

UDP Header

Bit Number

1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

Source Port	Destination Port
Length	Checksum

UDP Header Information

Common UDP Well-Known Server Ports

7 echo	138 netbios-dgm
19 chargen	161 snmp
37 time	162 snmp-trap
53 domain	500 isakmp
67 bootps (DHCP)	514 syslog
68 bootpc (DHCP)	520 rip
69 tftp	33434 traceroute
137 netbios-ns	

Length

(Number of bytes in entire datagram including header; minimum value = 8)

Checksum

(Covers pseudo-header and entire UDP datagram)

ARP

Bit Number

1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1

Hardware Address Type		Protocol Address Type
H/w Addr Len	Prot. Addr Len	Operation
Source Hardware Address		
Source Hardware Addr (cont.)		Source Protocol Address
Source Protocol Addr (cont.)		Target Hardware Address
Target Hardware Address (cont.)		
Target Protocol Address		

ARP Parameters (for Ethernet and IPv4)

Hardware Address Type

- 1 Ethernet
- 6 IEEE 802 LAN

Protocol Address Type

2048 IPv4 (0x0800)

Hardware Address Length

6 for Ethernet/IEEE 802

Protocol Address Length

4 for IPv4

Operation

- 1 Request
- 2 Reply

DNS

Bit Number

1 1 1 1 1 1
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

ID.							
QR	Opcode	AA	TC	RD	RA	Z	RCODE
QDCOUNT							
ANCOUNT							
NSCOUNT							
ARCOUNT							
Question Section							
Answer Section							
Authority Section							
Additional Information Section							

DNS Parameters

Query/Response

- 0 Query
- 1 Response

Opcode

- 0 Standard query (QUERY)
- 1 Inverse query (IQUERY)
- 2 Server status request (STATUS)

AA

(1 = Authoritative Answer)

TC

(1 = TrunCation)

RD

(1 = Recursion Desired)

RA

(1 = Recursion Available)

Z

(Reserved; set to 0)

Response code

- 0 No error
- 1 Format error
- 2 Server failure
- 3 Non-existent domain (NXDOMAIN)
- 4 Query type not implemented
- 5 Query refused

QDCOUNT

(No. of entries in Question section)

ANCOUNT

(No. of resource records in Answer section)

NSCOUNT

(No. of name server resource records in Authority section)

ARCOUNT

(No. of resource records in Additional Information section.)



TCP/IP and tcpdump

POCKET REFERENCE GUIDE

SANS Institute

incidents@sans.org

+1 317.580.9756

http://www.sans.org

http://www.incidents.org

tcpdump Usage

```
tcpdump [-aenStvx] [-F file]
[-i int] [-r file] [-s snaplen]
[-w file] ['filter_expression']
```

- e Display data link header.
- F Filter expression in file.
- i Listen on int interface.
- n Don't resolve IP addresses.
- r Read packets from file.
- s Get snaplen bytes from each packet.
- S Use absolute TCP sequence numbers.
- t Don't print timestamp.
- v Verbose mode.
- w Write packets to file.
- x Display in hex.
- X Display in hex and ASCII.

Acronyms

AH	Authentication Header (RFC 2402)	ISAKMP	Internet Security Association & Key Management Protocol (RFC 2408)
ARP	Address Resolution Protocol (RFC 826)	L2TP	Layer 2 Tunneling Protocol (RFC 2661)
BGP	Border Gateway Protocol (RFC 1771)	NNTP	Network News Transfer Protocol (RFC 977)
CWR	Congestion Window Reduced (RFC 2481)	OSPF	Open Shortest Path First (RFC 1583)
DF	Don't Fragment bit (IP)	POP3	Post Office Protocol v3 (RFC 1460)
DHCP	Dynamic Host Configuration Protocol (RFC 2131)	RFC	Request for Comments
DNS	Domain Name System (RFC 1035)	RIP	Routing Information Protocol (RFC 2453)
ECN	Explicit Congestion Notification (RFC 3168)	LDAP	Lightweight Directory Access Protocol (RFC 2251)
EIGRP	Extended IGRP (Cisco)	SKIP	Simple Key-Management for Internet Protocols
ESP	Encapsulating Security Payload (RFC 2406)	SMTP	Simple Mail Transfer Protocol (RFC 821)
FTP	File Transfer Protocol (RFC 959)	SNMP	Simple Network Management Protocol (RFC 1157)
GRE	Generic Routing Encapsulation (RFC 2784)	SSH	Secure Shell
HTTP	Hypertext Transfer Protocol (RFC 1945)	SSL	Secure Sockets Layer (Netscape)
ICMP	Internet Control Message Protocol (RFC 792)	TCP	Transmission Control Protocol (RFC 793)
IGMP	Internet Group Management Protocol (RFC 2236)	TFTP	Trivial File Transfer Protocol (RFC 1350)
IGRP	Interior Gateway Routing Protocol (Cisco)	TOS	Type of Service field (IP)
IMAP	Internet Message Access Protocol (RFC 2060)	UDP	User Datagram Protocol (RFC 768)
IP	Internet Protocol (RFC 791)		

All RFCs can be found at <http://www.rfc-editor.org>

ICMP

Bit Number

1111111111222222222233
01234567890123456789012345678901

Type	Code	Checksum
Other message-specific information...		

Type Name/Codes (Code=0 unless otherwise specified)

- 0 Echo Reply
- 3 Destination Unreachable
 - 0 Net Unreachable
 - 1 Host Unreachable
 - 2 Protocol Unreachable
 - 3 Port Unreachable
 - 4 Fragmentation Needed & DF Set
 - 5 Source Route Failed
 - 6 Destination Network Unknown
 - 7 Destination Host Unknown
 - 8 Source Host Isolated
 - 9 Network Administratively Prohibited
 - 10 Host Administratively Prohibited
 - 11 Network Unreachable for TOS
 - 12 Host Unreachable for TOS
 - 13 Communication Administratively Prohibited
- 4 Source Quench
- 5 Redirect
 - 0 Redirect Datagram for the Network
 - 1 Redirect Datagram for the Host
 - 2 Redirect Datagram for the TOS & Network
 - 3 Redirect Datagram for the TOS & Host
- 8 Echo
- 9 Router Advertisement
- 10 Router Selection
- 11 Time Exceeded
 - 0 Time to Live exceeded in Transit
 - 1 Fragment Reassembly Time Exceeded
- 12 Parameter Problem
 - 0 Pointer indicates the error
 - 1 Missing a Required Option
 - 2 Bad Length
- 13 Timestamp
- 14 Timestamp Reply
- 15 Information Request
- 16 Information Reply
- 17 Address Mask Request
- 18 Address Mask Reply
- 30 Traceroute

PING (Echo/Echo Reply)

Bit Number

1111111111222222222233
01234567890123456789012345678901

Type (8 or 0)	Code (0)	Checksum
Identifier		Sequence Number
Data...		

IP Header

Bit Number

1111111111222222222233
01234567890123456789012345678901

Version	IHL	Type of Service	Total Length	
Identification		Flags	Fragment Offset	
Time to Live	Protocol	Header Checksum		
Source Address				
Destination Address				
Options (optional)				

IP Header Contents

Version

- 4 IP version 4

Internet Header Length

Number of 32-bit words in IP header; minimum value = 5 (20 bytes) & maximum value = 15 (60 bytes)

Type of Service (PreDTRC_x) --> Differentiated Services

- | | |
|------------------------------|----------------------------|
| Precedence (000-111) | 000 |
| D (1 = minimize delay) | 0 |
| T (1 = maximize throughput) | 0 |
| R (1 = maximize reliability) | 0 |
| C (1 = minimize cost) | 1 = ECN capable |
| x (reserved and set to 0) | 1 = congestion experienced |

Total Length

Number of bytes in packet; maximum length = 65,535

Flags (xDM)

- x (reserved and set to 0)
- D (1 = Don't Fragment)
- M (1 = More Fragments)

Fragment Offset

Position of this fragment in the original datagram, in units of 8 bytes

Protocol

- | | | |
|--------|--------|----------|
| 1 ICMP | 17 UDP | 57 SKIP |
| 2 IGMP | 47 GRE | 88 EIGRP |
| 6 TCP | 50 ESP | 89 OSPF |
| 9 IGRP | 51 AH | 115 L2TP |

Header Checksum

Covers IP header only

Addressing

- | | | |
|--------------------------------|----------------------------------|--|
| NET_ID | RFC 1918 PRIVATE ADDRESSES | |
| 0-127 Class A | 10.0.0.0-10.255.255.255 | |
| 128-191 Class B | 172.16.0.0-172.31.255.255 | |
| 192-223 Class C | 192.168.0.0-192.168.255.255 | |
| 224-239 Class D (multicast) | | |
| 240-255 Class E (experimental) | | |
| HOST_ID | 0 Network value; broadcast (old) | |
| | 255 Broadcast | |

Options (0-40 bytes; padded to 4-byte boundary)

- | | |
|-----------------------|-------------------------|
| 0 End of Options list | 68 Timestamp |
| 1 No operation (pad) | 131 Loose source route |
| 7 Record route | 137 Strict source route |

TCP Header

Bit Number

1111111111222222222233
01234567890123456789012345678901

Source Port		Destination Port	
Sequence Number			
Acknowledgment Number			
Offset (Header Length)	Reserved	Flags	Window
Checksum		Urgent Pointer	
Options (optional)			

TCP Header Contents

Common TCP Well-Known Server Ports

- | | |
|----------------|------------------|
| 7 echo | 110 pop3 |
| 19 chargen | 111 sunrpc |
| 20 ftp-data | 119 nntp |
| 21 ftp-control | 139 netbios-ssn |
| 22 ssh | 143 imap |
| 23 telnet | 179 bgp |
| 25 smtp | 389 ldap |
| 53 domain | 443 https (ssl) |
| 79 finger | 445 microsoft-ds |
| 80 http | 1080 socks |

Offset

Number of 32-bit words in TCP header; minimum value = 5

Reserved

- 4 bits; set to 0
- ECN bits (used when ECN employed; else 00)
 - CWR (1 = sender has cut congestion window in half)
 - ECN-Echo (1 = receiver cuts congestion window in half)

Flags (UAPRSF)

- U (1 = Urgent pointer valid)
- A (1 = Acknowledgement field value valid)
- P (1 = Push data)
- R (1 = Reset connection)
- S (1 = Synchronize sequence numbers)
- F (1 = no more data; Finish connection)

Checksum

Covers pseudoheader and entire TCP segment

Urgent Pointer

Points to the sequence number of the byte following urgent data.

Options

- | | |
|------------------------|--------------------|
| 0 End of Options list | 3 Window scale |
| 1 No operation (pad) | 4 Selective ACK ok |
| 2 Maximum segment size | 8 Timestamp |