TCPDUMP Command man page with examples

NAME

tcpdump − dump traffic on a network

SYNOPSIS

tcpdump [−**AdDeflLnNOpqRStuUvxX**] [−**c** *count*]
[−**C** *file_size*] [−**F** *file*]
[−**i** *interface*] [−**m** *module*] [−**M** *secret*]
[−**r** *file*] [−**s** *snaplen*] [−**T** *type*] [−**w** *file*]
[−**W** *filecount*]
[−**E** *spi@ipaddr algo:secret,...*]
[−**y** *datalinktype*] [−**Z** *user*] [*expression*]

DESCRIPTION

Tcpdump prints out the headers of packets on a network interface that match the boolean *expression*. It can also be run with the −**w** flag, which causes it to save the packet data to a file for later analysis, and/or with the −**r** flag, which causes it to read from a saved packet file rather than to read packets from a network interface. In all cases, only packets that match *expression* will be processed by *tcpdump*.

Tcpdump will, if not run with the −**c** flag, continue capturing packets until it is interrupted by a SIGINT signal (generated, for example, by typing your interrupt character, typically control-C) or a SIGTERM signal (typically generated with the **kill**(1) command); if run with the −**c** flag, it will capture packets until it is interrupted by a SIGINT or SIGTERM signal or the specified number of packets have been processed.

When *tcpdump* finishes capturing packets, it will report counts of:

packets ‘‘captured’’ (this is the number of packets that *tcpdump* has received and processed);

packets ‘‘received by filter’’ (the meaning of this depends on the OS on which you’re running *tcpdump*, and possibly on the way the OS was configured - if a filter was specified on the command line, on some OSes it counts packets regardless of whether they were matched by the filter expression and, even if they were matched by the filter expression, regardless of whether *tcpdump* has read and processed them yet, on other OSes it counts only packets that were matched by the filter expression regardless of whether *tcpdump* has read and processed them yet, and on other OSes it counts only packets that were matched by the filter expression and were processed by *tcpdump*);

packets ‘‘dropped by kernel’’ (this is the number of packets that were dropped, due to a lack of buffer space, by the packet capture mechanism in the OS on which *tcpdump* is running, if the OS reports that information to applications; if not, it will be reported as 0).

On platforms that support the SIGINFO signal, such as most BSDs (including Mac OS X) and Digital/Tru64 UNIX, it will report those counts when it receives a SIGINFO signal (generated, for example, by typing your ‘‘status’’ character, typically control-T, although on some platforms, such as Mac OS X, the ‘‘status’’ character is not set by default, so you must set it with **stty**(1) in order to use it) and will continue capturing packets.

Reading packets from a network interface may require that you have special privileges:

Under SunOS 3.*x* or 4.*x* with NIT or BPF:

You must have read access to */dev/nit* or */dev/bpf**.

Under Solaris with DLPI:

You must have read/write access to the network pseudo device, e.g. */dev/le*. On at least some versions of Solaris, however, this is not sufficient to allow *tcpdump* to capture in promiscuous mode; on those versions of Solaris, you must be root, or *tcpdump* must be installed setuid to root, in order to capture in promiscuous mode. Note that, on many (perhaps all) interfaces, if you don't capture in promiscuous mode, you will not see any outgoing packets, so a capture not done in promiscuous mode may not be very useful.

Under HP-UX with DLPI:

You must be root or *tcpdump* must be installed setuid to root.

Under IRIX with snoop:

You must be root or *tcpdump* must be installed setuid to root.

Under Linux:

You must be root or *tcpdump* must be installed setuid to root (unless your distribution has a kernel that supports capability bits such as CAP_NET_RAW and code to allow those capability bits to be given to particular accounts and to cause those bits to be set on a user's initial processes when they log in, in which case you must have CAP_NET_RAW in order to capture and CAP_NET_ADMIN to enumerate network devices with, for example, the **−D** flag).

Under ULTRIX and Digital UNIX/Tru64 UNIX:

Any user may capture network traffic with *tcpdump*. However, no user (not even the super-user) can capture in promiscuous mode on an interface unless the super-user has enabled promiscuous-mode operation on that interface using *pfconfig*(8), and no user (not even the super-user) can capture unicast traffic received by or sent by the machine on an interface unless the super-user has enabled copy-all-mode operation on that interface using *pfconfig*, so *useful* packet capture on an interface probably requires that either promiscuous-mode or copy-all-mode operation, or both modes of operation, be enabled on that interface.

Under BSD (this includes Mac OS X):

You must have read access to */dev/bpf**. On BSDs with a devfs (this includes Mac OS X), this might involve more than just having somebody with super-user access setting the ownership or permissions on the BPF devices - it might involve configuring devfs to set the ownership or permissions every time the system is booted, if the system even supports that; if it doesn't support that, you might have to find some other way to make that happen at boot time.

Reading a saved packet file doesn't require special privileges.

OPTIONS

−A Print each packet (minus its link level header) in ASCII. Handy for capturing web pages.

−c Exit after receiving *count* packets.

−C Before writing a raw packet to a savefile, check whether the file is currently larger than *file_size* and, if so, close the current savefile and open a new one. Savefiles after the first savefile will have the name specified with the **−w** flag, with a number after it, starting at 1 and continuing upward. The units of *file_size* are millions of bytes (1,000,000 bytes, not 1,048,576 bytes).

−d Dump the compiled packet-matching code in a human readable form to standard output and stop.

−dd Dump packet-matching code as a **C** program fragment.

−ddd Dump packet-matching code as decimal numbers (preceded with a count).

−D Print the list of the network interfaces available on the system and on which *tcpdump* can capture packets. For each network interface, a number and an interface name, possibly followed by a text description of the interface, is printed. The interface name

or the number can be supplied to the **−i** flag to specify an interface on which to capture.
This can be useful on systems that don't have a command to list them (e.g., Windows systems, or UNIX systems lacking **ifconfig −a**); the number can be useful on Windows 2000 and later systems, where the interface name is a somewhat complex string.

The **−D** flag will not be supported if *tcpdump* was built with an older version of *libpcap* that lacks the **pcap_findalldevs()** function.

−e Print the link-level header on each dump line.

−E Use *spi@ipaddr algo:secret* for decrypting IPsec ESP packets that are addressed to *addr* and contain Security Parameter Index value *spi*. This combination may be repeated with comma or newline seperation.
Note that setting the secret for IPv4 ESP packets is supported at this time.

Algorithms may be **des-cbc**, **3des-cbc**, **blowfish-cbc**, **rc3-cbc**, **cast128-cbc**, or **none**. The default is **des-cbc**. The ability to decrypt packets is only present if *tcpdump* was compiled with cryptography enabled.

secret is the ASCII text for ESP secret key. If preceeded by 0x, then a hex value will be read.

The option assumes RFC2406 ESP, not RFC1827 ESP. The option is only for debugging purposes, and the use of this option with a true 'secret' key is discouraged. By presenting IPsec secret key onto command line you make it visible to others, via *ps*(1) and other occasions.

In addition to the above syntax, the syntax *file name* may be used to have tcpdump read the provided file in. The file is opened upon receiving the first ESP packet, so any special permissions that tcpdump may have been given should already have been given up.

−f Print 'foreign' IPv4 addresses numerically rather than symbolically (this option is intended to get around serious brain damage in Sun's NIS server — usually it hangs forever translating non-local internet numbers).
The test for 'foreign' IPv4 addresses is done using the IPv4 address and netmask of the interface on which capture is being done. If that address or netmask are not available, available, either because the interface on which capture is being done has no address or netmask or because the capture is being done on the Linux "any" interface, which can capture on more than one interface, this option will not work correctly.

−F Use *file* as input for the filter expression. An additional expression given on the command line is ignored.

−i Listen on *interface*. If unspecified, *tcpdump* searches the system interface list for the lowest numbered, configured up interface (excluding loopback). Ties are broken by choosing the earliest match.
On Linux systems with 2.2 or later kernels, an *interface* argument of ''any'' can be used to capture packets from all interfaces. Note that captures on the ''any'' device will not be done in promiscuous mode.

If the **−D** flag is supported, an interface number as printed by that flag can be used as the *interface* argument.

−l Make stdout line buffered. Useful if you want to see the data while capturing it. E.g., ''tcpdump −l | tee dat'' or ''tcpdump −l > dat & tail −f dat''.

−L List the known data link types for the interface and exit.

−m Load SMI MIB module definitions from file *module*. This option can be used several times to load several MIB modules into *tcpdump*.

−M Use *secret* as a shared secret for validating the digests found in TCP segments with the TCP-MD5 option (RFC 2385), if present.

−n Don't convert addresses (i.e., host addresses, port numbers, etc.) to names.

−N Don't print domain name qualification of host names. E.g., if you give this flag then

tcpdump will print ‘‘nic’’ instead of ‘‘nic.ddn.mil’’.

−O Do not run the packet-matching code optimizer. This is useful only if you suspect a bug in the optimizer.

−p *Don’t* put the interface into promiscuous mode. Note that the interface might be in promiscuous mode for some other reason; hence, ‘-p’ cannot be used as an abbreviation for ‘ether host {local-hw-addr} or ether broadcast’.

−q Quick (quiet?) output. Print less protocol information so output lines are shorter.

−R Assume ESP/AH packets to be based on old specification (RFC1825 to RFC1829). If specified, *tcpdump* will not print replay prevention field. Since there is no protocol version field in ESP/AH specification, *tcpdump* cannot deduce the version of ESP/AH protocol.

−r Read packets from *file* (which was created with the **−w** option). Standard input is used if *file* is ‘‘-’’.

−S Print absolute, rather than relative, TCP sequence numbers.

−s Snarf *snaplen* bytes of data from each packet rather than the default of 68 (with SunOS’s NIT, the minimum is actually 96). 68 bytes is adequate for IP, ICMP, TCP and UDP but may truncate protocol information from name server and NFS packets (see below). Packets truncated because of a limited snapshot are indicated in the output with ‘‘[|*proto*]’’, where *proto* is the name of the protocol level at which the truncation has occurred. Note that taking larger snapshots both increases the amount of time it takes to process packets and, effectively, decreases the amount of packet buffering. This may cause packets to be lost. You should limit *snaplen* to the smallest number that will capture the protocol information you’re interested in. Setting *snaplen* to 0 means use the required length to catch whole packets.

−T Force packets selected by "*expression*" to be interpreted the specified *type*. Currently known types are **aodv** (Ad-hoc On-demand Distance Vector protocol), **cnfp** (Cisco NetFlow protocol), **rpc** (Remote Procedure Call), **rtp** (Real-Time Applications protocol), **rtcp** (Real-Time Applications control protocol), **snmp** (Simple Network Management Protocol), **tftp** (Trivial File Transfer Protocol), **vat** (Visual Audio Tool), and **wb** (distributed White Board).

−t *Don’t* print a timestamp on each dump line.

−tt Print an unformatted timestamp on each dump line.

−ttt Print a delta (in micro-seconds) between current and previous line on each dump line.

−tttt Print a timestamp in default format proceeded by date on each dump line.

−u Print undecoded NFS handles.

−U Make output saved via the **−w** option ‘‘packet-buffered’’; i.e., as each packet is saved, it will be written to the output file, rather than being written only when the output buffer fills.

The **−U** flag will not be supported if *tcpdump* was built with an older version of *libpcap* that lacks the **pcap_dump_flush()** function.

−v When parsing and printing, produce (slightly more) verbose output. For example, the time to live, identification, total length and options in an IP packet are printed. Also enables additional packet integrity checks such as verifying the IP and ICMP header checksum.

When writing to a file with the **−w** option, report, every 10 seconds, the number of packets captured.

−vv Even more verbose output. For example, additional fields are printed from NFS reply packets, and SMB packets are fully decoded.

−vvv Even more verbose output. For example, telnet **SB** ... **SE** options are printed in full. With **−X** Telnet options are printed in hex as well.

−w Write the raw packets to *file* rather than parsing and printing them out. They can later be printed with the −r option. Standard output is used if *file* is ‘‘-’’.

−W Used in conjunction with the *−C* option, this will limit the number of files created to the specified number, and begin overwriting files from the beginning, thus creating a ’rotating’ buffer. In addition, it will name the files with enough leading 0s to support the maximum number of files, allowing them to sort correctly.

−x Print each packet (minus its link level header) in hex. The smaller of the entire packet or *snaplen* bytes will be printed. Note that this is the entire link-layer packet, so for

link layers that pad (e.g. Ethernet), the padding bytes will also be printed when the higher layer packet is shorter than the required padding.

−xx Print each packet, *including* its link level header, in hex.

−X Print each packet (minus its link level header) in hex and ASCII. This is very handy for analysing new protocols.

−XX Print each packet, *including* its link level header, in hex and ASCII.

−y Set the data link type to use while capturing packets to *datalinktype*.

−Z Drops privileges (if root) and changes user ID to *user* and the group ID to the primary group of *user*.

This behavior can also be enabled by default at compile time.

expression

selects which packets will be dumped. If no *expression* is given, all packets on the net will be dumped. Otherwise, only packets for which *expression* is ‘true’ will be dumped.

The *expression* consists of one or more *primitives.* Primitives usually consist of an *id* (name or number) preceded by one or more qualifiers. There are three different kinds of qualifier:

type qualifiers say what kind of thing the id name or number refers to. Possible types are **host**, **net , port** and **portrange**. E.g., ‘host foo’, ‘net 128.3’, ‘port 20’, ‘portrange 6000-6008’. If there is no type qualifier, **host** is assumed.

dir qualifiers specify a particular transfer direction to and/or from *id*. Possible directions are **src**, **dst**, **src or dst** and **src and dst**. E.g., ‘src foo’, ‘dst net 128.3’, ‘src or dst port ftp-data’. If there is no dir qualifier, **src or dst** is assumed. For some link layers, such as SLIP and the ‘‘cooked’’ Linux capture mode used for the ‘‘any’’ device and for some other device types, the **inbound** and **outbound** qualifiers can be used to specify a desired direction.

proto qualifiers restrict the match to a particular protocol. Possible protos are: **ether**, **fddi**, **tr**, **wlan**, **ip**, **ip6**, **arp**, **rarp**, **decnet**, **tcp** and **udp**. E.g., ‘ether src foo’, ‘arp net 128.3’, ‘tcp port 21’, ‘udp portrange 7000-7009’. If there is no proto qualifier, all protocols consistent with the type are assumed. E.g., ‘src foo’ means ‘(ip or arp or rarp) src foo’ (except the latter is not legal syntax), ‘net bar’ means ‘(ip or arp or rarp) net bar’ and ‘port 53’ means ‘(tcp or udp) port 53’.

[‘fddi’ is actually an alias for ‘ether’; the parser treats them identically as meaning ‘‘the data link level used on the specified network interface.’’ FDDI headers contain Ethernet-like source and destination addresses, and often contain Ethernet-like packet types, so you can filter on these FDDI fields just as with the analogous Ethernet fields. FDDI headers also contain other fields, but you cannot name them explicitly in a filter expression.

Similarly, ‘tr’ and ‘wlan’ are aliases for ‘ether’; the previous paragraph’s statements about FDDI headers also apply to Token Ring and 802.11 wireless LAN headers. For 802.11 headers, the destination address is the DA field and the source address is the SA field; the BSSID, RA, and TA fields aren’t tested.]

In addition to the above, there are some special ‘primitive’ keywords that don’t follow the pattern: **gateway**, **broadcast**, **less**, **greater** and arithmetic expressions. All of these are described below.

More complex filter expressions are built up by using the words **and**, **or** and **not** to combine primitives. E.g., ‘host foo and not port ftp and not port ftp-data’. To save typing, identical qualifier lists can be omitted. E.g., ‘tcp dst port ftp or ftp-data or domain’ is exactly the same as ‘tcp dst port ftp or tcp dst port ftp-data or tcp dst port domain’.

Allowable primitives are:

dst host *host*
True if the IPv4/v6 destination field of the packet is *host*, which may be either an address or a name.

src host *host*
True if the IPv4/v6 source field of the packet is *host*.

host *host*
True if either the IPv4/v6 source or destination of the packet is *host*.
Any of the above host expressions can be prepended with the keywords, **ip**, **arp**, **rarp**, or **ip6** as in:
ip host *host*
which is equivalent to:
ether proto *ip* **and host** *host*
If *host* is a name with multiple IP addresses, each address will be checked for a match.

ether dst *ehost*
True if the Ethernet destination address is *ehost*. *Ehost* may be either a name from /etc/ethers or a number (see *ethers*(5) for numeric format).

ether src *ehost*
True if the Ethernet source address is *ehost*.

ether host *ehost*
True if either the Ethernet source or destination address is *ehost*.

gateway *host*
True if the packet used *host* as a gateway. I.e., the Ethernet source or destination address was *host* but neither the IP source nor the IP destination was *host*. *Host* must be a name and must be found both by the machine's host-name-to-IP-address resolution mechanisms (host name file, DNS, NIS, etc.) and by the machine's host-name-to-Ethernet-address resolution mechanism (/etc/ethers, etc.). (An equivalent expression is
ether host *ehost* **and not host** *host*
which can be used with either names or numbers for *host / ehost*.) This syntax does not work in IPv6-enabled configuration at this moment.

dst net *net*
True if the IPv4/v6 destination address of the packet has a network number of *net*. *Net* may be either a name from /etc/networks or a network number (see *networks(5)* for details).

src net *net*
True if the IPv4/v6 source address of the packet has a network number of *net*.

net *net*
True if either the IPv4/v6 source or destination address of the packet has a network number of *net*.

net *net* **mask** *netmask*
True if the IPv4 address matches *net* with the specific *netmask*. May be qualified with **src** or **dst**. Note that this syntax is not valid for IPv6 *net*.

net *net*/*len*
True if the IPv4/v6 address matches *net* with a netmask *len* bits wide. May be qualified with **src** or **dst**.

dst port *port*
True if the packet is ip/tcp, ip/udp, ip6/tcp or ip6/udp and has a destination port value of *port*. The *port* can be a number or a name used in /etc/services (see *tcp*(7) and *udp*(7)). If a name is used, both the port number and protocol are checked. If a number or ambiguous name is used, only the port number is checked (e.g., **dst port 513** will print both tcp/login traffic and udp/who traffic, and **port domain** will print both tcp/domain and udp/domain traffic).

src port *port*
True if the packet has a source port value of *port*.

port *port*
True if either the source or destination port of the packet is *port*.

dst portrange *port1-port2*
True if the packet is ip/tcp, ip/udp, ip6/tcp or ip6/udp and has a destination port value between *port1* and *port2*. *port1* and *port2* are interpreted in the same fashion as the *port* parameter for **port**.

src portrange *port1-port2*
True if the packet has a source port value between *port1* and *port2*.

portrange *port1-port2*
True if either the source or destination port of the packet is between *port1* and *port2*.

Any of the above port or port range expressions can be prepended with the keywords, **tcp** or **udp**, as in:

```
tcp src port port
```

which matches only tcp packets whose source port is *port*.

less *length*
True if the packet has a length less than or equal to *length*. This is equivalent to:

```
len <= length.
```

greater *length*
True if the packet has a length greater than or equal to *length*. This is equivalent to:

```
len >= length.
```

ip proto *protocol*
True if the packet is an IPv4 packet (see *ip*(4P)) of protocol type *protocol*. *Protocol* can be a number or one of the names **icmp**, **icmp6**, **igmp**, **igrp**, **pim**, **ah**, **esp**, **vrrp**, **udp**, or **tcp**. Note that the identifiers **tcp**, **udp**, and **icmp** are also keywords and must be escaped via backslash (\), which is \\ in the C-shell. Note that this primitive does not chase the protocol header chain.

ip6 proto *protocol*
True if the packet is an IPv6 packet of protocol type *protocol*. Note that this primitive does not chase the protocol header chain.

ip6 protochain *protocol*
True if the packet is IPv6 packet, and contains protocol header with type *protocol* in its protocol header chain. For example,

```
ip6 protochain 6
```

matches any IPv6 packet with TCP protocol header in the protocol header chain. The packet may contain, for example, authentication header, routing header, or hop-by-hop option header, between IPv6 header and TCP header. The BPF code emitted by this primitive is complex and cannot be optimized by BPF optimizer code in *tcpdump*, so this can be somewhat slow.

ip protochain *protocol*
Equivalent to **ip6 protochain** *protocol*, but this is for IPv4.

ether broadcast
True if the packet is an Ethernet broadcast packet. The *ether* keyword is optional.

ip broadcast
True if the packet is an IPv4 broadcast packet. It checks for both the all-zeroes and all-ones broadcast conventions, and looks up the subnet mask on the interface on which the capture is being done.

If the subnet mask of the interface on which the capture is being done is not available, either because the interface on which capture is being done has no netmask or because the capture is being done on the Linux "any" interface, which can capture on more than one interface, this check will not work correctly.

ether multicast

True if the packet is an Ethernet multicast packet. The **ether** keyword is optional. This is shorthand for '**ether[0] & 1 != 0**'.

ip multicast

True if the packet is an IPv4 multicast packet.

ip6 multicast

True if the packet is an IPv6 multicast packet.

ether proto *protocol*

True if the packet is of ether type *protocol*. *Protocol* can be a number or one of the names **ip**, **ip6**, **arp**, **rarp**, **atalk**, **aarp**, **decnet**, **sca**, **lat**, **mopdl**, **moprc**, **iso**, **stp**, **ipx**, or **netbeui**. Note these identifiers are also keywords and must be escaped via backslash (\).

[In the case of FDDI (e.g., '**fddi protocol arp**'), Token Ring (e.g., '**tr protocol arp**'), and IEEE 802.11 wireless LANS (e.g., '**wlan protocol arp**'), for most of those protocols, the protocol identification comes from the 802.2 Logical Link Control (LLC) header, which is usually layered on top of the FDDI, Token Ring, or 802.11 header.

When filtering for most protocol identifiers on FDDI, Token Ring, or 802.11, *tcpdump* checks only the protocol ID field of an LLC header in so-called SNAP format with an Organizational Unit Identifier (OUI) of 0x000000, for encapsulated Ethernet; it doesn't check whether the packet is in SNAP format with an OUI of 0x000000. The exceptions are:

iso *tcpdump* checks the DSAP (Destination Service Access Point) and SSAP (Source Service Access Point) fields of the LLC header;

stp and **netbeui**

tcpdump checks the DSAP of the LLC header;

atalk *tcpdump* checks for a SNAP-format packet with an OUI of 0x080007 and the AppleTalk etype.

In the case of Ethernet, *tcpdump* checks the Ethernet type field for most of those protocols. The exceptions are:

iso, **stp**, and **netbeui**

tcpdump checks for an 802.3 frame and then checks the LLC header as it does for FDDI, Token Ring, and 802.11;

atalk *tcpdump* checks both for the AppleTalk etype in an Ethernet frame and for a SNAP-format packet as it does for FDDI, Token Ring, and 802.11;

aarp *tcpdump* checks for the AppleTalk ARP etype in either an Ethernet frame or an 802.2 SNAP frame with an OUI of 0x000000;

ipx *tcpdump* checks for the IPX etype in an Ethernet frame, the IPX DSAP in the LLC header, the 802.3-with-no-LLC-header encapsulation of IPX, and the IPX etype in a SNAP frame.

decnet src *host*

True if the DECNET source address is *host*, which may be an address of the form ''10.123'', or a DECNET host name. [DECNET host name support is only available on ULTRIX systems that are configured to run DECNET.]

decnet dst *host*

True if the DECNET destination address is *host*.

decnet host *host*

True if either the DECNET source or destination address is *host*.

ifname *interface*

True if the packet was logged as coming from the specified interface (applies only to packets logged by OpenBSD's **pf**(4)).

on *interface*

Synonymous with the **ifname** modifier.

rnr *num*
True if the packet was logged as matching the specified PF rule number (applies only to packets logged by OpenBSD's **pf**(4)).

rulenum *num*
Synonomous with the **rnr** modifier.

reason *code*
True if the packet was logged with the specified PF reason code. The known codes are: **match**, **bad-offset**, **fragment**, **short**, **normalize**, and **memory** (applies only to packets logged by OpenBSD's **pf**(4)).

rset *name*
True if the packet was logged as matching the specified PF ruleset name of an anchored ruleset (applies only to packets logged by **pf**(4)).

ruleset *name*
Synonomous with the **rset** modifier.

srnr *num*
True if the packet was logged as matching the specified PF rule number of an anchored ruleset (applies only to packets logged by **pf**(4)).

subrulenum *num*
Synonomous with the **srnr** modifier.

action *act*
True if PF took the specified action when the packet was logged. Known actions are: **pass** and **block** (applies only to packets logged by OpenBSD's **pf**(4)).

ip, **ip6**, **arp**, **rarp**, **atalk**, **aarp**, **decnet**, **iso**, **stp**, **ipx**, *netbeui*
Abbreviations for:
ether proto *p*
where *p* is one of the above protocols.

lat, **moprc**, **mopdl**
Abbreviations for:
ether proto *p*
where *p* is one of the above protocols. Note that *tcpdump* does not currently know how to parse these protocols.

vlan *[vlan_id]*
True if the packet is an IEEE 802.1Q VLAN packet. If *[vlan_id]* is specified, only true if the packet has the specified *vlan_id*. Note that the first **vlan** keyword encountered in *expression* changes the decoding offsets for the remainder of *expression* on the assumption that the packet is a VLAN packet. The **vlan** *[vlan_id]* expression may be used more than once, to filter on VLAN hierarchies. Each use of that expression increments the filter offsets by 4.

For example:
vlan 100 && vlan 200
filters on VLAN 200 encapsulated within VLAN 100, and
vlan && vlan 300 && ip
filters IPv4 protocols encapsulated in VLAN 300 encapsulated within any higher order VLAN.

mpls *[label_num]*
True if the packet is an MPLS packet. If *[label_num]* is specified, only true is the packet has the specified *label_num*. Note that the first **mpls** keyword encountered in *expression* changes the decoding offsets for the remainder of *expression* on the assumption that the packet is a MPLS-encapsulated IP packet. The **mpls** *[label_num]* expression may be used more than once, to filter on MPLS hierarchies. Each use of that expression increments the filter offsets by 4.

For example:
mpls 100000 && mpls 1024
filters packets with an outer label of 100000 and an inner label of 1024, and
mpls && mpls 1024 && host 192.9.200.1
filters packets to or from 192.9.200.1 with an inner label of 1024 and any

outer label.

pppoed True if the packet is a PPP-over-Ethernet Discovery packet (Ethernet type 0x8863).

pppoes True if the packet is a PPP-over-Ethernet Session packet (Ethernet type 0x8864). Note that the first **pppoes** keyword encountered in *expression* changes the decoding offsets for the remainder of *expression* on the assumption that the packet is a PPPoE session packet.

For example:

pppoes && ip

filters IPv4 protocols encapsulated in PPPoE.

tcp, **udp**, **icmp**

Abbreviations for:

ip proto *p* **or ip6 proto** *p*

where *p* is one of the above protocols.

iso proto *protocol*

True if the packet is an OSI packet of protocol type *protocol*. *Protocol* can be a number or one of the names **clnp**, **esis**, or **isis**.

clnp, **esis**, **isis**

Abbreviations for:

iso proto *p*

where *p* is one of the above protocols.

l1, **l2**, **iih**, **lsp**, **snp**, **csnp**, **psnp**

Abbreviations for IS-IS PDU types.

vpi *n* True if the packet is an ATM packet, for SunATM on Solaris, with a virtual path identifier of *n*.

vci *n* True if the packet is an ATM packet, for SunATM on Solaris, with a virtual channel identifier of *n*.

lane True if the packet is an ATM packet, for SunATM on Solaris, and is an ATM LANE packet. Note that the first **lane** keyword encountered in *expression* changes the tests done in the remainder of *expression* on the assumption that the packet is either a LANE emulated Ethernet packet or a LANE LE Control packet. If **lane** isn't specified, the tests are done under the assumption that the packet is an LLC-encapsulated packet.

llc True if the packet is an ATM packet, for SunATM on Solaris, and is an LLC-encapsulated packet.

oamf4s True if the packet is an ATM packet, for SunATM on Solaris, and is a segment OAM F4 flow cell (VPI=0 & VCI=3).

oamf4e True if the packet is an ATM packet, for SunATM on Solaris, and is an end-to-end OAM F4 flow cell (VPI=0 & VCI=4).

oamf4 True if the packet is an ATM packet, for SunATM on Solaris, and is a segment or end-to-end OAM F4 flow cell (VPI=0 & (VCI=3 | VCI=4)).

oam True if the packet is an ATM packet, for SunATM on Solaris, and is a segment or end-to-end OAM F4 flow cell (VPI=0 & (VCI=3 | VCI=4)).

metac True if the packet is an ATM packet, for SunATM on Solaris, and is on a meta signaling circuit (VPI=0 & VCI=1).

bcc True if the packet is an ATM packet, for SunATM on Solaris, and is on a broadcast signaling circuit (VPI=0 & VCI=2).

sc True if the packet is an ATM packet, for SunATM on Solaris, and is on a signaling circuit (VPI=0 & VCI=5).

ilmic True if the packet is an ATM packet, for SunATM on Solaris, and is on an ILMI circuit (VPI=0 & VCI=16).

connectmsg

True if the packet is an ATM packet, for SunATM on Solaris, and is on a signaling circuit and is a Q.2931 Setup, Call Proceeding, Connect, Connect Ack, Release, or Release Done message.

metaconnect

True if the packet is an ATM packet, for SunATM on Solaris, and is on a meta signaling circuit and is a Q.2931 Setup, Call Proceeding, Connect,

Release, or Release Done message.

expr relop expr

True if the relation holds, where *relop* is one of >, <, >=, <=, =, !=, and *expr* is an arithmetic expression composed of integer constants (expressed in standard C syntax), the normal binary operators [+, -, *, /, &, |, <<, >>], a length operator, and special packet data accessors. Note that all comparisons are unsigned, so that, for example, 0x80000000 and 0xffffffff are > 0. To access data inside the packet, use the following syntax:

```
proto [ expr : size ]
```

Proto is one of **ether, fddi, tr, wlan, ppp, slip, link, ip, arp, rarp, tcp, udp, icmp, ip6** or **radio**, and indicates the protocol layer for the index operation. (**ether, fddi, wlan, tr, ppp, slip** and **link** all refer to the link layer. **radio** refers to the "radio header" added to some 802.11 captures.) Note that *tcp*, *udp* and other upper-layer protocol types only apply to IPv4, not IPv6 (this will be fixed in the future). The byte offset, relative to the indicated protocol layer, is given by *expr*. *Size* is optional and indicates the number of bytes in the field of interest; it can be either one, two, or four, and defaults to one. The length operator, indicated by the keyword **len**, gives the length of the packet.

For example, '**ether[0] & 1 != 0**' catches all multicast traffic. The expression '**ip[0] & 0xf != 5**' catches all IPv4 packets with options. The expression '**ip[6:2] & 0x1fff = 0**' catches only unfragmented IPv4 datagrams and frag zero of fragmented IPv4 datagrams. This check is implicitly applied to the **tcp** and **udp** index operations. For instance, **tcp[0]** always means the first byte of the TCP *header*, and never means the first byte of an intervening fragment.

Some offsets and field values may be expressed as names rather than as numeric values. The following protocol header field offsets are available: **icmptype** (ICMP type field), **icmpcode** (ICMP code field), and **tcpflags** (TCP flags field).

The following ICMP type field values are available: **icmp-echoreply**, **icmp-unreach**, **icmp-sourcequench**, **icmp-redirect**, **icmp-echo**, **icmp-routeradvert**, **icmp-routersolicit**, **icmp-timxceed**, **icmp-paramprob**, **icmp-tstamp**, **icmp-tstampreply**, **icmp-ireq**, **icmp-ireqreply**, **icmp-maskreq**, **icmp-maskreply**.

The following TCP flags field values are available: **tcp-fin**, **tcp-syn**, **tcp-rst**, **tcp-push**, **tcp-ack**, **tcp-urg**.

Primitives may be combined using:

A parenthesized group of primitives and operators (parentheses are special to the Shell and must be escaped).

Negation ('**!**' or '**not**').

Concatenation ('**&&**' or '**and**').

Alternation ('||' or '**or**').

Negation has highest precedence. Alternation and concatenation have equal precedence and associate left to right. Note that explicit **and** tokens, not juxtaposition, are now required for concatenation.

If an identifier is given without a keyword, the most recent keyword is assumed. For example,

```
not host vs and ace
```

is short for

not host vs and host ace

which should not be confused with

not (host vs or ace)

Expression arguments can be passed to *tcpdump* as either a single argument or as multiple arguments, whichever is more convenient. Generally, if the expression contains Shell metacharacters, it is easier to pass it as a single, quoted argument. Multiple arguments are concatenated with spaces before being parsed.

EXAMPLES

To print all packets arriving at or departing from *sundown*:

tcpdump host sundown

To print traffic between *helios* and either *hot* or *ace*:

tcpdump host helios and \(hot or ace \)

To print all IP packets between *ace* and any host except *helios*:

tcpdump ip host ace and not helios

To print all traffic between local hosts and hosts at Berkeley:

tcpdump net ucb-ether

To print all ftp traffic through internet gateway *snup*: (note that the expression is quoted to prevent the shell from (mis-)interpreting the parentheses):

tcpdump 'gateway snup and (port ftp or ftp-data)'

To print traffic neither sourced from nor destined for local hosts (if you gateway to one other net, this stuff should never make it onto your local net).

tcpdump ip and not net *localnet*

To print the start and end packets (the SYN and FIN packets) of each TCP conversation that involves a non-local host.

tcpdump 'tcp[tcpflags] & (tcp-syn|tcp-fin) != 0 and not src and dst net *localnet*'

To print all IPv4 HTTP packets to and from port 80, i.e. print only packets that contain data, not, for example, SYN and FIN packets and ACK-only packets. (IPv6 is left as an exercise for the reader.)

tcpdump 'tcp port 80 and (((ip[2:2] - ((ip[0]&0xf)<<2)) - ((tcp[12]&0xf0)>>2)) != 0)'

To print IP packets longer than 576 bytes sent through gateway *snup*:

tcpdump 'gateway snup and ip[2:2] > 576'

To print IP broadcast or multicast packets that were *not* sent via Ethernet broadcast or multicast:

tcpdump 'ether[0] & 1 = 0 and ip[16] >= 224'

To print all ICMP packets that are not echo requests/replies (i.e., not ping packets):

tcpdump 'icmp[icmptype] != icmp-echo and icmp[icmptype] != icmp-echoreply'

OUTPUT FORMAT

The output of *tcpdump* is protocol dependent. The following gives a brief description and examples of most of the formats.

Link Level Headers

If the '-e' option is given, the link level header is printed out. On Ethernets, the source and destination addresses, protocol, and packet length are printed.

On FDDI networks, the '-e' option causes *tcpdump* to print the 'frame control' field, the source and destination addresses, and the packet length. (The 'frame control' field governs the interpretation of the rest of the packet. Normal packets (such as those containing IP datagrams) are 'async' packets, with a priority value between 0 and 7; for example, '**async4**'. Such packets are assumed to contain an 802.2 Logical Link Control (LLC) packet; the LLC header is printed if it is *not* an ISO datagram or a so-called SNAP packet.

On Token Ring networks, the '-e' option causes *tcpdump* to print the 'access control' and 'frame control' fields, the source and destination addresses, and the packet length. As on FDDI networks, packets are assumed to contain an LLC packet. Regardless of whether the '-e' option is specified or not, the source routing information is printed for source-routed packets.

On 802.11 networks, the '-e' option causes *tcpdump* to print the 'frame control' fields, all of the addresses in the 802.11 header, and the packet length. As on FDDI networks, packets are assumed to contain an LLC packet.

(N.B.: The following description assumes familiarity with the SLIP compression algorithm described in RFC-1144.)

On SLIP links, a direction indicator (''I'' for inbound, ''O'' for outbound), packet type, and compression information are printed out. The packet type is printed first. The three types are *ip*, *utcp*, and *ctcp*. No further link information is printed for *ip* packets. For TCP packets, the connection identifier is printed following the type. If the packet is compressed, its encoded header is printed out. The special cases are printed out as ***S+***n* and ***SA+***n*, where *n* is the amount by which the sequence number (or sequence number and ack) has changed. If it is not a special case, zero or more changes are printed. A change is indicated by U (urgent pointer), W (window), A (ack), S (sequence number), and I (packet ID), followed by a delta (+n or -n), or a new value (=n). Finally, the amount of data in the packet and compressed header length are printed.

For example, the following line shows an outbound compressed TCP packet, with an implicit connection identifier; the ack has changed by 6, the sequence number by 49, and the packet ID by 6; there are 3 bytes of data and 6 bytes of compressed header:

```
O ctcp * A+6 S+49 I+6 3 (6)
```

ARP/RARP Packets

Arp/rarp output shows the type of request and its arguments. The format is intended to be self explanatory. Here is a short sample taken from the start of an 'rlogin' from host *rtsg* to host *csam*:

```
arp who-has csam tell rtsg
arp reply csam is-at CSAM
```

The first line says that rtsg sent an arp packet asking for the Ethernet address of internet host csam. Csam replies with its Ethernet address (in this example, Ethernet addresses are in caps and internet addresses in lower case).

This would look less redundant if we had done *tcpdump −n*:

```
arp who-has 128.3.254.6 tell 128.3.254.68
arp reply 128.3.254.6 is-at 02:07:01:00:01:c4
```

If we had done *tcpdump −e*, the fact that the first packet is broadcast and the second is point-to-point would be visible:

```
RTSG Broadcast 0806  64: arp who-has csam tell rtsg
CSAM RTSG 0806  64: arp reply csam is-at CSAM
```

For the first packet this says the Ethernet source address is RTSG, the destination is the Ethernet broadcast address, the type field contained hex 0806 (type ETHER_ARP) and the total length was 64 bytes.

TCP Packets

(N.B.:The following description assumes familiarity with the TCP protocol described in RFC-793. If you are not familiar with the protocol, neither this description nor tcpdump will be of much use to you.)

The general format of a tcp protocol line is:

```
src > dst: flags data-seqno ack window urgent options
```

Src and *dst* are the source and destination IP addresses and ports. *Flags* are some combination of S (SYN), F (FIN), P (PUSH), R (RST), W (ECN CWR) or E (ECN-Echo), or a single '.' (no flags). *Data-seqno* describes the portion of sequence space covered by the data in this packet (see example below). *Ack* is sequence number of the next data expected the other direction on this connection. *Window* is the number of bytes of receive buffer space available the other direction on this connection. *Urg* indicates there is 'urgent' data in the packet. *Options* are tcp options enclosed in angle brackets (e.g., <mss 1024>).

Src, *dst* and *flags* are always present. The other fields depend on the contents of the packet's tcp protocol header and are output only if appropriate.

Here is the opening portion of an rlogin from host *rtsg* to host *csam*.

```
rtsg.1023 > csam.login: S 768512:768512(0) win 4096 <mss 1024>
csam.login > rtsg.1023: S 947648:947648(0) ack 768513 win 4096 <mss 1024>
rtsg.1023 > csam.login: . ack 1 win 4096
rtsg.1023 > csam.login: P 1:2(1) ack 1 win 4096
csam.login > rtsg.1023: . ack 2 win 4096
rtsg.1023 > csam.login: P 2:21(19) ack 1 win 4096
csam.login > rtsg.1023: P 1:2(1) ack 21 win 4077
csam.login > rtsg.1023: P 2:3(1) ack 21 win 4077 urg 1
csam.login > rtsg.1023: P 3:4(1) ack 21 win 4077 urg 1
```

The first line says that tcp port 1023 on rtsg sent a packet to port *login* on csam. The **S** indicates that the *SYN* flag was set. The packet sequence number was 768512 and it contained no data. (The notation is ‘first:last(nbytes)’ which means ‘sequence numbers *first* up to but not including *last* which is *nbytes* bytes of user data’.) There was no piggy-backed ack, the available receive window was 4096 bytes and there was a max-segment-size option requesting an mss of 1024 bytes.

Csam replies with a similar packet except it includes a piggy-backed ack for rtsg’s SYN. Rtsg then acks csam’s SYN. The ‘.’ means no flags were set. The packet contained no data so there is no data sequence number. Note that the ack sequence number is a small integer (1). The first time *tcpdump* sees a tcp ‘conversation’, it prints the sequence number from the packet. On subsequent packets of the conversation, the difference between the current packet’s sequence number and this initial sequence number is printed. This means that sequence numbers after the first can be interpreted as relative byte positions in the conversation’s data stream (with the first data byte each direction being ‘1’). ‘-S’ will override this feature, causing the original sequence numbers to be output.

On the 6th line, rtsg sends csam 19 bytes of data (bytes 2 through 20 in the rtsg → csam side of the conversation). The PUSH flag is set in the packet. On the 7th line, csam says it’s received data sent by rtsg up to but not including byte 21. Most of this data is apparently sitting in the socket buffer since csam’s receive window has gotten 19 bytes smaller. Csam also sends one byte of data to rtsg in this packet. On the 8th and 9th lines, csam sends two bytes of urgent, pushed data to rtsg.

If the snapshot was small enough that *tcpdump* didn’t capture the full TCP header, it interprets as much of the header as it can and then reports ‘‘[|*tcp*]’’ to indicate the remainder could not be interpreted. If the header contains a bogus option (one with a length that’s either too small or beyond the end of the header), *tcpdump* reports it as ‘‘[*bad opt*]’’ and does not interpret any further options (since it’s impossible to tell where they start). If the header length indicates options are present but the IP datagram length is not long enough for the options to actually be there, *tcpdump* reports it as ‘‘[*bad hdr length*]’’.

Capturing TCP packets with particular flag combinations (SYN-ACK, URG-ACK, etc.)

There are 8 bits in the control bits section of the TCP header:

CWR | *ECE* | *URG* | *ACK* | *PSH* | *RST* | *SYN* | *FIN*

Let’s assume that we want to watch packets used in establishing a TCP connection. Recall that TCP uses a 3-way handshake protocol when it initializes a new connection; the connection sequence with regard to the TCP control bits is

1) Caller sends SYN
2) Recipient responds with SYN, ACK
3) Caller sends ACK

Now we’re interested in capturing packets that have only the SYN bit set (Step 1). Note that we don’t want packets from step 2 (SYN-ACK), just a plain initial SYN. What we need is a correct filter expression for *tcpdump*.

Recall the structure of a TCP header without options:

```
 0                            15                              31
-----------------------------------------------------------------
|          source port          |       destination port        |
-----------------------------------------------------------------
```

```
|                        sequence number                        |
--------------------------------------------------------------------
|                     acknowledgment number                     |
--------------------------------------------------------------------
|  HL   | rsvd  |C|E|U|A|P|R|S|F|        window size            |
--------------------------------------------------------------------
|         TCP checksum          |       urgent pointer          |
--------------------------------------------------------------------
```

A TCP header usually holds 20 octets of data, unless options are present. The first line of the graph contains octets 0 - 3, the second line shows octets 4 - 7 etc.

Starting to count with 0, the relevant TCP control bits are contained in octet 13:

```
 0             7|             15|             23|             31
----------------|---------------|---------------|----------------
|  HL   | rsvd  |C|E|U|A|P|R|S|F|        window size            |
----------------|---------------|---------------|----------------
|                |  13th octet   |               |               |
```

Let’s have a closer look at octet no. 13:

```
                |               |
                |---------------|
                |C|E|U|A|P|R|S|F|
                |---------------|
                |7   5   3     0|
```

These are the TCP control bits we are interested in. We have numbered the bits in this octet from 0 to 7, right to left, so the PSH bit is bit number 3, while the URG bit is number 5.

Recall that we want to capture packets with only SYN set. Let’s see what happens to octet 13 if a TCP datagram arrives with the SYN bit set in its header:

```
                |C|E|U|A|P|R|S|F|
                |---------------|
                |0 0 0 0 0 0 1 0|
                |---------------|
                |7 6 5 4 3 2 1 0|
```

Looking at the control bits section we see that only bit number 1 (SYN) is set.

Assuming that octet number 13 is an 8-bit unsigned integer in network byte order, the binary value of this octet is

00000010

and its decimal representation is

```
   7     6     5     4     3     2     1     0
0*2 + 0*2 + 0*2 + 0*2 + 0*2 + 0*2 + 1*2 + 0*2  =  2
```

We’re almost done, because now we know that if only SYN is set, the value of the 13th octet in the TCP header, when interpreted as a 8-bit unsigned integer in network byte order, must be exactly 2.

This relationship can be expressed as

tcp[13] == 2

We can use this expression as the filter for *tcpdump* in order to watch packets which have only SYN set:

tcpdump -i xl0 tcp[13] == 2

The expression says "let the 13th octet of a TCP datagram have the decimal value 2", which is exactly what we want.

Now, let's assume that we need to capture SYN packets, but we don't care if ACK or any other TCP control bit is set at the same time. Let's see what happens to octet 13 when a TCP datagram with SYN-ACK set arrives:

```
|C|E|U|A|P|R|S|F|
|---------------|
|0 0 0 1 0 0 1 0|
|---------------|
|7 6 5 4 3 2 1 0|
```

Now bits 1 and 4 are set in the 13th octet. The binary value of octet 13 is

00010010

which translates to decimal

```
   7     6     5     4     3     2     1     0
0*2 + 0*2 + 0*2 + 1*2 + 0*2 + 0*2 + 1*2 + 0*2   = 18
```

Now we can't just use 'tcp[13] == 18' in the *tcpdump* filter expression, because that would select only those packets that have SYN-ACK set, but not those with only SYN set. Remember that we don't care if ACK or any other control bit is set as long as SYN is set.

In order to achieve our goal, we need to logically AND the binary value of octet 13 with some other value to preserve the SYN bit. We know that we want SYN to be set in any case, so we'll logically AND the value in the 13th octet with the binary value of a SYN:

```
     00010010 SYN-ACK              00000010 SYN
AND  00000010 (we want SYN)   AND  00000010 (we want SYN)
     --------                      --------
=    00000010                 =    00000010
```

We see that this AND operation delivers the same result regardless whether ACK or another TCP control bit is set. The decimal representation of the AND value as well as the result of this operation is 2 (binary 00000010), so we know that for packets with SYN set the following relation must hold true:

((value of octet 13) AND (2)) == (2)

This points us to the *tcpdump* filter expression

tcpdump -i xl0 'tcp[13] & 2 == 2'

Note that you should use single quotes or a backslash in the expression to hide the AND ('&') special character from the shell.

UDP Packets

UDP format is illustrated by this rwho packet:

```
actinide.who > broadcast.who: udp 84
```

This says that port *who* on host *actinide* sent a udp datagram to port *who* on host *broadcast*, the Internet broadcast address. The packet contained 84 bytes of user data.

Some UDP services are recognized (from the source or destination port number) and the higher level protocol information printed. In particular, Domain Name service requests (RFC-1034/1035) and Sun RPC calls (RFC-1050) to NFS.

UDP Name Server Requests

(N.B.:The following description assumes familiarity with the Domain Service protocol described in RFC-1035. If you are not familiar with the protocol, the following description will appear to be written in greek.)

Name server requests are formatted as

```
src > dst: id op? flags qtype qclass name (len)
h2opolo.1538 > helios.domain: 3+ A? ucbvax.berkeley.edu. (37)
```

Host *h2opolo* asked the domain server on *helios* for an address record (qtype=A) associated with

the name *ucbvax.berkeley.edu.* The query id was '3'. The '+' indicates the *recursion desired* flag was set. The query length was 37 bytes, not including the UDP and IP protocol headers. The query operation was the normal one, *Query*, so the op field was omitted. If the op had been anything else, it would have been printed between the '3' and the '+'. Similarly, the qclass was the normal one, *C_IN*, and omitted. Any other qclass would have been printed immediately after the 'A'.

A few anomalies are checked and may result in extra fields enclosed in square brackets: If a query contains an answer, authority records or additional records section, *ancount*, *nscount*, or *arcount* are printed as '[*n*a]', '[*n*n]' or '[*n*au]' where *n* is the appropriate count. If any of the response bits are set (AA, RA or rcode) or any of the 'must be zero' bits are set in bytes two and three, '[b2&3=*x*]' is printed, where *x* is the hex value of header bytes two and three.

UDP Name Server Responses

Name server responses are formatted as

```
src > dst:  id op rcode flags a/n/au type class data (len)
helios.domain > h2opolo.1538: 3 3/3/7 A 128.32.137.3 (273)
helios.domain > h2opolo.1537: 2 NXDomain* 0/1/0 (97)
```

In the first example, *helios* responds to query id 3 from *h2opolo* with 3 answer records, 3 name server records and 7 additional records. The first answer record is type A (address) and its data is internet address 128.32.137.3. The total size of the response was 273 bytes, excluding UDP and IP headers. The op (Query) and response code (NoError) were omitted, as was the class (C_IN) of the A record.

In the second example, *helios* responds to query 2 with a response code of non-existent domain (NXDomain) with no answers, one name server and no authority records. The '*' indicates that the *authoritative answer* bit was set. Since there were no answers, no type, class or data were printed.

Other flag characters that might appear are '−' (recursion available, RA, *not* set) and '|' (truncated message, TC, set). If the 'question' section doesn't contain exactly one entry, '[*n*q]' is printed.

Note that name server requests and responses tend to be large and the default *snaplen* of 68 bytes may not capture enough of the packet to print. Use the **−s** flag to increase the snaplen if you need to seriously investigate name server traffic. '**−s 128**' has worked well for me.

SMB/CIFS decoding

tcpdump now includes fairly extensive SMB/CIFS/NBT decoding for data on UDP/137, UDP/138 and TCP/139. Some primitive decoding of IPX and NetBEUI SMB data is also done.

By default a fairly minimal decode is done, with a much more detailed decode done if -v is used. Be warned that with -v a single SMB packet may take up a page or more, so only use -v if you really want all the gory details.

For information on SMB packet formats and what all te fields mean see www.cifs.org or the pub/samba/specs/ directory on your favorite samba.org mirror site. The SMB patches were written by Andrew Tridgell (tridge@samba.org).

NFS Requests and Replies

Sun NFS (Network File System) requests and replies are printed as:

```
src.xid > dst.nfs: len op args
src.nfs > dst.xid: reply stat len op results

sushi.6709 > wrl.nfs: 112 readlink fh 21,24/10.73165
wrl.nfs > sushi.6709: reply ok 40 readlink "../var"
sushi.201b > wrl.nfs:
     144 lookup fh 9,74/4096.6878 "xcolors"
```

```
wrl.nfs > sushi.201b:
     reply ok 128 lookup fh 9,74/4134.3150
```

In the first line, host *sushi* sends a transaction with id *6709* to *wrl* (note that the number following the src host is a transaction id, *not* the source port). The request was 112 bytes, excluding the UDP and IP headers. The operation was a *readlink* (read symbolic link) on file handle (*fh*) 21,24/10.731657119. (If one is lucky, as in this case, the file handle can be interpreted as a major,minor device number pair, followed by the inode number and generation number.) *Wrl* replies 'ok' with the contents of the link.

In the third line, *sushi* asks *wrl* to lookup the name '*xcolors*' in directory file 9,74/4096.6878. Note that the data printed depends on the operation type. The format is intended to be self explanatory if read in conjunction with an NFS protocol spec.

If the −v (verbose) flag is given, additional information is printed. For example:

```
sushi.1372a > wrl.nfs:
     148 read fh 21,11/12.195 8192 bytes @ 24576
wrl.nfs > sushi.1372a:
     reply ok 1472 read REG 100664 ids 417/0 sz 29388
```

(−v also prints the IP header TTL, ID, length, and fragmentation fields, which have been omitted from this example.) In the first line, *sushi* asks *wrl* to read 8192 bytes from file 21,11/12.195, at byte offset 24576. *Wrl* replies 'ok'; the packet shown on the second line is the first fragment of the reply, and hence is only 1472 bytes long (the other bytes will follow in subsequent fragments, but these fragments do not have NFS or even UDP headers and so might not be printed, depending on the filter expression used). Because the −v flag is given, some of the file attributes (which are returned in addition to the file data) are printed: the file type (''REG'', for regular file), the file mode (in octal), the uid and gid, and the file size.

If the −v flag is given more than once, even more details are printed.

Note that NFS requests are very large and much of the detail won't be printed unless *snaplen* is increased. Try using '**−s 192**' to watch NFS traffic.

NFS reply packets do not explicitly identify the RPC operation. Instead, *tcpdump* keeps track of ''recent'' requests, and matches them to the replies using the transaction ID. If a reply does not closely follow the corresponding request, it might not be parsable.

AFS Requests and Replies

Transarc AFS (Andrew File System) requests and replies are printed as:

```
src.sport > dst.dport: rx packet-type
src.sport > dst.dport: rx packet-type service call call-name args
src.sport > dst.dport: rx packet-type service reply call-name args

elvis.7001 > pike.afsfs:
     rx data fs call rename old fid 536876964/1/1 ".newsrc.new"
     new fid 536876964/1/1 ".newsrc"
pike.afsfs > elvis.7001: rx data fs reply rename
```

In the first line, host elvis sends a RX packet to pike. This was a RX data packet to the fs (fileserver) service, and is the start of an RPC call. The RPC call was a rename, with the old directory file id of 536876964/1/1 and an old filename of '.newsrc.new', and a new directory file id of 536876964/1/1 and a new filename of '.newsrc'. The host pike responds with a RPC reply to the rename call (which was successful, because it was a data packet and not an abort packet).

In general, all AFS RPCs are decoded at least by RPC call name. Most AFS RPCs have at least some of the arguments decoded (generally only the 'interesting' arguments, for some definition of interesting).

The format is intended to be self-describing, but it will probably not be useful to people who are not familiar with the workings of AFS and RX.

If the -v (verbose) flag is given twice, acknowledgement packets and additional header information is printed, such as the the RX call ID, call number, sequence number, serial number, and the RX packet flags.

If the -v flag is given twice, additional information is printed, such as the the RX call ID, serial number, and the RX packet flags. The MTU negotiation information is also printed from RX ack packets.

If the -v flag is given three times, the security index and service id are printed.

Error codes are printed for abort packets, with the exception of Ubik beacon packets (because abort packets are used to signify a yes vote for the Ubik protocol).

Note that AFS requests are very large and many of the arguments won't be printed unless *snaplen* is increased. Try using '**-s 256**' to watch AFS traffic.

AFS reply packets do not explicitly identify the RPC operation. Instead, *tcpdump* keeps track of ''recent'' requests, and matches them to the replies using the call number and service ID. If a reply does not closely follow the corresponding request, it might not be parsable.

KIP AppleTalk (DDP in UDP)

AppleTalk DDP packets encapsulated in UDP datagrams are de-encapsulated and dumped as DDP packets (i.e., all the UDP header information is discarded). The file */etc/atalk.names* is used to translate AppleTalk net and node numbers to names. Lines in this file have the form

```
number    name

1.254          ether
16.1      icsd-net
1.254.110 ace
```

The first two lines give the names of AppleTalk networks. The third line gives the name of a particular host (a host is distinguished from a net by the 3rd octet in the number − a net number *must* have two octets and a host number *must* have three octets.) The number and name should be separated by whitespace (blanks or tabs). The */etc/atalk.names* file may contain blank lines or comment lines (lines starting with a '#').

AppleTalk addresses are printed in the form

```
net.host.port

144.1.209.2 > icsd-net.112.220
office.2 > icsd-net.112.220
jssmag.149.235 > icsd-net.2
```

(If the */etc/atalk.names* doesn't exist or doesn't contain an entry for some AppleTalk host/net number, addresses are printed in numeric form.) In the first example, NBP (DDP port 2) on net 144.1 node 209 is sending to whatever is listening on port 220 of net icsd node 112. The second line is the same except the full name of the source node is known ('office'). The third line is a send from port 235 on net jssmag node 149 to broadcast on the icsd-net NBP port (note that the broadcast address (255) is indicated by a net name with no host number − for this reason it's a good idea to keep node names and net names distinct in /etc/atalk.names).

NBP (name binding protocol) and ATP (AppleTalk transaction protocol) packets have their contents interpreted. Other protocols just dump the protocol name (or number if no name is registered for the protocol) and packet size.

NBP packets are formatted like the following examples:

```
icsd-net.112.220 > jssmag.2: nbp-lkup 190: "=:LaserWriter@*"
jssmag.209.2 > icsd-net.112.220: nbp-reply 190: "RM1140:LaserWriter@*" 250
techpit.2 > icsd-net.112.220: nbp-reply 190: "techpit:LaserWriter@*" 186
```

The first line is a name lookup request for laserwriters sent by net icsd host 112 and broadcast on net jssmag. The nbp id for the lookup is 190. The second line shows a reply for this request (note that it has the same id) from host jssmag.209 saying that it has a laserwriter resource named

"RM1140" registered on port 250. The third line is another reply to the same request saying host techpit has laserwriter "techpit" registered on port 186.

ATP packet formatting is demonstrated by the following example:

```
jssmag.209.165 > helios.132: atp-req  12266<0-7> 0xae030001
helios.132 > jssmag.209.165: atp-resp 12266:0 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:1 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:2 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:3 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:4 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:5 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:6 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp*12266:7 (512) 0xae040000
jssmag.209.165 > helios.132: atp-req  12266<3,5> 0xae030001
helios.132 > jssmag.209.165: atp-resp 12266:3 (512) 0xae040000
helios.132 > jssmag.209.165: atp-resp 12266:5 (512) 0xae040000
jssmag.209.165 > helios.132: atp-rel  12266<0-7> 0xae030001
jssmag.209.133 > helios.132: atp-req* 12267<0-7> 0xae030002
```

Jssmag.209 initiates transaction id 12266 with host helios by requesting up to 8 packets (the '<0-7>'). The hex number at the end of the line is the value of the 'userdata' field in the request.

Helios responds with 8 512-byte packets. The ':digit' following the transaction id gives the packet sequence number in the transaction and the number in parens is the amount of data in the packet, excluding the atp header. The '*' on packet 7 indicates that the EOM bit was set.

Jssmag.209 then requests that packets 3 & 5 be retransmitted. Helios resends them then jssmag.209 releases the transaction. Finally, jssmag.209 initiates the next request. The '*' on the request indicates that XO ('exactly once') was *not* set.

IP Fragmentation

Fragmented Internet datagrams are printed as

(frag *id*:*size*@*offset*+**)**
(frag *id*:*size*@*offset***)**

(The first form indicates there are more fragments. The second indicates this is the last fragment.)

Id is the fragment id. *Size* is the fragment size (in bytes) excluding the IP header. *Offset* is this fragment's offset (in bytes) in the original datagram.

The fragment information is output for each fragment. The first fragment contains the higher level protocol header and the frag info is printed after the protocol info. Fragments after the first contain no higher level protocol header and the frag info is printed after the source and destination addresses. For example, here is part of an ftp from arizona.edu to lbl-rtsg.arpa over a CSNET connection that doesn't appear to handle 576 byte datagrams:

```
arizona.ftp-data > rtsg.1170: . 1024:1332(308) ack 1 win 4096 (frag 595a:328@0+)
arizona > rtsg: (frag 595a:204@328)
rtsg.1170 > arizona.ftp-data: . ack 1536 win 2560
```

There are a couple of things to note here: First, addresses in the 2nd line don't include port numbers. This is because the TCP protocol information is all in the first fragment and we have no idea what the port or sequence numbers are when we print the later fragments. Second, the tcp sequence information in the first line is printed as if there were 308 bytes of user data when, in fact, there are 512 bytes (308 in the first frag and 204 in the second). If you are looking for holes in the sequence space or trying to match up acks with packets, this can fool you.

A packet with the IP *don't fragment* flag is marked with a trailing **(DF)**.

Timestamps

By default, all output lines are preceded by a timestamp. The timestamp is the current clock time in the form

hh:mm:ss.frac

and is as accurate as the kernel's clock. The timestamp reflects the time the kernel first saw the packet. No attempt is made to account for the time lag between when the Ethernet interface removed the packet from the wire and when the kernel serviced the 'new packet' interrupt.

SEE ALSO

stty(1), pcap(3), bpf(4), nit(4P), pfconfig(8)

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It is currently being maintained by tcpdump.org.

The current version is available via http:
http://www.tcpdump.org/
The original distribution is available via anonymous ftp:
ftp://ftp.ee.lbl.gov/tcpdump.tar.Z
IPv6/IPsec support is added by WIDE/KAME project. This program uses Eric Young's SSLeay library, under specific configuration.

BUGS

Please send problems, bugs, questions, desirable enhancements, etc. to:
tcpdump-workers@tcpdump.org
Please send source code contributions, etc. to:
patches@tcpdump.org
NIT doesn't let you watch your own outbound traffic, BPF will. We recommend that you use the latter.

On Linux systems with 2.0[.x] kernels:
packets on the loopback device will be seen twice;

packet filtering cannot be done in the kernel, so that all packets must be copied from the kernel in order to be filtered in user mode;

all of a packet, not just the part that's within the snapshot length, will be copied from the kernel (the 2.0[.x] packet capture mechanism, if asked to copy only part of a packet to userland, will not report the true length of the packet; this would cause most IP packets to get an error from **tcpdump**);

capturing on some PPP devices won't work correctly.
We recommend that you upgrade to a 2.2 or later kernel.

Some attempt should be made to reassemble IP fragments or, at least to compute the right length for the higher level protocol.

Name server inverse queries are not dumped correctly: the (empty) question section is printed rather than real query in the answer section. Some believe that inverse queries are themselves a bug and prefer to fix the program generating them rather than *tcpdump*.

A packet trace that crosses a daylight savings time change will give skewed time stamps (the time change is ignored).

Filter expressions on fields other than those in Token Ring headers will not correctly handle source-routed Token Ring packets.

Filter expressions on fields other than those in 802.11 headers will not correctly handle 802.11 data packets with both To DS and From DS set.

ip6 proto should chase header chain, but at this moment it does not. **ip6 protochain** is supplied for this behavior.

Arithmetic expression against transport layer headers, like **tcp[0]**, does not work against IPv6 packets. It only looks at IPv4 packets.