Symbols

* (asterisk), 45, 78
: (colon), 69
! (exclamation point), 14, 53
> (greater-than sign), 8
. (period), 44, 53
| (pipe symbol), 93
# (pound sign), 8, 14, 69
? (question mark), 8–9

A

abbreviations
  command, 10
  interface names, 18
abort input errors, 50
access ports, 89
adapters, 4, 42
address announcements, BGP, 72–74
Address Resolution Protocol (ARP).
  See ARP (Address Resolution Protocol)
alerts
  logging level, 107
  security, 58
American Registry for Internet Numbers (ARIN), 69–71
AMI encoding, 34, 50
arguments, 9
ARIN (American Registry for Internet Numbers), 69–71
ARP (Address Resolution Protocol), 91
caches, 91
table, 91, 92–93

AS (Autonomous System), 66–68
paths, 67, 77, 79–80
ASNs (Autonomous System Numbers), 66, 69–71
asterisk (*), 45, 78
authentication, HSRP, 84
autonegotiation, 21–22
Autonomous System (AS). See AS (Autonomous System)
Autonomous System Numbers (ASNs), 66, 69–71
AutoSecure tool, 104
aux (auxiliary) ports, 5, 96–97

B

B8ZS encoding, 34, 50
backing up, configurations, 16
bandwidth
  asymmetrical, 68
  interfaces, 20
  networks, 23, 24, 28
  values, 20
BGP (Border Gateway Protocol)
  address announcements, 72–74
  AS and, 66–68
  ASNs for, 66, 69–71
  basics, 65, 66–68
  configuring, 72–75
dampening, 73
HSRP and, 84–85
IP addresses in, 26, 65–79
ISPs with, 69
limitations of, 67–68
load balancing in, 67, 78–81
loopback interfaces, 26
managing, 75–81
BGP (Border Gateway Protocol), continued
memory issues, 68
neighbors in, 73–74
netmasks and, 113–114
null interfaces, 26
preparations for, 68–71
problems with, 68, 77–78
propagating updates in, 81
requirements for, 68–71
resetting, 77–78
router features for, 68
routes in, 76–77
announcements, 66–72, 75, 77
maps in, 73, 74, 79–81
routing registries in, 71
traffic monitoring in, 77–78
bia (burned-in address), 21
BIOS mode, 58, 63
boot loader version, 6
boot sequence, 6
boot system command, 63
Border Gateway Protocol (BGP). See BGP (Border Gateway Protocol)
broadcasts, 49
pings, 23
BugTraq list, 58
burned-in address (bia), 21
BW (bandwidth) values, 20
C
cables
bad, 21
Cat 5, 39
coaxial, 6, 46
console, 4
crossover, 85
labeled, 92
problems with, 39
quality of, 39
RJ-45, 46
caches
ARP, 91
multicast, 23
routing, 23
carrier transitions, 50
Cat 5 cables, 39
CatOS (Catalyst Operating System), 88
CDP (Cisco Discovery Protocol), 90–91
CD-ROMs, router, 4
Channel Service Unit/Data Service Unit (CSU/DSU), 24, 39, 46, 53–55
circuits
data vs. voice, 34–35
demarc points, 46, 54
DS3, 6, 46
IDs, 25, 30
installing, 34
Internet. See Internet circuits
ISP repair of, 53–55
local, 34
loopback tests, 54
misprovisioned, 50
OC3, 6, 46
ordering, 33–35
private, 33, 35–39
smartjacks, 39, 46, 54, 55
T1, 45–48, 50–53, 78
tests, 43–45
troubleshooting, 50–53
Cisco
AutoSecure, 104
crash dumps, 42
routers. See routers
security notifications, 58
SmartNet contract. See SmartNet contract
switches. See switches
website, 3, 42
Cisco Discovery Protocol (CDP), 90–91
class C networks, 112
clear ip bgp command, 77
coaxial cables, 6, 46
collisions, 85
rates, 50
colon (:), 69
clear line command, 7–10
access to, 95–97
benefits of, 7
vs. configuration tools, 6, 7
configuring routers, 15
EXEC mode vs. privileged EXEC mode, 8
help for, 8–9
commands. See also individual command names
abbreviations, 10
administrative, 8, 15
collection, 15
diagnostic, 8
extended, 51
hints about, 8–9
listing, 10
comments, 14
community names, SNMP, 109
comp.dcom.sys.cisco newsgroup, 3
con (console) ports, 96–97
config-if command, 20
configuration dialog, 6
configuration register, 12
configurations
backing up, 16, 62
BGP, 72–75
changes to, 13, 15–16
command line, 6
comments in, 14
global variables, 14
headquarters routing, 38–39
interfaces, 16, 20
Internet connections, 28–31
private circuits, 35–39
reading, 14–16
remote office routing, 38
routers, 15
routing protocols, 14
running configuration, 12, 13
saving changes to, 16
startup configuration, 12, 13
statements, 14
static routing, 37–38
switch, 88–93
tools, 6
viewing, 13
configure mode, 15
connections
host, 91, 92–93
Internet. See Internet, connections
private, 31–35
serial, 50
SSH, 62, 96, 100, 101–102
telnet, 96, 100, 101
console
adapter, 4
cable, 4
messages logged to, 106–108
ports, 96–97
setup, 5
Coordinated Universal Time (UTC)
time zone, 105
copy command, 60–62
copy ftp command, 16
counters, resetting, 49
crash dumps, 42
crashes, router, 41–42
CRC errors, 49
critical logging level, 107
crossover cables, 85
cryptographic keys, 102
CSU/DSU (Channel Service Unit/Data Service Unit), 24, 39, 46, 53–55
customer number, 30

d
daemon facility, 108
Daylight Saving Time (DST), 105
DDoS (distributed denial-of-service) attacks, 23
debugging, 48–50, 106–108
logging level, 106
delays, HSRP, 84
demarc points, 46, 54
description keyword, 22
destination IP addresses, 37–38, 44, 77, 85
dial-up Internet access, 59
disaster recovery, 63
disk contents, viewing, 60
distributed denial-of-service (DDoS) attacks, 23
DNS (Domain Name System), 44–45
problems, 43–45
documentation, 3, 4, 59
domain names, 14, 101–102
Domain Name System (DNS). See DNS (Domain Name System)
dropped packets, 44, 45, 82
DS3 circuits, 6, 46
DST (Daylight Saving Time), 105
duplex keyword, 22
duplex settings, 21–22

E
emergencies logging level, 107
enable
  mode, 8, 60
  passwords, 8, 98–99
  secret passwords, 98–99
enable command, 8
encapsulation
  interfaces, 20, 24
  T1 lines, 24, 30
encryption, 15, 97
erase command, 63
events. See also troubleshooting
  abort input, 50
  counters, 48–49
  crashed routers, 42
  CRC, 49
debugging, 48–50, 106–108
  frame input, 49
  ignored, 50
  incrementing counter for, 48–49
  input, 48, 49–50
  logging level, 107
  messages, 3, 9
  output, 48, 50
  overrun, 50
  printed to serial console, 42
  types of, 49–50
  “unrecognized command,” 9
Ethernet
  interfaces, 5, 20–23, 50, 89
  IP addresses, 22, 30
  networks, 20–21
    basics, 20–21, 88
    Fast Ethernet, 93
    loops and, 88–89
  spanning tree protocol, 88–89
  troubleshooting, 42–43
exclamation point (!), 14, 53
EXEC mode, 8, 15, 98–99
exit command, 16
extended demarc points, 46
extended pings, 50–53

F
facilities, 108
failover. See HSRP
Fast Ethernet, 93
file servers, 62
firewalls
  blocked traceroute packets, 45
  proxy, 30
flash cards, 60, 61
flash memory, 60, 62
frame input errors, 49
frame relays, 33
front door passwords, 97–98, 99
FTP
  clients, 61
  copying files over, 61
  server log messages, 108
  servers, 16, 42, 58, 61
full routes, 67

G
gateways, 37–38, 82, 83. See also BGP
  (Border Gateway Protocol)
giant packets, 49
Google search engine, 3, 42
greater-than sign (>, 8
Greenwich Mean Time, 105

H
hardware
  description, 19
  platform, 6, 11
HDLC (High-level Data Link Control), 24, 30, 36, 37
headquarters routing, 38–39
help, 8–9
High-level Data Link Control
(HDLC), 24, 30, 36, 37
hints, command, 8–9
host address, 112
host connections, 91, 92–93
hostnames, 14, 44, 101–102
HSRP (Hot Standby Router
Protocol), 81–86
  authentication in, 84
  BGP and, 84–85
  delays in, 84
  groups, 86
  interface tracking in, 83
  IP addresses in, 82–85
  overview, 82
  preemption in, 83
  testing, 85–86
  tuning, 83–84
hubs, 21
hybrid mode, 88
HyperTerminal software, 5

I
ignored errors, 50
image files, 12, 59, 60–63
informational logging level, 106
input, 48
  errors, 48, 49–50
input/output rates, 49
interfaces, 17–26
  activating, 20
  characteristics, 18–20
  configuring, 16, 20
  debugging information, 48–50
  descriptions, 19, 22, 25
  disabling, 20
  displaying, 18
  encapsulation, 20, 24
  error types, 49–50
  Ethernet, 20–23, 50
  loopback, 25–26
  null, 26
  order of, 18
  overview, 17
  protocol status, 19
resetting, 47
serial, 24–25
switch, 89–90
types, 18, 25
up/down status, 19, 46
web, 100
interface tracking, HSRP, 83
Internet
  “black hole,” 45
circuits
  BGP and, 67
  identifying, 25
  redundancy and, 65
troubleshooting, 18, 43–45
connections
  bandwidth for, 28
circuit failures, 43
  configuring, 28–31
  dial-up, 59
  ISP selection, 28–29
  T1 lines for, 30–31
telcos, 29
  wireless, 59
service providers. See ISPs
  (Internet service
  providers)
Internet News, 3
Internet Protocol (IP). See IP
  (Internet Protocol)
IOS (Internetwork Operating
System)
  copying files in, 60–62
  disaster recovery, 63
disk contents, 60
  displaying information about,
  11–12
image files, 59, 60–63
installing, 62–63
  overview, 57
patch levels, 59
  preparations for, 58–62
  security notifications, 58
SmartNet contracts and, 58
switches and, 88
updates to, 57, 105
upgrading, 57–63
versions, 59, 60, 63
IP (Internet Protocol), 14
  addresses
    in BGP, 26, 65–79
    bogus route
      announcements, 71
      destination, 37–38, 44, 77, 85
      disabling broadcast pings, 23
      dropped packets, 44, 45, 82
      Ethernet interfaces, 22, 30
      in HSRP, 82–85
      loopback interfaces, 25–26
      netmasks for, 111, 112,
        113–114
      null interfaces, 26
      numbering, 35
      overview, 111–112
      private circuit, 35–37
      reserved, 35
      serial interfaces, 24–25,
        29–30
      specific vs. general routes, 38
      standby, 82–86
      subnets, 36–37
      unusable, 113
ISP (Internet service providers)
  with BGP, 69
  choosing, 28–29
  router configuration for, 29–31
  Routing Arbiter Database, 71
  in troubleshooting, 47, 53–55

labeled cables, 92
landline phones, 34
line commands, 95–97
line noise, 49
line protocol status, 19
live failover. See HSRP (Hot Standby Router Protocol)
load balancing, BGP, 67, 78–81
local circuits, 34
local logging, 106–107
logging, 106–108
  levels, 106–107
  traps, 108
login local keyword, 97, 100, 102
logins
  line commands for, 95–97
  passwords for, 96–99
  remote router access, 100–102
  usernames for, 99–100
loopback interfaces, 25–26
loopback tests, 54
looped networks, 88–89
loose source rerouting, 52

MAC (Media Access Control)
  addresses, 21, 91–92
  table, 92
  manuals, 3, 4
Maximum Transmission Unit (MTU) values, 19–20
MD5 hash, 99
Media Access Control. See MAC
memory
  BGP routers, 68
  configurations stored in, 12–13
  flash, 60, 62
  loss of, 62
  nonvolatile, 12
  write, 16
MRTG tool, 28, 78
MTU (Maximum Transmission Unit) values, 19–20
multicast routing caches, 23
multihoming, 69, 71
multi-interface routers, 33

NAT (Network Address Translation), 30, 35, 42
  devices, 42
  native mode, 88
  neighbors, BGP, 73–74
netmasks
  BGP and, 113–114
  considerations, 111–112, 113
  Ethernet interfaces, 22
  IP addresses and, 111, 112,
    113–114
  for private connections, 36
size of, 112
subnetting and, 36
network address, 112
Network Address Translation
(NAT), 30, 35, 42
networks. See also Internet
connections
bandwidth, 23, 24, 28
class C, 112
Ethernet. See Ethernet, networks
failures, 42–50
circuit design in, 45–46
circuit examination in, 46–47
initial circuit tests for, 43–45
interface debugging
information, 48–50
overview, 42–43
interfaces, 5–6
looped, 88–89
private, 31–35
problems with. See network
failures
serial, 24–25
services, 103–109
Cisco AutoSecure, 104
in configuration, 14
described, 103
disabling, 14
NTP, 104–106
router logging, 106–108
SNMP, 108–109
speed, 21–22, 23
VPNs, 31
WANs. See WANs (wide area
networks)
Network Time Protocol (NTP),
104–106
servers, 105–106
newsgroups, 3
noise, line, 49
no routes, 67
“no” setting, 14
notifications logging level, 107
NTP (Network Time Protocol),
104–106
servers, 105–106
null interfaces, 26
Null0 interface, 72
0
OC3 circuits, 6, 46
operating systems. See also IOS
(Internetwork Operating
System)
CatOS, 88
loading of, 6
Unix, 5, 16, 100, 107
Windows, 5, 7, 50, 100, 107
Org IDs, 69–70
output, 48
ers, 48, 50
out suffix, 74
overrun errors, 50
P
packets
AS paths, 67
blocked, 45
dropped, 44, 45, 82
giant, 49
ping, 52
rejected, 49
runt, 49
size of, 52–53
traceroute, 45
partial routes, 67
passwords, 97–99
consoles, 96
described, 97
enable, 8, 98–99
enable secret, 98–99
encryption, 15, 97
front door, 97–98, 99
FTP servers, 61
HSRP, 84
for logins, 96–99
SCP servers, 61–62
SSH, 96
standard, 97–99
telnet, 96, 101
unprivileged, 8
for users, 96–97
tty lines, 101
patch levels, 59
PCMCIA slots, 60
period (.), 44, 53
permit keyword, 73
ping command, 43, 52
pings
   disabling, 23
   extended, 50–53
   packets, 52
   in troubleshooting, 43–44,
       50–53
pipe symbol (|), 93
Point-to-Point Protocol (PPP),
   24–25, 26, 30, 36
ports, 5–6
   access, 89
   auxiliary, 5, 96–97
   console, 96–97
   Ethernet, 87, 89–92
   serial, 4, 5
   switch, 89, 90
   virtual terminals, 96, 97
pound sign (#), 8, 14, 69
powering on routers, 6
PPP (Point-to-Point Protocol),
   24–25, 26, 30, 36
preemption, HSRP, 83
private circuits, 33, 35–39
   IP addresses, 35–37
private connections, 31–35
private networks, 31–35
privileged EXEC mode, 8, 15, 99
privilege levels, 99
problems. See troubleshooting
proxy firewalls, 30

Q
question mark (?), 8–9

R
RADB (Routing Arbiter
   Database), 71
RANCID program, 16
RBOC (Regional Bell Operating
   Company), 34
rebooting router, 47
recovery documentation, 59
recurring keyword, 105
redundancy
   with BGP. See BGP (Border
       Gateway Protocol)
   with HSRP. See HSRP (Hot
       Standby Router Protocol)
Regional Bell Operating Company
   (RBOC), 34
release names, 59
reloads, 12
remote office routing, 38
remote router access, 100–102
resetting BGP, 77–78
resetting interface, 47
resources, 3–4
reverse DNS entries, 44–45
RJ-45 cables, 46
rommon mode, 58, 63
routers
   adapter, 4
   cable, 4
   CD-ROMs, 4
   choosing, 32–33
   configuring. See configurations
   displaying information about,
       11–12
documentation/manuals, 3, 4
domain names, 14, 101–102
help for, 8–9
hostnames, 14, 44, 101–102
interfaces. See interfaces
ISP configuration for, 29–31
logging in to, 6
logging services, 106–108
model information, 12
multi-interface, 33
passwords, 97–99
physical information about, 12
ports, 5–6
powering on, 6
prompt, 6
rebooting, 47
remote access, 100–102
resources, 3–4
running vs. startup, 12–13
setting time zone for, 105
software for, 4
support for, 3–4, 33
vs. switches, 87–88
technical support, 33, 42
traffic, 77–78
troubleshooting. See troubleshooting
unpacking, 4–6
uptime, 12
used, 33
 usernames, 8, 99–100, 101
warranties, 33, 42

routes
 announcements, 66–72, 75, 77
 BGP, 76–77
 flapping, 73, 77
 full, 67
 maps, BGP, 73, 74, 79–81
 none, 67
 partial, 67
 specific vs. general, 38
 updates to, 76, 77

routing
 caches, 23
 headquarters, 38–39
 loose source rerouting, 52
 protocols, 14, 15, 16, 37–38
 purpose of, 37
 registries, 71
 remote office, 38
 specific vs. general routes, 38
 static, 37–38, 72
 Routing Arbiter Database (RADB), 71
 RSA cryptographic key, 102
 running configuration, 12, 13
 runt packets, 49

S
 SCP, copying files over, 61–62
 SCP servers, 58, 61–62
 search engines, 3
 Secure Shell (SSH). See SSH (Secure Shell)
 security
 AutoSecure tool, 104
 CDP, 91
 community names and, 109
 dynamic protocols and, 37
 encryption, 15, 97
 open vs. closed code, 98
 passwords. See passwords
 upgrades and, 57, 58
 security notifications, 58
 serial
 connections, 50
 console, 42
 interface IP addresses, 29–30
 interfaces, 24–25, 29–30
 lines, 50
 links, 24–25, 37, 39, 51
 networks, 24–25
 port client software, 5
 ports, 4, 5
 servers
 file, 62
 FTP, 16, 42, 58, 61
 NTP, 105–106
 SCP, 58, 61–62
 SFTP, 108
 SNMP, 109
 SSH, 58, 99
 TFTP, 42, 58, 108
 time, 104–105
 service password-encryption command, 15
 services, network. See networks, services
 SFTP servers, 108
 show arp command, 91
 show command, 9, 10
 show interfaces command, 18, 46, 58
 show ip bgp command, 75, 76
 show ip route command, 76
 show line command, 96
 show logging command, 107
 show ntp status command, 106
 show running-config command, 13
 show standby command, 85
 show startup-config command, 13
 show tech command, 59
 show version command, 11–12, 60, 63
 Simple Network Management Protocol (SNMP), 108–109
 smartjacks, 39, 46, 54, 55
SmartNet contract
benefits of, 3–4
disaster recovery and, 63
importance of, 33
IOS upgrades and, 58
router crashes and, 41–42
SNMP (Simple Network Management Protocol), 108–109
queries, 109
servers, 109
software, router, 4
Software Advisor web tool, 59
spanning tree protocol, 88–89
speed settings, 21–22, 23
SSH (Secure Shell), 99, 100, 101–102
clients, 100, 102
connections, 62, 96, 100, 101–102
servers, 58, 99
standby addresses, HSRP, 82–86
startup configuration, 12, 13
statements, 14
static routing, 37–38, 72
strict source rerouting, 52
subnetting, 36–37
summer-time keyword, 105
SUP (supervisor) modules, 88
support, 33, 42
switches
bad, 21
Cisco Discovery Protocol, 90–91
configuring interfaces for, 89–90
hybrid mode, 88
native mode, 88
operating systems for, 88
overview, 87–88
ports, 89, 90
vs. routers, 87–88
spanning tree protocol, 88–89
syslogd (syslog daemon), 107–108
protocol, 107–108
server, 108
system image files, 12, 59, 60–63

T
T1
circuits, 45–48, 50–53, 78
interfaces, 6
lines
encapsulation protocols, 24, 30
Internet connections, 30–31
private circuits, 35–39
private connections, 31–35
TCP/IP data, 52
Technical Assistance Center, 101
Technical Assistant Requests, 4, 59
technical support, 33, 42
telcos
for Internet connections, 29
for loopback tests, 54
telnet connections, 96, 100, 101
terminals, 15. See also command line
TFTP servers, 42, 58, 108
Tier 1 NTP servers, 105
Tier 2 NTP servers, 105
time servers, 104–105
timestamps, NTP, 104–106, 107
time zones, 105
traceroute command, 44–45
traceroutes, 44–45
traffic monitoring, BGP, 77–78
troubleshooting, 41–55. See also
errors
bad serial connections, 50
BGP problems, 68, 77–78
cable-level problems, 39
circuits, 50–53
circuit tests for, 43–45
contacting ISP, 47, 53–55
debugging, 48–50, 106–108
DNS problems, 43–45
dropped packets, 44, 45, 82
Ethernet problems, 42–43
input/output rates, 49
Internet “black hole,” 45
networks. See networks, failures
pings in, 43–44, 50–53
rebooting router, 47
resetting counters, 49
resetting interface, 47
router crashes, 41–42
router logging and, 106–108
traceroute for, 44–45
wiring problems, 55

U
Unix-based systems, 5, 16, 100, 107
“unrecognized command” error, 9
updates
  BGP, 81
  configurations, 105
  IOS, 57, 105
  routes, 76, 77
  software, 3
upgrading IOS, 57–63
uptime, 12
Usenet, 3
usernames, 8, 99–100, 101
UTC (Coordinated Universal Time)
  time zone, 105

V
version numbers, 11, 59, 60, 63
VIPs (virtual IPs). See standby
  addresses, HSRP
virtual LANs (VLANs), 91
virtual private networks (VPNs), 31
virtual terminals (vty), 96, 97, 101
  lines, 96, 101
VLANs (virtual LANs), 91
voice circuits, 34–35
VPNs (virtual private networks), 31
  vty (virtual terminals), 96, 97, 101
  lines, 96, 101

W
WANs (wide area networks), 27–39
  considerations, 27
  Internet connections, 28–31
  private circuits, 35–39
  private connections, 31–35
  warnings, logging level, 107
  warranties, 33, 42
web interfaces, 100
Windows-based systems, 5, 7, 50, 100, 107
wireless Internet access, 59
wiring problems, 55
write memory command, 16
write terminal command, 13