

2ND
EDITION

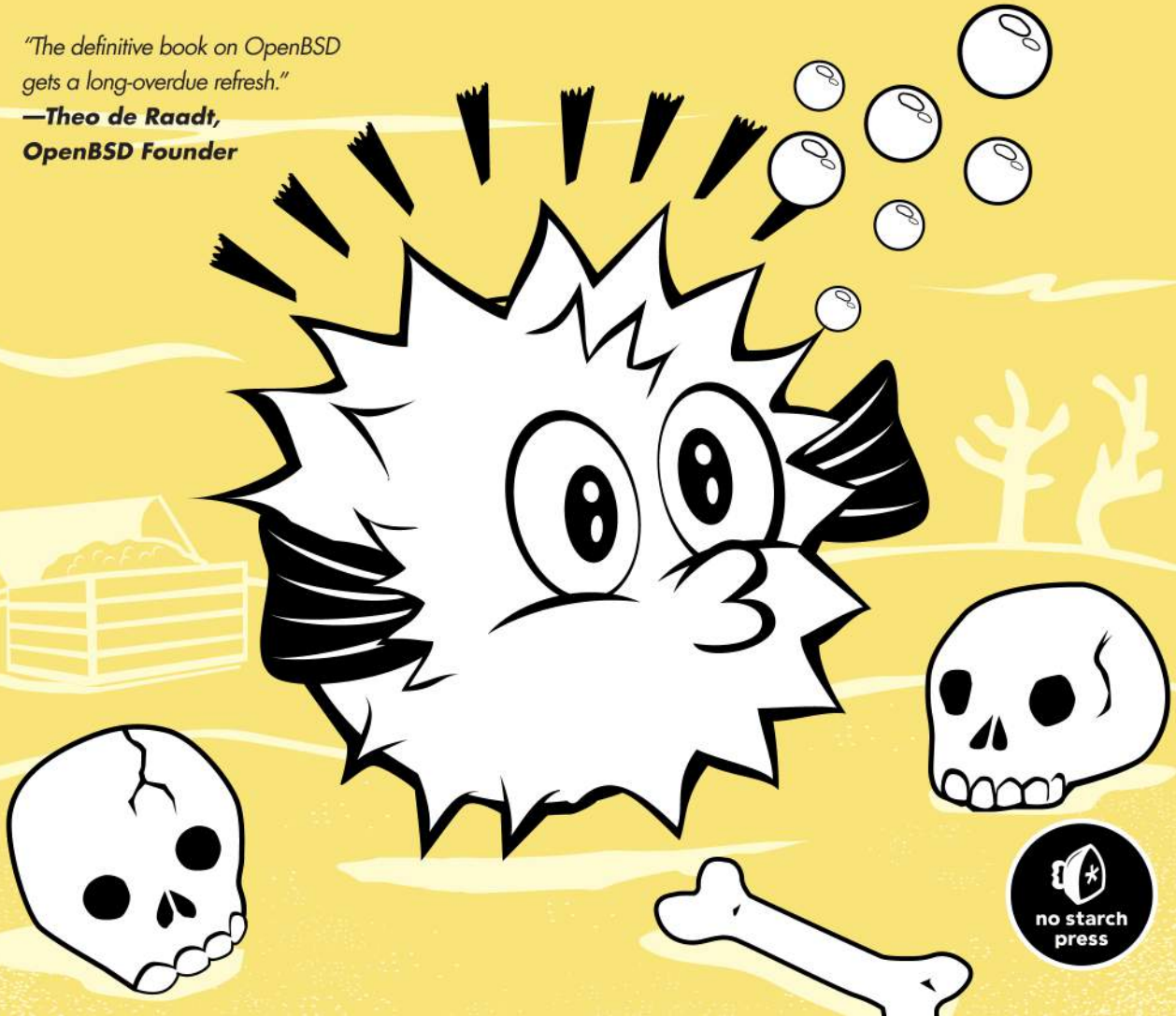
ABSOLUTE OPENBSD

UNIX FOR THE PRACTICAL PARANOID

MICHAEL W. LUCAS

*"The definitive book on OpenBSD
gets a long-overdue refresh."*

—**Theo de Raadt,**
OpenBSD Founder



INDEX

Symbols

- * (asterisk), as wildcard, 285
- @ symbol, to send messages to another host, 288
- \ (backslash), for line continuation, 78, 113
- \$ (dollar sign), in pathnames, 96
- ! (exclamation point)
 - to escape to command prompt, 43
 - as negation symbol, 117–118
 - in filter rule, 406
- > symbol, for `disklabel(8)` command prompt, 50
- # (hash mark), for comments, 33
- % (percent sign), for groups in user aliases, 114
- / (root) partition. *See* root (/) partition
- ~ (tilde), in pathnames, 96
- _ (underscore), for unprivileged user names, 103–104

A

- a command, 52
- abandoned IP addresses, 310
- abbreviations, for disk sizes, 52
- ABIs (application binary interfaces), 2
- abort (`fdisk`), 131
- account information access, controlling, 266
- ACPI (Advanced Configuration and Power Interface), 341
- `acpio` device, 341
- activ method for BSD authentication, 99
- active FTP, 437
- active partition, marking, 131
- address families, in packet filtering, 405
- Address Resolution Protocol (ARP), 185
 - IPv4 addresses and, 214
- address space layout randomization, 174
- `adduser(8)`, 87–89
 - batch flag, 89
 - configuring default settings, 87–88
 - options, 91–92
- administrator accounts, creating, 91–92

- Advanced Configuration and Power Interface (ACPI), 341
- advanced persistent threat (APT), 171
 - advocacy@OpenBSD.org*, 9
 - `afterboot(8)` man page, 57
- aggressive optimization for PF, 420
- aliases, 113–117
 - naming conventions, 117
 - nesting, 116
- alldirs option, for mount point in partition, 156
- ALTQ bandwidth management system, 439
- `/altroot` partition, 73
 - backup to, 148
- amd64 platform, 16
 - boot floppies, FFS support by, 133–134
 - floppy image for, 39
 - Intel Preboot Execution Environment on, 451
 - kernel configuration directory, 361
- anchors in PF, 434, 439
 - adding rules, 434–435
 - conditional filtering, 436
 - nested, 436–437
 - viewing and flushing, 436
- announce@OpenBSD.org*, 8
- anonymous CVS, 386
- antispoofing rule, 416
- Apache web server, 227
- APIs (application programming interfaces), 2
- application binary interfaces (ABIs), 2
- application menu, creating in X Windows System, 334
- application programming interfaces (APIs), 2
- applications. *See also* software
 - PF and, 400–401
 - preventing coverage by window, 336
- applications layer (OSI), 186–187
- `apropos(1)`, 5–6
- APT (advanced persistent threat), 171
- archives, of mailing lists, 10

- ARP (Address Resolution Protocol), 185
 - IPv4 addresses and, 214
- arp(8), 214
- asking questions, OpenBSD experts
 - reaction to, 11
- asterisk (*), as wildcard, 285
- asynchronous mounts, in FFS, 136
- AT&T, xxxi, xxxii
- atexit(), 174
- audio, 268
- audio device, 351
- auth facility, 283
- auth-defaults class, 100, 101
- authenticating packet filter
 - configuration, 256
- authentication methods for user
 - accounts, 99–100
- auth-ftp-defaults class, 100
- authorized users, repository of, 157
- authpf(8), 101
 - anchors for, 434
- authpriv facility, 283
- automation
 - packet filtering tables and, 425–426
 - of ports, 236
- automounter daemon, 256
- autonegotiation, in Ethernet network, 215
- availability, xxx

B

- back channel in FTP, 437
- background color of desktop, 335
- backslash (\), for line continuation, 78, 113
- backup
 - to */altroot* partition, 148
 - in daily maintenance, 280–281
 - of default kernel, 349
 - of GENERIC kernel, 358
 - before install, 37
 - of userland for diskless station, 456
- bandwidth management in PF, 439–445
 - assigning traffic to queues, 444
 - child queues, 442
 - for parent queue, 441
 - queue options, 442–443
- base operating system, preparing for your own OpenBSD, 383–384
- baseXX.tgz* file set, 24, 456
- Basic Input/Output System. *See* BIOS (Basic Input/Output System)
- beep of computer, 324
- Berkeley Internet Name Domain server (BIND), 211

- BerliOS, mirrors for, 247
- BGP (Border Gateway Protocol), 203
- BGP daemon, 257
- bgpd(8), 205, 257
- bidirectional NAT, 429–432
 - and packet filter rule order, 430–431
 - redirection, 431–432
 - and security, 430
- Big Giant Lock method, 18
- bigptmove, 337
- binary objects (blobs), 17–18
- binary object device drivers, 17
- binat-to keyword, 429
- BIND (Berkeley Internet Name Domain server), 211
- bind command, for mapping keys, 336
- binding, key sequence to `cwm` command, 332
- bioctl(8), 160
 - d flag, 165
- BIOS (Basic Input/Output System)
 - in boot process, 70
 - clock, 45
 - configuration, 38
- bios0 device, 341
- blanking screen, 324–325
- blobs (binary objects), 17–18
- block devices, 126–127
- block statement, 404
- blocks in FFS, 134
 - number of used, 143
- \$BLOCKSIZE environment variable, 143–144
- bogons, 422–423
- bonding, 221
- The Book of PF* (Hansteen), 256, 395, 448
- Boolean sysctls, 346
- boot command, 70
- boot loader, 69, 70
 - information on disk devices, 73
 - making settings permanent, 74–75
 - prompt, 70
- boot media, 22
 - creating, 38–40
 - boot CDs, 40
 - boot floppies, 39–40
- boot process, 69–84
 - from alternate hard disk, 73–74
 - in alternate kernel, 72–74
 - configuring VLANs, 224
 - delaying, 70
 - Ethernet network configuration at, 219–220
 - to graphic console, 67
 - interrupting, 41, 70
 - for kernel, 74

- kernel configuration in, 353
- multiuser startup, 79–84
- options before completing, 70–71
- serial consoles, 75–79
- setting sysctls at, 346–348
- setting wscons variables, 325
- in single-user mode, 71–72
- from softraid(4) devices, 166
- trunks at, 222
- and X Windows System, 330–331
- bootable partition, 131
- bootparamd(8) daemon, running, 454
- bootstrap tools, installing, 372
- boot-time securelevel, 178
- Border Gateway Protocol (BGP), 203
- borders for windows, 336
- botnets, 170
- Brauer, Henning, xxv–xxvi, 268*n*, 371*n*
- bridge(4) interfaces, 400
- broadcast address, 191
- broadcast protocol, Ethernet as, 213
- BSD, xxxi
 - license, xxxi, xxxii
- BSD authentication, 99
- /bsd* file, 349
- bsd* file set, 23–24
- bsd.mp* file set, 23–24
- bsd.rd* file set, 23–24
- BUFCACHEPERCENT value in kernel, 351
- bugs
 - identifying, 3
 - in releases, 58
- BUGS section, in man pages, 7
- build files for ports, 238
- _build* keyword, 265
- building
 - custom kernels, 365–366
 - troubleshooting errors in, 365–366
 - programs, virtual terminal SSH
 - connections for, 325
 - your own OpenBSD
 - getting source code, 384
 - preparations for, 383–388
 - reasons for, 382–383
- burncd (Unix), 40
- business card attachments, 13

C

- C compiler, 24
- C++ compiler, 24
- canaries, 174
- cap_mkdb(8), 95

- CARP (Command Address Redundancy Protocol), 316, 317
- CAT5 cable, 76
- CBQ (class-based queuing), 440
 - borrow option, 443
 - ruleset, 443–444
- CD drives, emulating floppies, 40
- cdemuXX.iso* image, 40
- cdio*(1), 152
- cdrecord* (Unix), 40
- CDs (compact discs), 153
 - booting from, 38, 40
 - mounting, 152
 - obtaining official, 20
- cdXX.iso* image, 40
- Changelogs* directory, 20
- character devices, 127
- chargen function (inetd), 317
- check command, 83
- chflags*(1), 176
- child queue, definitions, 442
- chio*(1) medium changer, 257
- chpass*(1), 93, 99, 266
- chroot, 460
- chrooting users, 319–322
- class-based queuing (CBQ), 440
 - borrow option, 443
 - ruleset, 443–444
- cleaning filesystems, 138, 374
- client for serial console, 76–77
 - port, 78–79
- clock in BIOS, 45
 - correcting, 294
- clri*(8), for dirty filesystem, 138
- collision domain, 213
- Command Address Redundancy Protocol (CARP), 316, 317
- command alias, 115
- command prompt. *See* prompt
- comments, hash mark (#) for, 33
- committers, xxxv
- communities in SNMP, 314
- compact discs. *See* CDs (compact discs)
- compilers, */usr* partition for, 28
- compressed tar files, for code
 - snapshots, 384
- Computer Science Research Group (CSRG), xxxi
- compXX.tgz* file set, 24
- concatenated disks, 162
- Concurrent Versions System (CVS), 385
 - mirrors, 386
- conditional filtering, anchors for, 436
- confidentiality, xxx

- config(8)
 - for kernel changes, 348–353
 - backup of default kernel, 349
 - changing constants, 352–353
 - help and list commands, 350–351
 - for testing custom kernel, 364–365
 - configuration, testing by rebooting, 57
 - connectionless protocol, 197
 - conservative optimization for PF, 419–420
 - console, 274
 - configuration with `wscons`, 324–325
 - const keyword (PF), for table, 422
 - content farms, bandwidth control
 - machines for, 440
 - contributors to OpenBSD, xxxiv
 - converting ISO images, 456
 - cooked device node, 126
 - Coordinated Universal Time (UTC), 45
 - coordinator for OpenBSD, xxxv
 - copycenter, xxxii
 - copying
 - disk images to disk, 40
 - files to other servers, 281
 - copyleft, xxxii
 - core programs, 24
 - coredumpsize variable, 96
 - country code, for USB keyboards, 66
 - cp(1), copying files with, 145
 - cpio(1), copying files with, 145
 - cputime variable, 96
 - cron facility, 283
 - cron(8), 109
 - cross-compiling, 383
 - crypto method for BSD authentication, 99
 - cryptography, OpenBSD support for, 10
 - cs(1), system-wide defaults for, 257
 - CSRG (Computer Science Research Group), xxxi
 - CTRL-ALT-DEL, effect of, 348
 - current resource limit, specifying, 97
 - current version of OpenBSD, 368–369
 - building, 392–393
 - source code for, 384
 - updating to, 387–388
 - cursor, controlling with keyboard, 335
 - custom kernels, 355–366
 - building, 365–366
 - cautions, 355–358
 - configuration, 359–365
 - device drivers, 359
 - keywords, 360
 - pseudo-devices, 359–360
 - configuration file, 362–364
 - identifying running, 366
 - installing, 366
 - preparations for, 358
 - problems building, 357
 - problems running, 358
 - reasons for, 356–357
 - removing devices, 363
 - removing options, 362–363
 - stripping down, 363
 - testing, 364–365
 - CVS (Concurrent Versions System), 385
 - mirrors, 386
 - CVS directory, 237
 - cwm(1) window manager, 330, 331–337
 - configuration file loss, 332
 - configuring, 331–332
 - modifier keys, 331–332
 - creating windows, 332–333
 - decorating, 335–336
 - exiting, 333
 - locking screen, 333–334
 - resizing terminal window, 333
 - `.cwmrc` file, 331
 - mapping keys in, 336
 - cylinders, 31
- ## D
- d command, 51
 - daemon
 - checking for running, 83
 - instructed to reread
 - configuration file, 83
 - unprivileged account for each, 103
 - daemon facility, 283
 - DaemonForums, 8
 - daily maintenance, 278–281
 - daily(8), 278
 - damaged filesystem, recovering, 139
 - data connection for FTP, 437
 - data integrity, synchronous
 - mounts for, 136
 - datalink layer (OSI), 185, 187
 - datasize variable, 96
 - date, setting, 60–61
 - date(1), 60, 61
 - DB9-to-RJ45 converters, 76
 - dd(1), 39–40
 - ddb.console sysctl, 348
 - ddb.panic sysctl, 348
 - de Raadt, Theo, xxxiii, xxxv, xxxvii
 - decrypted partition
 - automatic, 168
 - unmounting, 167
 - default accept, vs. default deny, 399
 - default answers, for installer, 42
 - default BSD pager, 5

- default gateway, 64
- _default keyword, 264–265
- default login class, for user, 87
- default partitioning, by installer, 26
- default permit or default deny, 404
- default route, 203
 - adding to routing table, 207
 - on Ethernet, configuring, 219
- default screensaver in `cwm`, 334
- default search domains, 210–211
- default shell for user, 87
- default user class, 94
 - definition, 94–95
- Defaults statement, 117
- delete command (`pfctl`), 425
- deleting
 - partitions, 51
 - routes, 207
 - `softraid(4)` devices, 165
 - user accounts, 92
- dependencies
 - for packages, 232, 234–235, 381
 - ports and, 241, 250–251
- DESCRIPTION section, in man pages, 7
- desktop OpenBSD, 323–337
 - background color, 335
 - console configuration with `wscons`, 324–325
 - `cwm(1)` window manager for, 331–337
 - `tmux` for virtual terminals, 325–329
 - X graphical interface setup, 330–331
- `$DESTDIR` environment variable, 390, 391
- destination address, in filter rule, 406
- destination port, in filter rule, 408–409
- detaching vnode devices from images, 154
- `/dev/console` file, 274
- developers' logs, 2
- device drivers
 - attachment to hardware, 341
 - binary object, 17
 - custom kernel configuration for, 359
 - enabling, 350, 352
 - finding, 352
 - for hardware sensors, 297–298
 - kernel and, 340, 349
 - minimizing number in custom kernel, 363
 - in OpenBSD, 41
 - for physical sensors, 297–298
- device names
 - device attachment vs., 127–128
 - for floppy drives, 39–40
 - for hard drives, 73
- device nodes, 126–128
- `df(1)`, 142
- `dhclient(8)`, 219
- DHCP, 212–213
 - getting IPv4 address from, 219
 - server setup for diskless install, 452–453
 - static IP address and, 42–43, 309
- `dhcpd` (DHCP daemon), 307–310
 - enabling, 309
- dial-up modem, 270
- Diffie-Hellman cryptography, 268
- directories
 - locking users in, 319–320
 - for new releases, 390
 - number of used filesystem blocks, 143
 - for `ttftpd`, 310–311
- dirty filesystems, 138
- discard function (`inetd`), 317
- disk drives. *See also* hard drives
 - CD drives emulating floppies, 40
 - changing basic parameters, 54
 - device names, 32
 - mounting, in single-user mode, 71–72
 - setup when installing OpenBSD, 46–47
 - custom layout, 49–54
- disk images, attaching vnode devices to, 154
- disklabel partitions, 31, 50
 - creating, 51–53, 132
 - for `softraid` device, 162
- disklabel unique identifier (DUID), 33
 - and `/etc/fstab` filesystem table, 128–129
- `disklabel(8)`, 25
 - command prompt, 50
 - expert mode for, 55
 - help for, 55
- disklabels, 31–34
 - advanced commands, 54–55
 - backing up and restoring, 133
 - creating, 144–145
 - erasing, 51
 - printing, 50, 53
 - viewing, 50–51, 132
 - writing new, 53–54
 - writing to disk, 53–54
- diskless installation, 450–454
 - DHCP server setup, 452–453
 - power for, 456
 - running, 454–456
 - TFTP server setup, 453
- display. *See* screen
- `display.kbdact` variable, 325
- `display.msact` variable, 325
- `display.outact` variable, 325

- display.screen_off variable, 325
- Distance Vector Multicast Routing Protocol (DVMRP), 258
- \$DISTDIR variable, 244
- distfiles* directory, 20
- distfiles*, for ports, 244
- divert-to keyword (PF), 433
- dmessage package, 343
- dmesg(8), 340
- DMZ, hosts in, 204
- DNS (Domain Name Service) servers, 65
- DNS queries, 399
- DNS resolution, 210–213
 - /etc/hosts* file, 212
 - resolver vs. dynamic configuration, 212–213
- DNS spoofing attacks, 115
- doc* directory, 21
- documentation, xxxvi–xxxvii
 - distribution set for, 23
 - man pages, 3–7
 - not provided by vendors, 17
- dollar sign (\$), in pathnames, 96
- domain, 210
- Domain Name Service (DNS) servers, 65
- “Don’t Track Access Time” mounts,
 - in FFS, 137
- du(1), 143
- dual-stacked setup, 188
- DUID (disklabel unique identifier), 33
 - and */etc/fstab* filesystem table, 128–129
- dump(8), 128, 139
 - avoiding for NFS mount, 160
 - backup, 258
 - copying files with, 145
- DVMRP (Distance Vector Multicast Routing Protocol), 258
- dvmrpd(8), 258
- Dvorak layout, 66
- dynamic clients, dhcpcd for
 - configuring, 307
- dynamic configuration, vs. resolver, 212–213
- dynamic network configuration, 64

E

- e command, 54
- echo function (inetd), 317
- ECN (Explicit Congestion Notification), 347, 443
- \$EDITOR environment variable, 110, 122
- EISA hardware, 16

- email
 - attachments, 13
 - for help request, 12–13
 - maintenance tasks results to local root account, 65
 - responding to, 14
 - sending, 13–14
- email software, configuration files for, 263
- embedded systems, and syslogd(8), 289
- emergency root partition, 148
- emulated CPUs, 19
- enc0 (encapsulating interface), 63, 216
- encrypt(1), 91
- encrypted partitions, 166–168
 - automatic decryption, 168
- encryption algorithm, for user passwords, 88
- Enhanced Small Device Interface (ESDI), 33
- environment variables
 - in */etc/login.conf* file, 97
 - and sudo(8), 119–120
- erasing. *See also* deleting disklabels, 51
- error messages
 - mmap: Cannot allocate memory, 149
 - NFS-related, 155
 - from snmpd, 315
- errors, from custom kernel, 364
- ESDI (Enhanced Small Device Interface), 33
- ESXi, 19
 - /etc/adduser.conf* file, 256
 - /etc/aliases* file, 278
 - /etc/amd* file, 256
 - /etc/authpf* directory, 256
 - /etc/bgpd.conf* file, 257
 - /etc/boot.conf* file, 74–75, 257
 - /etc/bootparams* file, 455
 - /etc/changelist* file, 257, 280
 - /etc/chio.conf* file, 257
 - /etc/csh.** files, 257
 - /etc/daily* file, VERBOSESTATUS, 281
 - /etc/daily.local* file, 148, 257, 278
 - /etc/dhclient.conf* file, 257
 - /etc/dhcpd.conf* file, 257, 308
 - /etc* directory, 255
 - files in, 256–276
 - merging changes, 393
 - across Unix variants, 256
 - updating, 375–380
 - sysmerge(8) to compare files, 376–378
 - /etc/disklabels/* directory, 257–258

- /etc/disktab* file, 258
- /etc/dumpdates* file, 258
- /etc/dvmpd.conf* file, 258
- /etc/ethers* file, 454
- /etc/exports* file, 156, 258, 455
- /etc/fastboot* script, 82
- /etc/fstab* file, 258
- /etc/firmware* file, 258–259
- /etc/fonts/* directory, 259
- /etc/fstab* file, 135, 149–150, 259
 - CD and FAT flash drive entry, 153
 - for mounting NFS share, 160
- /etc/fstab* filesystem table, and DUID for disk, 128–129
- /etc/ftpchroot* file, 259
- /etc/ftpusers* file, 259
- /etc/gettytab* file, 259
- /etc/group* file, 107, 260
 - editing, 93–94
- /etc/hostapd.conf* file, 260
- /etc/hostname.* files, 260
- /etc/hostname.if* file, route statement in, 207
- /etc/hostname.interfacename* file, 219
- /etc/hosts* file, 212, 260
- /etc/hosts.equiv* file, 260
- /etc/hosts.lpd* file, 260–261
- /etc/hotplug/* file, 261
- /etc/ifstated.conf* file, 261
- /etc/iked/* file, 261
- /etc/iked.conf* file, 261
- /etc/inetd.conf* file, 261, 317
- /etc/ipsec.conf* file, 261
- /etc/isakmpd* file, 261
- /etc/kbdtype* file, 66, 261
- /etc/kerberosV/* directory, 262
- /etc/ksh.kshrc* file, 262
- /etc/ldap/* file, 262
- /etc/ldapd.conf* file, 262
- /etc/localtime* file, 59, 262
- /etc/locate.rc* file, 262
- /etc/login.conf* file, 94, 262
 - changing, 95
 - environment variables, 97
 - legal values for variables, 95–96
 - sample entries from default, 100
- /etc/lynx.cfg* file, 262
- /etc/magic* file, 262
- /etc/mail/* directory, 263
- /etc/mail/aliases* file, 65, 263
- /etc/mailler.conf* file, 263
- /etc/mail.rc* file, 263
- /etc/man.conf* file, 264–265
- /etc/master.passwd* file, 88, 90
 - editing, 93–94, 266
 - fields, 267–268
- /etc/mixerctl.conf* file, 268
- /etc/mk.conf* file, 238, 268
- /etc/moduli* file, 268
- /etc/monthly* file, 268
- /etc/monthly.local* file, 268
- /etc/mold* file, 269
- /etc/mrouted.conf* file, 269
- /etc/mtree/* directory, 269
- /etc/mygate* script, 269
- /etc/myname* file, 61, 269
- /etc/named.conf* file, 121–122
- /etc/netstart* script, 62, 81, 219, 269
- /etc/networks* file, 269
- /etc/newsyslog.conf* file, 269, 290–292
- /etc/nginx/* file, 269–270
- /etc/nsd.conf* file, 270
- /etc/ntpd.conf* file, 60, 270, 294, 295
- /etc/ospf6d.conf* file, 270
- /etc/ospfd.conf* file, 270
- /etc/passwd* file, editing, 93–94
- /etc/pf.conf* file, 270, 397, 401, 422
 - anchor rules in, 435
 - anchor setting, 402
 - and FTP proxy, 438–439
 - options, 402
- /etc/pf.os* file, 270
- /etc/ppp/* file, 270
- /etc/printcap* file, 270, 306
- /etc/protocols* file, 186, 270
- /etc/pwd.db* file, 266
- /etc/raddb/servers* file, 101
- /etc/rbootd.conf* file, 271
- /etc/rc* script, 59, 79, 80–82, 271
- /etc/rc.conf* file, 59
 - OpenBSD defaults in, 59
- /etc/rc.conf* script, 80
- /etc/rc.conf.local* script, 59, 81, 296
 - deactivating functions in, 80
 - to disable PF, 397
 - to disable sshd, 318
 - enabling dhcpcd, 309
 - ftp-proxy enabled in, 438
 - snmpd to enable, 315
- /etc/rc.d* directory, 82
- /etc/rc.firsttime* script, 82
- /etc/rc.local* script, 81
- /etc/rc.securelevel* script, 81, 178
- /etc/rc.shutdown* script, 82
- /etc/relayd.conf* file, 271
- /etc/remote* file, 76, 78–79, 271
- /etc/resolv.conf* file, 210–212, 271
- /etc/resolv.conf.tail* file, 213, 271
- /etc/ripd.conf* file, 271
- /etc/rmt* file, 271
- /etc/rpc* file, 272

- /etc/sasyncd.conf* file, 272
- /etc/sensorsd.conf* file, 272, 298–300
- /etc/services* file, 199, 272, 317, 408
- /etc/shells* file, 88, 272
- /etc/skel/* file, 272
- /etc/sliphome/* file, 272
- /etc/snmpd.conf* file, 273, 314–315
- /etc/spwd.db* file, 266
- /etc/ssh/* file, 273
- /etc/ssh/sshd_config* file, 318–319
- /etc/ssl/* file, 273
- /etc/sudoers* file, 110, 111–113, 115–116, 273
 - aliases, 113–117
 - multiple entries in one field, 112
 - running commands as non-root users, 113
- /etc/sysctl.conf* file, 63, 178, 273, 344, 346–348
 - machdep.allowaperture=2 sysctl* in, 330
- /etc/syslog.conf* file, 273, 284–287
- /etc/systrace/* directory, 273
- /etc/termcap* file, 274
- /etc/tmux.conf* file, 329
- /etc/ttys* file, 274–276
- /etc/weekly.local* script, 276
- /etc/wsconsctl.conf* file, 276
- /etc/X11* directory, 276
- etcXX.tgz* file set, 24, 456
- /etc/ypldap.conf* file, 276
- Ethernet, 209, 213–215
 - configuring, 215–220
 - default routes, 219
 - dynamic network, 219
 - network at boot, 219–220
 - multiple IP addresses on one card, 218
 - speed and duplex, 215
- Ethernet cards, configuration file, 63
- Ethernet interfaces, 62–64
- ex2fs filesystem, 152
- ex3fs filesystem, 152
- exclamation point (!)
 - to escape to command prompt, 43
 - as negation symbol, 117–118
 - in filter rule, 406
- exclusions to packet filtering lists, 415
- execution forbidden mounts, 137–138
- exit command (*config*), 352
- exit command (*fdisk*), 131
- exiting, *cwm*, 333
- expert mode, for *disklabel*, 55
- Explicit Congestion Notification (ECN), 347, 443
- exporting filesystems, 155
- exports, NFS client mounting of, 155

F

- facilities for system logs, 283–284
 - combining, 285
- failover, 221
- fallback mirrors, 248–249
- family keyword, 212
- Fast File System (FFS), 29, 133–140
 - blocks, fragments, and inodes, 134
 - filesystems
 - creating, 134–135
 - integrity, 138–140
 - mount options, 135–138
 - versions, 133–134
- FAT filesystems, 150–151
- fdisk(8)*, 30
 - exiting, 131
 - and MBR partitions, 129–131, 144
- feh*, 335–336
- FFS. *See* Fast File System (FFS)
- FIFO (first-in, first-out) queuing, 440
- file flags, 175–177
- file sets, 23–25
 - custom, 458
 - selecting when installing OpenBSD, 47–49
 - for upgrade, 375
- File Transport Protocol. *See* FTP (File Transport Protocol)
- files
 - assigning ownership of, 108
 - copying to other servers, 281
 - identifying origin of, 232–234
 - logging to, 287
 - removing during upgrade, 372
- filesize variable, 96
- filesystems
 - adding new, 146
 - cleaning, 138, 374
 - exporting, 155, 156–157
 - foreign, 150–152
 - impact of block size on
 - partition size, 53
 - integrity checks, 71–72, 281
 - partition size and, 26
 - integrity in FFS, 138–140
 - memory, 148–150
 - mounting at nonstandard locations, 141
 - mounting for upgrade, 376
 - mounting images, 153–154
 - mounting remote, 159
 - mounting standard, 141
 - partition, 29

- recovering damaged, 139
- type on partition, 34
- filtering, `tcpdump`, 447–448
- finding. *See* search
- fingerprint scanners, 100
- firewall, 204, 396–397
 - avoiding install of unneeded file sets, 48
 - `dhcpd` and, 309–310
 - NAT and, 426
- firmware, 17–18, 259
- first-in, first-out (FIFO) queuing, 440
- `flag` command (`fdisk`), 131
- flash drives, 153
- `$FLAVOR` environment variable, 250
- floppy disk
 - boot loader information on drive, 73
 - booting installer from, 22, 38–40
 - floppyBXX.fs* image, 39
 - floppyCXX.fs* image, 39
 - floppyXX.fs* image, 39
 - `flush` command (`pfctl`), 425
 - force-starting software, 83–84
 - foreign filesystems, 150–152
 - fragmentation behavior of filesystem, 34
 - fragmented packets, 399
 - frags limit and, 418
 - fragments in FFS, 134
 - frame in datalink layer, 187
 - free lines, in kernel, 351
 - free use of OpenBSD, xxxvii–xxxviii
 - `fscsk(8)`, 71–72, 374
 - avoiding for NFS mount, 160
 - for dirty filesystem, 138
 - running, 139
 - trusting, 139–140
 - `fsdb(8)`, for dirty filesystem, 138
 - `fstat`, 202
 - `fstype`, 34
 - FTP (File Transport Protocol)
 - password source for connections, 101*n*
 - `pf(4)` and, 437–439
 - proxy, PF configuration and, 438–439
 - `ftp` facility, 283
 - FTP server, installing OpenBSD from, 23, 48
 - ftplist* file, 21
 - `ftp-proxy(8)`, 438–439
 - anchors for, 434
 - full-duplex connection, 215
 - `fvwm(1)`, 331
 - `fw_update` script, 259

G

- gameXX.tgz* file set, 24
- gateway, default, 64
- GENERIC kernel, 356
 - backup of, 358
 - configuration file, 361
 - configuring, 360–361
- geometry of disks, 31
- `getty(8)`, 79, 80
- GID (group unique number), 107
- gigabytes, for displaying partition size, 51
- global settings in `tmux`, 329
- Gnome, 331
- Gnu C Compiler Project, 247
- GNU mirror site, 247
- graphic console, 44
 - booting to, 67
- group unique number (GID), 107
- groups, 106–109
 - creating, 107–108
 - unprivileged user accounts and group permissions, 108–109
 - in user aliases, 114
 - user assignment to, 88
 - in batch mode, 90
- guard pages, 174

H

- hacker, definition of, 172
- half-duplex connection, 215
- Hansteen, Peter, *The Book of PF*, 256, 395, 448
- hard drives, 18–19. *See also* disk drives
 - adding new, 144–146
 - booting from alternate, 73–74
 - finding for booting, 73
 - multiple, 29–30
 - partitioning additional, 54
- hardened host, 398
- hardware, 16–19
 - connection to kernel, 342
 - device driver attachment to, 341
 - diskless, for OpenBSD, 451
 - `dmessage` to view installed devices, 343
 - setup for installing OpenBSD, 38
- hardware sensors, 296–301
 - configuring, 298–301
 - device drivers for, 297–298
 - time, 295
 - triggering action, 300–301
- hardware serial console, 75
- hash mark (#), for comments, 33

- HDLC (High-Level Data Link Control), 185
 - heads on disk drives, 31
 - help
 - creating good request, 12–13
 - for disklabel prompt, 55
 - help command (config), 350–351
 - help function, 70
 - hiding *cwm* windows, 333
 - high-latency optimization for PF, 420
 - High-Level Data Link Control (HDLC), 185
 - mapping keys in, 336
 - home directories
 - configuring for user, 87
 - macros to represent, 319–320
 - for unprivileged users, 102
 - /home* partition, 29, 87
 - creating, 53
 - \$HOME/.cwmrc* file, 331
 - \$HOME/.tmux.conf* file, 329
 - \$HOME/.xsession* file, 331
 - host access point daemon, 260
 - host aliases, 115
 - host MIBs, 313
 - hostapd(8), 260
 - hosting operation, 461
 - hostname, 62
 - hostname.if* file, 219
 - hostnames, 210
 - setting, 61–62
 - of system, 42
 - hosts file, 210
 - HTML, avoiding for email help
 - request, 13
 - HTTP protocol, 199
 - installation, 22–23
 - hubs, in Ethernet network, 213
 - Hurricane Electric, IPv6 tunnel
 - service, 224
 - hushlogin variable, 97
 - hw.allowpowerdown* sysctl, 179
 - hw.ncpufound* sysctl, 345
- I**
- i386 platform, 16
 - boot floppies, FFS support by, 133–134
 - floppy images for, 39
 - hard drive size limitations, 26–27
 - Intel Preboot Execution Environment on, 451
 - ICMP (Internet Control Message Protocol), 186, 196
 - redirects, *sysctl* to control, 347
 - states, 413
 - id(1)*, 107
 - IDE drives, 29
 - ifconfig(8)*, 62, 63, 191, 194, 216–218, 219–220
 - delete option, 217
 - to display VLAN interface, 224
 - ifstated(8)* (interface state daemon), 261
 - ifTable* (interface table), 313
 - ignorenologin* variable, 97
 - illegal packets, 415
 - in keyword, for direction in packet
 - filtering, 404–405
 - include statement
 - in kernel configuration, 360
 - in *pf.conf*, 445
 - incoming connections, restricting, 305
 - INDEX* file, 236
 - building database of, 240
 - index nodes. *See* inodes (index nodes)
 - indexing OpenBSD release, 392
 - inet*, 219–220
 - inetd(8)* (small-server handler), 261, 304–305
 - init(8)*, 59, 70
 - inodes (index nodes), 134
 - vs. vnodes, 150–151
 - install document, in OpenBSD
 - release, 15
 - installation preparations, 15–35
 - customizing, 458–460
 - disklabels, 31–34
 - file sets, 23–25
 - getting OpenBSD, 19–23
 - multiple hard drives, 29–30
 - OpenBSD hardware, 16–19
 - partition filesystems, 29
 - partitions, 25–29, 30–31
 - installing
 - custom kernel, 366
 - multiple operating systems on
 - computer, 37
 - packages, 230–232
 - ports and source code, 66
 - installing OpenBSD. *See also* installation preparations; setup after install
 - BIOS configuration, 38
 - boot media creation, 38–40
 - boot CDs, 40
 - boot floppies, 39–40

- disk drive
 - custom layout, 49–54
 - setup, 46–47
- file sets selection, 47–49
- hardware setup, 38
- multiple network cards and, 43–44
- running installation program, 41–43
- setting time zone, 45–46
- setting up services, 44
- installXX.iso* image, 40
- integrity, xxx
 - of packages, 229
- Intelligent Platform Management
 - Interface (IPMI), 297
- interface groups, 401–402
- interface main address, in filter rule, 407–408
- interface state daemon (*ifstated(8)*), 261
- interfaces
 - dynamic configuration, 220
 - setting PF to not manage, 420
- interim releases of OpenBSD, 369
- Internet, finding packages on, 230
- Internet connection, 183. *See also* TCP/IP
- Internet Control Message Protocol (ICMP), 186, 196
 - redirects, *sysctl* to control, 347
 - states, 413
- Internet downloads of OpenBSD, 20
- Internet Protocol (IP), 185
- Internet searches, on OpenBSD crypto hardware, 11
- Internet small service listener (*inetd(8)*), 261
- interrupt request (IRQ), 349
- interrupting boot process, 41
- IP addresses, 185, 189–192
 - abandoned, 310
 - adding, 217
 - multiple, on one Ethernet card, 218
 - private NAT, 426
 - removing, 217
 - static, 63–64
 - table in *pf.conf* file, 403
- IP aliases, 218
- IP routing, 202–207
 - deleting routes, 207
 - IPv4, 203–204
 - route flags, 206–207
 - route(8)* for managing, 204–207
- ipcalc* package, 191
- IPMI (Intelligent Platform Management Interface), 297
- ipmi(4)* driver, 349
- IPsec standard for VPNs, 261

- IPv4 addresses
 - and ARP, 214
 - netmask calculation, 190–191
 - network stacks, 188
 - pitfalls, 192
 - search for records, 212
 - special, 192
 - static, 63
 - unusable, 191
 - viewing, 191
- IPv4 packets, *sysctl* to control
 - forwarding, 347
- IPv6 addresses, 43, 192–196
 - assigning, 195–196
 - format for, 63
 - NAT and, 426
 - and neighbor discovery, 214
 - network stacks, 188
 - special, 194–195
 - subnets, 194
 - over tunnels, 224
- IPv6 packets, forwarding, *sysctl* to control, 347
- IRQ (interrupt request), 349
- ISA hardware, 16, 349
- ISO 8601 restricted time format, 291–292
- ISO images, converting, 456
- ISO-9660 filesystem, 152
- istatus* keyword, to ignore sensor, 300

J

- job control, xxxi

K

- kbd(8)*, 66
- KDE, 331
- Kerberos, 157
- kern facility, 283
- kernel, 23, 70. *See also* custom kernels; *sysctls* (system controls)
 - basics, 340–343
 - boot-time configuration, 353
 - booting, 74
 - booting alternate, 72
 - code snapshot for, 384
 - config(8)* for changing, 348–353
 - backup of default kernel, 349
 - changing constants, 352–353
 - help and list commands, 350–351
 - device drivers, 349
 - enabling, 350, 352
 - finding, 352

- kernel (*continued*)
 - GENERIC, 356
 - backup, 358
 - identifying running, 366
 - messages to userland, 340
 - modules, 179
 - startup messages, 340–341
 - upgrading, 388
 - kern.hostname sysctl, 346
 - kern.maxproc sysctl, 346
 - kern.ostype sysctl, 344, 346
 - kern.osversion sysctl, 344
 - kern.version sysctl, 344
 - keyboard
 - mapping, 66
 - modifier keys in *cwm* window manager, 331–332
 - unmapping and remapping, 336
 - for X Windows navigation, 335
 - keyboard-video-mouse (KVM) system, 75*n*
 - keyboard.type variable, 324
 - keywords
 - in custom kernel configuration, 360
 - for man page searches, 5–6
 - kill command (*pfctl*), 425
 - kill -session command (*tmux*), 328
 - Kozierok, Charles M., *The TCP/IP Guide*, 184, 397
 - krb5 method for BSD authentication, 99
 - krb5-or-pwd method for BSD authentication, 99
 - KVM (keyboard-vidе-mouse) system, 75*n*
 - KVM hypervisor (Linux), 19
 - KVM virtualization, 450
- L**
 - LACP (Link Aggregation Control Protocol), 221
 - lchpass method for BSD authentication, 99
 - LDAP (Lightweight Directory Access Protocol) daemon, 157, 262
 - integration, 100
 - LD_LIBRARY_PATH environment variable, 119
 - leases in DHCP, 307
 - least privilege approach, 86
 - libraries, */usr* partition for, 28
 - Lightweight Discovery Access Protocol (LDAP) daemon, 157, 262
 - Link Aggregation Control Protocol (LACP), 221
 - link aggregation protocols, 221
 - link local addresses, for IPv6, 195
 - Linux, KVM hypervisor, 19
 - list command (*config*), 350–351
 - lists, packet filtering with, 413–414
 - exclusions and negations, 415
 - lladdr (link local address), 216
 - lo0 (loopback) interface, 63, 216
 - load balancer, 271, 462
 - local distfile mirrors, 246–249
 - local installation server, install from, 23
 - local0 facility, 283
 - localcipher password control, 98
 - localhost
 - for IPv4, 192
 - for IPv6, 195
 - locking users, in directory, 319–320
 - log files
 - maintenance, 289–294
 - adding PID file, 293
 - monitoring, 293
 - newsyslog.conf* fields, 290–292
 - signal name, 293–294
 - for PF, 446–448
 - reading, 447
 - log rotation, 289–290
 - log sockets, 288
 - logging daemon (*syslogd*(8)), 273
 - customizing, 288
 - logging host, 288
 - logical interfaces, in OpenBSD, 216
 - logical port, 198
 - login classes, 94–101
 - definitions, 94–95
 - for RADIUS authentication, 100–101
 - for user, 89
 - login-backoff password control, 98
 - login_radius(8), 101
 - logins
 - default class for user, 87
 - to serial consoles, 79
 - logs
 - monitoring, 293
 - for system maintenance, 282–289
 - actions, 287–288
 - customizing *syslogd*, 288
 - and embedded systems, 289
 - facilities, 283–284
 - priority, 284
 - sorting messages with *syslogd*(8), 284–287
 - of TFTP transfers, 311
 - lookup keyword, for DNS resolution, 211
 - loopback address, 206
 - lost+found* directory, 139
 - lpd (printer daemon), 306–307
 - lpr facility, 283

- ls
 - la, 108
 - lo, 176
- lynx(1) text-mode web browser, 262
- M**
- m command, 55
- MAC (Media Access Control) addresses, 185, 213
 - for DHCP server client identity, 307
- machdep.allowaperture sysctl, 179, 330, 348
- machdep.kbdreset sysctl, 179, 348
- machine diskinfo command, 73
- machine keyword, in kernel
 - configuration, 360
- machine-dependent kernel configuration files, 361
- machine-independent kernel
 - configuration files, 360–361
- macppc (PowerPC-based Macintosh computers), 16
- macros, packet filtering with, 414–415
- magic number, 262
- mail aliases, setup after install, 65
- mail facility, 283
- mail server program, 263
- mailing lists on OpenBSD, 8–10, 11–14
 - archives of, 10
 - read-only, 9–10
- mailq, 263
- mainbus0, 341
- Maint (maintainer), for software, 240
- maintenance tasks, emailing results to
 - local root account, 65
- make build stage, 390
 - in port build, 246
- make checksum stage in port build, 244–245
- make clean stage in port build, 246
- make configure stage in port build, 245
- make extract stage in port build, 245
- make fake stage in port build, 246
- make fetch stage in port build, 244
- make install stage, 241
 - in port build, 246
- make package stage in port build, 246
- make patch stage in port build, 245
- make prepare stage in port build, 245
- make print-index, 239
- make update command, in port, 393
- make(1) program, 226
 - configuring, 268
- makefile*, 226, 236–237
- Makefile.inc*, 238
- makeoptions keyword, in kernel
 - configuration, 360
- makewhatis(8), 264
- making software, 226
- malloc(), 174
- malware, 400
- man (manual) pages, xxxvi–xxxvii, 3–7, 264–265
 - adding to directories, 264–265
 - contents, 6–7
 - defining sections, 265
 - for disklabel(8), 55
 - displaying, 265
 - finding, 5–6
 - moving through, 5
 - overlapping names, 6
 - search for cryptography, 10–11
 - viewing, 4–5
 - on web, 7
- Management Information Base.
 - See MIBs (Management Information Base)
- management-addresses file, 445
- manual pages. See man (manual) pages
- manXX.tgz* file set, 24
- mapping
 - filesystems to mount points, 128
 - keyboard, 336
- mark facility, 283
- marker in logs, 286
- MASTER_SITE_BERIOS variable, 247
- MASTER_SITE_OVERRIDE variable, 249
- Match keyword, 320
- match keyword, for bandwidth
 - management, 444–445
- maximizing cwm windows, 333
- maxproc variable, 96
- maxusers keyword, in kernel
 - configuration, 360
- MBR partitions, 30
 - creating, 46, 130–131, 144
 - and fdisk(8), 129–131
 - for softraid device, 162
 - viewing, 130
- mbrowse package, 313
- Media Access Control (MAC) addresses, 185, 213
 - for DHCP server client identity, 307
- megabytes, for displaying partition
 - size, 50
- memory (RAM), 18
 - interface use by, 317
 - log messages to, 289
 - protection, 172–175

- memory filesystems (MFS), 148–150
 - mounting at boot, 149–150
 - partitions, creating, 149
- memorylocked variable, 96
- memoryuse variable, 96
- merging */etc* file changes during upgrade, 379, 393
- message of the day (MOTD), 269
- messages
 - displaying for packages, 234
 - at kernel startup, 340–341
 - from kernel to userland, 340
 - from upgraded packages, 381–382
- metadata, 134
 - from softraid, 166
- Meyer, Scott, 187
- MFS. *See* memory filesystems (MFS)
- MIBs (Management Information Base)
 - PF SNMP, 316
 - for SNMP, 312–313
 - sysctl, 343–344
- Microsoft systems
 - Burn to Disc command, 40
 - floppy creation on, 40
 - NTFS partitions, 150
 - virtualization, 450
- minpasswordlen password control, 98
- mirroring (RAID-1), 161
- mirrors
 - CVS, 386
 - fallback, 248–249
 - local distfile, 246–249
 - of OpenBSD website, 8
 - preferred collection, 247–248
 - primary, 249
 - site layout for obtaining OpenBSD copy, 20–21
- misc@OpenBSD.org*, 9, 13–14
 - help for building custom kernel, 357
- mixectl(8), 268
- mkhybrid(8), 152
- monthly maintenance, 282
- more(1), 5
- MOTD (message of the day), 269
- mount command, 154
- mount point
 - mapping filesystems to, 128–129
 - for partition, 52
- mount(8), 140
- mount_cd9660(8), 152
- mountd startup script, reload argument, 157
- mountd(8) daemon, 155
- mounted files, listing all, 140
- mount_ext2fs(8), 152

- mounting
 - disks
 - in FFS, 135–138
 - in single-user mode, 71–72
 - filesystem images, 153–154
 - filesystems, for upgrade, 376
 - filesystems at nonstandard locations, 141
 - memory filesystems, at boot, 149–150
 - with options, 142
 - partitions, 140–142
 - standard filesystems, 141
- mount_mfs(8), 149
- mount_msdos(8), 151
- mount_ntfs(8), 151
- mounts, stackable, 146
- mouse, emulating three-button in X, 331
- moving, partitions, 145. *See also* navigation
- mrouted(8), 269
- MS-DOS filesystem, 151
- multicast routing, 269
- multipackages, 252
- multiple hard drives, 29–30
- multiple network cards, installing
 - OpenBSD and, 43–44
- multiprocessor kernel, 72
- multiprocessor support, 18
- multiuser startup, 79–84
- Mutt mail client, noatime mount option
 - and, 137
- mv(1), copying files with, 145

N

- NAME section, in man pages, 7
- name service servers, 65, 211
- named user account, 102
- names
 - for aliases, 117
 - for default kernel backup, 349
 - for disk device nodes, 126
 - for groups, 107
 - for man pages, overlapping, 6
 - for user accounts, 92
 - for windows
 - in *cwm*, 333
 - in *tmux*, 327
- NAT (network address translation), 396
 - bidirectional, 429–432
 - redirection, 431–432
 - and rule order, 430–431
 - and security, 430
 - configuring, 427
 - how it works, 427–428

- multiple addresses and interface groups, 432
- multiple or specific public addresses, 428–429
- packet filtering with, 426–433
- port manipulation and ranges, 432–433
- transparent interception, 433
- nat-to keyword, 427
- navigation, through man pages, 5
- ND (Neighbor Discovery), 185
 - IPv6 addresses and, 214
- ndp(8), 214
- negation symbol, exclamation point (!)
 - as, 117–118
 - in filter rule, 406
- negations in packet filtering lists, 415
- Neighbor Discovery (ND), 185
 - IPv6 addresses and, 214
- nested anchors in PF, 436–437
- nesting aliases, 116
- net.inet6.icmp6.rediraccept sysctl, 347
- net.inet6.ip6.accept_rtadv sysctl, 347
- net.inet6.ip6.forwarding sysctl, 347
- net.inet.icmp.rediraccept sysctl, 347
- net.inet.ip.forwarding sysctl, 345, 347
- net.inet.ip.sourceroute sysctl, 179
- net.inet.tcp.always_keepalive sysctl, 347
- netmask, 43
 - for alias addresses, 218
 - for IP addresses, 189–190
- net-snmp package of command-line tools, 313
- netstat, for determining open TCP ports, 200–202
- network adapter teaming, 221
- network address, 191
- network address translation. *See* NAT (network address translation)
- network cards, multiple, installing
 - OpenBSD and, 43–44
- network connection, 209–224
 - DNS resolution, 210–213
 - Ethernet, 213–215
 - trunking, 221–222
 - upgrading over, 374–375
 - VLANs, 223–224
- network devices, gathering
 - information on, 312
- Network File System. *See* NFS (Network File System)
- network interfaces
 - interrupting installer to identifying, 43
 - list of recognized, 62
 - recognition during install, 42
- network layers (OSI), 184–187
 - applications layer, 186–187
 - datalink layer, 185, 187
 - network layer, 185–186, 187
 - physical layer, 184, 187
 - transport layer, 186, 187
- network protocol, for packet filtering, 405–406
- network request, data transmission for, 187–188
- network servers, 303–322
 - DHCP daemon (dhcpd), 307–310
 - printer daemon (lpd), 306–307
 - small-server handler (inetd), 304–305
 - SNMP agent (snmpd), 312–317
 - SSH daemon (sshd), 317–322
 - TFTP daemon (tftpd), 310–311
- network stacks, 188–189
- Network Time Protocol (NTP) daemon (ntpd(8)), 44
 - configuring, 294
 - using, 296
- network.conf* file, 247, 248
 - MASTER_SITE_OVERRIDE variable, 249
- networking
 - setup after install, 62–65
 - default gateway, 64
 - dynamic configuration, 64
 - Ethernet interfaces, 62–64
 - name service servers, 65
 - starting in single-user mode, 72
- newaliases(8), 65, 263
- newcomers, in OpenBSD community, xxxiv
- newfs(1), 133
- newfs(8), 134–135, 139, 145
- news facility, 283
- newsyslog(8), 269, 290
- NFS (Network File System)
 - clients, 159–160
 - permitted, 158–159
 - multiple exports for one partition, 159
 - read-only mounts, 157
 - root directory setup, 455–456
 - setup, 154–155
 - and users, 157–158
- NFS server, 155–159
- nfsd(8) daemon, 155
- nginx web server, 229
- NKMEMPAGEs value in kernel, 351
- noatime mount option, in FFS, 137
- noauto mount option, 128
 - in FFS, 138
- nobody account, 103, 158
- nodev mount option, 128
 - in FFS, 137

- nodump file flag, 176
- noexec mount option, in FFS, 137–138
- nologin variable, 97
- normal optimization for PF, 419
- nosuid mount option, 128
- NTFS filesystem, 151
- NTFS partitions (Microsoft), 150
- ntpd(8) (NTP [Network Time Protocol] daemon), 44, 60
 - configuring, 294
 - using, 296
- ntpd_flags variable, 59
- ntrw.exe* program, 40
- null modem cable, for serial console,
 - 75–76
- numerical sysctls, 346

O

- OATH one-time passwords, 100
- official CDs, 20, 40
 - package files on, 228
 - upgrading from, 371, 373–375
- offset
 - for disklabel partition, 52
 - for MBR partition, 34
- on keyword, for packet filtering interface matching, 405
- one-to-one NAT, 429
- open code, 2
- open ports, testing for TCP, 198
- Open Shortest Path First (OSPF), 203
- Open Systems Interconnection (OSI) protocol stack, 184–187
 - Applications layer, 186–187
 - Datalink layer, 185, 187
 - Network layer, 185–186, 187
 - Physical layer, 184, 187
 - Transport layer, 186, 187
- OpenBGPD* directory, 21
- OpenBSD. *See also* desktop OpenBSD
 - birth of, xxxiii
 - build your own
 - preparations for, 383–388
 - reasons to, 382–383
 - choosing install media, 22–23
 - community, xxxiv
 - information sources, 1–2
 - customizing, 449–460
 - diskless installation, 450–454
 - installations, 458–460
 - running diskless, 454–456
 - upgrades, 460
 - USB installation media, 457
 - virtualization, 450
- FAQ, 8, 37
- information sources, 3–10
 - mailing lists, 8–10
 - man pages, 3–7
 - manual, 4
- obtaining a copy of, 19–23
 - boot media, 22
 - Internet downloads, 20
 - mirror site layout, 20–21
 - official CDs, 20, 40
 - release directories, 21–22
- problem-solving resources, 10–14
- security announcements, 172
- security flaws, 170
- source of problems, 2
- strengths, xxxv–xxxix
- support model, 2
- upgrade process, 371–373
- uses, xl
- versions, 368–371
- website, 7–8
 - for hardware compatibility lists, 38

OpenBSD Ports website, 230

OpenBSD-specific functions, MIBs for, 313

OpenBSD Upgrade Guide, 371–373, 460

openfiles variable, 96

OpenNTPD daemon, 60, 294

OpenNTPD directory, 21

OpenOffice, 336

OpenSSH directory, 21

operating systems

- /usr* partition for programs, 28
- installing multiple on one computer, 37
- multiple, 19
- source code for, installing, 66

Oracle VirtualBox, 450

orphaned devices, custom kernels and, 364

OSI. *See* Open Systems Interconnection (OSI) protocol stack

OSPF (Open Shortest Path First), 203

ospfd(8), 205

out keyword, for direction in packet filtering, 404–405

outgoing traffic, control of, 400

overlapping names, for man pages, 6

ownership, foreign filesystems and, 152

P

- p command, 50
- package repository, updating, 380–381

- packages
 - ambiguous, 231–232
 - dependencies for, 232, 234–235, 381
 - descriptions of, 233
 - finding, 229–232
 - with command prompt, 229
 - on Web, 230
 - installing, 230–232
 - for installing OpenBSD software, 227, 228–232
 - limitations, 235
 - listing files installed, 230–231
 - preparing upgrades, 372–373
 - and *rc.d* scripts, 252
 - uninstalling, 234–235
 - updating installed, 380–382
- packages* directory, 21
- packet filtering, 395. *See also* */etc/pf.conf*
 - file; firewall; *pf(4)*
 - activating rules, 409–410
 - basics, 398–401
 - blocking spoofed packets, 416
 - complete ruleset, 409
 - components, 401–403
 - control and configuration, 401
 - interface groups, 401–402
 - default accept vs. default deny, 399
 - as firewall, 397
 - limitations, 400–401
 - with lists, 413–414
 - with macros, 414–415
 - with NAT, 426–433
 - PF MIB for statistics, 316
 - reassembling packet, 416
 - rules, 403–411
 - default permit or default deny, 404
 - packet pattern matching, 404–409
 - and state table, 411–413
 - sanitizing traffic, 415–416
- packets, 187
 - fragmentation, 399
- parent queue, defining, 441
- partition filesystems, 29
- partitioning hard drive, data
 - deleted for, 46
- partitioning scheme, for multiple disks, 49
- partitions, 25–29, 30–31
 - bootable, 131
 - cylinder boundary to end, 52
 - deleting, 51
 - disklabel, 31. *See also* disklabel partitions
 - displaying size in gigabytes, 51
 - displaying size in megabytes, 50
 - encrypted, 166–168
 - exporting, 156
 - finding for booting, 73–74
 - free space on, 142–144
 - MBR, 30
 - creating, 46, 130–131, 144
 - and *fdisk(8)*, 129–131
 - viewing, 130
 - MFS, creating, 149
 - modifying existing, 55
 - mount point for, 52
 - mounting and unmounting, 140–142
 - multiple exports for one, 159–160
 - removing, 131
 - setting not to mount, 138
 - unmounting, 141–142
 - viewing contents, 73–74
- pass number, 128
- passive FTP, 437
- passphrase, for encrypted partition, 167, 168
- passwd* method for BSD authentication, 99
- passwd(1)* command, 58
- passwordcheck* password control, 98
- password-dead* password control, 99
- passwords
 - files for, 265–268
 - for groups, 107
 - non-echoing prompt, 91
 - root, 44–45
 - sudo caching, 120–121
 - for user account, 87, 89
 - and batch mode, 90–92
 - options, 98–99
- passwordtime* password control, 98
- passwordtries* password control, 98
- password-warn* password control, 98
- patches* directory, 21
- path variable, 97
 - in default class, 95
- pathnames, tilde (~) in, 96
- pausing boot process, 70
- percent sign (%), for groups in user aliases, 114
- per-host basis, @ symbol to override sudo defaults, 118
- permanently insecure mode, 178
- permission denied error, 86
- permissions
 - error from *ntrw*, 40
 - setuid* or *setgid*, 25
 - TFTP use of, 311
 - viewing for existing files, 108

- permissions scheme, file flags in, 175
- persist keyword (PF), for table, 422
- per-user basis, @ symbol to override sudo defaults, 118
- PF mailing list, 9
- pf(4) (PF), 270, 395
 - anchors, 434
 - adding rules, 434–435
 - bandwidth management, 439–445
 - queues for, 440–441
 - configuration, and FTP proxy, 438–439
 - enabling and configuring, 397–398
 - FTP and, 437–439
 - include files, 445
 - logging, 446–448
 - options, 417–420
 - fragmented packets, 418
 - set block-policy, 417
 - set limit, 417–419
 - set optimization, 419–420
 - set skip, 420
 - src-nodes limit, 418
 - states limit, 418–419
 - packet management, 421–448
 - with tables, 422–426
 - quick keyword, 446
 - ruleset tracing, 448
 - viewing active rules, 410–411
- pf.conf(5), scrub keyword, 416
- pfctl(8), 401, 409–410, 445
 - for anchor rule changes, 435
 - commands for tables, 423–424
 - to view state table, 411–412
 - viewing and flushing anchors with, 436
- pflog0 (PF logging), 63
- pflog(4) pseudo-device, 351
- pflogd(8), 446
- pflog(4) NetFlow exporter, 448
- physical interface for disk drive, 33
- physical layer (OSI), 184, 187
- PID file, adding, 293
- ping(8), 191, 196, 210–211
- pkg_add(1), 228, 230, 246, 381
 - verbose mode, 231
- pkg_delete(1), 234–235
- pkg_info(1), 229
- pkglocatedb, 233
- \$PKG_PATH environment variable, 228, 380
- pkill command, 83
- Point-to-Point Protocol (PPP), 185
- pointer movement commands, 337
- portability of OpenBSD, xxxvi
- portmap(8) daemon, 155
- ports
 - build stages, 243–246
 - code snapshot for, 384
 - customizing, 246–251
 - local distfile mirrors, 246–249
 - preferred collection mirrors, 247–248
 - flavors, 249
 - and dependencies, 250–251
 - uninstalling, 251
 - installing, 66
 - subpackages, 251–252
 - troubleshooting build failure, 242
 - upgrading, 393
- ports (TCP), 198–199
 - determining which are open, 200–202
 - with fstat, 202
 - with netstat, 200–202
 - filtering tcpdump on, 447
 - reserved, 199–200
- ports and packages system, 227–228
- ports collection, 235–241, 385
 - automation, 236
 - building ports, 241–246
 - finding software, 239–241
 - secondary ports, 237–238
- ports index, 239–240
- ports tree, 66, 236–237
 - read-only, 238–239
- ports.tar.gz file, 21, 66, 236, 384
- POSIX time zones, 60
- PostgreSQL port, 372–373
- PostScript, 306
- power button, 179
- power of Open BSD, xxxvi
- power sensors, 297
- PPP (Point-to-Point Protocol), 185
- Preboot eXecution Environment (PXE)
 - diskless booting method, 22, 450–451
- preening of filesystems, 138
- preferred collection mirrors, 247–248
- primary mirror, 249
- primary partitions, 30
- print (fdisk), 130
- printer capability file, 270
- printer daemon (lpd), 306–307
- printing disklabels, 50, 53
- priority
 - for log message, 284
 - for queue, 442

- priority queuing (PRIQ), 440
- priority variable, 97
- PRIQ (priority queuing), 440
- private communities in SNMP agents, 314
- private NAT addresses, 426–427
- private networks, IP addresses for, 192
- privilege, minimum level of, 86
- privileged account, risks from
 - regular use, 86
- processors, 18
- program name, sorting syslog
 - messages by, 286
- programs. *See* software
- prompt
 - boot loader, 70
 - for `disklabel(8)`, 50
 - escaping to, 43
 - for finding packages, 229
 - in `tmux`, 328–329
 - `ukc` for kernel editor, 353
- ProPolice, 173, 174
- proprietary hardware, 17–18
- proto keyword, for packet filtering, 405
- pseudo-devices, 351
 - custom kernel configuration for, 359–360
- pseudo-terminals, 274
- `ptrmove`, 337
- public communities in SNMP agents, 314
- PuTTY, 76
- PXE (Preboot eXecution Environment)
 - diskless booting method, 22, 450–451

Q

- `q` command, to write `disklabel` to disk, 53–54
- `qemu`, 19
- queues for bandwidth management, 440–441
 - assigning traffic to, 444
 - child queue, 442
 - match keyword, 444–445
 - options, 442–443
 - parent queue, 441
 - priority for, 442
 - viewing, 445
- quit command
 - with `config`, 353
 - with `fdisk`, 131

R

- RADIUS authentication, 99
 - login classes for, 100–101
- radius method for BSD authentication, 99
- RAID (Redundant Array of Independent Disks)
 - checking health status of devices in array, 164
 - sensors for controllers, 297
 - software, 160–166
 - types, 161–162
- RAM. *See* memory (RAM)
- random early detection, of packet loss, 443
- ranges of ports, `pf(4)` redirection of, 433
- `rarpd(8)`, for reverse ARP, 454–455
- raw devices, 127
- `rbootd(8)`, 271
- rc.d* scripts, 82
 - for third-party software, 83
- `rdist(1)` program, 281
- read-only mailing lists, 9–10
- read-only mount (`ro`), 128
- read-only mounts
 - in FFS, 135–136
 - in NFS, 157
- read-only ports tree, 238–239
- read-write (`rw`) mount option, 128
- read-write mounts, in FFS, 136
- reboot, 49
- rebooting
 - as part of upgrade, 380
 - to test configuration, 57
- redirecting email messages, 65
- Redundant Array of Independent Disks. *See* RAID (Redundant Array of Independent Disks)
- reinstalling OpenBSD, vs. upgrade, 371
- reject method for BSD authentication, 99
- `relayd(8)`, 271
 - anchors for, 434
- release directories, 21–22
 - contents after build, 391
- `$RELEASEDIR` environment variable, 390, 391
- releases of OpenBSD, 369–370
 - building, 389–392
 - bundling base system, 390–391
 - indexing, 392
 - using, 392
- remote filesystem, mounting, 159
- remote host, logging to, 288
- remote machines, connecting
 - with SSH, 334

- remote magnetic tape command (`rmt`), 271
- removable media, 153
- removing. *See* deleting
- repositories, for source code, 385–386
- Request for Comments. *See* RFC (Request for Comments)
- `requirehome` variable, 97
- reserved ports (TCP), 199–200
- resolver, 210
 - vs. dynamic configuration, 212–213
- resource limits, for user account, 96–97
- responding to email, 14
- `restore(8)`, copying files with, 145
- reverse ARP, `rarpd(8)` for, 454–455
- RFC (Request for Comments)
 - 1918 on private networks, 192, 426
 - 5737 on IPv4 addresses, 426
- RIP (Routing Information Protocol), 203
- RIP daemon, 271
- `ripd(8)`, 271
- `rmpoption` keyword, 362–363
- `rmt` (remote magnetic tape command), 271
- `rmuser(8)`, 92
- `rndc(8)`, 109
- `ro` (read-only) mount option, 128
- `.rodata` segments, 173
- root (`/`) partition, 26–27, 46
 - duplicating, 148
 - multiple disks and, 49–50
 - password, 44–45, 106
 - setting, 58
 - preparing for upgrade, 374
- root account, 86, 105
 - disallowing logins directly to, 275
 - email alias for, 278
 - emailing maintenance tasks results to
 - local, 65
 - hiding with `sudo`, 109–120
 - for initial setup, 57
 - secure console for, 275
- roundrobin method, 221
- `route add` command, 207
- `route delete` command, 207
- `route(8)`, 204–207, 219
- router advertisements, `sysctl` to
 - control, 347
- router discovery, 195
- routing, 203
- Routing Information Protocol (RIP), 203
- routing table, 204–205
- RPC, 272
- Rufus, 457
- `run as` alias, 114
 - override `sudo` defaults, 119
- `rw` (read-write) mount option, 128

S

- salt for password, 90
- sanitizing packet filtering traffic, 415–416
- `sappnd` file flag, 175, 179
- `sasyncd(8)` (security association synchronization daemon), 272
- SATA drives, 29
- `/sbin/nologin` shell, 102
- scheduled tasks, 277–282
 - custom scripts, 282
 - daily maintenance, 278–281
 - monthly maintenance, 282
 - weekly maintenance, 282
- `schg` file flag, 175, 179
- screen
 - blanking, 324–325
 - locking in `cwm`, 333–334
 - turning off display, 325
- script kiddies, 170
- script man page, 242
- scripts
 - for maintenance, 282
 - startup system, 80–82
- `scrub` keyword, 416
- scrubbing, 399
- SCSI drives, 29
- SCSI multipathing feature, experimental, 362
- search, 210–211
- search domains, default, 210–211
- search index, adding to routing table, 264
- searching
 - Internet, 11
 - within man page, 5
 - for cryptography, 10–11
 - for man pages, 5–6
 - for packages, 229–232
 - with command prompt, 229
 - on Web, 230
 - for software, 239–241
 - by keyword, 240
 - with SQL, 240–241
 - tables for packet filtering, 424
- secondary ports, 237–238
- sections in OpenBSD manual, 4
- sectors, 31–32
 - and disklabels, 32–34
 - number for drive, 34
- secure file transfer protocol (SFTP), 317
- Secure Shell daemon. *See* SSH (Secure Shell) daemon (`sshd`),
- Secure Sockets Layer (SSL)
 - certificates, 273

- securelevel(7), 177–181
 - determining appropriate, 180
 - in *rc.securelevel*, 81
 - weaknesses, 180–181
- security, xxx, xxxviii–xxxix, 169–181
 - attackers, 170–172
 - bidirectional NAT and, 430
 - faulty *sudo* setup impact, 110
 - file flags, 175–177
 - memory protection, 172–175
 - partitions for, 25
 - for SNMP, 314
 - system clock and, 60
 - updates for, 368
 - user damage to, 85
- security association synchronization
 - daemon (*sasyncd*(8)), 272
- security checks, in daily maintenance, 278–280
- security-announce@OpenBSD.org*, 9, 172
- SEE ALSO section, in man pages, 7
- segments, 187
- Sendmail, 263
- sensors in hardware, 272. *See also*
 - hardware sensors
- sensorsd*(8), 298, 317
 - variables, 301
- sensorsd.conf* file, 299–300
- serial connection, configuration, 271
- serial consoles, 75–79
 - client serial port, 78–79
 - logins, 79
 - setup, 77
 - testing configuration, 77
- Serial Line Internet Protocol (SLIP), 272
- serial ports, 274
- services, setup when installing
 - OpenBSD, 44
- sessions, in *tmux*, 327–328
- set block-policy drop (PF), 417
- set block-policy return (PF), 417
- set keyword, 417
- set limit option (PF), 417–419
- set optimization option (PF), 419–420
- set skip option (PF), 420
- set timeout command, 70
- setenv variable, 97
- setgid permissions, 25
- set-option command (*tmux*), 329
- setuid behavior, nosuid option
 - disallowing, 138
- setuid permissions, 25
- setuid root wrapper, 110
- setup after install, 57–84
 - booting to graphic console, 67
 - checking system errata, 58
 - hostname, 61–62
 - installing ports and source code, 66
 - keyboard mapping, 66
 - mail aliases and status mail, 65
 - networking, 62–65
 - default gateway, 64
 - dynamic configuration, 64
 - Ethernet interfaces, 62–64
 - name service servers, 65
 - root password setting, 58
 - software configuration, 59
 - time and date, 60–61
- set-window-option command (*tmux*), 329
- SFTP (secure file transfer protocol), 317
- SGI (Silicon Graphics), 16
- Shell option, in OpenBSD installer, 41
- shell script
 - OpenBSD installer as, 41
 - variable assignments in, 59
- shell variable, 97
- shells
 - login forbidden for unprivileged users, 102
 - modifying environment, 97
 - for user account, 88, 92
 - configuring default, 87
- shutdown, 179
 - of server software, 82
- SIGHUP, 293
- signal name, 293–294
- signature in email, 13
- Silicon Graphics (SGI), 16
- Simple Mail Transfer Protocol (SMTP), 263
- Simple Network Management Protocol (SNMP), 273
- single-user mode
 - boot process in, 71–72
 - mounting disks in, 71–72
 - root partition mounting as
 - read-only, 140
 - stackable mounts, 146
 - starting network in, 72
- siteXX.tgz* file, 373, 460
 - creating, 458–459
- sketch method for BSD authentication, 99
- skilled attackers, 171–172
- sleep, of screen, 325
- SLIP (Serial Line Internet Protocol), 272
- small-server handler (*inetd*), 304–305

- SMDS (Switched Multimegabit Data Service), 185
- SMTP (Simple Mail Transfer Protocol), 263
- snapshots* directory, 21
- snapshots versions of OpenBSD, 369
 - compressed tar files for, 384
- snk method for BSD authentication, 99
- SNMP client, *net-snmp* package of
 - command-line tools, 313
- SNMP (Simple Network Management Protocol), 273
- snmpd (SNMP agent), 312–317
 - configuring, 314–315
 - debugging, 315–316
 - getting information, 316–317
- soft update mounts, in FFS, 137
- softraid(4) devices, 160
 - booting from, 166
 - creating, 163–164
 - deleting, 165
 - failed volumes
 - identifying, 164
 - rebuilding, 164–165
 - preparing disks for, 162–163
 - reusing, 166
 - status, 164
- software
 - collections, 248
 - configuration, 59
 - force-starting, 83–84
 - logging to, 287
 - making, 226
 - management, 225–253
 - removing during upgrade, 372
 - source code for, 226–227
 - startup scripts, 82–83
- software RAID, 160–166
- software serial console, 75
- songs* directory, 21
- sorting
 - du output, 143
 - messages, *sylogd*(8) for, 284–287
- source address, in filter rule, 406
- source code, 226–227
 - to build custom kernel, 358
 - for OpenBSD, 28
 - for operating system, installing, 66
 - for ports, 241
 - updating, 385–388
 - for your own OpenBSD, 384
- source port, in filter rule, 408–409
- source routing, 179
- sparc64, 16
- spoofed packets, blocking, 416
- sqlports* package, 240
- src (userland) collection, 385
- src-nodes limit (PF), 418
- src.tar.gz* file, 21, 384
- SSH (Secure Shell) daemon (*sshd*), 82–83, 273, 317–322
 - connecting to remote machines
 - with, 334
 - disabling, 318
 - disabling root logins over, 45
 - enabling, 44
 - host keys, 318
 - network options, 318–319
- sshd_config* file, 321
- SSL (Secure Sockets Layer)
 - certificates, 273
- stable version of OpenBSD, 370
 - building, 387–388
 - source code for, 384
 - tag for, 385
 - updating to, 386–387
- stackable mounts, 146
- stacksize variable, 96
- staff user class, 94
- startup
 - enabling time correction at, 61
 - multiuser, 79–84
- startup scripts, 80–82
 - for packages, 252–253
 - software, 82–83
- startx command, 330
- state table, 398–399
 - filtering rules and, 411–413
- stateful inspection, 398–399
- stateful protocol, 197
- stateless filtering, 399
- stateless protocol, 197
- statelessness of NFS, 155
- states per source address, PF
 - tracking of, 418
- static IP address, 63–64, 216, 310
 - DHCP vs., 42–43
- static NAT, 429
- statistics
 - from operating system, SNMP for, 316
 - of PF, 418
- status bar in *tmux*, 326
 - options for, 329
- status mail, setup after install, 65
- stop argument, for scripts at shutdown, 83
- streaming protocol, TCP as, 197
- striping (RAID-0), 161
- striping data across disks (RAID-4), 161

- striping with parity across drives
 - (RAID-5), 161
- su(1), 106
- _subdir keyword, 265
- subject, for email help request, 12–13
- subnets, for IPv6 addresses, 194
- subpackages, 251–252
- sudo(8), 106, 109–120
 - changing default behavior, 117–119
 - configuring, 273
 - disadvantages, 109–110
 - and environment, 119–120
 - exclusions, 122–123
 - logs, 123, 293
 - overview, 110
 - password caching, 120–121
 - reason to use, 109
 - running commands, 121
- sudoedit(8), 110, 121–122
- \$SUDO_EDITOR environment variable, 122
- superblocks, in FFS, 134
- swap partition, 52–53
- swap space, 27
 - encrypting data written to, 348
 - mount point, 128
 - splitting between drives, 30
- Switched Multimegabit Data Service (SMDS), 185
- switches, 213
 - configuring for VLANs, 223
- switching between visible `cwm` windows, 333
- syslogd(8)
 - and embedded systems, 289
 - for sorting messages, 284–287
- SYN (synchronization) request, 398
- SYN+ACK packet, 398
- synchronous mounts, in FFS, 136
- SYNOPSIS section, in man pages, 7
- sysadmin accounts, creating, 91
- sysctl MIBs, 343–344
- sysctl(8), 343
 - for adjusting kernel, 340
- sysctls (system controls), 178, 343–348
 - changing values, 345
 - setting at boot, 346–348
 - sysctl MIBs, 343–344
 - value types, 345–346
 - viewing list of, 344–345
- syslog facility, 283
- syslog(3), 283
- syslogd(8) (logging daemon), 273
 - customizing, 288
- sysmerge(8)
 - to compare */etc* files, 376–378
 - finishing, 380
 - userland upgrade and, 389
- sys.tar.gz file, 21, 384
- sysstat pf, 418
- sysstat states, 412
- system controls. *See* sysctls (system controls)
- system errata, checking after install, 58
- system failures, swap space use in, 27
- system groups, in user aliases, 114
- system logs
 - actions, 287–288
 - adding timestamp, 286
 - customizing syslogd, 288
 - and embedded systems, 289
 - excluding information from, 285
 - facilities, 283–284
 - priority, 284
 - sorting messages with syslogd(8), 284–287
- system maintenance, 277–301
 - hardware sensors, 296–301
 - configuring, 298–301
 - device drivers for, 297–298
 - triggering action, 300–301
 - log file maintenance, 289–294
 - adding PID file, 293
 - monitoring, 293
 - newsyslog.conf* fields, 290–292
 - signal name, 293–294
 - scheduled tasks, 277–282
 - custom scripts, 282
 - daily maintenance, 278–281
 - monthly maintenance, 282
 - weekly maintenance, 282
 - system logs, 282–289
 - actions, 287–288
 - customizing syslogd, 288
 - and embedded systems, 289
 - facilities, 283–284
 - priority, 284
 - sorting messages with syslogd(8), 284–287
 - system time, 294–296
- system message buffer, 340
- system time, 294–296
- system-level append-only flag, 175
- system-level immutable flag, 175–176
- systems administration team, directing
 - mail sent to root to, 65
- systrace(4) system, 273

T

- table sysctl, 346
- tables for packet filtering, 422–426
 - and automation, 425–426
 - changing, 424–425
 - defining table, 422–423
 - searching, 424
 - using, 423
 - viewing, 423–424
- tag for repository version, 385
- tar files, creating, 458–459
- tar(1), copying files with, 145
- tasks. *See* scheduled tasks
- TCP (Transmission Control Protocol), 186, 197–198
 - keep-alive feature, sysctl to control, 347
 - open ports, 200–202
 - ports, 198–199
 - reserved ports, 199–200
 - states, 411–412
- tcpdump(8)
 - binary format for PF logs, 447
 - filtering, 447–448
- TCP/IP, 183–207. *See also* IP addresses
 - ICMP (Internet Control Message Protocol), 196
 - IP routing, 202–207
 - deleting routes, 207
 - IPv4, 203–204
 - route flags, 206–207
 - route(8) for managing, 204–207
 - network layers, 184–187
 - network request, data transmission for, 187–188
 - network stacks, 188–189
 - TCP. *See* TCP (Transmission Control Protocol)
 - UDP, 196–197
- The TCP/IP Guide* (Kozierok), 184, 397
- tcsh(1)
 - port for, 237
 - system-wide defaults for, 257
- tech@OpenBSD.org, 9
- temperature sensors, 297
- temporary root directories, 390
- term variable, 97
- termcap(5) database, 78
- terminal emulator (tip(1)), 76
- terminals, 274–276
 - configuring, 275
 - initializing, 79
 - running virtual with tmux, 325–329
- terminating windows in tmux, 327
- testing
 - configuration by rebooting, 57
 - custom kernels, 364–365
 - packet filtering rules, 410
 - serial configuration, 77
 - TFTP server, 311
- text-based email reader, OpenBSD users, 13
- TFTP (Trivial File Transfer Protocol), 310
 - server setup for diskless install, 453
 - testing server, 311
- tftpd (TFTP daemon), 310–311
- third parties, mailing lists, 9
- third-party software, *rc.d* scripts for, 83
- three-button mouse, emulating in X, 331
- three-way handshake, 197, 398
- thrsz for ALTQ, 441
- tilde (~), in pathnames, 96
- time and date, setting, 60–61
- time formats, in log file, 291
- time sensors, 295
- time zone, setting, 45–46, 60
- timeout
 - boot idle, 70
 - in PF, 399, 419
 - setting for boot, 74
- timestamp, adding to log file, 286
- timestamp* file, 21
- timestamp_timeout option, for sudo password caching, 120
- tip(1) (terminal emulator), 76
- /tmp* directory, 27
- tmux attach, 328
- tmux list-sessions, 328
- tmux(1), 325–329
 - command mode, 328–329
 - commands, 326–327
 - configuring, 329
 - help for, 327
 - sessions in, 327–328
 - setting options, 329
 - status bar and window names, 326
- token bucket regulator size
 - configuration, 441
- token method for BSD authentication, 99
- tools* directory, 21, 22
- traceroute(8), 196
- tracing, pf ruleset, 448
- tracks, on disk drives, 31
- traffic interception, 433
- Transmission Control Protocol. *See*
 - TCP (Transmission Control Protocol)
- transport layer (OSI), 186, 187
- Trivial File Transfer Protocol. *See* TFTP (Trivial File Transfer Protocol)

- troubleshooting
 - custom kernel build errors, 365–366
 - fsck for, 139
 - port build failure, 242
 - single-user mode for, 71
- trunking, 221–222
- tsch, installing from port, 242
- tunnels, IPv6 addresses over, 224
- tutorials, 4
 - in OpenBSD FAQ, 8
- twm(1), 331

U

- uappnd file flag, 175
- uchg file flag, 176
- UDP (User Datagram Protocol), 186, 196–197, 399
 - ports in netstat output, 201
 - states, 412–413
- UFS (Unix File System), 133
- UID (user ID), 88
 - NFS use of, 157
- uk> prompt (kernel editor), 353
- umask setting, for user, 95
- umask variable, 97
- umount(8), 141–142
- uname(1) command, 366, 381
- undeadly.org, 8
- underscore (`_`), for unprivileged user names, 103–104
- UNetbootin, 457
- uninstalling
 - flavored ports, 251
 - packages, 234–235
- University of California, xxxii–xxxiii
- UNIX, xxxi
 - development, xxxii
- Unix File System (UFS), 133
- Unix Systems Laboratories (USL), xxxii
- Unix-like systems, boot floppies, 39–40
- unmapping keyboard, 336
- unmounting
 - decrypted partition, 167
 - partitions, 141–142
- unprivileged user accounts, 102–104
 - creating, 104
 - uninstall packages and, 234
- upgrade and install kernel, 72
- upgrade.site script, 460
- upgrading
 - customizing, 373, 460
 - installed packages update, 380–382
 - mounting filesystems, 376
 - from official media, 373–375

- over network, 374–375
- process for, 371–373
- reasons for, 368
- USB disk
 - booting installer from, 22
 - customizing media for
 - installation, 457
- USB keyboards, country code for, 66
- user accounts
 - for administrators, creating, 91–92
 - authentication methods, 99–100
 - creating, 88–89
 - editing, 93–94
 - identifying group membership, 107
 - named, 102
 - nobody account, 103
 - password for, 87–88, 89
 - removing, 92
 - resource limits for, 96–97
 - restrictions, 92
 - temporarily disabling, 267
 - unprivileged, 102–104
- user aliases, 114
- user data partition, 25
- User Datagram Protocol. *See* UDP (User Datagram Protocol)
- user facility, 283
- user ID (UID), 88
 - NSF use of, 157
- user management, 85–104
 - root account, 86
- user shells, as sudo exclusions, 122
- userland, 340
 - building, 389
 - code snapshot for, 384
 - for diskless machine, 455
 - populating diskless, 456
- user-level append-only flag, 175
- user-level immutable flag, 176
- usernames, 88
 - files for, 265–268
- users
 - adding, 86–92
 - interactively, 87–89
 - noninteractively, 89–92
 - chrooting, 319–322
 - directing log messages to, 287
 - NFS and, 157–158
 - security problems from, 171
 - as security risk, 85
 - setting up first, 45
- USL (Unix Systems Laboratories), xxxii
 - `/usr` partition, 28
 - `/usr/local` directory, 231
 - `/usr/local` partition, 28

- /usr/mdec/* directory, 453
- /usr/obj* directory, for build, 384
- /usr/obj* partition, 28–29
- /usr/ports* directory, 66, 236
 - for build, 384
- /usr/ports/emulators* file, 450
- /usr/ports/INDEX* file, 239
- /usr/ports/sysutils/mtools*, 151
- /usr/share/zoneinfo* directory, 60
- /usr/src* directory, for build, 384
- /usr/src* partition, 28
- /usr/src/sys/arch* file, 361
- /usr/src/sys/arch/amd64* file, 365
- /usr/src/sys/conf* file, 360–361
- /usr/X11R6* partition, 28
- /usr/X11R6/share/X11/rgb.txt* file, 335–336
- /usr/xenocara* directory, for build, 384
- /usr/xobj* directory, for build, 384
- UTC (Coordinated Universal Time), 45
- uucp facility, 283
- uvideo(4), 351

V

- /var* partition, 28
- /var/backups* file, 280
- /var/db/pkg* file, 232
- /var/log/daemon* file, 300
- /var/log/pflog* file, 447
- /var/log/secure* file, 123
- /var/run/dmesg.boot* file, 340
- /var/www* directory, 320
- variables
 - for *login.conf*, 95–96
 - for ports collection, 238
- verbose mode
 - for *pkg_add(1)*, 231
 - for *snmpd*, 315
- versions of OpenBSD, 368–371
 - current, 368–369
 - building, 392–393
 - source code for, 384
 - updating to, 387–388
 - releases, 369–370
 - snapshots, 369
 - stable, 370
 - building, 387–388
 - source code for, 384
 - tag for, 385
 - updating to, 386–387
 - use decision, 370–371
- video device, kernel support for, 351
- vipw(8)*, 94, 266
- virtual consoles, 274

- virtual local area network (VLAN),
 - 223–224
 - and OpenBSD install, 42
- virtual memory, 27
- virtual node. See *vnode* (virtual node)
- Virtual PC, 450
- virtual terminals, running with *tmux*,
 - 325–329
- VirtualBox (Oracle), 19, 450
- virtualization, 19, 450
 - USB installation for, 456
- \$VISUAL* environment variable, 122
- visudo(8)* command, 110–111
- VLAN (virtual local area network),
 - 223–224
 - and OpenBSD install, 42
- vmemoryuse* variable, 96
- vm.swapencrypt.enable* *sysctl*, 348
- VMware, 19, 450
- vnconfig(8)*, 153, 154
- vnode* (virtual node). 151
 - attaching to disk images, 154
 - detaching from images, 154
 - vs. *inodes*, 150–151
- volumes in OpenBSD manual, 4

W

- web applications, 461
- web browser, *lynx(1)* text-mode, 262
- web server
 - installing OpenBSD from, 23
 - on OpenBSD, 229
- websites, on OpenBSD content, 8
- weekly maintenance, 282
- welcome message, default for user, 87
- welcome variable, 97
- _whatdb* keyword, 264
- whatis(1)*, 5–6, 10
 - database, 264
- wheel group, 88–89, 106
 - unlimited *sudo* access for, 114
- wildcard, in command alias, 115
- windows in *cwm*
 - creating, 332–333
 - managing, 333
- windows in *tmux*
 - changing current, 326–327
 - names, 326, 327
 - terminating, 327
- Windows NT operating systems, disk
 - images for, 40
- word *sysctls*, 346
- write caching, 136

Write Xor Execute (W^X), 173
writing, disklabel to disk, 53–54
wsconsctl(8), configuring console with,
324–325
www (website) collection, 385
W^X (Write Xor Execute), 173

X

X command, for disklabel expert mode, 55
X display manager. See xdm(1) (X display
manager)
X Windows System, 24, 323
 application menu creation, 334
 booting into, 330–331
 building, 389
 code snapshot for, 384
 connecting to remote machines
 with SSH, 334
 installer and, 44
 keyboard navigation, 335
 setting up, 330–331
x11 X Windows collection, 385
X-based graphic console, 67
xbaseXX.tgz file set, 24
xclock(1), 336
xdm(1) (X display manager), 44, 67
 /etc/rc.conf hook for starting, 330–331
Xenocara, 24, 323
 building, 389, 391–392
 setting up, 330–331
 window managers in, 331
xenocara X Windows collection, 385
xenocara.tar.gz file, 22, 384
xetcXX.tgz file set, 25
XF4 X Windows collection, 385
Xfce, 331
xfontXX.tgz file set, 25
xlock(1), 334
X.Org, 323
xscreensaver package, 334
xservXX.tgz file set, 25
xsetroot(1), 335
xshareXX.tgz file set, 25

Y

YP database, 276
yubikey method for BSD authentication, 99

Z

z command, 51
Zaurus personal digital assistants, 16