 bits
Type = 2	Code = 0	Checksum
MTU		
Portion of the discarded packet (1280 bytes max.)		

Time Exceeded (Type 3)

8 bits	8 bits	16 bits
Type = 3	Code = 0, 1	Checksum
Reserved		
Portion of the discarded packet (1280 bytes max.)		

Code 0	Hop limit exceeded in transit
Code 1	Fragmentation reassembly time exceeded

Parameter Problem (Type 4)

8 bits	8 bits	16 bits
Type = 4	Code = 0-2	Checksum
Pointer		
Portion of the discarded packet (1280 bytes max.)		

Code 0	Erroneous header field encountered
Code 1	Unrecognized Next Header type encountered
Code 2	Unrecognized IPv6 option encountered

Echo Request and Reply (Type 128 and 129)

8 bits	8 bits	16 bits
Type = 128, 129	Code = 0	Checksum
Identifier		Sequence number
Data		

Type 128	Echo Request
Type 129	Echo Reply

Neighbor Discovery Options

Source and Target Link-Layer Address Options (Type 1 and 2)

8 bits	8 bits	16 bits
Type = 1,2	Length = 1	Link-Layer Address (bytes 1-2)
Link-Layer Address (bytes 3-6)		

Type 1	Source link-layer address
Type 2	Target link-layer address

Prefix Information Option (Type 3)

8 bits	8 bits	16 bits	16 bits
Type = 3	Length = 4	Prefix Length L A	Reserved
Valid Lifetime			
Preferred Lifetime			
Reserved			
Prefix (64 bytes)			

L	On-link Flag
A	Autonomous address-configuration Flag

Redirected Header Option (Type 4)

8 bits	8 bits	16 bits
Type = 4	Length = 1	Reserved
Portion of the discarded packet (1280 bytes max.)		

MTU Option (Type 5)

8 bits	8 bits	16 bits
Type = 5	Length = 1	Reserved
MTU		

Neighbor Discovery Messages

Router Solicitation (Type 133)

8 bits	8 bits	16 bits
Type = 133	Code = 0	Checksum
Reserved		
Source Link-layer Address Option (8 bytes)		

Router Advertisement (Type 134)

8 bits	8 bits	16 bits
Type = 134	Code = 0	Checksum
Current Hop Limit M O Reserved		Router Lifetime
Reachable Time		
Retrans Timer		
Source Link-layer Address Option (8 bytes)		
MTU Option (8 bytes)		
Prefix Option $(8 + n \times 64$ bytes)		

M	Managed address configuration Flag
O	Stateful configuration Flag

Neighbor Solicitation (Type 135)

8 bits	8 bits	16 bits
Type = 135	Code = 0	Checksum
Reserved		
Target Unicast Address (16 bytes)		
Source Link-layer Address Option (8 bytes)		

Neighbor Advertisement (Type 136)

8 bits	8 bits	16 bits
Type = 136	Code = 0	Checksum
R S O 0		Reserved
Target Unicast Address (16 bytes)		
Source Link-layer Address Option (8 bytes)		

R	Router
S	Solicited
O	Override

Redirect (Type 137)

8 bits	8 bits	16 bits
Type = 137	Code = 0	Checksum
Reserved		
Target Address (16 bytes)		
Destination Address (16 bytes)		
Options		

Possible options: Target link-layer address, portion of the IP packet that caused the Redirect message (1280 bytes max.)

Multicast Listener Discovery

Multicast Listener Messages (Type 130, 131, 132)

8 bits	8 bits	16 bits
Type = 130-132	Code = 0	Checksum
Maximum Response Delay		Reserved
Multicast Address (16 bytes)		

Type 130	Multicast Listener Query
Type 131	Multicast Listener Report
Type 132	Multicast Listener Done