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package (1.12) supports only HTML 2.0, so, for example, there is no support for tables or colors.

An imagemap creation tool is also included, WebMap Version 1.0, which aids in creating clickable images. You can graphically define rectangular, circular and polygonal "hot spots" in an image, and you are able to zoom the image and display a grid. Apparently this version does not support GIF 89 format files, and it had trouble reading a number of JPEG images we tried. The documentation states that WebMap does not support JPEG files, but the application itself lists them as viable files.

Excite for Web Servers is provided in the NT version, which allows you to add concept-based searching to your site. Related sets of pages can be indexed and searched, and you can define custom query and results page styles. Configuration and setup of Excite is done through a Web browser using a set of CGI programs. Much of the customization of Excite involves editing Perl scripts, and the manual clearly details this process. A WAIS (Wide Area Information Server) Toolkit is also included, which allows you to create WAIS plain-text databases that can be searched by keyword from WAIS clients. There is also a WAIS gateway Perl script included for accessing the WAIS server from a Web browser.

To ease setting up a secure Web server, using SHTTP or SSL, a Security wizard takes you through the steps necessary for requesting an RSA Key Pair from VeriSign Inc. This wizard is also used to install assigned certificates.

If you want to conduct credit card transactions through your Web site, also included is WebCharge, an application for conducting NaBANCO, MDI, VISA and Transact Data Services Inc. credit transactions. Transactions can be entered by hand, or through the use of a CGI script. With WebCharge and SSL or SHTTP, you can conduct secure Web commerce. You'll need a modem for WebCharge to contact the appropriate clearinghouse, as well as your merchant data. All WebCharge transactions can be logged.

Finally, Web Commander includes SLmail95 Version 2.0 from Seattle Labs, an SMTP server for Microsoft Windows. This allows you to send and receive electronic mail from other SMTP servers (the default mail protocol of the Internet and UNIX systems). For use with the Internet, you will need the cooperation of an SMTP server already connected to the Internet.

## Summary

Luckman's Web Commander, with its suite of included tools, is pretty much all you'll need to set up a Web site of almost any kind. Even relatively sophisticated applications such as electronic commerce can be implemented. More than that, it includes almost everything you would need to connect a stand-alone PC to the Internet. The documentation is well written and more than complete and could almost be sold as a stand-alone Web site creation guide. As a Web server, Web Commander performs well (that is, we couldn't uncover any HTTP implementation errors), and the administration interface, while not completely intuitive, is easy to use and affords a unique holistic view of your Web site.

## Stronghold Secure Server

by Simson L. Garfinkel, Contributing Editor

**S**tronghold is a cryptographically enabled version of the popular Apache Web server that is available for every major version of UNIX. The program comes with complete source code and tools for creating your own digital certificates. For Web sites already using the Apache (or National Center for Supercomputing Applications) Web servers that are looking into offering cryptographic protection for user data, Stronghold is a low-cost server that offers very high performance. But beware: Neither the product nor the company appear very stable at this point.

Stronghold is the primary product of C2Net Software Inc., formerly Community ConneXion Inc., a small Internet service provider-turned software vendor located in Berkeley, CA. The program is a modified version of the Apache-SSL Web server, which is itself a version of the popular Apache Web server to which the public domain SSLeay SSL implementation has been added.



**Stronghold is a modified version of the Apache-SSL server.**

Although the Apache-SSL Web server is freely available on the Internet, if you plan to use it within the United States you would be best advised to purchase the product from C2Net, which has obtained all the necessary license agreements for the public key algorithms so that the SSL-enabled Web server can be used legally for commercial purposes. The company has also made the necessary arrangements with VeriSign Inc. so that Stronghold users can easily get VeriSign server certificates.

The Stronghold Web server can be downloaded from the C2Net Web site after you register—a process that requires you to provide C2Net with your email address and name. You are then given a password that can be used to download the server. The evaluation license allows you to use Stronghold for up to 30 days. When you pay for your license, your evaluation password is automatically turned into a commercial password, which lets you download updates to the server at will.

C2Net makes Stronghold available precompiled for 16 different architectures. The program can be downloaded only from a Web browser. (The company plans to have a media kit available soon that will contain precompiled versions of all of

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its servers.) Documentation is on the company's Web site at <http://stronghold.c2.net/support/docs/TOC.php>.

As this review goes to press, C2Net has announced Stronghold Version 2.0. The new version is based on Apache 1.2, includes full support for HTTP 1.1, better management of SSL certificates and significantly better handling of CGI scripts. Unfortunately, Version 2.0 was unavailable for review in time for this article.

## Installation

To install Stronghold, you download the program's tar file, unpack it and run an installation script. The script installs the server and its complete source code in a directory of your choosing, usually `/usr/local/apache`. The script also installs the SSL system in its own directory, usually `/usr/local/ssl`. The installation script then walks you through creating your server's RSA secret key and public key. The installation script uses your secret key to sign your own public key and installs this key in the SSL directory, so you can start using the cryptographically enabled features immediately. The script then walks you through the certificate request process, which essentially sends a copy of your public key off to VeriSign for a signature.

In addition to the clean install script, C2Net has also produced an upgrade script for the various versions of its servers. Unfortunately, because of changes to the Stronghold configuration file format and installation process between Versions 1.1, 1.2 and 1.3, I was never able to get the upgrade scripts to work properly. Further complicating the upgrading process was a nasty tendency on the part of the SSL installation script to erase your previously created secret key and try to create a new one. As always, before upgrading, be sure to back up all of your files! Otherwise, you may find yourself sending off another \$99 to VeriSign to sign your new public key.

Stronghold runs two Web server processes. The `httpd` process is a conventional Web server running, by default, on port 80. The `httpsd` process is the SSL-enabled Web server, which defaults to port 443. Stronghold 1.3 uses a separate configuration file for each of these processes but launches them from a single binary. The processes fork as necessary to accommodate demand. A special URL, `http://localhost/stronghold-status`, reveals the Apache server status for your machine, showing the number of processes running, the number idle, the connecting host and the HTTP command being processed.

A third process, `sessiond`, runs as well. This process maintains cryptographic state information between SSL sessions. When users are accessing a series of SSL-protected pages or services in a row, `sessiond` dramatically improves performance. Unfortunately, versions of the program that shipped with Stronghold 1.3 didn't work properly. (Stronghold Version 2.0 eliminates `sessiond` and instead caches SSL connections directly.)

I have been running Stronghold on an Intel Corp. 486 DX2 running at 66 MHz since April 1996. The server handles 10,000 hits/day without any noticeable load on my computer's puny processor. Sites that I have spoken with say that the Apache-SSL server has no problem keeping pace with 100,000 hits/day or more. When it's serving up unencrypted pages, Stronghold should have performance that is identical to the standard Apache server. Serving up encrypted pages puts a substantially higher load on the server, however, for each RSA decryption that needs to be performed. If you are only using SSL to process a few cryptographically protected forms, you should have few problems, but if you're doing a lot of transaction processing you may need to use a high-speed processor.

Stronghold 1.3 implements SSL 2.0. The program has support for client-side certificates. Unlike earlier versions, Stronghold 1.3 compiles easily and cleanly. You can add Apache modules by simply placing them in the source code directory and making a modification to the Apache configuration file, then doing a simple make.

## Less Than Perfect

Overall, while I'm quite impressed with the Apache-SSL technology, I'm less than wowed by C2Net Software engineering practices. Although the most up-to-date version of the Stronghold server is always on the company's Web site, C2Net did not archive older versions of its Web server. Nor does the company distribute bug fixes for its older versions. This means that sites that are running older versions and want to fix a bug or simply obtain a clean distribution are forced to upgrade.

C2Net's quality control has been less than stellar. An early version of one of the company's utilities crashed with a

Stronghold	
Company	C2Net Software Inc. 1212 Broadway, Ste. 1400 Oakland, CA 94612
Phone	(510) 986-8770
WWW	<a href="http://stronghold.c2.net/">http://stronghold.c2.net/</a>
Supported Platforms	DEC Ultrix, HP-UX, SunOS, Solaris, UnixWare, BSDI, FreeBSD, SCO UNIX, Linux and SGI IRIX.
Best Feature	Apache code base is very fast and widely understood.
Worst Feature	Poor software engineering in previous releases.
Price	\$495
Circle 151	

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core dump when a DES encryption routine was called, but only on computers running the BSDI operating system. Stronghold 1.3 shipped with a `sessiond` daemon that simply did not work. C2Net did not notify its customers of these problems, but instead waited for them to discover the problems on their own. Many of these problems may be resolved with Stronghold 2.0, which is largely based on technology from Thawte Consulting in South Africa.

When C2Net first started selling Stronghold for \$495, Netscape Communications Corp. had priced its Web servers at more than \$1,000. Today, Netscape has lowered the price of its Fast Track server to the point that the two servers must now compete on technology alone. With Version 2.0, C2Net will bundle the server with a server certificate from Thawte Consulting for \$595.

Stronghold is a good secure server if you want source code, if you already have Apache modules that you want to add, if you want to self-sign certificates, or if you simply want to patronize the underdog. Netscape's server, on the other hand, has significantly better management tools and an apparently more stable company behind it. Netscape's server runs on fewer versions of UNIX, but more operating systems—such as Windows NT and Windows 95. C2Net has promised that Stronghold 2.0 will be delivered with improved management tools.

My guess is that UNIX hackers and believers in free software will gravitate toward Stronghold, while big corporations that like doing business with other big corporations will go with Netscape. Because both servers appear to offer sufficient technology for getting the job done, nontechnical factors are likely to dominate the decision of which server to use.

## BSD/OS 2.1

by **Simson L Garfinkel, Contributing Editor**

For nearly a year, I've used Berkeley Software Design Inc.'s BSD/OS as the underlying operating system for an active Web site and a small Internet service provider with more than 450 customers. During that time, BSD/OS has been a strong performer with not a single crash. Once we had it up for more than two months, only taking the machine down to add another hard drive.

BSDI's technical support, attention to security and rapid release of updates has been nothing short of phenomenal. The underlying operating system is fast, efficient and requires surprisingly little RAM. Furthermore, BSD/OS is easy to install and has support for a surprisingly wide variety of interface devices. All of these factors combine to make BSD/OS the best platform for running Internet servers today.

## BSD Background

BSD/OS is an outgrowth of the Berkeley UNIX 4.4 and the Computer Science Research Group at the University of California at Berkeley. The UNIX is similar to several "free" versions of UNIX that are available for download on the Internet today, including BSD 4.4, FreeBSD, NetBSD and OpenBSD. These operating systems also have more than a passing resemblance to Linux, since most of the user-level commands that come with Linux are derived from the origi-

nal Berkeley UNIX. Some Linux distributions even replace parts of the Linux kernel with parts of the Berkeley kernel, with varying degrees of success.

Two things make BSD/OS fundamentally different from the plethora of free UNIX versions, however. The first is software quality and the attention to systems integration. Unlike the free UNIXs, BSD/OS is supplied as a complete, integrated operating system. The operating system installs cleanly, and all of the parts work together. A well-thought-out package system allows you to selectively install or deinstall parts of the operating system, source code and optional software packages. The file system is cleanly laid out. The BSDI Web site (<http://www.bsdi.com>) clearly states what hardware is supported and what is not.

The second big difference between BSD/OS and free UNIX is support. Since the release of BSD/OS Version 2.1, BSDI has distributed more than 40 patches on its Web site. The patches can be easily downloaded and install cleanly: They are all shell scripts that are run as superuser. There's no need to hand-edit configuration files, run patch to update source code or reinstall binaries. Furthermore, patches are distributed in a timely fashion: Days after the SYN flooding attack on PANIX, for example, BSDI distributed a fix that would protect computers running BSD/OS from the attack.

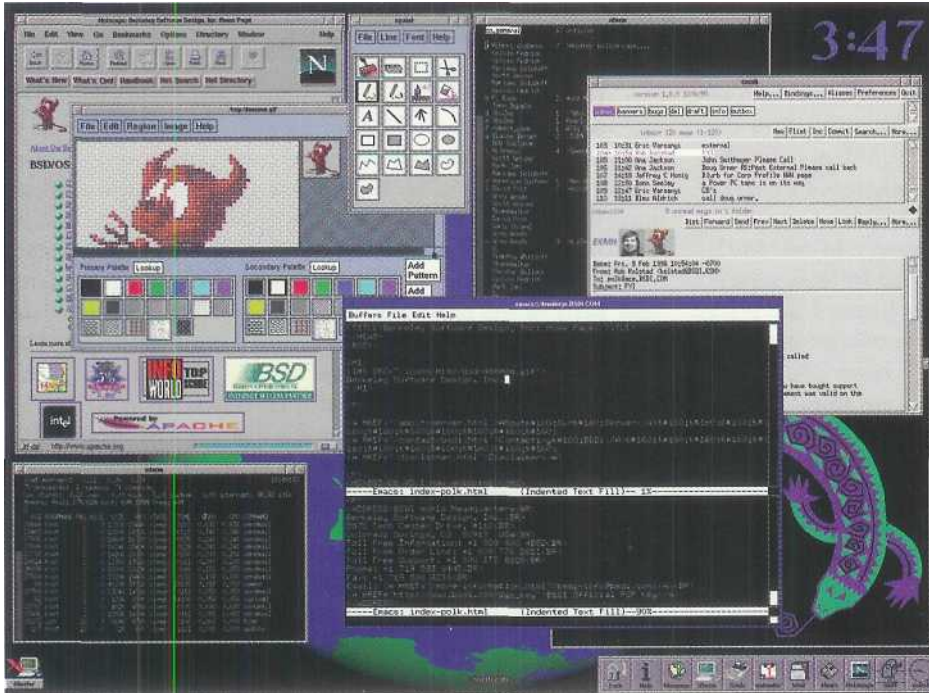
All of this quality and support comes at a price, of course. The base price of BSD/OS is \$995 for a license to run one to 16 concurrent users, \$1,995 for up to 64 users and \$2,995 for an unlimited binary license. A full source code license is \$2,995 to \$4,995. Support for the one-to-16 license is \$200 per year for upgrades, \$325 for upgrades and email support and \$500 for upgrades, email and telephone support.

Although these prices are nearly 100 times higher what you might expect to pay for FreeBSD or Linux, they are actually a bargain when you compare the price of a system running BSD/OS to a similarly configured server from Silicon Graphics Inc. or Sun Microsystems Inc. Reports from the field are that the Apache Web server running on a BSD/OS-equipped Pentium Pro with 64 MB of RAM can pump out Web pages at more than 45 Mb/s—enough to fill a T3. That's pretty good for a system that can be purchased for less than \$6,000.

## Getting to Know BSD/OS, Firsthand

We turned to BSD/OS for our Internet service provider in January 1996. We were desperate: The NeXT Computer Inc. NeXTstation that we had been using for the past four months had developed some sort of hardware or software problem and was crashing every eight to 12 hours. We had an old 486 PC with 16 MB of RAM sitting around the office: Instead of putting it on somebody's desk, as we had planned, we realized that it would be our new server.

First, we tried to install NetBSD on the machine. Although the install worked, we soon discovered that NetBSD used a different password encryption system than standard Berkeley UNIX to store encrypted passwords. Although the NetBSD system was superior and as a bonus could be exported from the United States, it was incompatible with all of our stored passwords. We also had a hard time compiling our Web server and utilities for the machines. Apparently, the version of NetBSD on the particular CD-



**BSD/OS is easy to install and has support for a surprising interface devices.**

ROM we had was just a little bit different from other versions of NetBSD that were circulating around the Internet.

We then tried to install FreeBSD and two flavors of Linux. Each time we ran into problems. The next day, my review copy of BSD/OS 2.1 showed up in the mail.

BSD/OS comes on a single CD-ROM and two floppy disks. The first floppy is a boot disk. It contains a miniature UNIX kernel, file system and installation program. The program will walk you through reformatting and initializing your hard drives, selecting which packages you wish to install, loading all of the software from the CD-ROM and setting up your Internet services. The operating system supports both IDE and SCSI hard disks and CD-ROMs, although if you have an IDE CD-ROM it must be on the first IDE controller. We have used BSD/OS with ISA, VESA and PCI interface cards. The kernel's autocofiguration process works as advertised, automatically enabling any interface card, hard drive, CD-ROM drive and tape drive that it finds.

Less than an hour after you insert that first floppy, you'll have a fully configured UNIX operating system on your local-area network, with a running Web server, mail server, POP server and lots of public-domain utilities. The second floppy disk, which is only distributed within the United States and Canada, contains DES and Kerberos.

The day after I got BSD/OS running, I found a pleasant surprise waiting for me. BSD/OS had run two jobs during the night and sent me the results by electronic mail. The first message consisted of the output for a few standard monitoring commands: `df` reporting the amount of free space left on my hard drives; `mailq` reporting the amount of email that was waiting in my queue for outbound delivery; and `ruptime`, reporting the status of other hosts on my network. The second report was the daily "insecurity" report, which is a simple

once-over scan of the system. This insecurity report tells you about users who have writable home directories or dot files, changes in programs that are in critical directories, changes in SUID or SGID programs, and other security-related events.

These reports aren't a fool-proof way of detecting an intruder. Because they are generated by programs that are based on your computer, and because the temporary files are not stored on removable media, a competent computer criminal could first break into your system and then disable the nightly insecurity report. Instead, the idea is to notify you of potential security problems so that you can fix them before somebody breaks in.

We were astonished with the speed of BSD/OS. For more than three months, we ran the operating system on our puny PC with

16 MB of RAM. The system had no difficulty running our Web server, which was getting something like 10,000 hits/day over a 128-Kb/s frame relay connection to the Internet. Compiles were a tad slow, so we added another 8 MB of RAM. After that, the system appeared to perform faster than a Sun SPARCstation 10 with 32 MB of RAM. Of course, we weren't running the X Window System on this machine. If you are interested in running a fast Web site, you shouldn't run X on your servers either.

If you do want to run X applications, then you'll be pleased by BSD/OS's ability to run SCO UNIX binaries. I haven't tested this out because I don't have any SCO binaries to run. But BSDI does make a big deal about this binary compatibility, so somebody must care about it.

## Useful System Management Functions

One of the best things about installing BSD/OS is that it feels like you get your own resident UNIX guru for free. There are lots of interesting daily, weekly and monthly scripts that do all sorts of useful system management functions. For example, log files don't grow out of control. They're neatly pruned back, compressed and archived. And the BSD/OS `/usr/contrib` directory is filled with all sorts of useful things that you could think of downloading from the Net, except that they've all been downloaded for you, compiled, installed and left ready-to-run.

Here's a list of some of the "contributed" software that comes with BSD/OS:

- Apache Web server
- bash
- elm
- Emacs
- Ghostscript

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- Hylafax, a full system for sending and receiving faxes
- ispell
- jove
- less
- lynx
- MH (email system)
- patch
- pcnfsd (added support for PC/NFS)
- perl4 and perl5
- pine
- screen
- SMB (provides file and print sharing to Windows-based machines)
- SNMP support
- tcl
- tcsh
- zup (Zmodem support)

There are dozens of other programs included that you would probably spend a good week downloading and installing.

BSD/OS isn't perfect. For example, after you install a kernel patch, it is necessary to run the `config` and make commands to relink and reinstall the system's kernel. This process could be automated. I'd also like to see `/usr/bin/perl` point to perl5 and not to perl4. Perhaps the most serious problem is

that BSD/OS has no support for running secure set-uid perl5 scripts. This is a serious failing that isn't present in any other version of UNIX for Intel-based processors.

## BSDI, the Company

One of the things that you're clearly buying with BSD/OS is support. So what's the strength of the company behind BSD/OS? BSDI was founded in January 1991. The company now has more than 50 employees, and more than \$10 million a year in revenues, says Rob Kolstad, the company's president. The company is profitable.

BSDI plans to ship Version 3.0 of its operating system early in 1997. That system should have Web-based management, as well as dramatically improved disk performance—as if BSDI needed to run faster.

One thing that's noticeably missing right now from BSD/OS is support for symmetric multiprocessing—something that's in Linux 2.0. Kolstad says that a lot of customers are asking for SMP, but it's really a check-off item. It's hard to imagine jobs that a 200-MHz Pentium Pro system with 64 MB of RAM and a PCI SCSI interface couldn't handle. SMP support

BSD/OS 2.1	
Company	Berkeley Software Design Inc. 5575 Tech Center Drive, #110 Colorado Springs, CO 80918
Phone	(800) 800-4BSD
Email	<a href="mailto:bsd-info@bsd.com">bsd-info@bsd.com</a>
WWW	<a href="http://www.bsd.com/">http://www.bsd.com/</a>
Best Feature	Fast, reliable UNIX.
Worst Feature	Lacks support for secure set-uid perl5 scripts.
Price	\$995 binary license \$2,995 source license
Circle 152	

should be added later this year, Kolstad says.

Although some sites are sure to upgrade immediately, my advice is to hold off on upgrading to 3.0 until the early adopters a chance to find the bugs and BSDI a chance to fix them.

I completely recommend BSD/OS. I run it myself. •



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