

Index

Numbers

- 2-Way state (OSPF neighbors), 131
- 6-to-4 tunnels, IPv4 to IPv6 transitions, 561

A

- ABR (Area Border Routers), 138, 187–189, 194**
- ack packets, EIGRP, 64**
- adjacencies**
 - Integrated IS-IS, 264–266
 - broadcast links, 266*
 - NBMA links, 266*
 - point-to-point links, 266*
 - multiple-area OSPF, troubleshooting, 215
 - OSPF, 132–134
- administrative distance (redistribution), 330, 344–345**
- advertised distance, DUAL, 67**
- advertisements**
 - Integrated IS-IS, 259–260
 - OSPF, 259–260
- AFI (Authority and Format Identifiers), ISO addressing, 262**
- aggregate-address command, BGP neighbors, 420–421**
- ALG (Application-Level Gateways), IPv4 to IPv6 transitions, 563**
- AND operations, IP addresses, 43**
- anycasts, 526**
 - IPv6 addressing, 530
 - loopback addresses, 527
 - subnet-router anycast addresses, 530
- Area 0 (OSPF), 137**
 - ABR, 138
 - backbone routers, 138
 - multiple-area structures, 188
- area area-id stub command, OSPF, 240**
 - area area-id stub no-summary command, multiple-area OSPF structures, 202–203
 - area default-cost command, multiple-area OSPF structures, 204–205
 - area nssa command, OSPF, 241
 - area range command
 - multiple-area OSPF structures, 199
 - OSPFv3 configuration, 553
 - area stub command, multiple-area OSPF structures, 201
 - area virtual-link command, multiple-area OSPF structures, 205
 - area-id stub no-summary command, OSPF, 240
- areas**
 - Integrated IS-IS, 258
 - designing for IS-IS routers, 271–272*
 - ISO addressing, 264*
 - multiple-area OSPF structures
 - Area 0, 188*
 - calculating costs of paths to other areas, 191–192*
 - NSSA, 188*
 - number of areas per ABR, 194*
 - ordinary areas, 188*
 - path selection between areas, 190–191*
 - stub areas, 188*
 - totally stubby areas, 188*
- AS (Autonomous Systems), 399–400**
- AS external ASBR summary link LSA (Type 4), multiple-area OSPF, 188**
- ASBR (Autonomous System Boundary Routers), 138, 187**
- Attempt state (OSPF neighbors), 131**
- attributes**
 - BGP, 442–443
 - Local-Preference attribute, 444, 447*
 - MED attribute, 447*

verifying configuration of, 448–450
Weight attribute, 444

OSPF, 128

authentication

BGP neighbors, 421

EIGRP, 101–102

OSPF, 241

MD5, 242–243

plaintext passwords, 242

self-assessment, 233

OSPFv3, 549

Authentication field (IPv6 packet headers), 525

Automatic Private IP Addressing, 386

Auto-RP (Auto-Rendezvous Points), 505

B

backbone areas (OSPF). See Area 0 (OSPF)

backbone routers, 138, 187

bandwidth

EIGRP

configuration, 102–104

metrics, 65

OSPF, changing costs, 143

bandwidth command, EIGRP, 103–104

bandwidth-percent command, EIGRP

point-to-point network configuration, 104

BDR (Backup Designated Routers), OSPF, 133–137

BGP (Border Gateway Protocol)

AS, 399–400

attributes, 442–443

Local-Preference attribute, 444, 447

MED attribute, 447

verifying configuration of, 448–450

Weight attribute, 444

characteristics of, 30

default metrics, configuring, 342

enabling, 415

hierarchies, 401

Internet connections, 402–404

neighbors

aggregating routes, 420–421

authentication, 421

configuring, 416

defining advertised networks, 420

external peering, 419

forcing next-hop addresses, 419

identifying via neighbor command, 415–418

internal peering, 418

managing/verifying configurations, 421–422

resetting, 422–423

self-assessment, 411–414

source IP addresses, 418–419

peer groups, 415–416

peers, 400

record keeping, 401

route selection, 443

controlling via Local-Preference attribute, 444, 447

controlling via MED attribute, 447

controlling via Weight attribute, 444

self-assessment, 437–441

route stability, 399

self-assessment, 395–398

states of, 405–406

synchronization, 405

uses of, 402

BIA (Bump-in-the-API), IPv4 to IPv6 transitions, 563

binary numbers

converting decimal numbers to, 42

IP addresses, 41–43

BIS (Bump-in-the-Stack), IPv4 to IPv6 transitions, 563

bit buckets. See null interfaces

bootstrap router method, PIM, 505

broadcast network type (OSPF),

configuring, 174

broadcasting, 463

IPv6, 527

IS-IS configuration over NBMA, 290–292

LAN, 466

links, Integrated IS-IS

establishing adjacencies, 266

propagating LSP, 268–269

C

capacity planning, multiple-area structures, 192–193

number of areas per ABR, 194

number of neighbors per router, 194

case studies, redistribution, 348

default networks in redistributed environments, 353–354

route redistribution

with redundant paths, 350–352

without redundant paths, 349

CEF (Cisco Express Forwarding), IPv6,

enabling for, 551

CGMP, 481

checking OSPF configurations on a single router, 157

checksums, IPv6 packet headers, 525

CIDR (Classless Interdomain Routing), 26

Cisco-specific standards, OSPF, 169

classful addressing, IP addresses, 43

classful routing protocols, 26–27

classless routing protocols, 26–27

clear counters tunnel command, IPv6 manual tunnels, 561

clear ip ospf process command, 137

clear ipv6 command, verifying IPv6 configuration, 554

clients, DHCP, 388

CLNP (Connectionless Network Protocol), 255

CLNS (Connectionless Network Services), 255

clns routing command, IS-IS configuration, 286 configuring

administrative distance (redistribution), 344–345

BGP

attributes, verifying configuration of,

448–450

neighbors, 416, 421–422

peer groups, 416

default routes (routing updates), 348

EIGRP

authentication, 101–102

bandwidth command, 103–104

bandwidth configuration, 102–104

bandwidth-percent command, 104

ip bandwidth-percent-eigrp command, 105

load balancing, 98

network command, 92–93

network mask command, 93

optional commands list, 94

passive-interface command, 92–93

point-to-point network

configuration, 104

router command, 92

self-assessment, 87–90

show interface command, 103

stub routers, 96–97

summarizing, 94–95

tuning, 99–101

IGMP, 485

groups, 486–487

ip igmp join-group command, 487

ip igmp static-group command, 487

show ip igmp groups command, 486

show ip igmp interface command, 486

snooping, 487–488

Integrated IS-IS, 285

clns routing command, 286

is-type level-1 command, 286–288

is-type level-2 command, 286–288

NBMA configuration, 290–293

self-assessment, 281–284

summarization, 288–290

IPv6, 551–559

metrics, redistribution, 341–344

multicasting, 498

dense routing protocols, 500

PIM, 500–510

RPF, 499

self-assessment, 493–497

sparse routing protocols, 500

trees, 499–501

multiple-area OSPF

area area-id stub no-summary

command, 202–203

area default-cost command, 204–205

- area range command*, 199
- area stub command*, 201
- area virtual-link command*, 205
- configuration example*, 207–208
- enabling network command*, 197
- enabling OSPF routing protocols*, 196–197
- optional configuration commands*, 198–205
- required configuration commands*, 196–197
- summary-address command*, 200
- verifying configuration*, 208–212

NBMA, Integrated IS-IS configuration, 290–293

OSPF

- broadcast network type*, 174
- nonbroadcast environments*, 173–175
- point-to-multipoint networks*, 174
- point-to-point frame relay subinterfaces*, 175
- single routers*, 157

OSPFv3, 552–554

- show ipv6 ospf command*, 556
- show ipv6 ospf database command*, 557–559
- show ipv6 ospf interface command*, 555–556
- show ipv6 ospf neighbor command*, 557

passive interfaces (routing updates), 346

redistribution, 339

- administrative distance*, 344–345
- default metrics*, 341–344
- syntax of*, 340–341

RID, 142

route maps, 373

- match commands*, 374–375
- set commands*, 375–376

RP, Sparse-Dense Mode (PIM), 506–510

static routes (routing updates), 346–347

Connect state (BGP), 405

converged networks

- redistribution, 334
- security, 21
- traffic types, 20–21

convergence times (routing protocols), 28

core protocols, 334

cost command, OSPF, 142

CSNP (Complete SNP), 259

D

data link layers, multicasting support, 481

database topologies, 129

DBD (Database Descriptor) packets (OSPF), 138

debug command

- BGP neighbors, 422
- OSPF, 155
- troubleshooting
 - EIGRP, 109*
 - Integrated IS-IS operation, 306*

debug eigrp packets command, EIGRP, 102

debug ip dhcp server events command, DHCP clients, 389

debug ip dhcp server packets command, DHCP clients, 389

debug ip eigrp command, troubleshooting EIGRP, 109

debug ip eigrp neighbors command, troubleshooting EIGRP, 109

debug ip eigrp packet command, troubleshooting EIGRP, 109

debug ip eigrp summary command, troubleshooting EIGRP, 109

debug ip ospf adjacency command, MD5 authentication, 243

debug ip ospf events command, troubleshooting multiple-area OSPF, 214

debug ip packet command, troubleshooting multiple-area OSPF, 214

decimal numbers, converting to binary numbers, 42

decision routing process (Integrated IS-IS), 270–271

default-metric command, configuring default metrics, 341–344

default routes, routing updates, 336, 348

delay, EIGRP metrics, 65

Dense Mode (PIM), 501–502

dense routing protocols, multicasting, 500

Destination Address field (IPv6 packet headers), 523

Destination options field (IPv6 packet headers), 523

DHCP (Dynamic Host Control Protocol)

- advantages of, 385
- Automatic Private IP Addressing, 386
- clients, 388

- relays, 387–388
- self-assessment, 381–384
- servers, 386–387
- troubleshooting, 389

DHCPv6, IPv6 address assignment, 533

DIS (Designated Intermediate Systems), 258

distance command, configuring

- administrative distance (redistribution), 345, 353**

distance vector routing protocols, 25

distribute lists

- redistribution, 354–356
- routing updates, 338

distribute-list command, filtering routing updates, 355–356

distribution trees, multicasting, 500

Down state (OSPF neighbors), 131

DR (Designated Routers), OSPF, 133–137, 143, 168–169

DSP (Domain Specific Parts), ISO

- addressing, 262**

DUAL (Diffusing Update Algorithm), EIGRP, 63, 66, 69

- advertised distance, 67
- feasibility requirements, 67
- feasible distance, 67
- feasible successors, 68
- updating routing tables
 - active mode, 80*
 - passive mode, 78–79*

E

edge protocols, 334

EGP (Exterior Gateway Protocols), 27

EIGRP (Enhanced Interior Gateway Routing Protocol), 59

- ack packets, 64
- authentication, 101–102
- characteristics of, 30
- configuring
 - network command, 92–93*
 - network mask command, 93*
 - passive-interface command, 92–93*
 - router command, 92*
 - self-assessment, 87–90*
- DUAL, 63, 66, 69

- advertised distance, 67*
- feasibility requirements, 67*

- feasible distance, 67*

- feasible successors, 68*

- updating routing tables in active mode, 80*

- updating routing tables in passive mode, 78–79*

hello packets, 63

incremental updates, 71

IPv6 routing, 548

load balancing, variance command, 98

metrics, 64–66

neighbor discovery/recovery, 63–64

neighbor tables

- becoming a neighbor, 73*

- contents of, 72*

network design, 80–82

protocol-dependent modules, 63

queries, 70

query packets, 64

query scoping, 94

reliable incremental updates, 63

reply packets, 64

routing tables

- path selection, 77*

- updating in active mode with DUAL, 80*

- updating in passive mode with DUAL, 78–79*

RTP, 63

self-assessment, 59–62

stub routers, 96–97

summarizing, 94–95

topology tables

- adding networks to, 75–76*

- contents of, 73*

- finding alternative paths to remote networks, 76–77*

- maintaining, 74*

- removing paths from, 76*

- removing routers from, 76*

- traffic flows, 74*

troubleshooting, 108–109

tuning, 99

- hello timers, 100–101*

- hold timers, 101*

- ip hello-interval eigrp command, 100–101*

- ip hold-time eigrp command, 101*

unequal-cost load sharing, 71

update packets, 63

updates, multicast addressing, 71
 verifying, 105–108

WAN

bandwidth command, 103–104
bandwidth configuration, 102–104
bandwidth-percent command, 104
ip bandwidth-percent-egrp command, 105
point-to-point network configuration, 104
show interface command, 103

eigrp stub command, EIGRP, 96–97

encapsulation

Integrated IS-IS, 260–261
 OSPF, 260–261

enterprise campus network design model, 18–19

enterprise composite network design model, 15

enterprise campus design model, 18–19
 enterprise edge design model, 19
 service provider edge design model, 19

enterprise edge network design model, 19

ESH (End System Hellos), IS-IS Hello packets, 256

ESP (Encapsulating Security Payload) field (IPv6 packet headers), 525

Established state (BGP), 405

Exchange state (OSPF neighbors), 132

exponential growth, network design, 11

Exstart state (OSPF neighbors), 131

Extension Headers field (IPv6 packet headers), 523

external link LSA (Type 5), multiple-area OSPF, 188

external peering, BGP neighbors, 419

external routes (redistribution), 326

external summarization, multiple-area OSPF structures, 194

F

feasibility requirements, DUAL, 67

feasible distance, DUAL, 67

feasible successors, DUAL, 68

feedback (route), redistribution, 331–332

filtering routing updates, redistribution, 354–356

Flow Label field (IPv6 packet headers), 523, 526

Fragment field (IPv6 packet headers), 525

fragmentation, IPv6 packet headers, 525

frame-relay map clns command, Integrated IS-IS configuration, 291

frame-relay map commands, Integrated IS-IS configuration, 292–293

frame-relay map ip command, Integrated IS-IS configuration, 291

full-mesh Frame Relay networks, OSPF, 171

Full state (OSPF neighbors), 132

G - H

general queries, IGMP, 483

global aggregate unicast addresses, IPv6, 528–529

group-specific queries, IGMP, 483

hello messages, OSPF, 130–133

Hello packets

EIGRP, 63

IS-IS

ESH, 256

IIH, 256, 276

ISH, 256

OSPF, 138

hello timers, EIGRP, 100–101

hierarchical address structures, 260

hierarchical network design model, 13–15

HODSP (High Order DSP), ISO

addressing, 262

hold timers, EIGRP, 101

Hop Limit field (IPv6 packet headers), 523

Hop-by-Hop options field (IPv6 packet headers), 523

hub and spoke networks, scalability, 11–12

hybrid multipoint networks, EIGRP

bandwidth configuration, 104

I

ID (Interface Identifiers), IPv6 addressing, 527

IDI (Initial Domain Identifiers), ISO

addressing, 262

Idle state (BGP), 405

IDP (Inter Domain Parts), ISO addressing, 262**IGMP (Internet Group Management Protocol)**

- configuring, 485
 - groups, 486–487*
 - IGMP snooping, 487–488*
 - ip igmp join-group command, 487*
 - ip igmp static-group command, 487*
 - show ip igmp groups command, 486*
 - show ip igmp interface command, 486*
- IGMPv1, 482
- IGMPv2, 483–484
- IGMPv3 (RFC 3376), 484–485
- self-assessment, 477–480
- snooping, 482, 487–488
- versions, determining, 485

IGP (Internal Gateway Protocols), 27, 30**IGRP (Interior Gateway Routing Protocols), 30****IIH (Intermediate-to-Intermediate Hellos),****IS-IS Hello packets, 256****IIN (Intelligent Information Networks), 21–23****imaging applications, multicasting, 472****incremental updates, EIGRP, 63, 71****Init state (OSPF neighbors), 131****integrated applications phase (IIN), 23****Integrated IS-IS (Intermediate System-to-Intermediate System)**

- adjacencies, 264–266
- as router-to-router protocol, 255
- configuring, 285
 - cls routing command, 286*
 - is-type level-1 command, 286–288*
 - is-type level-2 command, 286–288*
 - NBMA configuration, 290–293*
 - summarization, 288–290*
- decision routing process, 270–271
- default metrics, configuring, 342
- design considerations, 272
- development of, 255
- DIS, 258
- Integrated IS-IS, 270, 276, 285, 294
- ISO addressing, 261–264
- NBMA design, 273
- OSPF versus, 257
 - advertisements, 259–260*
 - areas, 258*
 - development of, 261*

- encapsulation, 260–261*
- LAN topologies, 258*
- main differences between, 258*

PDU

- Hello packets, 256*
- LSP packets, 257*

routers, area design, 271–272

routing levels, 256

self-assessments, 249–254, 281–284

SNP, 259

summarization, 272–273

TLV

- advertisements, 259–260*
- structure of, 257*

troubleshooting

- debug commands, 306*
- show isis spf-log command, 304–305*

update routing process

- determining LSP validity in databases, 269–270*
- sending/receiving LSP, 267–269*

verifying operation, 294

- show cls interface command, 297–299*
- show cls neighbors command, 295–297*

- show isis database command, 300–301*
- show isis database detail command, 301–303*

vocabulary of, 255–256

integrated services phase (IIN), 22**integrated transport phase (IIN), 22****interarea summarization, multiple-area****OSPF structures, 194****interesting traffic, 347****interfaces**

- loopback, RID, 141–142
- redistribution, 336

routers, modifying, 288

internal peering, BGP neighbors, 418**internal routers**

- loopback interfaces, 141–142
- multiple-area OSPF, 187

internal routes (redistribution), 326**Internet connections, BGP, 402–404****IP addresses**

- AND operations, 43
- BGP neighbors, 418–419
- binary numbering fundamentals, 41–43
- broadcasting, 463, 466

- calculating network ranges via subnet masks, 44–46
- classful addressing, 43
- multicasting, 463–467, 471–472
- reviewing, 41
- self-assessment, 37–40
- unicasting, 463
- ip bandwidth-percent-igrp command, EIGRP point-to-point network configuration, 105**
- ip dhcp relay information option command, DHCP relays, 388**
- ip forward-protocol udp command, DHCP relays, 388**
- ip hello-interval eigrp command, EIGRP, 100–101**
- ip helper-address command, DHCP relays, 388**
- ip hold-time eigrp command, EIGRP, 101**
- ip igmp join-group command, 487**
- ip igmp static-group command, 487**
- ip ospf authentication command, OSPF authentication, 242**
- ip ospf network command, OSPF, 172, 176**
- ip ospf network point-to-multipoint command, 173–174**
- ip ospf network point-to-multipoint non-broadcast command, OSPF nonbroadcast environments, 174**
- ip ospf priority command, OSPF nonbroadcast environments, 173**
- ip summary-address eigrp command, EIGRP, 95**
- IPv4 (Internet Protocol version 4)**
 - IPv6, transitioning to, 559, 563
 - ALG, 563*
 - BIA, 563*
 - BIS, 563*
 - dual stack configurations, 559–560*
 - SIIT, 563*
 - tunneling, 560–562*
 - packet headers versus IPv6 headers, 525
 - scarcity of, 521
- IPv6 (Internet Protocol version 6)**
 - addressing
 - anycasts, 526, 530*
 - assignments, 532–533*
 - broadcasts, 527*
 - ID, 527*
 - loopback addresses, 527*
 - multicasting, 526, 531–532*
 - representing addresses, 526*
 - structures of, 552*
 - types of, 526–527*
 - unicasts, 526, 528–530*
 - CEF, enabling, 551
 - configuring, 551–552, 554–559
 - development of, 521
 - features of, 522
 - mobility, 533–534
 - packet headers
 - Authentication field, 525*
 - checksums, 525*
 - Destination Address field, 523*
 - Destination options field, 523*
 - ESP (Encapsulating Security Payload) field, 525*
 - Extension Headers field, 523*
 - Flow Label field, 523, 526*
 - Fragment field, 525*
 - fragmentation, 525*
 - Hop Limit field, 523*
 - Hop-by-Hop options field, 523*
 - IPv4 headers versus, 525*
 - Next Header field, 523*
 - Payload Length field, 523*
 - Routing field, 523*
 - Source Address field, 523*
 - Traffic Class field, 523*
 - Version field, 523*
 - routing
 - EIGRP, 548*
 - IS-IS, 548*
 - MP-BGP4, 548*
 - OSPFv3, 548–551*
 - RIPng, 548*
 - static routes, 547*
 - self-assessments, 517–520, 543–545
 - transitioning IPv4 to
 - ALG, 563*
 - BIA, 563*
 - BIS, 563*
 - dual stack configurations, 559–560*
 - SIIT, 563*
 - tunneling, 560–562*
- ISATAP, IPv4 to IPv6 transitions, 562**
- ISH (Intermediate System Hellos), IS-IS Hello packets, 256**

IS-IS

- characteristics of, 30
- IPv6 routing, 548

ISO addressing, Integrated IS-IS, 261

- address components, 262–263
- AFI, 262
- area routing, 264
- DSP, 262
- example of, 263–264
- HODSP, 262
- IDI, 262
- IDP, 262
- NET, 263
- NSAP, 263
- NSEL, 262
- rules of, 263
- System ID, 262

is-type level-1 command, Integrated IS-IS configuration, 286–288**is-type level-2 command, Integrated IS-IS configuration, 286–288****J - K - L****LAN (Local Area Networks)**

- broadcasting, 466
- multicasting, 467
- topologies, Integrated IS-IS, 258

Leave Group messages, IGMP, 483**linear growth, network design, 12****link-local unicast addresses, IPv6, 529–530****link-state routing protocols, 25, 128–130**

- networks, 132
- updating local network tables, 129

Loading state (OSPF neighbors), 132**loads, EIGRP**

- balancing, 98
- metrics, 65
- sharing, 71

Local-Preference attribute, controlling BGP route selection, 444, 447**log-adjacency-changes command, troubleshooting multiple-area OSPF, 213–214****loopback addresses, IPv6 addressing, 527****loopback interface, configuring OSPF on internal routers, 141–142****LSA (Link-State Advertisements), OSPF**

- multiple-area OSPF structures
 - ABR LSA propagation, 189*
 - AS external ASBR summary link LSA (Type 4), 188*
 - external link LSA (Type 5), 188*
 - Network external LSA (Type 7), 188*
 - network link LSA (Type 2), 188*
 - network summary link LSA (Type 3), 188*
 - router link LSA (Type 1), 187*
 - routing table codes and associated LSA, 191–192*
- OSPFv3, 550–551

LSAck (Link State Acknowledgements) packets (OSPF), 138**LSP**

- Integrated IS-IS update routing process
 - determining database validity in, 269–270*
 - sending/receiving, 267–269*
- packets (IS-IS), 257

LSR (Link State Requests) packets (OSPF), 138**LSU (Link State Update) packets (OSPF), 138****M****MAC addresses, multicasting, 468, 471, 481****manual tunnels, IPv4 to IPv6 transitions, 560****many-to-many applications, multicasting, 472****many-to-one applications, multicasting, 472****mapping agents, multicasting, 505****match commands, route map configuration, 374–375****match statements, 378****MD5 (Message Digest 5), authentication, 242–243****MED (Multi-Exit Discriminator) attribute, controlling BGP route selection, 447****Membership Report IGMP messages, 482****memory, routers, 186****metrics**

- EIGRP, 64–66
- redistribution, configuring
 - administrative distance, 344–345*
 - default metrics, 341–344*

- mobility, IPv6, 533–534**
- modification, routers, 288**
- MP-BGP4, IPv6 routing, 548**
- multiarea OSPF networks, troubleshooting, 217**
- multicasting, 463–465, 526**
 - addressing, EIGRP updates, 71
 - configuring, self-assessment, 493–497
 - data link layer support, 481
 - IGMP, 482
 - imaging applications, 472
 - IP addressing, 471–472
 - IPv6 addressing, 531–532
 - issues of, 473
 - LAN, 467
 - loopback addresses, 527
 - MAC addressing, 468, 471
 - many-to-many applications, 472
 - many-to-one applications, 472
 - mapping agents, 505
 - one-to-many applications, 472
 - publishing server contact information, 498
 - routing applications, 472
 - routing traffic, 498
 - dense routing protocols, 500*
 - PIM, 500–510*
 - RPF, 499*
 - sparse routing protocols, 500*
 - trees, 499–501*
 - RP, 502, 505
 - self-assessment, 459–462
 - shared whiteboard applications, 472
 - VoIP scenario, 465–466
 - whiteboarding applications, 472
- multihoming, BGP Internet connections, 402–403**
- multiple-area OSPF (Open Shortest Path First)**
 - ABR, 187
 - ABR LSA propagation, 189
 - Area 0, 188
 - AS external ASBR summary link LSA (Type 4), 188
 - ASBR, 187
 - backbone routers, 187
 - calculating costs of paths to other areas, 191–192
 - capacity planning, 192–194
 - configuring
 - area area-id stub no-summary command, 202–203*
 - area default-cost command, 204–205*
 - area range command, 199*
 - area stub command, 201*
 - area virtual-link command, 205*
 - configuration example, 207–208*
 - enabling network command, 197*
 - enabling OSPF routing protocols, 196–197*
 - optional configuration commands, 198–205*
 - required configuration commands, 196–197*
 - summary-address command, 200*
 - verifying configuration, 208–212*
 - external link LSA (Type 5), 188
 - internal routers, 187
 - network external LSA (Type 7), 188
 - network link LSA (Type 2), 188
 - network summary link LSA (Type 3), 188
 - NSSA, 188
 - ordinary areas, 188
 - over NBMA networks, 196
 - path selection between areas, 190–191
 - purpose of, 186
 - router link LSA (Type 1), 187
 - routing table codes and associated LSA, 191–192
 - self-assessment, 179–185
 - stub areas, 188
 - summarization, 192, 194
 - totally stubby areas, 188
 - troubleshooting, 212
 - adjacencies, 215*
 - debug ip ospf events command, 214*
 - debug ip packet command, 214*
 - log-adjacency-changes command, 213–214*
 - virtual links, 192–195, 205
- multiplexing, network design, 12–13**
- multipoint networks, 104**

N

NBMA

clouds, EIGRP bandwidth configuration, 103–104

Integrated IS-IS

configuring for, 290–293

designing for, 273

links, establishing adjacencies, 266

multiple-area OSPF structures, 196

neighbor command

identifying BGP neighbors, 415–418

OSPF nonbroadcast environments, 173

neighbor peer-group command, BGP peer groups, 416

neighbor tables (EIGRP), 72–73

neighbor update-source command, BGP neighbors, 419

neighbors. *See also* peers

adjacencies, Integrated IS-IS, 264–266

BGP

aggregating routes, 420–421

authentication, 421

defining advertised networks, 420

external peering, 419

forcing next-hop addresses, 419

identifying neighbors via neighbor command, 415–418

internal peering, 418

managing/verifying configurations, 421–422

resetting, 422–423

self-assessments, 411–414

source IP addresses, 418

discovery/recovery, EIGRP, 63–64

multiple-area OSPF structures, number of neighbors per router, 194

OSPF, 129–132

recognition, OSPF, 170

verifying, Sparse-Dense Mode (PIM), 508

NET (ISO addressing), 263

NET addresses, 264

network command

BGP neighbors, defining advertised networks, 420

configuring passive interfaces (routing updates), 346

EIGRP, 92–93

multiple-area OSPF structures, enabling in, 197

OSPF, 140–142, 157

passive interfaces, 336

network external LSA (Type 7), multiple-area OSPF, 188

network link LSA (Type 2), multiple-area OSPF, 188

network mask command, EIGRP, 93

network summary link LSA (Type 3), multiple-area OSPF, 188

networks

broadcast network type

configuring OSPF networks, 174

CIDR, 26

converged networks

redistribution, 334

security, 21

traffic types, 20–21

designing, 5

EIGRP, 80–82

enterprise composite design model, 15, 18–19

hierarchical design model, 13–15

IIN, 21–23

multiplexing, 12–13

scalability, 10–12

self-assessment, 5–8

SONA, 23

EIGRP

network design, 80–82

topology tables, 75–77

hub and spoke networks, scalability, 11–12

hybrid multipoint networks, EIGRP

bandwidth configuration, 104

link-state routing protocols, 132

multipoint networks, EIGRP bandwidth configuration, 104

OSPF

Cisco-specific standards, 169

full-mesh Frame Relay networks, 171

neighbor recognition, 170

nonbroadcast environments, 170–175

partial-mesh Frame Relay networks, 171–172

point-to-multipoint nonbroadcast

OSPF networks, 169

- point-to-multipoint OSPF networks, 169*
- RFC-compliance standards, 169*
- subinterfaces, 171*
- timers, 170*
- point-to-multipoint networks, configuring
 - OSPF networks, 174
- point-to-point networks
 - configuring OSPF networks, 175*
 - EIGRP configuration, 104*
 - VLSM, 26
- next Header field (IPv6 packet headers), 523**
- next-hop addresses, BGP neighbors, 419**
- next-hop-self command, BGP neighbors, 419**
- no auto-summary command, EIGRP, 95**
- NSAP (ISO addressing), 263**
- NSEL, ISO addressing, 262**
- NSSA (Not So Stubby Areas), OSPF, 240**
 - area nssa command, 241
 - multiple-area structures, 188
- null interfaces, routing updates, 337**

O

- one-to-many applications, multicasting, 472**
- Open Confirm state (BGP), 405**
- open routing protocols, 28–29**
- Open Sent state (BGP), 405**
- ordinary areas (OSPF), multiple-area structures, 188**
- OSI (Open System Interconnection), Integrated IS-IS**
 - as router-to-router protocol, 255
 - development of, 255
 - vocabulary of, 255–256
- OSPF (Open Shortest Path First)**
 - adjacencies, 132–134
 - as routing protocol, 139
 - authentication, 241
 - MD5, 242–243*
 - plaintext passwords, 242*
 - BDR, 133–134, 136–137
 - broadcast network type, configuring
 - via, 174
 - characteristics of, 30
 - checking configurations on a single router, 157
 - Cisco-specific standards, 169
 - configuration commands for multiarea networks, troubleshooting, 217
 - cost command, 142
 - default metrics, configuring, 342
 - DR, 133–134, 136–137, 143, 168–169
 - full-mesh Frame Relay networks, 171
 - hello messages, 130–133
 - Integrated IS-IS versus, 257
 - advertisements, 259–260*
 - areas, 258*
 - development of, 261*
 - encapsulation, 260–261*
 - LAN topologies, 258*
 - main differences between, 258*
 - ip ospf network command, 176
 - link-state routing protocols, 128–130
 - multiple-area structures
 - ABR, 138, 187*
 - ABR LSA propagation, 189*
 - Area 0, 137, 188*
 - area area-id stub no-summary command, 202–203*
 - area default-cost command, 204–205*
 - area range command, 199*
 - area stub command, 201*
 - area virtual-link command, 205*
 - AS external ASBR summary link LSA (Type 4), 188*
 - ASBR, 138, 187*
 - backbone routers, 138, 187*
 - calculating costs of paths to other areas, 191–192*
 - capacity planning, 192–194*
 - configuration example, 207–208*
 - DBD, 138*
 - enabling network command, 197*
 - enabling OSPF routing protocols, 196–197*
 - external link LSA (Type 5), 188*
 - Hello packets, 138*
 - internal routers, 187*
 - LSAck packets, 138*
 - LSR packets, 138*
 - LSU packets, 138*
 - network link LSA (Type 2), 188*
 - network summary link LSA (Type 3), 188*
 - NSSA, 188*
 - NSSA external LSA (Type 7), 188*

- optional configuration commands, 198–205
- ordinary areas, 188
- over NBMA networks, 196
- packet types, 138
- path selection between areas, 190–191
- purpose of, 186
- required configuration commands, 196–197
- router link LSA (Type 1), 187
- routing table codes and associated LSA, 191–192
- self-assessment, 179–185
- show ip ospf border-routers command, 208–209
- show ip ospf database command, 211–212
- show ip ospf virtual-links command, 210–211
- show ip route command, 209–210
- stub areas, 188
- summarization, 192–194
- summary-address command, 200
- totally stubby areas, 188
- troubleshooting, 212–215
- verifying configuration, 208–212
- virtual links, 192–195, 205
- neighbors, 129
 - 2-Way state, 131
 - Attempt state, 131
 - Down state, 131
 - Exchange state, 132
 - Exstart state, 131
 - Full state, 132
 - Init state, 131
 - Loading state, 132
 - recognition, 170
 - relationship states, 131
- network command, 140–141
- network topologies, self-assessment, 163–167
- network types, 168
- nonbroadcast environments
 - configuring point-to-multipoint networks, 174
 - configuring via broadcast network types, 174
 - configuring via point-to-point frame relay subinterfaces, 175
 - ip ospf network command, 172
 - ip ospf network point-to-multipoint command, 173–174
 - ip ospf network point-to-multipoint non-broadcast command, 174
 - ip ospf priority command, 173
 - neighbor command, 173
 - network types in, 170
- NSSA, 240–241
- partial-mesh Frame Relay networks, 171–172
- point-to-multipoint networks, configuring, 174
- point-to-multipoint nonbroadcast OSPF networks, 169
- point-to-multipoint OSPF networks, 169
- point-to-point frame relay subinterfaces, configuring, 175
- RFC-compliance standards, 169
- routing tables, topology databases, 129
- self-assessment, 231–233
- show ip ospf virtual-links, 211
- single-area structures, configuring
 - changing bandwidth costs, 142–143
 - debug commands, 155
 - example of, 143
 - internal router options, 141–143
 - problems with, 137
 - required commands, 139–141
 - self-assessment, 123–127
 - show commands list, 144
 - show ip ospf command, 144–145
 - show ip ospf database command, 146–147
 - show ip ospf interface command, 147–150
 - show ip ospf neighbor command, 150–151
 - show ip protocols command, 152–153
 - show ip route command, 154
- single router configurations, 157
- speakers, 130
- standard-area ABR, 234
- stub areas, 232–233, 236–238
- subinterfaces, 171
- timers, 170
- totally stubby areas, 239–240
- troubleshooting, 132, 241

ospf auto-cost reference-bandwidth
command, changing bandwidth costs, 143

OSPFv2, 548–550

OSPFv3

- address prefixes, 551
- authentication, 549
- configuring, 552–554
 - show ipv6 ospf command, 556*
 - show ipv6 ospf database command, 557–559*
 - show ipv6 ospf interface command, 555–556*
 - show ipv6 ospf neighbor command, 557*
- IPv6 routing, 548–551
- LSA types, 550–551

P

packet headers

- IPv4 headers versus IPv6, 525
- IPv6
 - Authentication field, 525*
 - checksums, 525*
 - Destination Address field, 523*
 - Destination options field, 523*
 - ESP (Encapsulating Security Payload) field, 525*
 - Extension Headers field, 523*
 - Flow Label field, 523, 526*
 - Fragment field, 525*
 - fragmentation, 525*
 - Hop Limit field, 523*
 - Hop-by-Hop options field, 523*
 - IPv4 headers versus, 525*
 - Next Header field, 523*
 - Payload Length field, 523*
 - Routing field, 523*
 - Source Address field, 523*
 - Traffic Class field, 523*
 - Version field, 523*

partial-mesh Frame Relay networks, OSPF, 171–172

passive interface command, 336

- configuring static routes, 347
- EIGRP, 92–93

passive interfaces

- redistribution, 336
- routing updates, 335–336, 346

passwords (plaintext), authentication of OSPF, 242

paths

- EIGRP topology tables, removing from, 76
- selecting (redistribution), 330

Payload Length field (IPv6 packet headers), 523

PDU (Protocol Data Units), IS-IS

- Hello packets, 256
- LSP packets, 257

peer groups (BGP), 415

peers (BGP), 400. *See also* neighbors

- external peering, 419
- internal peering, 418

PIM (Protocol Independent Multicast), 500

- bootstrap router method, 505
- Dense Mode, 501–502
- IGMP, 483
- Sparse-Dense Mode, 504–505
 - configuring RP, 506–507*
 - enabling multicast routing, 506*
 - turning on PIM, 506*
 - verifying multicast routing, 510*
 - verifying neighbors, 508*
 - verifying routes, 507–508*
 - verifying RP, 509*
- Sparse Mode, 502
- version 1, 504–505
- version 2, 505

PIM-DM (PIM Dense Mode), 501–502

PIM-SM (PIM Sparse Mode), 502

ping command, troubleshooting redistribution, 357

ping ipv6 command, verifying IPv6 configuration, 554

plaintext passwords, OSPF, 242

point-to-multipoint networks, OSPF, 174

point-to-multipoint nonbroadcast OSPF networks, 169

point-to-multipoint OSPF networks, 169

point-to-point configurations, Integrated IS-IS over NBMA, 292–293

point-to-point links, Integrated IS-IS

- establishing adjacencies, 266
- propagating LSP, 268

point-to-point networks

- EIGRP configuration
 - bandwidth-percent command, 104*
 - ip bandwidth-percent-igrp command, 105*
- OSPF, configuring, 175

policy routing, route maps

- characteristics of, 371–372
- configuring, 373–376
- example of, 372–373
- self-assessment, 367–370
- tracking, 376
- uses of, 371

priority command, determining DR for OSPF, 143**proprietary routing protocols, 28–29****protocol-dependent modules, EIGRP, 63****pseudonodes. See DIS (Designated Intermediate Systems)****PSNP (Partial SNP), 259****publishing server contact information, multicasting, 498****Q - R****queries**

- EIGRP, 70
- IGMP, 482–483
- scoping, 70, 94

query packets, EIGRP, 64**redistribute command**

- configuring default metrics, 341–342
- routing updates, 339

redistribute connected subnets command, 140**redistribution, 326**

- administrative distance, 330, 344–345
- case studies, 348
 - default networks in redistributed environments, 353–354*
 - route redistribution with redundant paths, 350–352*
 - route redistribution without redundant paths, 349*
- configuring, 339
 - administrative distance, 344–345*
 - default metrics, 341–344*
 - syntax of, 340–341*

- examples of, 352
- external routes, 326
- internal routes, 326
- multiple protocols, 320
- path selection, 330
- potential problems with, 330
 - exchanging routing protocol-specific parameters, 334*
 - network convergence, 334*
 - route feedback, 331–332*
 - routing loops, 331–332*
 - suboptimal routing decisions, 333–334*
- problems with, 331
- route maps
 - characteristics of, 371–372*
 - configuring, 373–376*
 - example of, 372–373*
 - self-assessment, 367–370*
 - tracking, 376*
 - uses of, 371*
- routing updates
 - default routes, 336, 348*
 - distribute lists, 338, 354–356*
 - filtering, 354–356*
 - null interfaces, 337*
 - passive interfaces, 335–336, 346*
 - route maps, 338*
 - static routes, 336, 346–347*
- seed metrics, 329–330
- self-assessment, 321–325
- troubleshooting, 356–357
- verifying, 356

redundant Internet connections.

See multihoming

relays, DHCP, 387–388**reliability, EIGRP metrics, 65****reliable incremental updates, EIGRP, 63****remote networks, EIGRP topology tables, 76–77****reply packets, EIGRP, 64****resetting BGP neighbors, 422–423****RFC-compliance standards, OSPF, 169****RID (router IDs)**

- configuring, 141–142
- loopback interface, 141–142

RIP (Routing Information Protocol)

- characteristics of, 30
- default metrics, configuring, 342

RIPng, IPv6 routing, 548

route-map command, 373**route maps**

- characteristics of, 371–372
- configuring, 373
 - match commands, 374–375*
 - set commands, 375–376*
- example of, 372–373
- routing updates, 338
- self-assessment, 367–370
- statements, 377
- tracking, 376
- uses of, 371

router command, EIGRP, 92**router ID. See RID****router-id command, 142****router link LSA (Type 1), multiple-area OSPF, 187****routers**

- ABR, multiple-area OSPF, 187–189
- ASBR, multiple-area OSPF, 187
- backbone routers, multiple-area OSPF, 187
- CPU utilization, checking, 186
- DR, OSPF, 168–169
- EIGRP topology tables, removing from, 76
- feedback, redistribution, 331–332
- hello messages, OSPF, 130–133
- Integrated IS-IS
 - area design, 271–272*
 - configuration, 286–288*
- internal routers, multiple-area OSPF, 187
- memory utilization, 186
- modifying, 288
- multicasting, IPv6 addressing, 532
- multiple-area OSPF structures, number of neighbors per router, 194
- OSPF
 - ABR, 138*
 - ASBR, 138*
 - backbone routers, 138*
 - BDR, 133–137*
 - DR, 133–137*
 - neighbors, 131–132*
 - single router configuration, 157*
- stub routers, EIGRP, 96–97
- subnet-router anycast addresses, 530

routes

- dampening, 422
- static, 336
- verifying, Sparse-Dense Mode (PIM), 507–508

routing

IPv6

- EIGRP, 548*
- IS-IS, 548*
- MP-BGP4, 548*
- OSPFv3, 548–551*
- RIPng, 548*
- static routes, 547*
- multicasting traffic, 498
 - dense routing protocols, 500*
 - PIM, 500–510*
 - RPF, 499*
 - sparse routing protocols, 500*
 - trees, 499–501*

routing applications, multicasting, 472**Routing field (IPv6 packet headers), 523****routing loops, redistribution, 331–332****routing protocols**

BGP (Border Gateway Protocol)

- AS, 399–400*
- attributes, 442–443*
- attributes, Local-Preference attribute, 444, 447*
- attributes, MED attribute, 447*
- attributes, verifying configuration of, 448–450*
- attributes, Weight attribute, 444*
- characteristics of, 30*
- configuring neighbors, 416*
- configuring peer groups, 416*
- enabling, 415*
- hierarchies, 401*
- identifying neighbors via neighbor command, 415–416, 418*
- Internet connections, 402–404*
- loop detection, 400*
- neighbors, aggregating routes, 420–421*
- neighbors, authentication, 421*
- neighbors, defining advertised networks, 420*
- neighbors, external peering, 419*
- neighbors, forcing next-hop addresses, 419*
- neighbors, internal peering, 418*
- neighbors, managing/verifying configurations, 421–422*
- neighbors, resetting, 422–423*
- neighbors, source IP addresses, 418–419*

- peer groups, 415*
 - peers, 400*
 - record keeping, 401*
 - route selection, 443–444, 447*
 - route stability, 399*
 - self-assessment, 395–398, 411–414, 437–441*
 - states of, 405–406*
 - synchronization, 405*
 - uses of, 402*
 - classful routing protocols, 26–27
 - classless routing protocols, 26–27
 - convergence times, 28
 - distance vector routing protocols, 25
 - EGP, 27
 - EIGRP, characteristics of, 30
 - IGP, 27, 30
 - IGRP, characteristics of, 30
 - IS-IS, characteristics of, 30
 - link state routing protocols, 25, 128
 - modern routing protocols, characteristics of, 29
 - multiple-area OSPF, enabling in, 196–197
 - multiple protocols within organizations, reasons for, 328
 - older routing protocols, characteristics of, 29
 - open routing protocols, 28–29
 - OSPF, 139
 - attributes of, 128*
 - characteristics of, 30*
 - proprietary routing protocols, 28–29
 - redistribution
 - administrative distance, 330, 344–345*
 - case studies, 348–354*
 - configuring, 339–345*
 - default routes, 336*
 - default updates, 348*
 - distribute lists, 338, 354–356*
 - exchanging routing protocol-specific parameters, 334*
 - external routes, 326*
 - filtering for, 354–356*
 - internal routes, 326*
 - network convergence, 334*
 - null interfaces, 337*
 - path selection, 330*
 - potential problems with, 330–334*
 - route feedback, 331–332*
 - route maps, 338, 367–376*
 - routing loops, 331–332*
 - routing updates, 335–336, 346–347*
 - seed metrics, 329–330*
 - self-assessment, 321–325*
 - static routes, 336*
 - supoptimal routing decisions, 333–334*
 - troubleshooting, 356–357*
 - verifying, 356*
 - RIP, characteristics of, 30
 - routing tables**
 - EIGRP, 77
 - active mode, updating in via DUAL, 80*
 - passive mode, updating in via DUAL, 78–79*
 - path selection, 77*
 - OSPF, topology databases, 129
 - RP (Rendezvous Points), 502**
 - Auto-RP, 505
 - configuring, Sparse-Dense Mode (PIM), 506–510
 - verifying, Sparse-Dense Mode (PIM), 509
 - RPF (Reverse Path Forwarding), multicasting, 499**
 - RTP (Reliable Transport Protocol), EIGRP, 63**
- ## S
- scalability, network design, 10–12, 80–82**
 - schema poisoning, 23**
 - security, converged networks, 21**
 - seed metrics (routing protocols), redistribution, 329–330**
 - self-assessments**
 - BGP, 395–398
 - neighbors, 411–414*
 - route selection, 437–441*
 - DHCP, 381–384
 - EIGRP, 59–62, 87–90
 - IGMP, 477–480
 - Integrated IS-IS, 249–254, 281–284
 - IP addresses, 37–40
 - IPv6, 517–520, 543–545
 - multicasting, 459–462, 493–497
 - network design, 5–8

- OSPF, 231
 - authentication*, 233
 - multiple-area structures*, 179–185
 - network topologies*, 163–167
 - single-area structures*, 123–127
 - stub areas*, 232–233
- redistribution, 321–325
- route maps, 367–370
- summarization, 37–40
- servers**
 - contact information, publishing via multicasting, 498
 - DHCP, 386–387
- service provider edge network design model**, 19
- set commands, route map configuration**, 375–376
- shared whiteboard applications, multicasting**, 472
- show clns interface command, verifying Integrated IS-IS operation**, 297–299
- show clns neighbors command, verifying Integrated IS-IS operation**, 295–297
- show command, OSPF**, 157, 241
- show interface command, EIGRP**, 103
- show interface tunnel command, IPv6 manual tunnels**, 561
- show ip bgp command**
 - BGP attributes, verifying configuration of, 448–450
 - BGP neighbors, 421
- show ip bgp neighbors command, BGP neighbors**, 422
- show ip bgp summary command, BGP neighbors**, 421
- show ip dhcp binding command, DHCP clients**, 389
- show ip dhcp clear binding command, DHCP clients**, 389
- show ip dhcp database command, DHCP clients**, 389
- show ip dhcp server statistics command, DHCP clients**, 389
- show ip eigrp neighbors command, EIGRP verification**, 105–106
- show ip eigrp topology command, EIGRP verification**, 105–107
- show ip eigrp traffic command, EIGRP verification**, 105, 108
- show ip igmp group command, IGMP**, 484–486
- show ip igmp interface command**, 486
- show ip igmp snooping command, IGMP snooping**, 487
- show ip mroute command, Sparse-Dense Mode (PIM)**, 507
- show ip neighbor interface command, OSPF**, 150–151
- show ip ospf border-routers command, verifying multiple-area OSPF structure configurations**, 208–209
- show ip ospf command**, 144–145, 157
- show ip ospf database command**, 157
 - link-state databases, viewing current status of, 129–130
 - OSPF, 146–147
 - verifying multiple-area OSPF structure configurations, 211–212
- show ip ospf interface command**, 147–150, 157, 243
- show ip ospf neighbor command, MD5 authentication**, 243
- show ip ospf virtual-links command, verifying multiple-area OSPF structure configurations**, 210–211
- show ip pim interface command, Sparse-Dense Mode (PIM)**, 508
- show ip pim neighbor command, Sparse-Dense Mode (PIM)**, 509
- show ip pim rp command, Sparse-Dense Mode (PIM)**, 509
- show ip protocols interface command, OSPF**, 152–153
- show ip route command, verifying multiple-area OSPF structure configurations**, 209–210
- show ip route interface command, OSPF**, 154
- show ip router command, viewing routing tables**, 191
- show ip rpf command, Sparse-Dense Mode (PIM)**, 510
- show ipv6 interface command, verifying IPv6 configuration**, 555
- show ipv6 ospf command, verifying IPv6 configuration**, 556
- show ipv6 ospf database command, verifying IPv6 configuration**, 557–559

- show ipv6 ospf interface command, verifying IPv6 configuration, 555–556
 - show ipv6 ospf neighbor command, verifying IPv6 configuration, 557
 - show ipv6 route command, verifying IPv6 configuration, 554
 - show isis database command, verifying Integrated IS-IS operation, 300–301
 - show isis database detail command, verifying Integrated IS-IS operation, 301–303
 - show isis spf-log command, troubleshooting Integrated IS-IS operation, 304–305
 - show memory free command, checking memory utilization on routers, 186
 - show multicast group command, IGMP snooping, 487
 - show multicast router command, IGMP snooping, 487
 - show processes cpu command, BGP neighbors, 422
 - show processes cpu sorted command, checking CPU utilization on routers, 186
 - SIIT (Stateless IP/ICMP Translation), IPv4 to IPv6 transitions, 563
 - single routers, OSPF, 157
 - slash notation, 44
 - SNP (Sequence Number Packets), Integrated IS-IS, 259
 - soft-reconfiguration-inbound command, resetting BGP neighbors, 423
 - SONA (Services-Oriented Network Architecture), 23
 - Source Address field (IPv6 packet headers), 523
 - source-distribution trees, multicasting, 501
 - Sparse-Dense Mode (PIM), 504–505
 - multicast routing
 - configuring RP, 506–507
 - enabling, 506
 - turning on PIM, 506
 - verifying multicast routing, 510
 - verifying neighbors, 508
 - verifying routes, 507–508
 - verifying RP, 509
 - Sparse Mode (PIM), 502
 - sparse routing protocols, multicasting, 500
 - speakers, OSPF, 130
 - standard-area ABR, OSPF, 234
 - standard areas (OSPF). *See* ordinary areas (OSPF)
 - stateless autoconfiguration, IPv6 address assignment, 532
 - Stateless DHCPv6, IPv6 address assignment, 533
 - static routes
 - IPv6 routing, 547
 - redistribution, 336
 - routing updates, 336, 346–347
 - stub areas (OSPF), 236–238
 - commands, 202
 - multiple-area structures, 188
 - self-assessment, 232–233
 - stub routers, EIGRP, 96–97
 - subinterfaces, OSPF, 171
 - subnet masks
 - calculating network ranges (IP addresses), 44–46
 - VLSM, 26
 - subnet-router anycast addresses, IPv6, 530
 - subnetting, 44
 - successors (feasible), DUAL, 68
 - summarization, 46
 - advantages of, 47
 - example of, 50
 - Integrated IS-IS configuration, 272–273, 288–290
 - multiple-area OSPF structures, 192–194
 - self-assessment, 37–40
 - summary addresses, composing, 48–50
 - summarizing EIGRP, 94–95
 - summary-address command
 - Integrated IS-IS configuration, 289–290
 - multiple-area OSPF structures, 200
 - synchronization, BGP, 405
 - System ID, ISO addressing, 262
- ## T
- Teredo, IPv4 to IPv6 transitions, 562
 - timers, OSPF, 170
 - TLV (IS-IS)
 - advertisements, 259–260
 - structure of, 257

topologies

database, 129

EIGRP

*metrics, 65**tables, 73–77*

LAN, Integrated IS-IS, 258

OSPF

*building routing tables, 129**self-assessment, 163–167***totally stubby areas (OSPF)**

area area-id stub command, 240

area-id stub no-summary command, 240

multiple-area structures, 188

traceroute command, troubleshooting redistribution, 357**tracking route maps, 376****Traffic Class field (IPv6 packet headers), 523****trees (multicasting), 499**

distribution trees, 500

source-distribution trees, 501

troubleshooting

DHCP, 389

EIGRP, 81, 108–109

Integrated IS-IS operation

*debug commands, 306**show isis spf-log command, 304–305*

multiple-area OSPF configurations, 212, 217

*adjacencies, 215**debug ip ospf events command, 214**debug ip packet command, 214**log-adjacency-changes command, 213–214*

OSPF, 132, 241

redistribution, 356–357

tuning EIGRP, 99

hello timers, 100–101

hold timers, 101

ip hello-interval eigrp command, 100–101

ip hold-time eigrp command, 101

tunnel mode ipv6ip command, IPv6 manual tunnels, 561**tunneling IPv4 to IPv6 transitions**

6-to-4 tunnels, 561

ISATAP, 562

manual tunnels, 560

Teredo, 562

U**undebug all command, troubleshooting****EIGRP, 109****unequal-cost load sharing, EIGRP, 71****unicasts, 463, 526**

IPv6 addressing

*global aggregatable unicast addresses, 528–529**link-local unicast addresses, 529–530*

loopback addresses, 527

update packets, EIGRP, 63**update routing process (Integrated IS-IS), LSP**

determining validity in databases, 269–270

sending/receiving, 267–269

updates

EIGRP

*incremental updates, 71**multicast addressing, 71**reliable incremental updates, 63*

local network tables, link-state routing protocols, 129

routing updates (redistribution), 335

*default routes, 336, 348**distribute lists, 338**null interfaces, 337**passive interfaces, 335–336, 346**receiving, BGP Internet**connections, 403**route maps, 338**static routes, 336, 346–347***V****variance command, EIGRP, 98****verifying**

EIGRP

*show ip eigrp neighbors command, 105–106**show ip eigrp topology command, 105–107**show ip eigrp traffic command, 105, 108*

Integrated IS-IS operation, 294

*show clns interface command, 297–299**show clns neighbors command, 295–297*

show isis database command, 300–301
show isis database detail command,
 301–303
 IPv6 configuration
clear ipv6 command, 554
ping ipv6 command, 554
show ipv6 interface command, 555
show ipv6 ospf command, 556
*show ipv6 ospf database
 command*, 557–559
show ipv6 ospf interface command,
 555–556
show ipv6 ospf neighbor command,
 557
show ipv6 route command, 554
 multicast routing, Sparse-Dense Mode
 (PIM), 510
 multiple-area OSPF configurations
show ip ospf border-routers command,
 208–209
show ip ospf database command,
 211–212
show ip ospf virtual-links command,
 210–211
show ip route command, 209–210

neighbors, Sparse-Dense Mode (PIM), 508
 redistribution, 356
 routes, Sparse-Dense Mode (PIM), 507–508
 RP, Sparse-Dense Mode (PIM), 509
Version field (IPv6 packet headers), 523
**virtual links, multiple-area OSPF structures,
 192–195, 205**
virtualization of resources, 22
VLSM (Variable Length Subnet Masks), 26
VoIP (Voice-Over-IP), multicasting, 465–466

W - X - Y - Z

WAN (Wide-Area Networks), EIGRP
 bandwidth
bandwidth command, 103–104
bandwidth configuration, 102–104
bandwidth-percent command, 104
*ip bandwidth-percent-eigrp
 command*, 105
 point-to-point network configuration, 104
 show interface command, 103
**Weight attribute, controlling BGP route
 selection, 444**
whiteboarding applications, multicasting, 472