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ANY "DISPUTE" THAT IS NOT RESOLVED THROUGH THE INFORMAL NEGOTIATION PROCESS DESCRIBED ABOVE SHALL BE RESOLVED EXCLUSIVELY THROUGH BINDING ARBITRATION. "DISPUTE" is defined as any disagreement, cause of action, claim, controversy, or proceeding between you and any SONY entity related to or arising out of the SOFTWARE or this EULA. DISPUTE is to be given the broadest possible meaning that will be enforced. If a DISPUTE arises, you agree to first give notice to SONY by contacting Sony Electronics Inc. at 16530 Via Esprillo, MZ 1105, San Diego, CA 92127, Attn: Legal Department, and engaging in good faith negotiations to attempt to resolve any DISPUTE for at least 14 days, except that you or Sony (or any of its affiliates) may skip this informal negotiation procedure for DISPUTE enforcing, protecting, or concerning the validity of intellectual property rights.

ARBITRATION INSTRUCTIONS

To begin arbitration, either you or SONY must make a written demand to the other for arbitration. The arbitration will take place before a single arbitrator. It will be administered in keeping with the Expedited Procedures of the Commercial Arbitration Rules, and the Supplementary Proceedings for Consumer-Related disputes when applicable ("Rules") of the American Arbitration

Association ("AAA") in effect when the claim is filed. You may get a copy of AAA's Rules by contacting AAA at (800) 778-7879 or visiting www.adr.org. The filing fees to begin and carry out arbitration will be shared between you and SONY, but in no event shall your fees ever exceed the amount allowable by the special rules for Consumers Disputes provided for by AAA, at which point SONY will cover all additional administrative fees and expenses. This does not prohibit the arbitrator from giving the winning party their fees and expenses of the arbitration when appropriate pursuant to the Rules. Unless you and SONY agree differently, the arbitration will take place in the county and state where you live, and applicable federal or state law shall govern the substance of any DISPUTE. The Federal Arbitration Act, 9 U.S.C. § 1, et seq., will govern the arbitration itself and not any state law on arbitration. The arbitrator's decision will be binding and final, except for a limited right of appeal under the Federal Arbitration Act. The arbitrator may award declaratory or injunctive relief only in favor of the party seeking relief, and only to the extent necessary to provide relief warranted by that party's individual claim. Any court with jurisdiction over the parties may enforce the arbitrator's decision.

SMALL CLAIMS EXCEPTION

Despite the provisions set forth above, you have the right to litigate any DISPUTE in small claims court or other similar court of limited jurisdiction, to the extent the amount at issue does not exceed \$15,000, and as long as such court has proper jurisdiction and all other requirements (including amount in controversy) are satisfied.

CLASS ACTION WAIVER

YOU UNDERSTAND AND ACKNOWLEDGE THAT BY AGREEING TO BINDING ARBITRATION, YOU ARE GIVING UP THE RIGHT TO LITIGATE (OR PARTICIPATE IN AS A PARTY OR CLASS MEMBER) ANY DISPUTES IN COURT BEFORE A JUDGE OR JURY. ANY DISPUTE RESOLUTION PROCEEDING WILL BE CONDUCTED ONLY ON AN INDIVIDUAL BASIS, AND BOTH PARTIES AGREE NOT TO HAVE ANY DISPUTE HEARD AS A CLASS ACTION, REPRESENTATIVE ACTION, CONSOLIDATED ACTION, OR PRIVATE ATTORNEY GENERAL ACTION, UNLESS ALL PARTIES INVOLVED IN THE DISPUTE SPECIFICALLY AGREE TO DO SO IN WRITING FOLLOWING INITIATION OF THE ARBITRATION.

OPT-OUT INSTRUCTIONS

IF YOU DO NOT WISH TO BE BOUND BY THE BINDING ARBITRATION PROVISION AND/OR THE CLASS ACTION WAIVER ABOVE, THEN: (1) YOU MUST NOTIFY SONY IN WRITING WITHIN 30 DAYS OF THE DATE THAT YOU FIRST USE THE SOFTWARE OR AGREE TO THIS EULA, WHICHEVER OCCURS FIRST; (2) YOUR WRITTEN NOTIFICATION MUST BE MAILED TO SONY ELECTRONICS INC., 16530 VIA ESPRILLO, MZ 1105, SAN DIEGO CA 92127, ATTN: LEGAL DEPARTMENT; AND (3) YOUR WRITTEN NOTIFICATION MUST INCLUDE: (A) YOUR NAME; (B) YOUR ADDRESS; (C) THE DATE YOU FIRST USED THE SOFTWARE OR AGREED TO THIS EULA; AND (D) A CLEAR STATEMENT THAT YOU DO NOT WISH TO RESOLVE DISPUTES WITH ANY SONY ENTITY THROUGH ARBITRATION AND/OR TO BE BOUND BY THE CLASS ACTION WAIVER.

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MISCELLANEOUS

Any DISPUTE determined not subject to arbitration and not initiated in small claims court will be litigated by either party in a court of competent jurisdiction in either the superior court for the County of San Diego or in the United States District Court for the Southern District of California.

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- linux-kernel
- busybox
- dosfstools
- gcc-gplv3-libs
- glibc
- procps
- util-linux-ng
- pump

Source code for such software above can be obtained using the following link:
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This C header file is part of the SoftFloat IEC/IEEE Floating-point Arithmetic Package, Release 2a.

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Nelson Morgan and John Wawrzyniec. More information is available through the Web page

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Introduction

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o freetype-devel@nongnu.org

Discusses bugs, as well as engine internals, design issues, specific licenses, porting, etc.

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Libjpeg

The Independent JPEG Group's JPEG software

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DOCUMENTATION ROADMAP

This file contains the following sections:

OVERVIEW	General description of JPEG and the IJG software.
LEGAL ISSUES	Copyright, lack of warranty, terms of distribution.
REFERENCES	Where to learn more about JPEG.
ARCHIVE LOCATIONS	Where to find newer versions of this software.
ACKNOWLEDGMENTS	Special thanks.
FILE FORMAT WARS	Software *not* to get.
TO DO	Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:

install.txt	How to configure and install the IJG software.
usage.txt	Usage instructions for cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom.
*.1	Unix-style man pages for programs (same info as usage.txt).
wizard.txt	Advanced usage instructions for JPEG wizards only.
change.log	Version-to-version change highlights.

Programmer and internal documentation:

libjpeg.txt	How to use the JPEG library in your own programs.
example.c	Sample code for calling the JPEG library.
structure.txt	Overview of the JPEG library's internal structure.
filelist.txt	Road map of IJG files.
coderules.txt	Coding style rules --- please read if you contribute code.

Please read at least the files install.txt and usage.txt. Some information can also be found in the JPEG FAQ (Frequently Asked Questions) article. See ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or more of the REFERENCES, then looking at the documentation files (in roughly the order listed) before diving into the code.

OVERVIEW

This package contains C software to implement JPEG image encoding, decoding, and transcoding. JPEG (pronounced "jay-peg") is a standardized compression method for full-color and gray-scale images.

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. We have made no provision for supporting the hierarchical or lossless processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application.

We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The emphasis in designing this software has been on achieving portability and flexibility, while also making it fast enough to be useful. In particular, the software is not intended to be read as a tutorial on JPEG. (See the REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

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The IJG distribution formerly included code to read and write GIF files. To avoid entanglement with the Unisys LZW patent, GIF reading support has been removed altogether, and the GIF writer has been simplified to produce "uncompressed GIFs". This technique does not use the LZW algorithm; the resulting GIF files are larger than usual, but are readable by all standard GIF decoders.

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REFERENCES

We recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm is Wallace, Gregory K. "The JPEG Still Picture Compression Standard", Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44. (Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PostScript file containing a revised version of Wallace's article is available at <http://www.ijg.org/files/wallace.ps.gz>. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides good explanations and example C code for a multitude of compression methods including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best currently available description of JPEG is the textbook "JPEG Still Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1. Price US\$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2). Although this is by far the most detailed and comprehensive exposition of JPEG publicly available, we point out that it is still missing an explanation of the most essential properties and algorithms of the underlying DCT technology. If you think that you know about DCT-based JPEG after reading this book, then you are in delusion. The real fundamentals and corresponding potential of DCT-based JPEG are not publicly known so far, and that is the reason for all the mistaken developments taking place in the image coding domain.

The original JPEG standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83. IJG JPEG 8 introduces an implementation of the JPEG SmartScale extension which is specified in a contributed document at ITU and ISO with title "ITU-T JPEG-Plus Proposal for Extending ITU-T T.81 for Advanced Image Coding", April 2006, Geneva, Switzerland. The latest version of the document is Revision 3.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, revision 1.02. JFIF 1.02 has been adopted as an Ecma International Technical Report and thus received a formal publication status. It is available as a free download in PDF format from <http://www.ecma-international.org/publications/techreports/E-TR-098.htm>. A PostScript version of the JFIF document is available at <http://www.ijg.org/files/jfif.ps.gz>. There is also a plain text version at <http://www.ijg.org/files/jfif.txt.gz>, but it is missing the figures.

The TIFF 6.0 file format specification can be obtained by FTP from <ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz>. The JPEG incorporation scheme found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems. IJG does not recommend use of the TIFF 6.0 design (TIFF Compression tag 6). Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from <http://www.ijg.org/files/>. It is expected that the next revision of the TIFF spec will replace the 6.0 JPEG design with the Note's design. Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note.

ARCHIVE LOCATIONS

The "official" archive site for this software is www.ijg.org. The most recent released version can always be found there in directory "files". This particular version will be archived as <http://www.ijg.org/files/jpegsr8c.tar.gz>, and in Windows-compatible "zip" archive format as <http://www.ijg.org/files/jpegsr8c.zip>.

The JPEG FAQ (Frequently Asked Questions) article is a source of some general information about JPEG.

It is available on the World Wide Web at <http://www.faqs.org/faqs/jpeg-faq/> and other news.answers archive sites, including the official news.answers archive at rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/.

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Thank to Andrew Finkenstadt for hosting the ijg.org site.

Last but not least special thank to Thomas G. Lane for the original design and development of this singular software package.

FILE FORMAT WARS

The ISO JPEG standards committee actually promotes different formats like "JPEG 2000" or "JPEG XR" which are incompatible with original DCT-based JPEG and which are based on faulty technologies. IJG therefore does not and will not support such momentary mistakes (see REFERENCES).

We have little or no sympathy for the promotion of these formats. Indeed, one of the original reasons for developing this free software was to help force convergence on common, interoperable format standards for JPEG files.

Don't use an incompatible file format!

(In any case, our decoder will remain capable of reading existing JPEG image files indefinitely.)

TO DO

Version 8 is the first release of a new generation JPEG standard to overcome the limitations of the original JPEG specification. More features are being prepared for coming releases...

Please send bug reports, offers of help, etc. to jpeg-info@uc.ac.

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A "png_get_copyright" function is available, for convenient use in "about" boxes and the like:

```
printf("%s", png_get_copyright(NULL));
```

Also, the PNG logo (in PNG format, of course) is supplied in the files "pngbar.png" and "pngbar.jpg (88x31)" and "pngnow.png" (98x31).

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glennrp@users.sourceforge.net
December 17, 2015

Lighttpd

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Written by: Philip Hazel
Email local part: ph10
Email domain: cam.ac.uk

University of Cambridge Computing Service,
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Pcre

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You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the library 'Frob' (a library for tweaking knobs) written by James Random Hacker.

<signature of Ty Coon>, 1 April 1990
Ty Coon, President of Vice

That's all there is to it!

Tcp-wrapper

@(#) README 1.30 97/03/21 19:27:21

This is the 7.6 version of the TCP/IP daemon wrapper package.

Thank you for using this program. If you like it, send me a postcard. My postal address is at the bottom of this file.

Read the BLURB file for a brief summary of what is new. The CHANGES file gives a complete account of differences with respect to previous releases.

Announcements of new releases of this software are posted to Usenet (comp.security.unix, comp.unix.admin), to the cert-tools mailing list, and to a dedicated mailing list. You can subscribe to the dedicated mailing list by sending an email message to majordomo@wzv.win.tue.nl with in the body (not subject): subscribe tcp-wrappers-announce.

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1 - Introduction

With this package you can monitor and filter incoming requests for the SYSTAT, FINGER, FTP, TELNET, RLOGIN, RSH, EXEC, TFTP, TALK, and other network services.

It supports both 4.3BSD-style sockets and System V.4-style TLI. Praise yourself lucky if you don't know what that means.

The package provides tiny daemon wrapper programs that can be installed without any changes to existing software or to existing configuration files. The wrappers report the name of the client host and of the requested service; the wrappers do not exchange information with the client or server applications, and impose no overhead on the actual conversation between the client and server applications.

Optional features are: access control to restrict what systems can connect to what network daemons; client user name lookups with the RFC 931 etc. protocol; additional protection against hosts that pretend to have someone else's host name; additional protection against hosts that pretend to have someone else's host address.

The programs are very portable. Build procedures are provided for many common (and not so common) environments, and guidelines are provided in case your environment is not among them.

Requirements are that network daemons are spawned by a super server such as the inetd; a 4.3BSD-style socket programming interface and/or System V.4-style TLI programming interface; and the availability of a syslog(3) library and of a syslogd(8) daemon. The wrappers should run without modification on any system that satisfies these requirements. Workarounds have been implemented for several common bugs in systems software.

What to do if this is your first encounter with the wrapper programs:

- 1) read the tutorial sections for an introduction to the relevant concepts and terminology;
- 2) glance over the security feature sections in this document;
- 3) follow the installation instructions (easy or advanced). I recommend that you first use the default security feature settings. Run the wrappers for a few days to become familiar with their logs, before doing anything drastic such as cutting off access or installing booby traps.

2 - Disclaimer

The wrapper programs rely on source address information obtained from network packets. This information is provided by the client host. It is not 100 percent reliable, although the wrappers do their best to expose forgeries.

In the absence of cryptographic protection of message contents, and of cryptographic authentication of message originators, all data from the network should be treated with sound scepticism.

THIS RESTRICTION IS BY NO MEANS SPECIFIC TO THE TCP/IP PROTOCOLS.

3 - Tutorials

The tutorial sections give a gentle introduction to the operation of the wrapper programs, and introduce some of the terminology that is used in the remainder of the document: client, server, the inetd and syslogd daemons, and their configuration files.

3.1 - How it works

Almost every application of the TCP/IP protocols is based on a client-server model. For example, when a user invokes the telnet command to connect to one of your systems, a telnet server process is executed on the target host. The telnet server process connects the user to a login process. A few examples of client and server programs are shown in the table below:

client	server	application
telnet	telnetd	remote login
ftp	ftpd	file transfer
finger	fingerd	show users

The usual approach is to run one single daemon process that waits for all kinds of incoming network connections. Whenever a connection is established, this daemon (usually called inetd) runs the appropriate server program and goes back to sleep, waiting for other connections.

The wrapper programs rely on a simple, but powerful mechanism. Instead of directly running the desired server program, the inetd is tricked into running a small wrapper program. The wrapper logs the client host name or address and performs some additional checks. When all is well, the wrapper executes the desired server program and goes away.

The wrapper programs have no interaction with the client user (or with the client process). Nor do the wrappers interact with the server application. This has two major advantages: 1) the wrappers are application-independent, so that the same program can protect many kinds of network services; 2) no interaction also means that the wrappers are invisible from outside (at least for authorized users).

Another important property is that the wrapper programs are active only when the initial contact between client and server is established. Once a wrapper has done its work there is no overhead on the client-server conversation.

The simple mechanism has one major drawback: the wrappers go away after the initial contact between client and server processes, so the wrappers are of little use with network daemons that service more than one client. The wrappers would only see the first client attempt to contact such a server. The NFS mount daemon is a typical example of a daemon that services requests from multiple clients. See the section on related software for ways to deal with such server programs.

There are two ways to use the wrapper programs:

- 1) The easy way: move network daemons to some other directory and fill the resulting holes with copies of the wrapper programs. This approach involves no changes to system configuration files, so there is very little risk of breaking things.
- 2) The advanced way: leave the network daemons alone and modify the inetd configuration file. For example, an entry such as:

```
tftp dgram udp wait root /usr/etc/tpcd in.tftpd -s /tftboot
```


When a tftp request arrives, inetd will run the wrapper program (tcpd) with a process name 'in.tftpd'. This is the name that the wrapper will use when logging the request and when scanning the optional access control tables. 'in.tftpd' is also the name of the server program that the wrapper will attempt to run when all is well. Any arguments ('-s /tftpboot' in this particular example) are transparently passed on to the server program.

For an account of the history of the wrapper programs, with real-life examples, see the section below on related documents.

3.2 - Where the logging information goes

The wrapper programs send their logging information to the syslog daemon (syslogd). The disposition of the wrapper logs is determined by the syslog configuration file (usually /etc/syslog.conf). Messages are written to files, to the console, or are forwarded to a @loghost. Some syslogd versions can even forward messages down a pipeline.

Older syslog implementations (still found on Ultrix systems) only support priority levels ranging from 9 (debug-level messages) to 0 (alerts). All logging information of the specified priority level or more urgent is written to the same destination. In the syslog.conf file, priority levels are specified in numerical form. For example,

```
8usr/spool/mqueue/syslog
```

causes all messages with priority 8 (informational messages), and anything that is more urgent, to be appended to the file /usr/spool/mqueue/syslog.

Newer syslog implementations support message classes in addition to priority levels. Examples of message classes are: mail, daemon, auth and news. In the syslog.conf file, priority levels are specified with symbolic names: debug, info, notice, ..., emerg. For example,

```
mail.debug /var/log/syslog
```

causes all messages of class mail with priority debug (or more urgent) to be appended to the /var/log/syslog file.

By default, the wrapper logs go to the same place as the transaction logs of the sendmail daemon. The disposition can be changed by editing the Makefile and/or the syslog.conf file. Send a 'kill -HUP' to the syslogd after changing its configuration file. Remember that syslogd, just like sendmail, insists on one or more TABs between the left-hand side and the right-hand side expressions in its configuration file.

Solaris 2.x note: the syslog daemon depends on the m4 macro processor. The m4 program is installed as part of the software developer packages.

Trouble shooting note: when the syslogging does not work as expected, run the program by hand ('syslogd -d') and see what really happens.

4 - Features

4.1 - Access control

When compiled with -DHOSTS_ACCESS, the wrapper programs support a simple form of access control. Access can be controlled per host, per service, or combinations thereof. The software provides hooks for the execution of shell commands when an access control rule fires; this feature may be used to install "booby traps". For details, see the hosts_access.5 manual page, which is in 'nroff -man' format. A later section describes how you can test your access control rules.

Access control can also be used to connect clients to the "right" service. What is right may depend on the requested service, the origin of the request, and what host address the client connects to. Examples:

- (1) A gopher or www database speaks native language when contacted from within the country, otherwise it speaks English.
- (2) A service provider offers different ftp, gopher or www services with different internet hostnames from one host (section 4.6).

Access control is enabled by default. It can be turned off by editing the Makefile, or by providing no access control tables. The install instructions below describe the Makefile editing process.

The hosts_options.5 manual page ('nroff -man' format) documents an extended version of the access control language. The extensions are disabled by default. See the section below on language extensions.

Later System V implementations provide the Transport Level Interface (TLI), a network programming interface that performs functions similar to the Berkeley socket programming interface. Like Berkeley sockets, TLI was designed to cover multiple protocols, not just Internet.

When the wrapper discovers that the TLI interface sits on top of a TCP/IP or UDP/IP conversation it uses this knowledge to provide the same functions as with traditional socket-based applications. When some other protocol is used underneath TLI, the host address will be some universal magic cookie that may not even be usable for access control purposes.

4.2 - Host name spoofing

With some network applications, such as RSH or RLOGIN, the client host name plays an important role in the authentication process. Host name information can be reliable when lookups are done from a _local_ hosts table, provided that the client IP address can be trusted.

With _distributed_ name services, authentication schemes that rely on host names become more problematic. The security of your system now may depend on some far-away DNS (domain name server) outside your own control.

The wrapper programs verify the client host name that is returned by the address->name DNS server, by asking for a second opinion. To this end, the programs look at the name and addresses that are returned by the name->address DNS server, which may be an entirely different host.

If any name or address discrepancies are found, or if the second DNS opinion is not available, the wrappers assume that one of the two name servers is lying, and assume that the client host pretends to have someone else's host name.

When compiled with -DPARANOID, the wrappers will always attempt to look up and double check the client host name, and will always refuse service in case of a host name/address discrepancy. This is a reasonable policy for most systems.

When compiled without -DPARANOID, the wrappers by default still perform hostname lookup. You can match hosts with a name/address discrepancy with the PARANOID wildcard and decide whether or not to grant service.

Automatic hostname verification is enabled by default. Automatic hostname lookups and verification can be turned off by editing the Makefile. The configuration and installation section below describes the Makefile editing process.

4.3 - Host address spoofing

While host name spoofing can be found out by asking a second opinion, it is much harder to find out that a host claims to have someone else's network address. And since host names are deduced from network addresses, address spoofing is at least as effective as name spoofing.

The wrapper programs can give additional protection against hosts that claim to have an address that lies outside their own network. For example, some far-away host that claims to be a trusted host within your own network. Such things are possible even while the impersonated system is up and running.

This additional protection is not an invention of my own; it has been present for at least five years in the BSD rsh and rlogin daemons.

Unfortunately, that feature was added *after* 4.3 BSD came out, so that very few, if any, UNIX vendors have adopted it. Our site, and many other ones, has been running these enhanced daemons for several years, and without any ill effects.

When the wrapper programs are compiled with -DKILL_IP_OPTIONS, the programs refuse to service TCP connections with IP source routing options. -DKILL_IP_OPTIONS is not needed on modern UNIX systems that can stop source-routed traffic in the kernel. Examples are 4.4BSD derivatives, Solaris 2.x, and Linux. See your system manuals for details.

If you are going to use this feature on SunOS 4.1.x you should apply patch 100804-03+ or 101790-something depending on your SunOS version. Otherwise you may experience "BAD TRAP" and "Data fault" panics when the getsockopt() system call is executed after a TCP RESET has been received. This is a kernel bug, it is not the fault of the wrappers.

The feature is disabled by default. It can be turned on by editing the Makefile. The configuration and installation section below describes the Makefile editing process.

UDP services do not benefit from this additional protection. With UDP, all you can be certain of is the network packet's destination address.

4.4 - Client username lookups

The protocol proposed in RFC 931 provides a means to obtain the client user name from the client host. The requirement is that the client host runs an RFC 931-compliant daemon. The information provided by such a daemon is not intended to be used for authentication purposes, but it can provide additional information about the owner of a TCP connection.

The RFC 931 protocol has diverged into different directions (IDENT, TAP, RFC 1413). To add to the confusion, they all use the same network port. The daemon wrappers implement a common subset of the protocols.

There are some limitations: the number of hosts that run an RFC 931 (or compatible) daemon is limited (but growing); client user name lookups do not work for datagram (UDP) services. More seriously, client user name lookups can cause noticeable delays with connections from non-UNIX PCs. Recent PC software seem to have fixed this (for example NCSA telnet). The wrappers use a 10-second timeout for RFC931 lookups, to accommodate slow networks and slow hosts.

By default, the wrappers will do username lookup only when the access control rules require them to do so (via user@host client patterns, see the hosts_access.5 manual page) or when the username is needed for %<letter> expansions.

You can configure the wrappers to always perform client username lookups, by editing the Makefile. The client username lookup timeout period (10 seconds default) can be changed by editing the Makefile. The installation sections below describe the Makefile editing process.

On System V with TLI-based network services, client username lookups will be possible only when the underlying network protocol is TCP/IP.

4.5 - Language extensions

The wrappers sport only a limited number of features. This is for a good reason: programs that run at high privilege levels must be easy to verify. And the smaller a program, the easier to verify. There is, however, a provision to add features.

The options.c module provides a framework for language extensions.

Quite a few extensions have already been implemented; they are documented in the hosts_options.5 document, which is in 'nroff -man' format. Examples: changing the severity level at which a request for service is logged; "allow" and "deny" keywords; running a customized server instead of the standard one; many others.

The language extensions are not enabled by default because they introduce an incompatible change to the access control language syntax. Instructions to enable the extensions are given in the Makefile.

4.6 - Multiple ftp/gopher/www archives on one host

Imagine one host with multiple internet addresses. These addresses do not need to have the same internet hostname. Thus, it is possible to offer services with different internet hostnames from just one host.

Service providers can use this to offer organizations a presence on the "net" with their own internet hostname, even when those organizations aren't connected to the Internet at all. To the end user it makes no difference, because applications use internet hostnames.

There are several ways to assign multiple addresses to one machine.

The nice way is to take an existing network interface and to assign additional internet addresses with the 'ifconfig' command. Examples:

```
Solaris 2: ifconfig le0:1 <address> netmask <mask> up
4.4 BSD: ifconfig en0 alias <address> netmask <mask>
```

On other systems one has to increase the number of network interfaces:

either with hardware interfaces, or with pseudo interfaces like SLIP or PPP. The interfaces do not need to be attached to anything. They just need to be up and to be assigned a suitable internet address and mask.

With the wrapper software, 'daemon@host' access control patterns can be used to distinguish requests by the network address that they are aimed at. Judicious use of the 'twist' option (see the hosts_options.5 file, 'nroff -man' format) can guide the requests to the right server. These can be servers that live in separate chroot areas, or servers modified to take additional context from the command line, or a combination.

Another way is to modify gopher or www listeners so that they bind to only one specific network address. Multiple gopher or www servers can then be run side by side, each taking requests sent to its respective network address.

4.7 - Banner messages

Some sites are required to present an informational message to users before they attempt to login. Banner messages can also be useful when denying service: instead of simply dropping the connection a polite explanation is given first. Finally, banners can be used to give your system a more personal touch.

The wrapper software provides easy-to-use tools to generate pre-login banners for ftp, telnet, rlogind etc. from a single prototype banner textfile. Details on banners and on-the-fly %<letter> expansions are given in the hosts_options.5 manual page ('nroff -man' format). An example is given in the file Banners.Makefile.

In order to support banner messages the wrappers have to be built with language extensions enabled. See the section on language extensions.

4.8 - Sequence number guessing

Recently, systems came under attack from intruders that exploited a well-known weakness in TCP/IP sequence number generators. This weakness allows intruders to impersonate trusted hosts. Break-ins have been reported via the rsh service. In fact, any network service can be exploited that trusts the client host name or address.

A long-term solution is to stop using network services that trust the client host name or address, and to use data encryption instead.

A short-term solution, as outlined in in CERT advisory CA-95:01, is to configure network routers so that they discard datagrams from "outside" with an "inside" source address. This approach is most fruitful when you do not trust any hosts outside your local network.

The IDENT (RFC931 etc.) client username lookup protocol can help to detect host impersonation attacks. Before accepting a client request, the wrappers can query the client's IDENT server and find out that the client never sent that request.

When the client host provides IDENT service, a negative IDENT lookup result (the client matches 'UNKNOWN@host') is strong evidence of a host impersonation attack.

A positive IDENT lookup result (the client matches 'KNOWN@host') is less trustworthy. It is possible for an attacker to spoof both the client request and the IDENT lookup connection, although doing so should be much harder than spoofing just a client request. Another possibility is that the client's IDENT server is lying.

Client username lookups are described in more detail in a previous section. Pointers to IDENT daemon software are described in the section on related software.

5 - Other works

5.1 - Related documents

The war story behind the tcp wrapper tools is described in:

W.Z. Venema, "TCP WRAPPER, network monitoring, access control and booby traps", UNIX Security Symposium III Proceedings (Baltimore), September 1992.

ftp.win.tue.nl:/pub/security/tcp_wrapper.ps.Z (postscript)
ftp.win.tue.nl:/pub/security/tcp_wrapper.txt.Z (flat text)

The same cracker is also described in:

W.R. Cheswick, "An Evening with Berferd, In Which a Cracker is Lured, Endured, and Studied", Proceedings of the Winter USENIX Conference (San Francisco), January 1992.

research.att.com:/dist/internet_security/berferd.ps

An updated version of the latter paper appeared in:

W.R. Cheswick, S.M. Bellovin, "Firewalls and Internet Security", Addison-Wesley, 1994.

Discussions on internet firewalls are archived on ftp.greatcircle.com. Subscribe to the mailing list by sending a message to majordomo@greatcircle.com

With in the body (not subject): subscribe firewalls.

5.2 - Related software

Network daemons etc. with enhanced logging capabilities can generate massive amounts of information: our 150+ workstations generate several hundred kbytes each day. egrep-based filters can help to suppress some of the noise. A more powerful tool is the Swatch monitoring system by Stephen E. Hansen and E. Todd Atkins. Swatch can process log files in real time and can associate arbitrary actions with patterns; its applications are by no means restricted to security. Swatch is available ftp.stanford.edu, directory /general/security-tools/swatch.

Socks, described in the UNIX Security III proceedings, can be used to control network traffic from hosts on an internal network, through a firewall host, to the outer world. Socks consists of a daemon that is run on the firewall host, and of a library with routines that redirect application socket calls through the firewall daemon. Socks is available from s1.gov in /pub/firewalls/socks.tar.Z.

For a modified Socks version by Ying-Da Lee (ylee@syl.dl.nec.com) try ftp.nec.com, directory /pub/security/socks.cstc.

Tcpr is a set of perl scripts by Paul Ziemba that enable you to run ftp and telnet commands across a firewall. Unlike socks it can be used with unmodified client software. Available from ftp.alantec.com, /pub/tcpr.

The TIS firewall toolkit provides a multitude of tools to build your own internet firewall system. ftp.tis.com, directory /pub/firewalls.

Versions of rshd and rlogind, modified to report the client user name in addition to the client host name, are available for anonymous ftp (ftp.win.tue.nl:/pub/security/logdaemon-XX.tar.Z). These programs are drop-in replacements for SunOS 4.x, Ultrix 4.x, SunOS 5.x and HP-UX 9.x. This archive also contains ftpd/rexecd/login versions that support S/Key or SecureNet one-time passwords in addition to traditional UNIX reusable passwords.

The securelib shared library by William LeFebvre can be used to control access to network daemons that are not run under control of the inetd or that serve more than one client, such as the NFS mount daemon that runs until the machine goes down. Available from eecs.nwu.edu, file /pub/securelib.tar.

xinetd (posted to comp.sources.unix) is an inetd replacement that provides, among others, logging, username lookup and access control.

However, it does not support the System V TLI services, and involves much more source code than the daemon wrapper programs. Available from ftp.uu.net, directory /usenet/comp.sources.unix.

netlog from Texas A&M relies on the SunOS 4.x /dev/nit interface to passively watch all TCP and UDP network traffic on a network. The current version is on net.tamu.edu in /pub/security/TAMU.

Where shared libraries or router-based packet filtering are not an option, an alternative portmap daemon can help to prevent hackers from mounting your NFS file systems using the proxy RPC facility.

ftp.win.tue.nl:/pub/security/portmap-X.shar.Z was tested with SunOS 4.1.X Ultrix 3.0 and Ultrix 4.x, HP-UX 8.x and some version of AIX. The protection is less effective than that of the securelib library because portmap is mostly a dictionary service.

An rpcbind replacement (the Solaris 2.x moral equivalent of portmap) can be found on ftp.win.tue.nl in /pub/security. It prevents hackers from mounting your NFS file systems by using the proxy RPC facility.

Source for a portable RFC 931 (TAP, IDENT, RFC 1413) daemon by Peter Eriksson is available from ftp.lysator.liu.se:/pub/ident/servers.

Some TCP/IP implementations come without syslog library. Some come with the library but have no syslog daemon. A replacement can be found in ftp.win.tue.nl:/pub/security/surrogate-syslog.tar.Z. The fakesyslog library that comes with the nntp sources reportedly works well, too.

6 - Limitations

6.1 - Known wrapper limitations

Many UDP (and rpc/udp) daemons linger around for a while after they have serviced a request, just in case another request comes in. In the inetd configuration file these daemons are registered with the 'wait' option. Only the request that started such a daemon will be seen by the wrappers. Such daemons are better protected with the securelib shared library (see: Related software).

The wrappers do not work with RPC services over TCP. These services are registered as rpc/tcp in the inetd configuration file. The only non-trivial service that is affected by this limitation is rexd, which is used by the on(1) command. This is no great loss. On most systems, rexd is less secure than a wildcard in /etc/hosts.equiv.

Some RPC requests (for example: rwall, rup, rusers) appear to come from the server host. What happens is that the client broadcasts its request to all portmap daemons on its network; each portmap daemon forwards the request to a daemon on its own system. As far as the rwall etc. daemons know, the request comes from the local host.

Portmap and RPC (e.g. NIS and NFS) (in)security is a topic in itself. See the section in this document on related software.

6.2 - Known system software bugs

Workarounds have been implemented for several bugs in system software. They are described in the Makefile. Unfortunately, some system software bugs cannot be worked around. The result is loss of functionality.

IRIX has so many bugs that it has its own README.IRIX file.

Older ConvexOS versions come with a broken rcvfrom(2) implementation. This makes it impossible for the daemon wrappers to look up the client host address (and hence, the name) in case of UDP requests. A patch is available for ConvexOS 10.1; later releases should be OK.

With early Solaris (SunOS 5) versions, the syslog daemon will leave behind zombie processes when writing to logged-in users. Workaround: increase the syslogd threshold for logging to users, or reduce the wrapper's logging severity.

On some systems, the optional RFC 931 etc. client username lookups may trigger a kernel bug. When a client host connects to your system, and the RFC 931 connection from your system to that client is rejected by a router, your kernel may drop all connections with that client. This is not a bug in the wrapper programs: complain to your vendor, and don't enable client user name lookups until the bug has been fixed.

Reportedly, SunOS 4.1.1, Next 2.0a, ISC 3.0 with TCP 1.3, and AIX 3.2.2 and later are OK.

Sony News/OS 4.51, HP-UX 8-something and Ultrix 4.3 still have the bug. Reportedly, a fix for Ultrix is available (CXO-8919).

The following procedure can be used (from outside the tue.nl domain) to find out if your kernel has the bug. From the system under test, do:

```
% ftp 131.155.70.19
```

This command attempts to make an ftp connection to our anonymous ftp server (ftp.win.tue.nl). When the connection has been established, run the following command from the same system under test, while keeping the ftp connection open:

```
% telnet 131.155.70.19 111
```

Do not forget the `111' at the end of the command. This telnet command attempts to connect to our portmap process. The telnet command should fail with: "host not reachable", or with a timeout error. If your ftp connection gets messed up, you have the bug. If the telnet command does not fail, please let me know a.s.a.p.!

For those who care, the bug is that the BSD kernel code was not careful enough with incoming ICMP UNREACHABLE control messages (it ignored the local and remote port numbers, and therefore zapped *all* connections with the remote system). The bug is still present in the BSD NET/1 source release (1989) but apparently has been fixed in BSD NET/2 (1991).

7 - Configuration and installation

7.1 - Easy configuration and installation

The "easy" recipe requires no changes to existing software or configuration files. Basically, you move the daemons that you want to protect to a different directory and plug the resulting holes with copies of the wrapper programs.

If you don't run Ultrix, you won't need the miscd wrapper program. The miscd daemon implements among others the SYSTAT service, which produces the same output as the WHO command.

Type `make' and follow the instructions. The Makefile comes with ready-to-use templates for many common UNIX implementations (sun, ultrix, hp-ux, aix, irix,...).

IRIX has so many bugs that it has its own README.IRIX file.

When the `make' succeeds the result is five executables (six in case of Ultrix).

You can use the `tcpdchk' program to identify the most common problems in your wrapper and inetd configuration files.

With the `tcpdmatch' program you can examine how the wrapper would react to specific requests for service.

The `safe_finger' command should be used when you implement booby traps: it gives better protection against nasty stuff that remote hosts may do in response to your finger probes.

The `try-from' program tests the host and username lookup code. Run it from a remote shell command (`rsh host /some/where/try-from') and it should be able to figure out from what system it is being called.

The tcpd program can be used to monitor the telnet, finger, ftp, exec, rsh, rlogind, tftp, talk, comsat and other tcp or udp services that have a one-to-one mapping onto executable files.

The tcpd program can also be used for services that are marked as rpc/udp in the inetd configuration file, but not for rpc/tcp services such as rexd. You probably do not want to run rexd anyway. On most systems it is even less secure than a wildcard in /etc/hosts.equiv.

With System V.4-style systems, the tcpd program can also handle TLI services. When TCP/IP or UDP/IP is used underneath TLI, tcpd provides the same functions as with socket-based applications. When some other protocol is used underneath TLI, functionality will be limited (no client username lookups, weird network address formats).

Decide which services you want to monitor. Move the corresponding vendor-provided daemon programs to the location specified by the REAL_DAEMON_DIR constant in the Makefile, and fill the holes with copies of the tcpd program. That is, one copy of (or link to) the tcpd program for each service that you want to monitor. For example, to monitor the use of your finger service:

```
# mkdir REAL_DAEMON_DIR
# mv /usr/etc/in.fingerd REAL_DAEMON_DIR
# cp tcpd /usr/etc/in.fingerd
```

The example applies to SunOS 4. With other UNIX implementations the network daemons live in /usr/libexec, /usr/sbin or in /etc, or have no "in." prefix to their names, but you get the idea.

File protections: the wrapper, all files used by the wrapper, and all directories in the path leading to those files, should be accessible but not writable for unprivileged users (mode 755 or mode 555). Do not install the wrapper set-uid.

Ultrix only: If you want to monitor the SYSTAT service, move the vendor-provided miscd daemon to the location specified by the REAL_DAEMON_DIR macro in the Makefile, and install the miscd wrapper at the original miscd location.

In the absence of any access-control tables, the daemon wrappers will just maintain a record of network connections made to your system.

7.2 - Advanced configuration and installation

The advanced recipe leaves your daemon executables alone, but involves simple modifications to the inetd configuration file.

Type `make' and follow the instructions. The Makefile comes with ready-to-use templates for many common UNIX implementations (sun, ultrix, hp-ux, aix, irix, ...).

IRIX users should read the warnings in the README.IRIX file first.

When the `make' succeeds the result is five executables (six in case of Ultrix).

You can use the `tcpdchk' program to identify the most common problems in your wrapper and inetd configuration files. With the `tcpdmatch' program you can examine how the wrapper would react to specific requests for service.

The `try-from' program tests the host and username lookup code. Run it from a remote shell command (`rsh host /some/where/try-from') and it should be able to figure out from what system it is being called.

The `safe_finger' command should be used when you implement a booby trap: it gives better protection against nasty stuff that remote hosts may do in response to your finger probes.

The tcpd program can be used to monitor the telnet, finger, ftp, exec, rsh, rlogind, tftp, talk, comsat and other tcp or udp services that have a one-to-one mapping onto executable files.

With System V.4-style systems, the tcpd program can also handle TLI services. When TCP/IP or UDP/IP is used underneath TLI, tcpd provides the same functions as with socket-based applications. When some other protocol is used underneath TLI, functionality will be limited (no client username lookups, weird network address formats).

The tcpd program can also be used for services that are marked as rpc/udp in the inetd configuration file, but not for rpc/tcp services such as rexd. You probably do not want to run rexd anyway. On most systems it is even less secure than a wildcard in /etc/hosts.equiv.

Install the tcpd command in a suitable place. Apollo UNIX users will want to install it under a different name because the name "tcpd" is already taken; a suitable name would be "frontd".

File protections: the wrapper, all files used by the wrapper, and all directories in the path leading to those files, should be accessible but not writable for unprivileged users (mode 755 or mode 555). Do not install the wrapper set-uid.

Then perform the following edits on the inetd configuration file (usually /etc/inetd.conf or /etc/inet/inetd.conf):

```
finger stream tcp nowait nobody /usr/etc/in.fingerd in.fingerd
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
```

becomes:

```
finger stream tcp nowait nobody /usr/etc/tcpd in.fingerd
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
```

Send a `kill -HUP' to the inetd process to make the change effective. Some IRIX inetd implementations require that you first disable the finger service (comment out the finger service and `kill -HUP' the inetd) before you can turn on the modified version. Sending a HUP twice seems to work just as well for IRIX 5.3, 6.0, 6.0.1 and 6.1.

AIX note: you may have to execute the `inetimp' command after changing the inetd configuration file.

The example applies to SunOS 4. With other UNIX implementations the network daemons live in /usr/libexec, /usr/sbin, or /etc, the network daemons have no "in." prefix to their names, or the username field in the inetd configuration file may be missing.

When the finger service works as expected you can perform similar changes for other network services. Do not forget the `kill -HUP'.

The miscd daemon that comes with Ultrix implements several network services. It decides what to do by looking at its process name. One of the services is systat, which is a kind of limited finger service. If you want to monitor the systat service, install the miscd wrapper in a suitable place and update the inetd configuration file:

```
systat stream tcp nowait /suitable/place/miscd systatd
```

Ultrix 4.3 allows you to specify a user id under which the daemon will be executed. This feature is not documented in the manual pages. Thus, the example would become:

```
systat stream tcp nowait nobody /suitable/place/miscd systatd
```

Older Ultrix systems still run all their network daemons as root.

In the absence of any access-control tables, the daemon wrappers will just maintain a record of network connections made to your system.

7.3 - Daemons with arbitrary path names

The above tcpd examples work fine with network daemons that live in a common directory, but sometimes that is not practical. Having soft links all over your file system is not a clean solution, either.

Instead you can specify, in the inetd configuration file, an absolute path name for the daemon process name. For example,

```
ntalk dgram udp wait root /usr/etc/tcpd /usr/local/lib/ntalkd
```

When the daemon process name is an absolute path name, tcpd ignores the value of the REAL_DAEMON_DIR constant, and uses the last path component of the daemon process name for logging and for access control.

7.4 - Building and testing the access control rules

In order to support access control the wrappers must be compiled with the -DHOSTS_ACCESS option. The access control policy is given in the form of two tables (default: /etc/hosts.allow and /etc/hosts.deny). Access control is disabled when there are no access control tables, or when the tables are empty.

If you haven't used the wrappers before I recommend that you first run them a couple of days without any access control restrictions. The logfile records should give you an idea of the process names and of the host names that you will have to build into your access control rules.

The syntax of the access control rules is documented in the file hosts_access.5, which is in `nroff -man' format. This is a lengthy document, and no-one expects you to read it right away from beginning to end. Instead, after reading the introductory section, skip to the examples at the end so that you get a general idea of the language.

Then you can appreciate the detailed reference sections near the beginning of the document.

The examples in the hosts_access.5 document (`nroff -man' format) show two specific types of access control policy: 1) mostly closed (only permitting access from a limited number of systems) and 2) mostly open (permitting access from everyone except a limited number of trouble makers). You will have to choose what model suits your situation best. Implementing a mixed policy should not be overly difficult either.

Optional extensions to the access control language are described in the hosts_options.5 document (`nroff -man' format).

The `tcpdchk' program examines all rules in your access control files and reports any problems it can find. `tcpdchk -v' writes to standard output a pretty-printed list of all rules. `tcpdchk -d' examines the hosts.allow and hosts.deny files in the current directory. This program is described in the tcpdchk.8 document (`nroff -man' format).

The `tcpdmatch' command can be used to try out your local access control files. The command syntax is:

```
tcpdmatch process_name hostname (e.g.: tcpdmatch in.ftpd localhost)
```

```
tcpdmatch process_name address (e.g.: tcpdmatch in.ftpd 127.0.0.1)
```

This way you can simulate what decisions will be made, and what actions will be taken, when hosts connect to your own system. The program is described in the tcpdmatch.8 document (`nroff -man' format).

Note 1: `tcpdmatch -d' will look for hosts.{allow,deny} tables in the current working directory. This is useful for testing new rules without bothering your users.

Note 2: you cannot use the `tcpdmatch' command to simulate what happens when the local system connects to other hosts.

In order to find out what process name to use, just use the service and watch the process name that shows up in the logfile. Alternatively, you can look up the name from the inetd configuration file. Coming back to the tftp example in the tutorial section above:

```
tftp dgram udp wait root /usr/etc/tcpd in.ftpd -s /tftpboot
```

This entry causes the inetd to run the wrapper program (tcpd) with a process name `in.ftpd'. This is the name that the wrapper will use when scanning the access control tables. Therefore, `in.ftpd' is the process name that should be given to the `tcpdmatch' command. On your system the actual inetd.conf entry may differ (tftp instead of in.ftpd, and no `root' field), but you get the idea.

When you specify a host name, the `tcpdmatch' program will use both the host name and address. This way you can simulate the most common case where the wrappers know both the host address and the host name. The `tcpdmatch' program will iterate over all addresses that it can find for the given host name.

When you specify a host address instead of a host name, the `tcpdmatch' program will pretend that the host name is unknown, so that you can simulate what happens when the wrapper is unable to look up the client host name.

7.5 - Other applications

The access control routines can easily be integrated with other programs. The hosts_access.3 manual page (`nroff -man' format) describes the external interface of the libwrap.a library.

The tcpd program can even be used to control access to the mail service. This can be useful when you suspect that someone is trying out some obscure sendmail bug, or when a remote site is misconfigured and keeps hammering your mail daemon.

In that case, sendmail should not be run as a stand-alone network listener, but it should be registered in the inetd configuration file.

For example:

```
smtp stream tcp nowait root /usr/etc/tcpd /usr/lib/sendmail -bs
```

You will still need to run one sendmail background process to handle queued-up outgoing mail. A command like:

```
/usr/lib/sendmail -q15m
```

(no `-bd' flag) should take care of that. You cannot really prevent people from posting forged mail this way, because there are many unprotected smtp daemons on the network.

8 - Acknowledgements

Many people contributed to the evolution of the programs, by asking inspiring questions, by suggesting features or bugfixes, or by submitting source code. Nevertheless, all mistakes and bugs in the wrappers are my own.

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Zlib

ZLIB DATA COMPRESSION LIBRARY

zlib 1.2.3 is a general purpose data compression library. All the code is thread safe. The data format used by the zlib library is described by RFCs (Request for Comments) 1950 to 1952 in the files <http://www.ietf.org/rfc/rfc1950.txt> (zlib format), [rfc1951.txt](http://www.ietf.org/rfc/rfc1951.txt) (deflate format) and [rfc1952.txt](http://www.ietf.org/rfc/rfc1952.txt) (gzip format). These documents are also available in other formats from <ftp://ftp.uu.net/graphics/png/documents/zlib/zdoc-index.html>

All functions of the compression library are documented in the file `zlib.h` (volunteer to write man pages welcome, contact zlib@gzip.org). A usage example of the library is given in the file `example.c` which also tests that the library is working correctly. Another example is given in the file `minigzip.c`. The compression library itself is composed of all source files except `example.c` and `minigzip.c`.

To compile all files and run the test program, follow the instructions given at the top of `Makefile`. In short "make test; make install" should work for most machines. For Unix: `./configure; make test; make install`. For MSDOS, use one of the special makefiles such as `Makefile.msc`. For VMS, use `make_vms.com`.

Questions about zlib should be sent to zlib@gzip.org, or to Gilles Vollant info@winimage.com for the Windows DLL version. The zlib home page is <http://www.zlib.org> or <http://www.gzip.org/zlib/> Before reporting a problem, please check this site to verify that you have the latest version of zlib; otherwise get the latest version and check whether the problem still exists or not.

PLEASE read the zlib FAQ http://www.gzip.org/zlib/zlib_faqs.html before asking for help.

Mark Nelson markn@ieee.org wrote an article about zlib for the Jan. 1997 issue of Dr. Dobbs' Journal; a copy of the article is available in <http://dogma.net/markn/articles/zlibtool/zlibtool.htm>

The changes made in version 1.2.3 are documented in the file `ChangeLog`.

Unsupported third party contributions are provided in directory "contrib".

A Java implementation of zlib is available in the Java Development Kit
<http://java.sun.com/j2se/1.4.2/docs/api/java/util/zip/package-summary.html>
See the zlib home page <http://www.zlib.org> for details.

A Perl interface to zlib written by Paul Marquess <pmqs@cpan.org> is in the CPAN
(Comprehensive Perl Archive Network) sites
<http://www.cpan.org/modules/by-module/Compress/>

A Python interface to zlib written by A.M. Kuchling <amk@amk.ca> is
available in Python 1.5 and later versions, see <http://www.python.org/doc/lib/module-zlib.html>

A zlib binding for TCL written by Andreas Kupries <a.kupries@westend.com> is available at
http://www.oche.de/~akupries/soft/trf/trf_zip.html

An experimental package to read and write files in .zip format, written on top of zlib by Gilles
Vollant <info@winimage.com>, is available in the contrib/minizip directory of zlib.

Notes for some targets:

- For Windows DLL versions, please see win32/DLL_FAQ.txt
- For 64-bit Irix, deflate.c must be compiled without any optimization. With -O, one libpng test fails. The test works in 32 bit mode (with the -n32 compiler flag). The compiler bug has been reported to SGI.
- zlib doesn't work with gcc 2.6.3 on a DEC 3000/300LX under OSF/1 2.1 it works when compiled with cc.
- On Digital Unix 4.0D (formerly OSF/1) on AlphaServer, the cc option -std1 is necessary to get gzprintf working correctly. This is done by configure.
- zlib doesn't work on HP-UX 9.05 with some versions of /bin/cc. It works with other compilers. Use "make test" to check your compiler.
- gzdopen is not supported on RISCOS, BEOS and by some Mac compilers.
- For PalmOs, see <http://palmzlib.sourceforge.net/>
- When building a shared, i.e. dynamic library on Mac OS X, the library must be installed before testing (do "make install" before "make test"), since the library location is specified in the library.

Acknowledgments:

The deflate format used by zlib was defined by Phil Katz. The deflate and zlib specifications were written by L. Peter Deutsch. Thanks to all the people who reported problems and suggested various improvements in zlib; they are too numerous to cite here.

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If you use the zlib library in a product, we would appreciate *not* receiving lengthy legal documents to sign. The sources are provided for free but without warranty of any kind. The library has been entirely written by Jean-loup Gailly and Mark Adler; it does not include third-party code.

If you redistribute modified sources, we would appreciate that you include in the file ChangeLog history information documenting your changes. Please read the FAQ for more information on the distribution of modified source versions.

<http://www.sony.net/>

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