Index

SYMBOLS
$ (dollar signs), line scrolling, 133
^ (caret symbols), command errors, 133
? (question marks), router commands, 133
128-bit IP version 6 (IPv6), 30

A
access
control lists. See ACLs
layers, 9
VPNs, 69
tty, restricting, 143
access-class command, 143
access-list command, 73
ACLs (access control lists), 73
anemod, 74
applying, 73
configuring, 141, 197
creating, 73
extended, 40, 74, 142
filtering options, 142
guidelines, 73
IP address matching, 40
named, 40, 142
number specifications, 141
numbered, 197
overview, 189
packets, 39
placement, 143, 175
standard, 40, 74
traffic, controlling, 73
user protection, 74
verifying, 74, 175
tty access, restricting, 143
VTY lines, 74
wildcard masks, 73
active hubs, 49
AD (administrative distance), 19, 91
adaptability of LANs, 54
adaptive cut-through mode (switches), 17
adding CCNA to resumes, 207
Address Resolution Protocol (ARP), 6, 52
addresses
broadcast, 29
classes (LANs), 52-53
DHCP, 110
IP
allocation, 71
binary-to-decimal conversion, 57
broadcast, 58
classes, 29, 57, 184
finding, 6
hosts, obtaining, 30
Internet, 28
IPv6, 30
matching, 40
name associations, 107
NAT, 61-62
network addresses, determining, 27
obtaining, 53
octets, 29, 57
private, 58
reserved network, 58
subnetting, 58-61
troubleshooting, 167-168
VLSMs, 60
MAC, 15
clearing/viewing, 136
finding, 6
port associations, 51
static configuration, 137
network, 29
determining, 27, 60
private, 30
private, 186
administrative distance (AD), 19, 91
advanced certifications, 208
advertisement requests, 117
allocating IP addresses, 71
American Registry of Internet Numbers (ARIN), 19
analog dial-up WAN service, 79
AND operator, 27, 60
application layer
OSI, 4
protocols, 182
TCP/IP, 5
OSI layers, 6
protocols, 9
applying ACLs, 73
ARIN (American Registry of Internet Numbers), 19
ARP (Address Resolution Protocol), 6, 52
AS (autonomous system) numbers, 19
ATM WAN service, 80
authentication
OSPF, 95
PPP, 145-146
avoiding loops, 184

B
backing up
IOS images, 129
routers, 195
switches, 137-138
bandwidth
EIGRP, 97
interfaces, 94
LANs, 121-122
RECN (Backward ECN), 85
BGP (Border Gateway Protocol), 20, 65
BIA addresses. See MAC addresses
BIDs (bridge IDs), 11
binary-to-decimal conversions, 27, 57
bindings (DHCP), 111
bits per second (bps), 121
blocking port state, 12
Boolean logic, 27
Boot ROM, 36
boot system commands, 127
booting routers, 127-128, 195
BOOTP (Bootstrap Protocol), 30, 71
Border Gateway Protocol (BGP), 20, 65
BPDUs, sending, 11
bps (bits per second), 121
bridges
IDs, 11
LANs, 49-51
network functionality, improving, 17
root, 11
broadcasts
addresses, 29, 58
DHCP, 111
LANs, 17
Layer 2, 17
burned-in addresses (BIA). See MAC addresses
buses, 15, 35, 49

C
cable modem WAN service, 80
cabling, 50
caret symbols (^), command errors, 133
Carrier Sense Multiple Access/Collision Detection (CSMA/CD), 17, 39
Catalyst 1900 switch configuration, 136
Catalyst 2950 switch configuration, 136
CCNP (Cisco Certified Network Professional), 208
CCSP (Cisco Certified Security Professional), 208
CDP (Cisco Discovery Protocol), 159
activity, monitoring, 160
device details, 160
enabled devices, viewing, 159
information, clearing, 159
SNAP, 159
starting, 159
turning off, 160
version 2, 159
cdp enable command, 159
cdp run command, 159
CDPv2 (CDP version 2), 159
central office (CO), 43
central processing unit (CPU), 35
certificates, 207
certified score reports, 205
CHAP (Challenge Handshake Authentication Protocol), 82
Cisco
Certified Network Professional (CCNP), 208
Certified Security Professional (CCSP), 208
devices, 159-160
Discovery Protocol, 159-160
HDLC encapsulation, 82
IOS, 36, 196
routers, 37
Three-Layer Hierarchical Model, 55
class boundaries, ignoring, 90
Class C Subnet chart, 187
classes
address, 52-53
IP addresses, 29, 57, 184
clear cdp counters command, 159
clear isdn bri command, 178
clearing
MAC addresses, 136
switches, 135
CLI (command-line interface), 36, 99
clock command, 133
clock rate command, 100, 191
CO (central office), 43
coaxial cables, 122
collisions
domains, 17, 52
late, 186
local, 185
networks, 39, 51
remote, 185
command-line interface (CLI), 36, 99
commands
access-class, 143
access-list, 73
ACLs, configuring, 197
boot system, 127
CDP activity monitoring, 160
cdp enable, 159
cdp run, 159
Cisco IOS editing, 196
clear cdp counters, 159
clear isdn bri, 178
clock, 133
clock rate, 100, 191
command history, 134
configure terminal, 133
debuge
DDR, troubleshooting, 178
EIGRP, troubleshooting, 165
IGRP, 163-165
OSPF, troubleshooting, 165
RIP, 164-165
troubleshooting, 172
debug frame-relay lmi, 178
debug ip dhcp server events, 111
debug ppp interface, 177
editing, 134
errors, 133
extended ping, 168
history, 134
ip access-group, 73
ip classless, 90
ip default-network, 163
ip helper-address, 111
ip route 0.0.0.0/0, 163
isdn call interface, 178
LANs, 199-201
no cdp enable, 160
no cdp run, 160
no debug all, 164
no ip subnet-zero, 60
passive-interface, 91
ping
ICMP messages, 32
Layer 3 connectivity, 155, 171
routers
booting, 195
configuration/backup, 195
initial, 196
viewing, 133
show, 106-107, 159
ACLs, verifying, 175
EIGRP verification, 98, 165
IGRP verification, 163-165
OSPF, troubleshooting, 165
RIP verification, 164-165
show access-lists, 175
show cdp neighbors, 159
show cdp neighbors detail, 160
show controllers, 172
show flash, 130
show history, 134
show interface, 177
show ip dhcp binding, 111
show ip dhcp server statistics, 111
show ip interface, 175
show ip protocols, 163, 172
show ip rip database, 163
show ip route, 163, 172
show isdn status, 177
show running config, 115, 175
show version, 36
show vlan, 115
switches, 135, 196
telnet, 167
terminal editing, 134
terminal history size, 134
terminal monitor, 172
terminal no editing, 134
tftpdmld, 130
traceroute, 171-172
troubleshooting, 172
undebug all, 164
vlan database, 114-115
VLANs, 199-201
WANs, 197-199
xmodem, 130
communication
CSMA/CD, 39
LANs, 52
networks, 99
nodes, 3
serial WANs, 45, 81
service providers, 43, 78
switches, 51
TCP, 7
WAN data, 44
components
LANs, 15
routers, 35
configuration files
copying, 128
restoring, 127
storing, 126
configuration registers
customizing, 128
values, 195
configure terminal command, 133
configuring
ACLs, 141
commands, 197
extended, 142
named, 142
DDR, 147-149
DHCP, 110
dynamic NAT, 108
EIGRP, 96-98
Frame Relay, 149-150
IGRP, 92
interfaces
bandwidth, 94
deleting, 101
descriptions, 101
Ethernet, 101-102
IP addressing conventions, 99
loopbacks, 94, 102
serial, 100-102
VLSMs, 93
ISDN, 146-147
load balancing paths, 91
local intranets, 69
login banners, 107
NAT
overload, 109, 192
verifying, 110
OSPF, 93-95
passwords, 105-106
port security, 137
RIP, 90, 93
routers
commands, 195
console, 192
DHCP, 192
Frame Relay PVC, 149
hostnames, 105
initial configuration example, 135
NAT, 192
restoring, 171
vty, 192
routes
default, 90
static, 89
serial interfaces, 191
static MAC addresses, 137
static NAT, 108
static routes, 91
subinterfaces, 150
switches
  Catalyst 1900, 136
  Catalyst 2950, 136
  clearing, 135
  customizing, 125-126
trunk, 193
VLANs, 113
  global configuration mode, 114
  static commands, 193
subinterfaces, 117
trunking, 115
verifying, 114-115
  vlan database command, 114
VTP, 117, 193
WANs
  commands, 197-199
  PPP encapsulation, 145
connections
  Frame Relay networks, 85
  LANs, 16
  Frame Relay, 85
  switches, 16
Layer 3, 171
Layer 4, 157
redundant, 11
routers, 35-36
trunk, 161
WANs, 43
  branch networks, 81
  cabling, 43
demarcation points, 43
digital, 45
equipment, 43
HSSI, 43
physical, 77
speeds, 43
switched circuits, 44, 79
types, 77
console
  configuring, 192
  passwords, 105
TIA/EIA-232 port connections, 37
content addressable memory (CAM), 51
control messages, 32
controlling
  traffic, 73
  VTY lines with ACLs, 74
convergence
  networks, 11
  routers, 19
copying configuration files, 128
core layer (three-layer hierarchical model), 9
CPE (customer premises equipment), 43
CPU (central processing unit), 35
CRC (cyclic redundancy check), 39
crossover cables, 123
crosstalk, 122-123
CSMA/CD (Carrier Sense Multiple Access/Collision Detection), 17, 39
customer premises equipment (CPE), 43
customizing
  configuration registers, 128
  routers boot process, 128
  switch configurations, 125-126
  VLANs, 116
cyclic redundancy check (CRC), 39

D
data field (IP packets), 31
data flow, 39-40
data link layer
  OSI, 4
  WANs, 44, 78
data terminal equipment (DTE), 43
DDR (dial-on-demand routing), 45, 178
  configuring, 147-149
  troubleshooting, 178
dead intervals (OSPF), 95
debug commands
  DDR, troubleshooting, 178
  EIGRP, troubleshooting, 165
  IGRP, 163-165
  OSPF, troubleshooting, 165
  RIP, 164-165
  troubleshooting, 172
debug frame-relay lmi command, 178
debug ip dhcp server events command, 111
debug ppp command, 177
decimal and binary conversions, 27
default administrative distances, 164
default routes, 22
  configuring, 90
  propagating with OSPF, 96
  verifying, 90

deleting
  interface configurations, 101
  static routes, 92
  VLANs, 115
demarcation points (WANs), 43
denial-of-service (DoS) attacks, 33
designs
  LANs, 187
  networks, 9
  WANs, 81
destination address field (IP packets), 31
devices
  Cisco, 159-160
  network, 49
DHCP (Dynamic Host Configuration Protocol), 30, 70
  addresses, excluding, 110
  bindings, 111
  broadcasts, 111
  configuring, 110, 192
  host IP addresses, 53
  internetworks, 70
  IP address allocation, 71
  message counts, 111
  processes, 111
  starting/stopping, 111
dial-on-demand routing. See DDR
dialer profiles, 148-149
diffusing update algorithm (DUAL), 24-25
digital connections (WANs), 45
digital subscribe line (DSL), 77
distance vector protocols, 20, 64, 183
distribution layer (three-layer hierarchical model), 9
DNS (Domain Name System), 6
dollar signs ($), line scrolling, 133
DoS (denial-of-service) attacks, 33
DSL (digital subscriber line), 77
DSL, WAN service, 80
DTE (data terminal equipment), 43
DUAL (diffusing update algorithm),
  24-25
Dynamic Host Configuration Protocol.
  See DHCP
dynamic NAT, 108

E
editing keys/commands, 134
EIGRP (Enhanced Interior Gateway Routing Protocol), 20, 64
  advanced features, 24, 67
  bandwidth, 97
  configuring, 96
  DUAL algorithm, 25
  features, 66
  multiprotocol support, 23
  packets, 24
  route summaries, 97-98
  topology tables, 24
  troubleshooting, 165
  verifying, 98
enabling
  PPP, 145
  SNMP, 112
capsulation
  PPP, 145-146
  WANs, 186
crypting passwords, 106
Enhanced Interior Gateway Routing Protocol. See EIGRP
enterprise servers (LANs), 54
Ethernet
  frames, 16
  interfaces, 101-102
  LANs, 16, 50
  Layer 2 technology, 5
  networks, 17
exam day, 205
excluding addresses (DHCP), 110
EXEC mode routers, 133
extending
  ACLs, 40, 74, 142
  ping command, 168
  stars, 15, 49
extranet VPNs, 22
F

failing the exam, 208
far-end crosstalk (FEXT), 123
FDDI (Fiber Distributed Data Interface), 5
feasible distance field (EIGRP topology table), 24
feasible successor routes, 24
FECN (Forward ECN), 85
FEXT (far-end crosstalk), 123
Fiber Distributed Data Interface (FDDI), 5
fiber-optic cables, 122
fields
  EIGRP topology table, 24
  Ethernet frames, 16
  IP packets, 31
  ISDN frames, 83
  Layer 2 frames, 5
  TCP segments, 8
files (configuration)
  copying, 128
  restoring, 127
  storing, 126
filtering
  ACL options, 142
  traffic, 52
flags field (IP packets), 31
flash, 35, 130
flat WAN topology, 81
flow control, 6-7
Forward ECN (FECN), 85
forwarding
  DHCP broadcasts, 111
  frames, 11
  port state, 12
fragment offset field (IP packets), 31
Frame Relay, 85, 186
  configuring, 149-150
  connections, 85
  inverse ARP messages, 86
  LAN connections, 85
  LMIs, 85
  switches, 79, 85
  verifying, 178
virtual circuits, 85
WANs, 44-46, 80
frames
  Ethernet, 16
  forwarding, 11
  HDLC, 78
  ISDN, 83
  Layer 2, 5
  processing, 17
  runts, 39
  WANs, 44
full-duplex bandwidth, 17

G - H

Gbps (gigabits per second), 121
global configuration mode (VLANs), 114
HCCs (horizontal cross-connects), 54
HDLC frames, 78
header checksum field (IP packets), 31
hello intervals, 95
hello packets, 23
hierarchy
  defined, 49
  networks, 15
high-bandwidth low latency WANs, 81
High-Speed Serial Interface (HSSI), 43, 78
history of commands, 134
horizontal cross-connects (HCCs), 54
host-to-network layer, 6
hostnames (routers)
  configuring, 105
  testing, 108
hosts
  full-duplex bandwidth, 17
  interfaces, 99
  IP addresses, obtaining, 30, 53
  LANs, 52
  sessions, 7
  simultaneous services, 33
  traffic, 53
HSSI (High-Speed Serial Interface), 43, 78
hubs, 49
ICMP (Internet Control Message Protocol), 32
identification field (IP packets), 31
IDF (intermediate distribution facility), 54
IEEE (Institute of Electrical and Electronics Engineers), 113
IFS (IOS File System), 128
IGRP (Interior Gateway Routing Protocol), 20, 64
configuring, 92
exterior routes, 22
interior routes, 22
routing updates, 21
system routes, 22
troubleshooting, 163-165
verifying, 163
images
IOS, 129-130
names, 185
initial router commands, 196
initial router configuration example, 135
Institute of Electrical and Electronics Engineers (IEEE), 113
Integrated Service Digital Network. See ISDN
Inter-Switch Link (ISL), 113
interfaces
configuration mode (routers), 100
configuring
bandwidth, 94
deleting, 101
descriptions, 101
Ethernet, 101-102
IP addressing conventions, 99
loopbacks, 94, 102
serial, 100, 102
VLSMs, 93
information field (EIGRP topology table), 24
ISDN, 84
OSPF costs, 95
routing, 35, 91
serial, 191
Interior Gateway Routing Protocol. See IGRP

interior routes (IGRP), 22
intermediate distribution facility (IDF), 54
Internet
Control Message Protocol (ICMP), 32
IP addresses, 28
layer (TCP/IP), 6
internetworks
DHCP, 70-71
dividing switches into VLANs, 70
NAT/PAT, 70
types, 188
VLANs, 70
WANs, 71-72, 80
intranet VPNs, 69
inverse ARP messages, 86
IOS File System (IFS), 128
IOS images, 129-130
IOS naming conventions, 129
ip access-group command, 73
IP addresses
allocating, 71
binary-to-decimal conversion, 57
broadcast, 58
classes, 29, 57, 184
finding, 6
hosts, obtaining, 30
Internet, 28
IPv6, 30
matching, 40
name associations, 107
NAT, 61-62
network addresses, determining, 27
obtaining, 53
octets, 29, 57
private, 58
reserved network, 58
subnetting, 58-60
troubleshooting, 167-168
VLSMs, 60
ip classless command, 90
IP Control Protocol (IPCP), 82
ip default-network command, 163
IP header length field (IP packets), 31
ip helper-address command, 111
IP packets, 31
ip route 0.0.0.0/0 command, 163
IPCP (IP Control Protocol), 82
IPv6 (128-bit IP version 6), 30
ISDN (Integrated Service Digital Network), 77
BRI, 146
configuring, 147
frame fields, 83
interfaces, 84
out-of-band signaling, 83
PRI, 146
PRI E1, 147
protocols, 83, 190
reference points, 83-84, 190
verifying, 177
WANs, 45, 79
ISD call interface command, 178
ISL (Inter-Switch Link), 113
The IT Career Builder's Toolkit, 207

J - K - L

kbps (kilobits per second), 121
keys, 134

LANs (local area networks)
adaptability, 54
address classes, 52-53
ARP, 52
bandwidth, 121-122
bridges, 50-51
broadcasts, 17
cabling
legacy 10 Mbps Ethernet standards, 124
types, 122
UTP, 123
Cisco Three-Layer Hierarchical Model, 55
client/server models, 51
collisions, 17, 51-52
communication, 52
components, 15
connections, 16
Frame Relay, 85
switches, 16
data, analyzing, 54
designs, 187
enterprise servers, 54
Ethernet, 16, 50
expectations, 54
full-duplex bandwidth, 17
functionality, 54
gateways to WANs, 78
hosts, 52
IP addresses, 53
latency, 17, 51
Layer 2 broadcasts, 17
local intranets, 69
manageability, 54
network devices, 49
NICs, 51-52
noise, 122-123
OSI Layer 1 schemes, 54
OSI Layer 2 schemes, 55
OSI Layer 3 schemes, 55
peer-to-peer networks, 51
performance, 52
physical layers, 50, 54
private addresses, 53, 186
repeaters, 50
requirements, 54
routers, 35, 54
scalability, 54
segmenting with routers, 63
signals, 122
switches
content addressable memory, 51
host traffic, regulating, 53
local machines, identifying, 53
ports, 51
topologies, 183
traffic, filtering, 52
troubleshooting
CDP, 159-161
commands, 199-201
virtual circuits, 51
wireless, 50
LAPF (Link Access Procedure for Frame Relay), 85
last mile, 43
late collisions, 39, 186
latency
LANs, 51
networks, 17
Layer 2 broadcasts, 17
Layer 2 frames, 5
Layer 3 connectivity
testing, 155
troubleshooting, 171
Layer 4 connectivity, 157
layers
data link, 44
models, 181
OSI, 3-5
physical
LANs, 50, 54
WANs, 44
TCP/IP, 28
application, 5-6, 9
internet, 6
network access, 6
transport, 6-8
three-layer hierarchical model, 9
transport, 32
WANs, 78
LCP (Link Control Protocol), 82
learning port state, 12
leased line WAN service, 80
LED lights (routers), 37
Link Access Procedure for Frame Relay (LAPF), 85
Link Control Protocol (LCP), 82
link management identifiers (LMIs), 85
link-state protocols, 20, 65
distance vector protocols, compared, 64
updates, 22
vector, 183
Linksys routers, 21
listening port state, 12
LMIs (link management identifiers), 85
load balancing paths/routers, 91
local area networks. See LANs
local collisions, 39, 185
local intranets, 69
local loops, 43
local machines (LANs), 53
logical topologies, 15
login banners, 107
loopback interfaces, configuring, 102
loops
avoiding, 184
redundancy, 182
routers, 21
switching, 12

M
MAC (Media Access Control) addresses, 15
clearing/viewing, 136
finding, 6
port associations, 51
static configuration, 137
main distribution facility (MDF), 54
management ports, 36
MANs (metropolitan-area networks), 69
masks (VLSMs), 60
Mbps (megabits per second), 121
MDF (main distribution facility), 54
Media Access Control. See MAC addresses
megabits per second (Mbps), 121
membership (VLANs), 70
memory
content addressable, 51
nonvolatile random-access (NVRAM), 35
read-only (ROM), 35
routers, viewing, 36
mesh, 49
mesh networks, 15
messages
counts (DHCP), 111
inverse ARP, 86
VTP, 116
metropolitan-area networks (MANs), 69
microsegmentation, 17
models
layered, 181
OSI
Layer 3 connectivity, 155
Layer 4 connectivity, 157
networks, 155-157
overview, 155, 181
testing, 167
troubleshooting, 199
TCP/IP, 181
monitoring CDP activity, 160
Moran, Matthew, 207
multicasting (VTP), 116

N
names
ACLs, 40, 74, 142
images, 185
IOS naming conventions, 129
IP address association, 107
NAT (network address translation), 61, 70
configuring, 110, 192
dynamic, 108
tinternetworks, 70
IP addresses, 61-62
overload, 109
packets, 110
static, 108
NCP (Network Control Protocol), 82
near-end crosstalk (NEXT), 123
network address translation. See NAT
Network Control Protocol (NCP), 82
network interface cards (NICs), 49-52
networks
access layer, 6
addresses, 29
determining, 27, 60
private, 30
cabling, 122-124
class boundaries, ignoring, 90
Class C Subnet, 187
collisions, 39, 51-52
communication, 99
convergence, 11
designing, 9
devices (LANs), 49
Ethernet, 17
functionality, improving, 17
latency, 17
layer, 4
OSI management model, 157
paths (routers), 63
peer-to-peer, 51
performance, 52
physical topology, 15
protocols. See protocols
PSNs, 79
segments, 70
signals, 122
subnetworks, 30
troubleshooting, 155-156, 171
types, 69, 188
NEXT (near-end crosstalk), 123
NICs (network interface cards), 49-52
no cdp enable command, 160
no cdp run command, 160
no debug all command, 164
no ip subnet-zero command, 60
nodes of communication, 3
noise (LANs), 122-123
number specifications (ACLs), 141
numbered ACLs, 197
NVRAM (nonvolatile random-access memory), 35

O
octets (IP addresses), 29, 57
official certificates, 207
Open Shortest Path First. See OSPF
operating environments, 36
options field (IP packets), 31
Organizational Unique Identifiers (OUIs), 15
OSI (Open Source Initiative)
layers
application, 4
data link, 4-5
LAN designs, 187
Layer 1 schemes, 54
Layer 2 schemes, 55
Layer 3 schemes, 55, 63
network, 4
PDUs, 4
physical, 4
presentation, 4
session, 4
transport, 4
model
benefits, 3
Layer 3 connectivity, 155
Layer 4 connectivity, 157
layers, 3-4
networks, 155-157
overview, 155, 181
TCP/IP, compared, 28
testing, 167
troubleshooting, 199
TCP/IP, compared, 4
OSPF (Open Shortest Path First), 64, 93, 164
authentication, 95
configuring, 93
databases, 22
default routes, propagating, 96
features, 65-66
hello packets, 23
hello/dead intervals, 95
interface costs, 95
loopback interface, 94
priorities, 94
testing, 96
troubleshooting, 164-165
updates, 22-23
OUIs (Organizational Unique Identifiers), 15
out-of-band signaling, 83
overview, 155, 181
TCP/IP, compared, 28
testing, 167
troubleshooting, 199

P

packet-switched networks (PSNs), 44, 79
packets
ACL management, 39
EIGRP, 24
hello, 23
IP, 31
NAT, 110
paths, 19-20
padding field (IP packets), 31
PAP (Password Authentication Protocol), 82
PAR (positive acknowledgement and retransmission), 33
passive-interface command, 91
Password Authentication Protocol (PAP), 82
passwords
console, 105
encrypting, 106
privileged EXEC mode, 106
virtual terminal, 105
PAT (port address translation), 70
paths
load balancing, 91
packets, 19-20
PCMCIA (Personal Computer Memory Card International Association), 35
PDUs (protocol data units), 28, 181
peer-to-peer networks, 51
per-packet load balancing, 91
permanent virtual circuits (PVCs), 79
Personal Computer Memory Card International Association (PCMCIA), 35
phone calls (WANs), 44
physical layers
LANs, 50, 54
OSI, 4
WANs, 44, 78
physical topology (networks), 15
physical WAN connections, 77
ping command
extended, 168
ICMP messages, 32
Layer 3 connectivity, 155, 171
plain old telephone service (POTS), 77
Point-to-Point Protocol. See PPP
port address translation (PAT), 70
ports
demarcation points, 43
MAC address associations, 51
number assignments, 33
number ranges, 33
security, 137
STP states, 12, 182
switches, 51
transport layer, 8, 182
positive acknowledgement and retransmission (PAR), 33
POTS (plain old telephone service), 77
power sum near-end crosstalk (PSNEXT), 123
power supplies (routers), 35
PPP (Point-to-Point Protocol), 82
  authentication, 145-146
  enabling, 145
  encapsulation, 145-146
  LCP, 82
  NCP, 82
  session establishment, 82, 190
presentation layer (OSI), 4
preventing loops, 21
priorities
  OSPF, 94
  routes, 91
private addresses
  IP addresses, 58
  LANs, 53, 186
  networks, 30
privileged EXEC mode, 106, 133
processes (DHCP), 111
processing frames, 17
professional certifications, 208
protecting users (ACLs), 74
protocol data units (PDUs), 28, 181
protocol field (IP packets), 31
protocols
  application layer, 9, 182
  ARP, 6, 52
  BOOTP, 30, 71
  CDP, 159-160
  CHAP, 82
  configured, viewing, 92
  defined, 49
DHCP
  addresses, excluding, 110
  bindings, 111
  broadcasts, 111
  configuring, 110, 192
  host IP addresses, 53
  internetworks, 70
  IP address allocation, 71
  message counts, 111
  processes, 111
  starting/stopping, 111
  distance vector, 20, 64, 183
EIGRP, 20, 64
  advanced features, 24, 67
  bandwidth, 97
  configuring, 96
  DUAL algorithm, 25
features, 66
  multiprotocol support, 23
packets, 24
route summaries, 97-98
topology tables, 24
troubleshooting, 165
verifying, 98
ICMP, 32
IGRP, 20, 64
  configuring, 92
  exterior routes, 22
  interior routes, 22
  routing updates, 21
  system routes, 22
  troubleshooting, 163-165
  verifying, 163
ISDN, 77
  BRI, 146
  configuring, 147
  frame fields, 83
  interfaces, 84
  out-of-band signaling, 83
  PRI, 146
  PRI E1, 147
  protocols, 83, 190
  reference points, 83-84, 190
  verifying, 177
LCP, 82
link-state, 20, 65
  distance vector protocols, compared, 64
  updates, 22
  vector, 183
NCP, 82
network, 15
PAP, 82
PPP, 82
  authentication, 145-146
  enabling, 145
  encapsulation, 145-146
  LCP, 82
  NCP, 82
  session establishment, 82, 190
RARP, 6, 30
RIP, 30, 64
  configuring, 90
  Linksys support, 21
  load balancing, 91
troubleshooting, 164-165
  verifying, 164
version 1, 22, 65
version 2, 22, 65, 93
routing, 19, 63
BGP, 20, 65
default administrative distances, 164
distance vector, 20
EIGRP. See EIGRP
IGRP, 20-22, 64
link-state, 20, 22
listing of, 64, 188
OSI Layer 3, 63
OSPF, 22-23, 64-66
RIP. See RIP
syntax, 190-191
troubleshooting, 201
RSTP, 12
SNAP, 159
STP
BIDs, 11
loop redundancy, preventing, 182
network convergence, 11
port states, 12, 182
redundant connections, 11
switching loops, 12
troubleshooting, 161
TCP/IP
DoS attacks, 33
hosts, 33
layers, 5-8, 28
network communication, 99
OSI, compared, 4, 28
overview, 181
PAR, 33
PDUs, 28
ports, 33
sliding windows, 7
TCP communication, 7
TCP segments, 8
transport layer, 32
UDP, 8
VTP, 113
configuring, 117, 193
messages, 116
modes, 193
multicasting, 116
switch modes, 116
WANs, 189, 202
PSNEXT (power sum near-end crosstalk), 123

PSNs (packet-switched networks), 44, 79
PVCs (permanent virtual circuits), 79

Q - R
question marks (?), router commands, 133
radio frequency (RF), 50
RAM (random-access memory), 35
Rapid Spanning Tree Protocol (RSTP), 12
RARP (Reverse Address Resolution Protocol), 6, 30
read-only memory (ROM), 35
redundancy
connections, 11
loops, 182
reference points (ISDN), 83-84, 190
remote collisions, 39, 185
repeaters (LANs), 49-50
reported distance field (EIGRP topology table), 24
requirements
exam day, 205
LANs, 54
reserved network IP addresses, 58
restoring
collection files, 127
IOS images, 129-130
routers, 171
switches, 138
restricting vty access, 143
retaking the exam, 208
Reverse Address Resolution Protocol (RARP), 6, 30
RF (radio frequency), 50
rings, 15, 49
RIP (Routing Information Protocol), 20, 64
configuring, 90
Linksys support, 21
load balancing, 91
troubleshooting, 164-165
verifying, 164
version 1, 22, 65
version 2, 22, 65, 93
RJ-45 connectors, 50
rollover cables, 123
ROM (read-only memory), 35
ROM Monitor (ROMMON), 36
ROMMON (ROM Monitor), 36
root bridges, 11
route source field (EIGRP topology table), 24
route status field (EIGRP topology table), 24
routers
ACL placement, 175
available commands, 133
backing up, 195
boot process, 127-12, 195
Cisco, 37
CLI modes, 36
commands, 196
configuration
commands, 195
console, 192
DHCP, 192
Frame Relay PVC, 149
modes, 99-100
NAT, 192
registers, customizing, 128
saving, 126
vty, 192
connecting, 35-36
console TIA/EIA-232 port connections, 37
convergence, 19
default routes, 22
EXEC mode, 133
flash, 130
hostnames
configuring, 105
testing, 108
initial configuration example, 135
interfaces, 99
internal components, 35
LANs, 49, 54
communication, 52
segmenting, 63
LED lights, 37
Linksys, 21
load balancing, 91
loops
avoiding, 184
preventing, 21
memory, viewing, 36
networks
class boundaries, 90
functionality, improving, 17
paths, 63
operating environments, 36
packets, 19-20
restoring, 171
route poisoning, 21
routing metrics, 21
SNMP, enabling, 112
software compatibility, 36
starting, 195
traffic, filtering, 52
troubleshooting, 171
VTY lines, 74
as WAN devices, 145
routes
default, 22
configuring, 90
propagating with OSPF, 96
verifying, 90
EIGRP summaries, 97-98
exterior, 22
feasible successor, 24
interior, 22
poisoning, 21
priorities, 91
static
configuring, 89-91
deleting, 92
verifying, 90
successor, 24
system, 22
updates, 91
routing
DDR, 178
metrics, 21
protocols
BGP, 20, 65
default administrative distances, 164
distance vector, 20
EIGRP. See EIGRP
IGRP, 20-22, 64
link-state, 20-22
listing of, 64, 188
OSI Layer 3, 63
OSPF, 22-23, 64-66
RIP. See RIP
routed protocols, compared, 19
syntax, 190-191
troubleshooting, 201
tables, 19, 163
troubleshooting, 165
Routing Information Protocol. See RIP
RSTP (Rapid Spanning Tree Protocol), 12
runts, 39, 186
SANs (storage-area networks), 69
saving router configurations, 126
scalability (LANs), 54
ScTP (screened twisted pair), 122
security
ports, 137
user protection, 74
WANs, 81
segments
LANs, 63
networks, 70
TCP, 8
sending BPDUs, 11
serial communication (WANs), 45, 81
serial interfaces, configuring, 100-102, 191
service profile identifiers (SPIDs), 84
session layer (OSI), 4
sessions
PPP, 190
starting, 7
shielded twisted pair (STP), 122
show access-lists command, 175
show cdp command, 159
show cdp neighbors command, 159
show cdp neighbors detail command, 160
show commands, 106-107
ACLs, 175
EIGRP, 98, 165
IGRP, 163-165
OSPF, troubleshooting, 165
RIP, 164-165
show controllers command, 172
show flash command, 130
show history command, 134
show interface command, 177
show ip dhcp binding command, 111
show ip dhcp server statistics command, 111
show ip interface command, 175
show ip protocols command, 163, 172
show ip rip database command, 163
show ip route command, 16, 172
show isdn status command, 177
show running config command, 115, 175
show version command, 36
show vlan command, 115
signals (network), 122
SIMMs (single inline memory modules), 35
single inline memory modules (SIMMs), 35
sliding windows (TCP/IP), 7
SMTP (Simple Mail Transfer Protocol), 6
SNAP (Subnetwork Access Protocol), 159
SNMP (Simple Network Management Protocol), 6, 112
software compatibility (routers), 36
SONET (Synchronous Optical Network), 77
source address field (IP packets), 31
Spanning Tree Protocol. See STP
SPIDs (service profile identifiers), 84
standard ACLs, 40, 74
stars, 15, 49
starting
CDP, 159
DHCP, 111
routers, 195
static MAC address configuration, 137
static NAT, 108
static routes
administrative distance, 19
configuring, 89, 91
deleting, 92
verifying, 90
static VLANs, 70
stopping DHCP, 111
storage-area networks (SANs), 69
storing configuration files, 126
STP (Spanning Tree Protocol), 11, 182
   BIDs, 11
   loop redundancy, preventing, 182
   network convergence, 11
   port states, 12, 182
   redundant connections, 11
   switching loops, 12
   troubleshooting, 161
STP (shielded twisted pair), 122
straight-through cables, 123
subinterfaces
   configuring, 150
   VLANs, 117
subnet masks
   VLSMs, 60
   wildcard masks, compared, 40
subnetting
   Class C networks, 187
   IP addresses, 58
      borrowed bits with corresponding
      mask, 58
      eight borrowed bits, 60
      network addresses, determining, 60
      seven borrowed bits, 60
      two borrowed bits, 59
   VLSMs, 61
Subnetwork Access Protocol (SNAP), 159
subnetworks, 30
subset advertisements, 117
successor routes, 24
summary advertisements, 117
SVCs (switched virtual circuits), 79
switched circuits (WANs), 44, 79
switches
   adaptive cut-through mode, 17
   backing up, 137-138
   BIDs, 11
   BPDUs, sending, 11
   commands, 196
   communication, 51
   configuring
      Catalyst 1900, 136
      Catalyst 2950, 136
      clearing, 135
      customizing, 125-126
   dividing into VLANs, 70
Frame Relay, 85
   virtual circuits, 79
   WANs, 44-46
frames
   forwarding, 11
   processing, 17
LANs, 49
   connections, 16
   content addressable memory, 51
   host traffic, regulating, 53
   local machines, identifying, 53
   ports, 51
MAC addresses, 136-137
microsegmentation, 17
network functionality, improving, 17
port security, 137
restoring, 138
static VLANs, 113
STP, 11, 182
trunks, 115
switching loops, 12
Synchronous Optical Network (SONET), 77
system routes (IGRP), 22
T
tables
   routing, 19, 163
topology, 24
Tbps (terabits per second), 121
TCP segments, 8
TCP/IP (Transmission Control Protocol/Internet Protocol)
   DoS attacks, 33
   hosts, 33
   layers, 28
      application, 5-6, 9
      internet, 6
      network access, 6
      transport, 6-8
   network communication, 99
   OSI, compared, 4, 28
   overview, 181
   PAR, 33
   PDUs, 28
   ports, 33
   sliding windows, 7
TCP
communication, 7
segments, 8
transport layer, 32
TDM (time division multiplexing), 81
telnet command, 167
terabits per second (Tbps), 121
terminal editing command, 134
terminal history size command, 134
terminal monitor command, 172
terminal no editing command, 134
testing. See also troubleshooting
Layer 3 connectivity, 155
Layer 4 connectivity, 157
OSI model, 167
OSPF, 96
routers, 108
tftpdnld command, 130
three-layer designs (WANs), 81
three-layer hierarchical model, 9
time division multiplexing (TDM), 81
time to live field (IP packets), 31
Token Ring Layer 2 technology, 5
topologies
LANs, 183
logical, 15
physical, 15
tables, 24
total length field (IP packets), 31
trace route command, 171-172
traffic
controlling, 73
filtering, 52
hosts, 53
Transmission Control Protocol/Internet Protocol. See TCP/IP
transport layer
OSI, 4
ports, 182
TCP/IP, 6, 32
flow control, 6-7
ports, 8
sessions, 7
TCP communication, 7
troubleshooting. See also testing
commands, 172
DDR, 178
DoS attacks, 33
EIGRP, 165
extended ping command, 168
IGRP, 165
IP addresses, 167-168
LANs
CDP, 159-161
commands, 199-201
Layer 3 connectivity, 171
networks, 155-156, 171
OSI model, 199
OSPF, 164-165
RIP, 165
routers, 171
routing, 165
protocols, 163-164, 201
tables, 163
STP, 161
trunk connections, 161
VLANs, 161, 199-201
WANs
Frame Relay, 178
ISDNs, 177
protocols, 202
serial connections, 177
trunk
configuring, 193
connections, 161
switches, 115
VLANs, 115
turning off
CDP, 160
EIGRP route summaries, 97
type of service field (IP packets), 31

U - V
UDP (User Datagram Protocol), 8
undebug all command, 164
unencrypted passwords, 106
unshielded twisted pair (UTP), 122-123, 194
updates
link-state protocols, 22
OSPF, 22-23
routes, 91
User Datagram Protocol (UDP), 8
users, protecting, 74
UTP (unshielded twisted pair), 122-123, 194

variable-length subnet masks. See VLSMs
VCCs (vertical cross-connects), 54
VCs (virtual circuits), 79
  Frame Relay networks, 85
LANs, 51
verifying
  ACLs, 74, 175
  DDR configuration, 149
  EIGRP, 98
  Frame Relay, 150, 178
  ISDNs, 147, 177
  NAT configurations, 110
  OSPF priorities, 94
  routes, 90
  routing protocols, 163-164
  VLAN configuration, 114-115
version field (IP packets), 31
vertical cross-connects (VCCs), 54
viewing
  cdp-enabled devices, 159
  Cisco neighboring devices, 159
  commands, 133
  configured protocols, 92
  DHCP, 111
  flash, 130
  MAC addresses, 136
  memory, 36
  NAT packets, 110
virtual circuits. See VCs
Virtual LANs. See VLANs
virtual private networks (VPNs), 69, 77
virtual terminal passwords, 105
vlan database command, 114-115
VLAN Trunking Protocol. See VTP
VLANs (Virtual LANs), 113
  configuring, 113
  global configuration mode, 114
  static commands, 193
  subinterfaces, 117
  verifying, 114-115
  vlan database command, 114
  customizing, 116
  deleting, 115
  dividing switches into, 70
  features, 113
  membership, 70
  overview, 193
  static, 70
  troubleshooting, 161, 199-201
  trunking, 115
VTP
  configuring, 117
  messages, 116
  modes, 193
  multicasting, 116
  switch modes, 116
VLSMs (variable-length subnet masks), 60, 92
  interfaces, configuring, 93
  IP address subnets, 61
VPNs (virtual private networks), 69, 77
VTP (VLAN Trunking Protocol), 113
  configuring, 117, 193
  messages, 116
  modes, 193
  multicasting, 116
  switch modes, 116
vty
  access, restricting, 143
  configuring, 192
  lines, controlling, 74

W
WANs (wide-area networks), 69
  Cisco HDLC encapsulation, 82
  communication service providers, 43, 78
  configuring
    commands, 197-199
    PPP encapsulation, 145
  connections, 43
    branch networks, 81
    cabling, 43
    demarcation points, 43
    digital, 45
    equipment, 43
    HSSI, 43
    provider central office, 43
    speeds, 43
    switched circuits, 44, 79
    types, 77
data communication, 44
data link layers, 44, 78
DDR, 45, 147-149
defined, 69
designing, 81
encapsulation, 186
flat topology, 81
Frame Relay, 85
  configuring, 149-150
  connections, 85
  inverse ARP messages, 86
  LAN connections, 85
  LMIs, 85
  switches, 44-46, 85
  virtual circuits, 85
frames, 44
gateways to LANs, 78
high-bandwidth/low latency, 81
internetworks, 71-72, 80
ISDN
  BRI, configuring, 146
  configuring, 147
  frame fields, 83
  interfaces, 84
  out-of-band signaling, 83
  PRI, configuring, 146
  PRI E1, configuring, 147
  protocols, 83
  reference points, 83-84
  verifying, 147
packet-switched networks, 44
phone calls, 44
physical connections, 77
physical layers, 44, 78
PPP
  authentication, 145-146
  enabling, 145
  encapsulation, 145-146
  LCP, 82
  NCP, 82
  session establishment, 82, 190
protocols, 189, 202
routers
  connecting, 36
  as WAN devices, 145
security, 81
serial communication, 45, 81
services, 79-80
three-layer designs, 81
troubleshooting, 177-178

websites
  certificate online support, 207
  Wikipedia, 3
wide-area networks. See WANs
Wikipedia website, 3
wildcard masks
  ACLs, 73
  subnet masks, compared, 40
WLANs (wireless LANs), 50

X - Y - Z

X.25 WAN service, 80
xmodem command, 130

YAOMC (Yet Another OSI Model Chart), 3-4