



# CCNP Routing and Switching

## Portable Command Guide

All the CCNP ROUTE 300-101 and  
SWITCH 300-115 commands in one  
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# **CCNP Routing and Switching Portable Command Guide**

Scott Empson  
Patrick Gargano  
Hans Roth

**Cisco Press**

800 East 96th Street  
Indianapolis, Indiana 46240 USA

# CCNP Routing and Switching Portable Command Guide

Scott Empson, Patrick Gargano, Hans Roth

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## Contents at a Glance

Introduction xix

### Part I: ROUTE

- CHAPTER 1** Basic Network and Routing Concepts 1
- CHAPTER 2** EIGRP Implementation 13
- CHAPTER 3** Implementing a Scalable Multiarea Network OSPF-Based Solution 41
- CHAPTER 4** Configuration of Redistribution 91
- CHAPTER 5** Path Control Implementation 111
- CHAPTER 6** Enterprise Internet Connectivity 119
- CHAPTER 7** Routers and Router Protocol Hardening 155

### Part II: SWITCH

- CHAPTER 8** Basic Concepts and Network Design 191
- CHAPTER 9** Campus Network Architecture 197
- CHAPTER 10** Implementing Spanning Tree 221
- CHAPTER 11** Implementing Inter-VLAN Routing 241
- CHAPTER 12** Implementing High-Availability Networks 259
- CHAPTER 13** First-Hop Redundancy Implementation 277
- CHAPTER 14** Campus Network Security 311

### Appendixes

- APPENDIX A** Private VLAN Catalyst Switch Support Matrix 337
- APPENDIX B** Create Your Own Journal Here 339
- Index 359

## Table of Contents

Introduction xix

### Part I: ROUTE

<b>CHAPTER 1</b>	Basic Network and Routing Concepts	1
	Cisco Hierarchical Network Model	1
	Cisco Enterprise Composite Network Model	2
	Typically Used Routing Protocols	2
	IGP Versus EGP Routing Protocols	3
	Routing Protocol Comparison	3
	Administrative Distance	3
	Static Routes: permanent Keyword	4
	Floating Static Routes	5
	Static Routes and Recursive Lookups	5
	Default Routes	6
	Verifying Static Routes	6
	Assigning IPv6 Addresses to Interfaces	7
	Implementing RIP Next Generation (RIPng)	7
	Verifying and Troubleshooting RIPng	8
	Configuration Example: RIPng	9
	IPv6 Ping	11
	IPv6 Traceroute	12
<b>CHAPTER 2</b>	EIGRP Implementation	13
	Configuring EIGRP	14
	EIGRP Router ID	15
	EIGRP Autosummarization	15
	Passive EIGRP Interfaces	16
	“Pseudo” Passive EIGRP Interfaces	17
	EIGRP Timers	17
	Injecting a Default Route into EIGRP: Redistribution of a Static Route	18
	Injecting a Default Route into EIGRP: IP Default Network	18
	Injecting a Default Route into EIGRP: Summarize to 0.0.0.0/0	19

---

Accepting Exterior Routing Information: default-information	20
Load Balancing: Maximum Paths	20
Load Balancing: Variance	20
Bandwidth Use	21
Stub Networks	21
EIGRP Unicast Neighbors	22
EIGRP over Frame Relay: Dynamic Mappings	23
EIGRP over Frame Relay: Static Mappings	24
EIGRP over Frame Relay: EIGRP over Multipoint Subinterfaces	25
EIGRP over Frame Relay: EIGRP over Point-to-Point Subinterfaces	26
EIGRP over MPLS: Layer 2 VPN	28
EIGRP over MPLS: Layer 3 VPN	30
EIGRPv6	31
Enabling EIGRPv6 on an Interface	31
Configuring the Percentage of Link Bandwidth Used by EIGRPv6	32
EIGRPv6 Summary Addresses	32
EIGRPv6 Timers	32
EIGRPv6 Stub Routing	32
Logging EIGRPv6 Neighbor Adjacency Changes	33
Adjusting the EIGRPv6 Metric Weights	33
EIGRP Address Families	33
Named EIGRP Configuration Modes	34
Verifying EIGRP and EIGRPv6	35
Troubleshooting EIGRP	37
Configuration Example: EIGRPv4 and EIGRPv6 using Named Address Configuration	37

## **CHAPTER 3** Implementing a Scalable Multiarea Network OSPF-Based Solution 41

OSPF Message Types	42
OSPF LSA Types	43
Configuring OSPF	44
Using Wildcard Masks with OSPF Areas	44
Configuring Multiarea OSPF	45
Loopback Interfaces	45
Router ID	46
DR/BDR Elections	46
Passive Interfaces	46

Modifying Cost Metrics	47
OSPF auto-cost reference-bandwidth	47
OSPF LSDB Overload Protection	48
Timers	48
IP MTU	49
Propagating a Default Route	49
OSPF Special Area Types	49
Stub Areas	50
Totally Stubby Areas	50
Not-So-Stubby Areas	51
Totally NSSA	51
Route Summarization	52
Interarea Route Summarization	52
External Route Summarization	52
Configuration Example: Virtual Links	52
OSPF and NBMA Networks	53
OSPF over NBMA Topology Summary	57
IPv6 and OSPFv3	57
Enabling OSPF for IPv6 on an Interface	58
OSPFv3 and Stub/NSSA Areas	58
Interarea OSPFv3 Route Summarization	59
Enabling an IPv4 Router ID for OSPFv3	59
Forcing an SPF Calculation	59
IPv6 on NBMA Networks	60
OSPFv3 Address Families	60
Verifying OSPF Configuration	61
Troubleshooting OSPF	63
Configuration Example: Single-Area OSPF	64
Configuration Example: Multiarea OSPF	65
Configuration Example: OSPF and NBMA Networks	69
Configuration Example: OSPF and Broadcast Networks	72
Configuration Example: OSPF and Point-to-Multipoint Networks	76
Configuration Example: OSPF and Point-to-Point Networks Using Subinterfaces	80
Configuration Example: IPv6 and OSPFv3	83
Configuration Example: OSPFv3 with Address Families	86

---

<b>CHAPTER 4</b>	<b>Configuration of Redistribution</b>	<b>91</b>
	Defining Seed and Default Metrics	91
	Redistributing Connected Networks	93
	Redistributing Static Routes	93
	Redistributing Subnets into OSPF	93
	Assigning E1 or E2 Routes in OSPF	94
	Redistributing OSPF Internal and External Routes	95
	Configuration Example: Route Redistribution for IPv4	95
	Configuration Example: Route Redistribution for IPv6	97
	Verifying Route Redistribution	98
	Route Filtering Using the distribute-list Command	98
	Configuration Example: Inbound and Outbound Distribute List Route Filters	99
	Configuration Example: Controlling Redistribution with Outbound Distribute Lists	100
	Verifying Route Filters	100
	Route Filtering Using Prefix Lists	101
	Configuration Example: Using a Distribute List That References a Prefix List to Control Redistribution	103
	Verifying Prefix Lists	104
	Using Route Maps with Route Redistribution	104
	Configuration Example: Route Maps	105
	Manipulating Redistribution Using Route Tagging	106
	Changing Administrative Distance for Internal and External Routes	108
	Passive Interfaces	108
<b>CHAPTER 5</b>	<b>Path Control Implementation</b>	<b>111</b>
	Verifying Cisco Express Forwarding	111
	Configuring Cisco Express Forwarding	111
	Path Control with Policy-Based Routing	112
	Verifying Policy-Based Routing	113
	Configuration Example: PBR with Route Maps	114
	Cisco IOS IP Service Level Agreements	115
	Step 1: Define One (or More) Probe(s)	116
	Step 2: Define One (or More) Tracking Object(s)	117
	Step 3a: Define the Action on the Tracking Object(s)	117
	Step 3b: Define Policy Routing Using the Tracking Object(s)	117
	Step 4: Verify IP SLA Operations	118



<b>CHAPTER 6</b>	<b>Enterprise Internet Connectivity</b>	<b>119</b>
	Configuring a Provider Assigned Static or DHCP IPv4 Address	120
	Configuring Static NAT	121
	Configuring Dynamic NAT	121
	Configuring NAT Overload (PAT)	122
	Verifying NAT	124
	NAT Virtual Interface	124
	Configuration Example: NAT Virtual Interfaces and Static NAT	124
	Configure Basic IPv6 Internet Connectivity	125
	Configuring IPv6 ACLs	126
	Verifying IPv6 ACLs	127
	Configuring Redistribution of Default Routes with Different Metrics in a Dual-Homed Internet Connectivity Scenario	127
	Configuring BGP	128
	BGP and Loopback Addresses	129
	iBGP Next-Hop Behavior	129
	eBGP Multihop	130
	Verifying BGP Connections	132
	Troubleshooting BGP Connections	132
	Default Routes	133
	Attributes	134
	Route Selection Decision Process	134
	Weight Attribute	134
	Using AS_PATH Access Lists to Manipulate the Weight Attribute	136
	Using Prefix Lists and Route Maps to Manipulate the Weight Attribute	136
	Local Preference Attribute	137
	Using AS_PATH Access Lists with Route Maps to Manipulate the Local Preference Attribute	138
	AS_PATH Attribute Prepending	139
	AS_PATH: Removing Private Autonomous Systems	141
	MED Attribute	142
	Route Aggregation	144
	Route Reflectors	145
	Regular Expressions	146
	Regular Expressions: Examples	146
	BGP Route Filtering Using Access Lists and Distribute Lists	147

---

Configuration Example: Using Prefix Lists and AS_PATH Access Lists	149
BGP Peer Groups	150
MP-BGP	151
Configure MP-BGP Using Address Families to Exchange IPv4 and IPv6 Routes	151
Verifying MP-BGP	153
<b>CHAPTER 7</b> Routers and Routing Protocol Hardening	155
Securing Cisco Routers According to Recommended Practices	156
Securing Cisco IOS Routers Checklist	156
Components of a Router Security Policy	157
Configuring Passwords	157
Password Encryption	158
Configuring SSH	159
Restricting Virtual Terminal Access	160
Securing Access to the Infrastructure Using Router ACLs	161
Configuring Secure SNMP	162
Configuration Backups	165
Implementing Logging	166
Disabling Unneeded Services	169
Configuring Network Time Protocol	169
NTP Configuration	170
NTP Design	171
Securing NTP	172
Verifying NTP	173
SNTP	174
Setting the Clock on a Router	174
Using Time Stamps	178
Configuration Example: NTP	178
Authentication of Routing Protocols	182
Authentication Options for Different Routing Protocols	182
Authentication for EIGRP	183
Authentication for OSPF	185
Authentication for BGP and BGP for IPv6	189

**Part II: SWITCH**

<b>CHAPTER 8</b>	<b>Basic Concepts and Network Design</b>	<b>191</b>
	Hierarchical Model (Cisco Enterprise Campus Architecture)	191
	Verifying Switch Content-Addressable Memory	192
	Switching Database Manager Templates	192
	Configuring SDM Templates	192
	Verifying SDM Templates	193
	LLDP (802.1AB)	194
	Configuring LLDP	194
	Verifying LLDP	195
	Power over Ethernet	196
	Configuring PoE	196
	Verifying PoE	196
<b>CHAPTER 9</b>	<b>Campus Network Architecture</b>	<b>197</b>
	Virtual LANs	198
	Creating Static VLANs	198
	Normal-Range static VLAN Configuration	198
	Extended-Range static VLAN Configuration	199
	Assigning Ports to Data and Voice VLANs	199
	Using the range Command	200
	Dynamic Trunking Protocol	200
	Setting the Trunk Encapsulation and Allowed VLANs	201
	Verifying VLAN Information	202
	Saving VLAN Configurations	202
	Erasing VLAN Configurations	203
	Verifying VLAN Trunking	203
	VLAN Trunking Protocol	204
	Using Global Configuration Mode	204
	Verifying VTP	206
	Configuration Example: VLANs	206
	Layer 2 Link Aggregation	209
	Link Aggregation Interface Modes	210
	Guidelines for Configuring Link Aggregation	210
	Configuring L2 EtherChannel	211
	Configuring L3 EtherChannel	211

---

Verifying EtherChannel	212
Configuring EtherChannel Load Balancing	212
Configuration Example: PAgP EtherChannel	213
DHCP for IPv4	216
Configuring Basic DHCP Server for IPv4	216
Configuring DHCP Manual IP Assignment for IPv4	217
Implementing DHCP Relay IPv4	217
Verifying DHCP for IPv4	218
Implementing DHCP for IPv6	218
Configuring DHCPv6 Server	219
Configuring DHCPv6 Client	219
Configuring DHCPv6 Relay Agent	220
Verifying DHCPv6	220
<b>CHAPTER 10</b> Implementing Spanning Tree	221
Spanning-Tree Standards	222
Enabling Spanning Tree Protocol	222
Configuring the Root Switch	223
Configuring a Secondary Root Switch	224
Configuring Port Priority	224
Configuring the Path Cost	224
Configuring the Switch Priority of a VLAN	225
Configuring STP Timers	225
Verifying STP	226
Cisco STP Toolkit	226
Port Error Conditions	231
FlexLinks	231
Changing the Spanning-Tree Mode	231
Extended System ID	232
Enabling Rapid Spanning Tree	232
Enabling Multiple Spanning Tree	233
Verifying MST	235
Troubleshooting Spanning Tree	235
Configuration Example: PVST+	235
Spanning-Tree Migration Example: PVST+ to Rapid-PVST+	239

**CHAPTER 11** Implementing Inter-VLAN Routing 241

Inter-VLAN Communication Using an External Router: Router-on-a-Stick 241

Inter-VLAN Routing Tips 242

Removing L2 Switch Port Capability of a Switch Port 242

Configuring SVI Autostate 243

Inter-VLAN Communication on a Multilayer Switch Through a Switch Virtual Interface 243

Configuration Example: Inter-VLAN Communication 244

Configuration Example: IPv6 Inter-VLAN Communication 251

**CHAPTER 12** Implementing High-Availability Networks 259

Configuring IP Service Level Agreements (Catalyst 3750) 260

Configuring Authentication for IP SLA 262

Monitoring IP SLA Operations 262

Implementing Port Mirroring 262

Default SPAN and RSPAN Configuration 262

Configuring Local SPAN 263

Local SPAN Guidelines for Configuration 263

Configuring Local SPAN Example 264

Configuring Remote SPAN 267

Remote SPAN Guidelines for Configuration 267

Configuring Remote SPAN Example 268

Verifying and Troubleshooting Local and Remote SPAN 269

Switch Virtualization 269

StackWise 270

Virtual Switching System 271

**CHAPTER 13** First-Hop Redundancy Implementation 277

First-Hop Redundancy 278

Hot Standby Router Protocol 278

Configuring Basic HSRP 278

Default HSRP Configuration Settings 279

Verifying HSRP 279

HSRP Optimization Options 279

Multiple HSRP Groups 281

---

HSRP IP SLA Tracking	283
HSRPv2 for IPv6	284
Debugging HSRP	285
Virtual Router Redundancy Protocol	285
Configuring VRRP	285
Interface Tracking	287
Verifying VRRP	287
Debugging VRRP	287
Gateway Load Balancing Protocol	287
Configuring GLBP	288
Interface Tracking	290
Verifying GLBP	290
Debugging GLBP	291
IPv4 Configuration Example: HSRP on L3 Switch	291
IPv4 Configuration Example: GLBP	296
IPv4 Configuration Example: VRRP on Router and L3 Switch	300
IPv6 Configuration Example: HSRP on Router and L3 Switch	304

## **CHAPTER 14** Campus Network Security 311

Switch Security Recommended Practices	312
Configuring Switch Port Security	313
Sticky MAC Addresses	313
Verifying Switch Port Security	314
Recovering Automatically from Error-Disabled Ports	315
Verifying Autorecovery of Error-Disabled Ports	315
Configuring Port Access Lists	315
Creating and Applying Named Port Access List	316
Configuring Storm Control	316
Implementing Authentication Methods	317
Local Database Authentication	317
RADIUS Authentication	318
TACACS+ Authentication	319
Configuring Authorization and Accounting	321
Configuring 802.1x Port-Based Authentication	322
Configuring DHCP Snooping	323
Verifying DHCP Snooping	324
IP Source Guard	324

- Dynamic ARP Inspection 325
  - Verifying DAI 326
- Mitigating VLAN Hopping: Best Practices 326
- VLAN Access Lists 327
  - Verifying VACLs 329
  - Configuration Example: VACLs 329
- Private VLANs 331
  - Verifying PVLANS 332
  - Configuration Example: PVLANS 333

## **Appendixes**

- APPENDIX A** Private VLAN Catalyst Switch Support Matrix 337

- APPENDIX B** Create Your Own Journal Here 339

- Index 359

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---

## Dedications

As always, this book is dedicated to Trina, Zach, and Shae. —Scott Empson

To my wife, Kathryn, for her patience, encouragement, love and understanding. I am a much better person thanks to her (or so she says. She also says there should be a comma after “love.”). —Patrick Gargano

I’d like to again thank my wife, Carol, for her constant support and understanding during those times I’ve spent writing in the basement. —Hans Roth

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To our technical reviewer, Diane Teare: Wow, thanks for making me go deep.

Scott and Patrick: Thanks for your help, positive approach, and expertise. It was a very great pleasure.

## Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ( [ ] ) indicate an optional element.
- Braces ( { } ) indicate a required choice.
- Braces within brackets ( [ { } ] ) indicate a required choice within an optional element.

---

## Introduction

Welcome to *CCNP Routing and Switching Portable Command Guide*! This book is the result of a redesign by Cisco of their professional-level certification exams to more closely align with the industry's need for networking talent as we enter the era of "the Internet of Everything." The previous success of the last editions of both the ROUTE and SWITCH books prompted Cisco Press to approach me with a request to update the book with the necessary new content to help both students and IT professionals in the field study and prepare for the new CCNP ROUTE and SWITCH exams. This time around, after many long talks with Hans and Patrick, Cisco Press, and other trusted IT colleagues, the decision was made to combine both ROUTE and SWITCH into a single volume. Hopefully, you will find value in having both exams' content in a single (albeit slightly thicker) volume. For someone who originally thought that a Portable Command Guide would be fewer than 100 pages in length and limited to the Cisco Academy program for its complete audience, I am continually amazed that my little engineering journal has caught on with such a wide range of people throughout the IT community.

For those of you who have worked with these books before, thank you for looking at this one. I hope that it will help you as you prepare for the vendor exam, or assist you in your daily activities as a Cisco network administrator/manager. For those of you new to the Portable Command Guides, you are reading what is essentially a cleaned-up version of my own personal engineering journals—a small notebook that I carry around with me that contains little nuggets of information; commands that I use but then forget; IP address schemes for the parts of the network I work with only on occasion; and those little reminders for those concepts that you only work with once or twice a year, but still need to know when those times roll around. As an educator who teaches these topics to post-secondary students, the classes I teach sometime occur only once a year; all of you out there can attest to the fact that it is extremely difficult to remember all those commands all the time. Having a journal of commands at your fingertips, without having to search the Cisco website (or if the network is down and you are the one responsible for getting it back online) can be a real timesaver.

With the creation of the new CCNP exam objectives, there is always something new to read, or a new podcast to listen to, or another slideshow from Cisco Live that you missed or that you just want to review again. The engineering journal can be that central repository of information that will not weigh you down as you carry it from the office or cubicle to the server and infrastructure rooms in some remote part of the building or some branch office.

To make this guide a more realistic one for you to use, the folks at Cisco Press have decided to continue with an appendix of blank pages—pages that are there for you to put your own personal touches (your own configurations, commands that are not in this book but are needed in your world, and so on). That way, this book will hopefully look less like the authors' journals and more like your own.

## Who Should Read This Book?

This book is for those people preparing for the CCNP ROUTE and/or SWITCH exams, whether through self-study, on-the-job training and practice, study within the Cisco Academy Program, or study through the use of a Cisco Training Partner. There are also some handy hints and tips along the way to make life a bit easier for you in this endeavor. It is small enough that you will find it easy to carry around with you. Big, heavy textbooks might look impressive on your bookshelf in your office, but can you really carry them all around with you when you are working in some server room or equipment closet somewhere?

## Strategies for Exam Preparation

The strategy you use for CCNP ROUTE and SWITCH might differ slightly from strategies used by other readers, mainly based on the skills, knowledge, and experience you already have obtained. For instance, if you have attended a ROUTE or SWITCH course, you might take a different approach than someone who learned routing via on-the-job training. Regardless of the strategy you use or the background you have, this book is designed to help you get to the point where you can pass the exam with the least amount of time required. For instance, there is no need for you to practice or read about EIGRP, OSPF, HSRP, or VLANs if you fully understand it already. However, many people like to make sure that they truly know a topic and therefore read over material that they already know. Several book features will help you gain the confidence that you need to be convinced that you know some material already, and to also help you know what topics you need to study more.

## How This Book Is Organized

Although this book could be read cover to cover, I strongly advise against it, unless you really are having problems sleeping at night. The book is designed to be a simple listing of those commands needed to be understood to pass the ROUTE and SWITCH exams. Portable Command Guides contain very little theory; it has been designed to list out commands needed at this level of study.

This book follows the list of objectives for the CCNP ROUTE and SWITCH exams:

### Part I: ROUTE

- **Chapter 1, “Basic Networking and Routing Concepts”**: This chapter shows the Cisco Hierarchical Model of Network Design; the Cisco Enterprise Composite Network Model; static and default Routes; Administrative Distances; IPv6 Addresses; and RIPng.
- **Chapter 2, “EIGRP Implementation”**: This chapter deals with EIGRP—the design, implementation, verification, and troubleshooting of this protocol in both IPv4 and IPv6.
- **Chapter 3, “Implementing a Scalable Multiarea Network OSPF Based Solution”**: This chapter deals with OSPF; a review of configuring OSPF, both

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single area (as a review) and multiarea. Topics again include the design, implementation, verification, and troubleshooting of the protocol in both IPv4 and IPv6.

- **Chapter 4, “Configuration of Redistribution”**: This chapter shows how to manipulate routing information. Topics include prefix lists, distribution lists, route maps, route redistribution, and static routes in both IPv4 and IPv6.
- **Chapter 5, “Path Control Implementation”**: This chapter deals with those tools and commands that you can use to help evaluate network performance issues and control the path. Topics include CEF, Cisco IOS IP SLAs, and policy-based routing using route maps in both IPv4 and IPv6.
- **Chapter 6, “Enterprise Internet Connectivity”**: This chapter starts with DHCP and NAT and then deals with the use of BGP to connect an enterprise network to a service provider. Topics include the configuration, verification, and troubleshooting of a BGP-based solution, BGP attributes, regular expressions, and BGP route filtering using access lists.
- **Chapter 7, “Routers and Router Protocol Hardening”**: This chapter starts with checklists to follow when securing Cisco routers and the components of a router security policy. It then moves into topics such as password encryption, SSH, secure SNMP, backups, logging, and Network Time Protocol (NTP), and finishes with authentication of EIGRP, OSPF, and BGP.

## Part II: SWITCH

- **Chapter 8, “Basic Concepts and Network Design”**: This chapter covers topics such as SDM templates, LLDP, PoE, and switch verification commands.
- **Chapter 9, “Campus Network Architecture”**: This chapter provides information on virtual LANs—creating, verifying, and troubleshooting them, along with EtherChannel, DHCPv4 and DHCPv6, and configuring and verifying voice VLANs.
- **Chapter 10, “Implementing Spanning Tree”**: This chapter provides information on the configuration of spanning tree, along with commands used to verify the protocol and to configure enhancements to spanning tree, such as Rapid Spanning Tree and Multiple Spanning Tree. The Cisco STP Toolkit is also shown here, along with FlexLinks.
- **Chapter 11, “Implementing Inter-VLAN Routing”**: This chapter shows the different ways to enable inter-VLAN communication—using an external router or using SVIs on a multilayer switch.
- **Chapter 12, “Implementing High-Availability Networks”**: This chapter covers topics such as IP service level agreements, port mirroring, and switch virtualization.
- **Chapter 13, “First-Hop Redundancy Implementation”**: This chapter provides information needed to ensure that you have first-hop redundancy; HSRP, VRRP, and GLBP are shown here in both IPv4 and IPv6.
- **Chapter 14, “Campus Network Security”**: Security is the focus of this chapter. Topics covered include switch security recommended practices, static MAC addresses, port security, 802.1x authentication, mitigating VLAN hopping, DHCP snooping, DAI, and private VLANs.

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# Configuration of Redistribution

This chapter provides information about the following redistribution topics:

- Defining seed and default metrics
- Redistributing connected networks
- Redistributing static routes
- Redistributing subnets into OSPF
- Assigning E1 or E2 routes in OSPF
- Redistributing OSPF internal and external routes
- Configuration example: route redistribution for IPv4
- Configuration example: route redistribution for IPv6
- Verifying route redistribution
- Route filtering using the **distribute-list** command
  - Configuration example: inbound and outbound distribute list route filters
  - Configuration example: controlling redistribution with outbound distribute lists
  - Verifying route filters
- Route filtering using prefix lists
  - Configuration example: using a distribute list that references a prefix list to control redistribution
  - Verifying prefix lists
- Using route maps with route redistribution
  - Configuration example: route maps
- Manipulating redistribution using route tagging
- Changing administrative distance for internal and external routes
- Passive interfaces

## Defining Seed and Default Metrics

Router(config)# <b>router eigrp 100</b>	Starts the EIGRP routing process.
Router(config-router)# <b>network 172.16.0.0</b>	Specifies which network to advertise in EIGRP.



<pre>Router(config-router)# redistribute rip  Router(config-router)#default- metric 1000 100 250 1 1500 Or Router(config-router)# redistribute rip metric 1000 100 250 1 1500</pre>	<p>Redistributes routes learned from RIP into EIGRP.</p> <p>The metrics assigned to these learned routes will be calculated using the following components:</p> <p>1000 = Bandwidth in Kbps  100 = Delay in tens of microseconds  255 = Reliability out of 255  1 = Load out of 255  1500 = Maximum transmission unit (MTU) size</p> <p>The <b>metric</b> keyword in the second option assigns a starting EIGRP metric that is calculated using the following components: 1000, 100, 255, 1 1500.</p>
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**NOTE:** The values used in this command constitute the seed metric for these RIP routes being redistributed into EIGRP. The seed metric is the initial value of an imported route and it must be consistent with the destination protocol.

**NOTE:** The default seed metrics are as follows:

- Connected: 1
- Static: 1
- RIP: Infinity
- EIGRP: Infinity
- OSPF: 20 for all except for BGP, which is 1
- BGP: BGP metric is set to IGP metric value

**NOTE:** If both the **metric** keyword in the **redistribute** command and the **default-metric** command are used, the value of the **metric** keyword in the **redistribute** command takes precedence.

**TIP:** If a value is not specified for the **metric** option, and no value is specified using the **default-metric** command, the default metric value is 0, except for Open Shortest Path First (OSPF) Protocol, where the default cost is 20. Routing Information Protocol (RIP) and Enhanced Interior Gateway Routing Protocol (EIGRP) must have the appropriate metrics assigned to any redistributed routes; otherwise, redistribution will not work. Border Gateway Protocol (BGP) will use the Internal Gateway Protocol (IGP) metric, while both connected networks and static routes will receive an initial default value of 1.

**TIP:** The **default-metric** command is useful when routes are being redistributed from more than one source because it eliminates the need for defining the metrics separately for each redistribution.

**TIP:** Redistributed routes between EIGRP processes do not need metrics configured. Redistributed routes are tagged as EIGRP external routes and will appear in the routing table with a code of D EX.

## Redistributing Connected Networks

Router(config)# <b>router ospf 1</b>	Starts the OSPF routing process.
Router(config-router)# <b>redistribute connected</b>	Redistributes all directly connected networks.
	<b>NOTE:</b> It is not necessary to redistribute networks that are already configured under the routing protocol.
	<b>NOTE:</b> The <b>connected</b> keyword refers to routes that are established automatically by virtue of having enabled IP on an interface. For routing protocols such as OSPF, Intermediate System-to-Intermediate System (IS-IS), and EIGRP, these routes are redistributed as external to the autonomous system.
Router(config-router)# <b>redistribute connected metric 50</b>	Redistributes all directly connected networks and assigns them a starting metric of 50.
	<b>NOTE:</b> The <b>redistribute connected</b> command is <i>not</i> affected by the <b>default-metric</b> command.

## Redistributing Static Routes

Router(config)# <b>ip route 10.1.1.0 255.255.255.0 serial 0/0/0</b>	Creates a static route for network 10.1.1.0/24 exiting out of interface Serial 0/0/0
Router(config)# <b>router eigrp 10</b>	Starts the EIGRP routing process
Router(config-router)# <b>redistribute static</b>	Redistributes static routes on this router into the EIGRP routing process

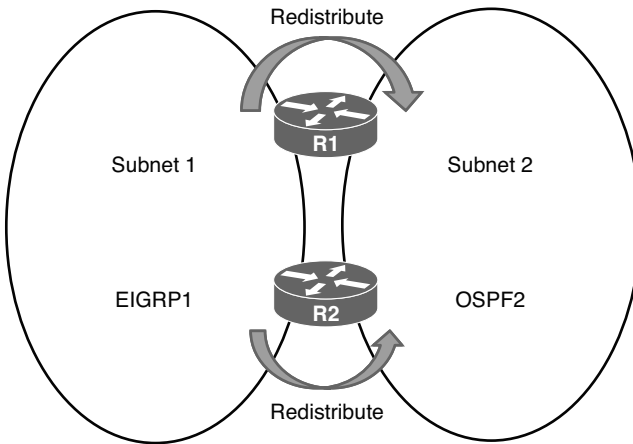
## Redistributing Subnets into OSPF

Router(config)# <b>router ospf 1</b>	Starts the OSPF routing process.
Router(config-router)# <b>redistribute eigrp 10 metric 100 subnets</b>	Redistributes routes learned from EIGRP autonomous system 10. A metric of 100 is assigned to all routes. Subnets will also be redistributed.
	<b>NOTE:</b> Without the <b>subnets</b> keyword, no subnets will be redistributed into the OSPF domain. (Only routes that are in the routing table with the default classful mask will be redistributed.)

## Assigning E1 or E2 Routes in OSPF

Router (config)# <b>router ospf 1</b>	Starts the OSPF routing process.
Router (config-router)# <b>redistribute eigrp 1 metric-type 1</b>	Redistributes routes learned from EIGRP autonomous system 1. Routes will be advertised as E1 routes.
	<b>NOTE:</b> If the <b>metric-type</b> argument is not used, routes will be advertised by default in OSPF as E2 routes. E2 routes have a default fixed cost of 20 associated with them, but this value can be changed with the <b>metric</b> keyword. The metric will not change as the route is propagated throughout the OSPF area. E1 routes will have internal area costs added to the seed metric.

**TIP:** Use external type 1 (E1) routes when there are multiple Autonomous System Border Routers (ASBRs) advertising an external route to the same autonomous system to avoid suboptimal routing (see Figure 4-1).



**Figure 4-1** Network Topology with Two ASBRs

**TIP:** Use external type 2 (E2) routes if only one ASBR is advertising an external route to the AS (see Figure 4-2).

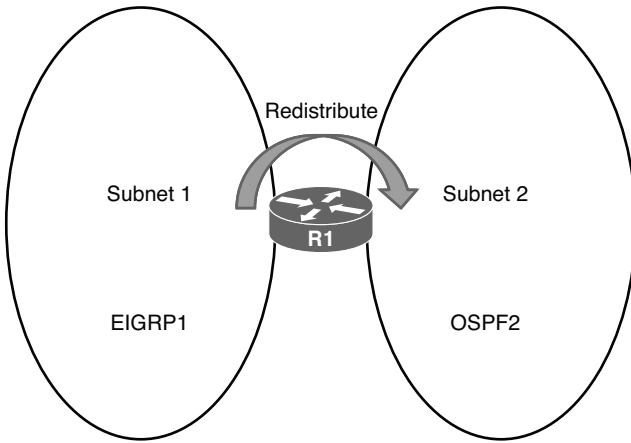


Figure 4-2 Network Topology with One ASBR

## Redistributing OSPF Internal and External Routes

<pre>Router(config)#router eigrp 10</pre>	<p>Starts the EIGRP routing process for autonomous system 10.</p>
<pre>Router(config-router)# redistribute ospf 1 match internal external 1 external 2</pre>	<p>Redistributes routes learned from OSPF process ID 1. The keywords <b>match internal external 1</b> and <b>external 2</b> instruct EIGRP to only redistribute internal, external type 1 and type 2 OSPF routes.</p>
	<p><b>NOTE:</b> The default behavior when redistributing OSPF routes is to redistribute all routes—internal, external 1, and external 2. The keywords <b>match internal external 1</b> and <b>external 2</b> are required only if router behavior is to be modified.</p>

## Configuration Example: Route Redistribution for IPv4

Figure 4-3 shows the network topology for the configuration that follows, which demonstrates how to configure single point two-way basic redistribution between EIGRP and OSPF for IPv4, using the commands covered in this chapter. For this configuration example, assume that EIGRP and OSPF routing has been configured correctly on all four routers.

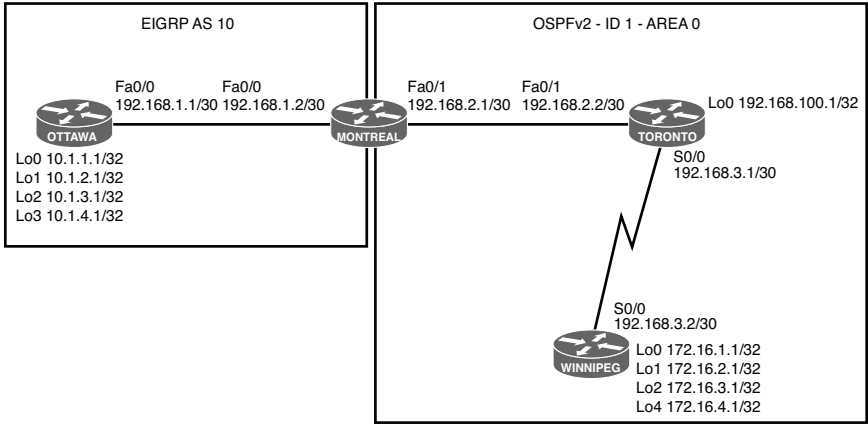


Figure 4-3 Network Topology for IPv4 Route Redistribution

MONTREAL (config)# <b>router eigrp 10</b>	Enters EIGRP configuration mode.
MONTREAL (config-router)# <b>redistribute ospf 1 metric 1500 10 255 1 1500</b>	Redistributes routes from OSPF process ID 1 into EIGRP AS 10 and assigns a seed metric to these routes.
MONTREAL (config-router)# <b>exit</b>	Returns to global configuration mode.
MONTREAL (config)# <b>router ospf 1</b>	Enters OSPF configuration mode.
MONTREAL (config-router)# <b>redistribute eigrp 10 subnets</b>	Redistributes classless routes from EIGRP autonomous system 10 into OSPF process ID 1 as external type 2 (E2) with a metric of 20, which is fixed and does not change across the OSPF domain.
	<b>NOTE:</b> Omitting the <b>subnets</b> keyword is a common configuration error. Without this keyword, only networks in the routing table with a classful mask will be redistributed. Subnets will not be redistributed, and subnets will not be automatically summarized and redistributed.
MONTREAL (config-router)# <b>redistribute eigrp 10 metric-type 1 subnets</b>	Redistributes classless routes from EIGRP autonomous system 10 into OSPF process ID 1 as external type 1 (E1). Type 1 external routes calculate the cost by adding the external cost (20) to the internal cost of each link that the packet crosses.

## Configuration Example: Route Redistribution for IPv6

Figure 4-4 shows the network topology for the configuration that follows, which demonstrates how to configure single point two-way basic redistribution between EIGRP and OSPF for IPv6, using the commands covered in this chapter. For this configuration example, assume that EIGRP and OSPF routing for IPv6 has been configured correctly on all four routers.

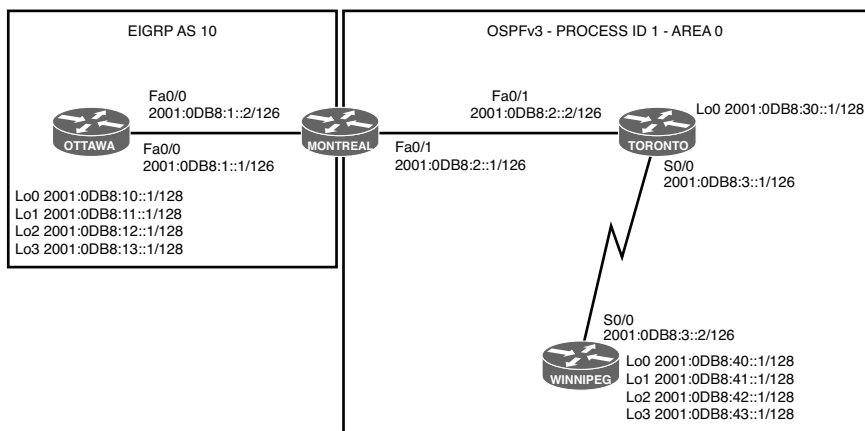


Figure 4-4 Network Topology for IPv6 Route Redistribution

MONTREAL (config) # <b>ipv6 router eigrp 10</b>	Enters IPv6 EIGRP configuration mode.
MONTREAL (config-router) # <b>redistribute ospf 1 metric 1500 10 255 1 1500 include-connected</b>	Redistributes IPv6 routes from OSPF process ID 1 into EIGRP autonomous system 10 and assigns a seed metric to these routes.
	<b>NOTE:</b> With the <b>include-connected</b> command, you instruct the target routing protocol to redistribute the routes that are learned by the source protocol and also the connected interfaces if the source routing protocol is running on them.
MONTREAL (config-router) # <b>exit</b>	Returns to global configuration mode.
MONTREAL (config) # <b>ipv6 router ospf 1</b>	Enters IPv6 OSPF configuration mode.
MONTREAL (config-router) # <b>redistribute eigrp 10 include-connected</b>	Redistributes IPv6 routes from EIGRP autonomous system 10 into OSPF process ID 1 as external type 2 (E2) with a metric of 20, which is fixed and does not change across the OSPF domain.

<pre>MONTREAL(config-router)# redistribute eigrp 10 metric-type 1 include-connected</pre>	<p>Redistributes IPv6 routes from EIGRP autonomous system 10 into OSPF process ID 1 as external type 1 (E1). Type 1 external routes calculate the cost by adding the external cost (20) to the internal cost of each link that the packet crosses.</p>
	<p><b>NOTE:</b> The <b>subnets</b> keyword does not exist in OSPFv3 redistribution configuration.</p>

## Verifying Route Redistribution

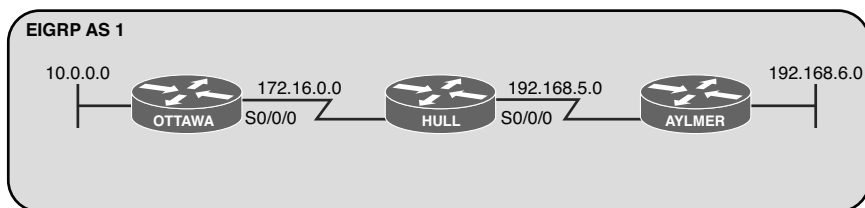
<pre>Router#show ip route Router#show ipv6 route</pre>	<p>Displays the current state of the routing table</p>
<pre>Router#show ip eigrp topology Router#show ipv6 eigrp topology</pre>	<p>Displays the EIGRP topology table</p>
<pre>Router#show ip protocols Router#show ipv6 protocols</pre>	<p>Displays parameters and the current state of any active routing process</p>
<pre>Router#show ip rip database Router#show ipv6 rip database</pre>	<p>Displays summary address entries in the RIP routing database</p>
<pre>Router#show ip ospf database Router#show ipv6 ospf database</pre>	<p>Displays the link-state advertisement (LSA) types within the link-state database (LSDB)</p>

## Route Filtering Using the distribute-list Command

<pre>Router(config)#router eigrp 10</pre>	<p>Starts the EIGRP routing process for autonomous system 10</p>
<pre>Router(config-router)#distribute- list 1 in</pre>	<p>Creates an incoming global distribute list that refers to access control list (ACL) 1</p>
<pre>Router(config-router)#distribute- list 2 out</pre>	<p>Creates an outgoing global distribute list that refers to ACL 2</p>
<pre>Router(config-router)#distribute- list 3 in fastethernet0/0</pre>	<p>Creates an incoming distribute list for interface FastEthernet0/0 and refers to ACL 3</p>
<pre>Router(config-router)#distribute- list 4 out serial0/0/0</pre>	<p>Creates an outgoing distribute list for interface Serial0/0/0 and refers to ACL 4</p>
<pre>Router(config-router)#distribute- list 5 out ospf 1</pre>	<p>Filters updates advertised from OSPF process ID 1 into EIGRP autonomous system 10 according to ACL 5</p>

## Configuration Example: Inbound and Outbound Distribute List Route Filters

Figure 4-5 shows the network topology for the configuration that follows, which demonstrates how to configure inbound and outbound route filters to control routing updates using the commands covered in this chapter. Assume that all basic configurations and EIGRP routing have been configured correctly.



**Figure 4-5** Network Topology for Inbound and Outbound Distribute List Route Filters

The first objective is to prevent router AYLNER from learning the 10.0.0.0/8 network using an outbound distribute list on router HULL.

HULL(config)# <b>access-list 10 deny 10.0.0.0 0.255.255.255</b>	Creates a standard ACL number 10 and explicitly denies the 10.0.0.0/8 network
HULL(config)# <b>access-list 10 permit any</b>	Adds a second line to ACL 10 which permits all other networks
HULL(config)# <b>router eigrp 1</b>	Enters EIGRP autonomous system 1 routing process
HULL(config-router)# <b>distribute-list 10 out</b> Or HULL(config-router)# <b>distribute-list 10 out serial0/0/0</b>	Creates an outbound global distribute list that refers to ACL 10  Creates an outgoing distribute list for interface Serial0/0/0 that refers to ACL 10

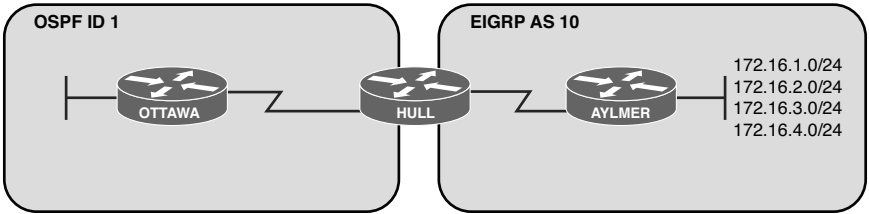
The second objective is to prevent router OTTAWA from learning the 192.168.6.0/24 network using an inbound distribute list on router OTTAWA.

OTTAWA(config)# <b>access-list 20 deny 192.168.6.0 0.0.0.255</b>	Creates a standard ACL number 20 and explicitly denies the 192.168.6.0/24 network
OTTAWA(config)# <b>access-list 20 permit any</b>	Adds a second line to ACL 20 which permits all other networks
OTTAWA (config)# <b>router eigrp 1</b>	Enters EIGRP autonomous system 1 routing process
OTTAWA(config-router)# <b>distribute-list 20 in</b> Or OTTAWA(config-router)# <b>distribute-list 20 in serial0/0/0</b>	Creates an inbound global distribute list that refers to ACL 20  Creates an inbound distribute list for interface Serial0/0/0 that refers to ACL 20



### Configuration Example: Controlling Redistribution with Outbound Distribute Lists

Figure 4-6 shows the network topology for the configuration that follows, which demonstrates how to control redistribution with an outbound distribute list using the commands covered in this chapter. Assume that all basic configurations and EIGRP and OSPF routing have been configured correctly.



**Figure 4-6** Network Topology for Controlling Redistribution with Outbound Distribute Lists

The objective is to prevent networks 172.16.3.0/24 and 172.16.4.0/24 from being redistributed into the OSPF domain.

HULL(config)# <b>access-list 30</b> <b>permit 172.16.1.0 0.0.0.255</b>	Creates a standard ACL number 30 and explicitly permits the 172.16.1.0/24 network.
HULL (config)# <b>access-list 30</b> <b>permit 172.16.2.0 0.0.0.255</b>	Adds a second line to ACL 30 that explicitly permits the 172.16.2.0/24 network.
HULL(config)# <b>router ospf 1</b>	Enters OSPF process ID 1 routing process.
HULL(config-router)# <b>redistribute</b> <b>eigrp 10 subnets</b>	Redistributes all EIGRP networks into OSPF.
HULL(config-router)# <b>distribute-</b> <b>list 30 out eigrp 10</b>	Creates an outbound distribute list to filter routes being redistributed from EIGRP into OSPF.
	<b>NOTE:</b> The implicit “deny any” statement at the end of the access list prevents routing updates about any other network from being advertised. As a result, networks 172.16.3.0/24 and 172.16.4.0/24 will not be redistributed into OSPF.

### Verifying Route Filters

Router# <b>show ip protocols</b>	Displays the parameters and current state of active routing protocols
----------------------------------	---

**Routing Protocol is "eigrp 10"**

```

Outgoing update filter list for all interfaces is 2
  Redistributed ospf 1 filtered by 5
    Serial 0/0/0 filtered by 4
Incoming update filter list for all interfaces is 1
  FastEthernet0/0 filtered by 3

```

**NOTE:** For each interface and routing process, Cisco IOS permits the following:

- One incoming global distribute list
- One outgoing global distribute list
- One incoming interface distribute list
- One outgoing interface distribute list
- One outgoing redistribution distribute list

**CAUTION:** Route filters have *no* effect on LSAs or the LSDB. A basic requirement of link-state routing protocols is that routers in an area must have identical LSDBs.

**NOTE:** OSPF routes *cannot* be filtered from entering the OSPF database. The **distribute-list in** command filters routes only from entering the routing table, but it doesn't prevent link-state packets (LSP) from being propagated.

The command **distribute-list out** works only on the routes being redistributed by the ASBR into OSPF. It can be applied to external type 2 and external type 1 routes but *not* to intra-area and interarea routes.

## Route Filtering Using Prefix Lists

The general syntax for configuring a prefix list is as follows:

```

Router(config)#ip prefix-list list-name [seq seq-value] deny | permit
network/len [ge ge-value] [le le-value]

```

The table that follows describes the parameters for this command.

Parameter	Description
<i>list-name</i>	The name of the prefix list
<b>seq</b>	(Optional) Applies a sequence number to the entry being created or deleted
<i>seq-value</i>	(Optional) Specifies the sequence number
<b>deny</b>	Denies access to matching conditions
<b>permit</b>	Permits access for matching conditions
<i>network/len</i>	(Mandatory) The network number and length (in bits) of the netmask
<b>ge</b>	(Optional) Applies <i>ge-value</i> to the range specified

Parameter	Description
<i>ge-value</i>	(Optional) Specifies the lesser value of a range (the “from” portion of the range description)
<b>le</b>	(Optional) Applies <i>le-value</i> to the range specified
<i>le-value</i>	(Optional) Specifies the greater value of a range (the “to” portion of the range description)

**TIP:** You must define a prefix list before you can apply it as a route filter.

**TIP:** There is an implicit deny statement at the end of each prefix list.

**TIP:** The range of sequence numbers that can be entered is from 1 to 4,294,967,294. If a sequence number is not entered when configuring this command, a default sequence numbering is applied to the prefix list. The number 5 is applied to the first prefix entry, and subsequent unnumbered entries are incremented by 5.

A router tests for prefix list matches from the lowest sequence number to the highest.

By numbering your **prefix-list** statements, you can add new entries at any point in the list.

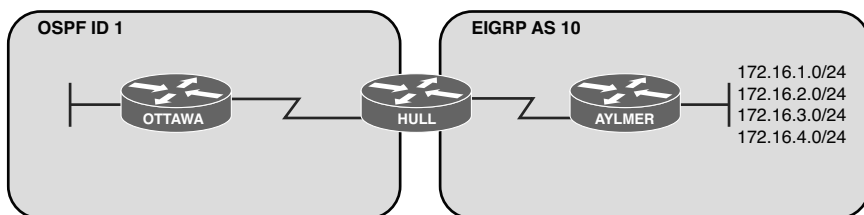
The following examples show how you can use the **prefix-list** command to filter networks using some of the more commonly used options.

Router(config)# <b>ip prefix-list ROSE permit 192.0.0.0/8 le 24</b>	Creates a prefix list that will accept a netmask of up to 24 bits ( <b>le</b> meaning less than or equal to) in routes with the prefix 192.0.0.0/8. Because no sequence number is identified, the default number of 5 is applied.
Router(config)# <b>ip prefix-list ROSE deny 192.0.0.0/8 ge 25</b>	Creates a prefix list that will deny routes with a netmask of 25 bits or greater ( <b>ge</b> meaning greater than or equal to) in routes with the prefix 192.0.0.0/8. Because no sequence number is identified, the number 10 is applied—an increment of 5 over the previous statement.
	<b>NOTE:</b> This configuration will permit routes such as 192.2.0.0/16 or 192.2.20.0/8, but will deny a more specific subnet such as 192.168.10.128/25.
Router(config)# <b>ip prefix-list TOWER permit 10.0.0.0/8 ge 16 le 24</b>	Creates a prefix list that permits all prefixes in the 10.0.0.0/8 address space that have a netmask of between 16 and 24 bits (greater than or equal to 16 bits, and less than or equal to 24 bits).

Router(config)#ip prefix-list TEST seq 5 permit 0.0.0.0/0	Creates a prefix list and assigns a sequence number of 5 to a statement which permits only the default route 0.0.0.0/0.
Router(config)#ip prefix-list TEST seq 10 permit 0.0.0.0/0 ge 30 le 30	Creates a prefix list and assigns a sequence number of 10 to a statement that permits any prefix with a netmask of exactly 30 bits.
Router(config)#ip prefix-list TEST seq 15 permit 0.0.0.0/0 le 32	Creates a prefix list and assigns a sequence number of 15 to a statement that permits any address or subnet (permit any).
Router(config)#no ip prefix- list TEST seq 10	Removes sequence number 10 from the prefix list.

### Configuration Example: Using a Distribute List That References a Prefix List to Control Redistribution

Figure 4-7 shows the network topology for the configuration that follows, which demonstrates how to control redistribution with a prefix list using the commands covered in this chapter. Assume that all basic configurations and EIGRP and OSPF routing have been configured correctly.



**Figure 4-7** Network Topology for Distribute List Configuration with Prefix Lists

The objective is to prevent networks 172.16.3.0/24 and 172.16.4.0/24 from being redistributed into the OSPF domain.

HULL(config)#ip prefix- list FILTER seq 5 permit 172.16.1.0/24	Creates a prefix list called FILTER with a first sequence number of 5 that explicitly permits the 172.16.1.0/24 network.
HULL (config)#ip prefix- list FILTER seq 10 permit 172.16.2.0/24	Adds a second line to the FILTER prefix list that explicitly permits the 172.16.2.0/24 network.
HULL(config)#router ospf 1	Enters OSPF process ID 1 routing process.
HULL(config-router)# redistribute eigrp 10 subnets	Redistributes all EIGRP networks into OSPF.

HULL(config-router)# <b>distribute-list prefix FILTER out eigrp 10</b>	Creates an outbound distribute list to filter routes being redistributed from EIGRP into OSPF that references the prefix list.
	<b>NOTE:</b> The implicit deny any statement at the end of the prefix list prevents routing updates about any other network from being advertised. As a result, networks 172.16.3.0/24 and 172.16.4.0/24 will not be redistributed into OSPF.

**TIP:** You can attach prefix lists to the redistribution process either via a distribute list or via a route map.

## Verifying Prefix Lists

<b>show ip prefix-list [detail   summary]</b>	Displays information on all prefix lists. Specifying the <b>detail</b> keyword includes the description and the hit count (the number of times the entry matches a route) in the display.
<b>clear ip prefix-list prefix-list- name [network/length]</b>	Resets the hit count shown on prefix list entries.

## Using Route Maps with Route Redistribution

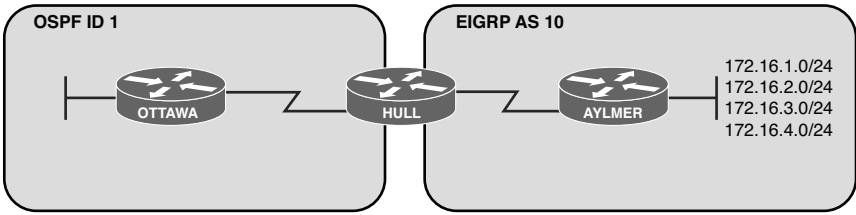
Router(config)# <b>route-map MY_MAP permit 10</b>	Creates a route map called MY_MAP. This <b>route-map</b> statement will permit redistribution based on subsequent criteria. A sequence number of 10 is assigned.
Router(config-route-map)# <b>match ip address 5</b>	Specifies the match criteria (the conditions that should be tested); in this case, match addresses filtered using a standard access list number 5.
Router(config-route-map)# <b>set metric 500</b>	Specifies the set action (what action is to be performed if the match criteria is met); in this case, set the external metric to 500 (instead of the default value of 20).
Router(config-route-map)# <b>set metric-type type-1</b>	Specifies a second set action for the same match criteria. In this case, set the external OSPF network type to E1.

Router(config-route-map)# <b>route-map MY_MAP deny 20</b>	Adds a second statement to the MY_MAP route map that will deny redistribution based on subsequent criteria.
Router(config-route-map)# <b>match ip address prefix-list MY_PFL</b>	Specifies the match criteria (the conditions that should be tested); in this case, match addresses filtered using a prefix list named MY_PFL.
Router(config-route-map)# <b>route-map MY_MAP permit 30</b>	Adds a third statement to the MY_MAP route map that will permit redistribution based on subsequent criteria.
	<b>NOTE:</b> No “match” criteria are explicitly specified; all other routes will be redistributed with the following “set” criteria applied.
Router(config-route-map)# <b>set metric 5000</b>	Specifies the set action (what action is to be performed if the match criteria is met); in this case, set the external metric to 5000 (instead of the default value of 20)
Router(config-route-map)# <b>set metric-type type 2</b>	Specifies a second set action for the same match criteria; in this case, set the external OSPF network type to E2. This is optional since the default type for redistributed routes into OSPF is external type 2.
Router(config-route-map)# <b>router ospf 10</b>	Enters OSPF process ID 10 routing process.
Router(config-router)# <b>redistribute eigrp 1 route-map MY_MAP subnets</b>	Redistributes only EIGRP routes that are permitted by route map MY_MAP into OSPF.

**NOTE:** When used to filter redistribution, route map **permit** or **deny** statements determine whether the route will be redistributed. Routes without a match will not be redistributed. The route map stops processing at the first match (similar to an access list or prefix list). There is always an implicit deny statement at the end of a route map.

## Configuration Example: Route Maps

Figure 4-8 shows the network topology for the configuration that follows, which demonstrates how to control redistribution with a route map using the commands covered in this chapter. Assume that all basic configurations and EIGRP and OSPF routing have been configured correctly.



**Figure 4-8** Network Topology for Route Map Configuration

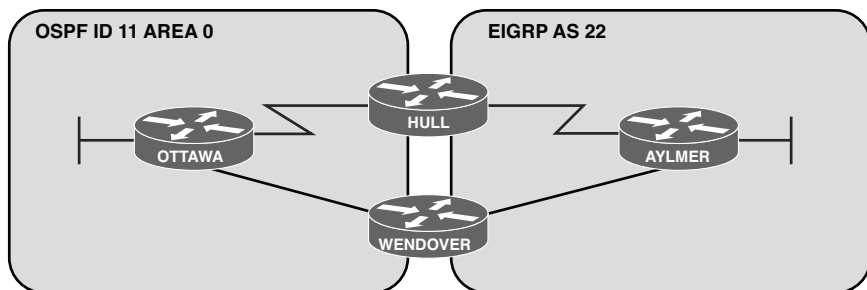
The objective is to only redistribute networks 172.16.1.0/24 and 172.16.2.0/24 into OSPF and advertise them as external type 1 (E1) routes with an external metric of 50.

HULL(config)# <b>access-list 5 permit 172.16.1.0 0.0.0.255</b>	Creates a standard ACL number 5 and explicitly permits the 172.16.1.0/24 network.
HULL (config)# <b>access-list 5 permit 172.16.2.0 0.0.0.255</b>	Adds a second line to ACL 5 that explicitly permits the 172.16.2.0/24 network.
HULL(config)# <b>route-map FILTER permit 10</b>	Creates a route map called FILTER. This route map will permit traffic based on subsequent criteria. A sequence number of 10 is assigned.
HULL(config-route-map)# <b>match ip address 5</b>	Specifies the match criteria; match addresses filtered from ACL 5.
HULL(config-route-map)# <b>set metric 50</b> HULL(config-route-map)# <b>set metric-type type-1</b>	Specifies the set actions (what actions are to be performed if the match criterion is met); in this case, sets the external metric to 50 <i>and</i> sets the type to external type 1 (E1).
HULL(config)# <b>router ospf 1</b>	Enters OSPF process ID 1 routing process.
HULL(config)# <b>redistribute eigrp 10 subnets route-map FILTER</b>	Redistributes only those EIGRP networks into OSPF which match the route map.
	<b>NOTE:</b> Networks 172.16.2.0/24 and 172.16.3.0/24 will not be redistributed because of the implicit deny any at the end of the route map.

## Manipulating Redistribution Using Route Tagging

Two-way multipoint redistribution can introduce routing loops in the network. One option to prevent redistribution of already redistributed routes is to use route tagging. In two-way multipoint redistribution scenarios, route tags must be applied and filtered in both direction and on both routers performing redistribution.

Figure 4-9 shows the network topology for the configuration that follows, which demonstrates how to control redistribution with route tags using the commands covered in this chapter. Assume that all basic configurations and EIGRP and OSPF routing have been configured correctly. A tag number of 11 is used to identify OSPF routes, and a tag of 22 is used to identify EIGRP routes.



**Figure 4-9** Network Topology for Redistribution Using Route Tagging

The following configuration needs to be entered on both the HULL and WENDOVER routers.

HULL(config)# <b>route-map EIGRPtoOSPF deny 10</b> HULL(config-route-map)# <b>match tag 11</b>	Creates a route map named EIGRPtoOSPF and denies redistribution for all routes tagged with the value 11.
HULL(config-route-map)# <b>route-map EIGRPtoOSPF permit 20</b> HULL(config-route-map)# <b>set tag 22</b>	Creates a second statement for route map EIGRPtoOSPF permitting all other routes to be redistributed with a tag of 22.
HULL(config-route-map)# <b>route-map OSPFtoEIGRP deny 10</b> HULL(config-route-map)# <b>match tag 22</b>	Creates a route map names OSPFtoEIGRP and denies redistribution for all routes tagged with the value 22.
HULL(config-route-map)# <b>route-map OSPFtoEIGRP permit 20</b> HULL(config-route-map)# <b>set tag 11</b>	Creates a second statement for route map OSPFtoEIGRP permitting all other routes to be redistributed with a tag of 11.
HULL(config-route-map)# <b>router ospf 11</b>	Enters OSPF configuration mode.
HULL(config-router)# <b>redistribute eigrp 22 subnets route-map EIGRPtoOSPF</b>	Redistributes all EIGRP routes with a tag of 22 into the OSPF domain.
HULL(config-router)# <b>router eigrp 22</b>	Enters EIGRP configuration mode.



HULL (config-router)# <b>redistribute ospf 11 metric 1500 1 255 1 1500 route-map OSPFtoEIGRP</b>	Redistributes all OSPF routes with a tag of 11 into the EIGRP domain.
	<b>NOTE:</b> The result here is to ensure only routes originating in the OSPF domain are redistributed into EIGRP, while only routes originating in the EIGRP domain are redistributed into the OSPF domain.

## Changing Administrative Distance for Internal and External Routes

The commands to change the administrative distance (AD) for internal and external routes are as follows.

Router (config)# <b>router ospf 1</b>	Starts the OSPF routing process
Router (config-router)# <b>distance ospf intra-area 105 inter-area 105 external 125</b>	Changes the AD to 105 for intra-area and interarea routes, and changes the AD to 125 for external routes
Router (config)# <b>router eigrp 100</b>	Starts the EIGRP routing process
Router (config-router)# <b>distance eigrp 80 105</b>	Changes the AD to 80 for internal EIGRP routes and changes the AD to 105 for EIGRP external routes
Router (config)# <b>router bgp 65001</b>	Starts the BGP routing process
Router (config-router)# <b>distance bgp 30 200 220</b>	Changes the AD to 30 for external BGP routes, 200 for internal BGP routes and 220 for local BGP routes

## Passive Interfaces

Router (config)# <b>router rip</b>	Starts the RIP routing process.
Router (config-router)# <b>passive-interface serial0/0/0</b>	Sets the interface as passive, meaning that routing updates will not be sent out this interface.
	<b>NOTE:</b> For RIP, the <b>passive-interface</b> command will prevent the interface from sending out routing updates but will allow the interface to receive updates.
Router (config)# <b>router rip</b>	Starts the RIP routing process.

Router (config-router) # <b>passive-interface default</b>	Sets all interfaces as passive.
	<b>TIP:</b> The <b>passive-interface default</b> command is useful for Internet service provider (ISP) and large enterprise networks, where a distribution router may have as many as 200 interfaces.
Router (config-router) # <b>no passive-interface fastethernet0/0</b>	Activates the FastEthernet0/0 interface to send and receive updates.

**CAUTION:** For OSPF, a passive interface does not send or process received Hellos. This prevents routers from becoming neighbors on that interface. A better way to control OSPF routing updates is to create a stub area, a totally stubby area, or a not-so-stubby area (NSSA).

**CAUTION:** When the **passive-interface** command is used with EIGRP, inbound and outbound hello packets are not sent. This prevents routers from becoming EIGRP neighbors. A passive interface cannot send EIGRP hellos, which prevents adjacency relationships with link partners. An administrator can create a “pseudo” passive EIGRP interface by using a route filter that suppresses all routes from the EIGRP routing update. An example of this is shown in Chapter 2, “EIGRP Implementation.”

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## Numbers

- 802.1x port-based authentication, 322
- 2960 switches and VLAN configuration, 208
- 3560 switches and VLAN configuration, 206, 209

## A

- ABR-1 routers and multiarea OSPF configuration, 67
- ABR-2 routers and multiarea OSPF configuration, 68
- Access 1 switches (2960)
  - PVST+ configuration, 238
  - STP migration, 240
- Access 2 switches (2960)
  - PVST+ configuration, 239
  - STP migration, 240
- access lists
  - AS\_PATH access lists
    - local preference attribute (BGP) manipulation, 138
    - weight attribute (BGP) manipulation, 136
  - BGP route filtering, 147-148
- accounting, 321
- ACL (Access Control Lists)
  - IPv6 ACL
    - configuring, 126-127
    - verifying, 127
  - NTP, 172-173
  - PACL configuration, 315-316
  - router ACL, securing infrastructure access, 161
  - VACL
    - configuring, 327-328
    - verifying, 329
  - VT access restriction, 160-161
- AD (Administrative Distances)
  - commands, 4
  - redistribution, AD changes for internal/external routes, 108
  - routing protocols, 3
- address families
  - EIGRP, 33
  - MP-BGP configuration, 151-153
  - OSPFv3, 60-61, 86-89
- address/interface assignments, IPv6, 7
- aggregate routes, BGP, 144
- ALSwitch1 (2960) and PAgP
  - EtherChannel configuration, 214
- ALSwitch1 routers, NTP configuration, 181
- ALSwitch2 (2960) and PAgP
  - EtherChannel configuration, 215

ALSwitch2 routers, NTP configuration, 182

AS\_PATH access lists

BGP, AS\_PATH access list configuration, 149

local preference attribute (BGP) manipulation, 138

weight attribute (BGP) manipulation, 136

AS\_PATH attribute prepending (BGP), 139-141

ASBR (Autonomous System Border Routers)

multiarea OSPF configuration, 66

OSPF redistribution, E1/E2 route assignments, 94

Austin routers

OSPF configuration

broadcast networks, 74

NBMA networks, 70

point-to-multipoint networks, 78

point-to-point networks with subinterfaces, 81

single-area OSPF, 64

RIPng configuration, 10

authentication, 182

802.1x port-based authentication, 322

BGP, 182, 189-190

EIGRP, 182-183, 185

HSRP, 281

IP SLA (Catalyst 3750), 262

local database authentication, 317

NTP, 172

OSPF protocol

OSPFv2 authentication, 182, 183, 185-187, 189

OSPFv3 authentication, 182, 187-189

RADIUS authentication, 318

legacy configuration, 318

modular configuration, 318-319

RIPng, 182-183

TACACS+ authentication, 319

legacy configuration, 320

modular configuration, 320

authorization, 321

auto-cost reference-bandwidth, OSPF protocol, 47

autonomous systems (private), removing with AS\_PATH attribute prepending (BGP), 141

autorecovery of error-disabled ports, 315

autosummarization, EIGRP, 15-16

## B

BackboneFast command and STP, 228

backups

routers, security configuration backups, 165-166

VSS configuration backups, 272

bandwidth

EIGRP, 21, 32

OSPF protocol, 47

basic IPv6 Internet connectivity, 125

BDR (Backup Designated Routers), OSPF BDR elections, 46

BGP (Border Gateway Protocol)

AS\_PATH access lists, 149

AS\_PATH attribute prepending, 139-141

authentication, 182, 189-190

configuring, 128-129

default routes, 133-134

eBGP multihops, 130-131

iBGP next-hop behavior, 129-130

- local preference attribute, 137
  - AS\_PATH access lists and local preference manipulation, 138
  - route maps and local preference manipulation, 138
- loopback addresses, 129
- MED attribute, 142-144
- MP-BGP, 151
  - configuring, 151-153
  - verifying, 153
- peer groups, 150-151
- prefix lists, 149
- redistribution, 92
- route aggregation, 144
- route filtering, 146-147
- route reflectors, 145
- route selection process, 134
- routing protocol comparison chart, 3
- troubleshooting connections, 132-133
- verifying connections, 132
- weight attribute, 134-135
  - AS\_PATH access lists and weight manipulation, 136
  - prefix lists and weight manipulation, 136-137
  - route maps and weight manipulation, 136-137
- BPDU Filter command and STP, 227
- BPDU Guard command and STP, 227
- broadcast networks, OSPF protocol, 72-75

## C

### campus networks

#### DHCP for IPv4

- configuring basic DHCP server for IPv4, 216
- configuring DHCP manual IP assignment for IPv4, 217
- DHCP relay IPv4, 217-218
- verifying, 218

#### DHCP for IPv6, 218

- client configuration, 219
- relay agent configuration, 220
- server configuration, 219
- verifying, 220

#### DTP, 200-201

#### EtherChannel and Layer 2 link aggregation, 209

- configuration guidelines, 210-211

- L2 EtherChannel configuration, 211

- L3 EtherChannel configuration, 211

- link aggregation interface modes, 210

- load balancing, 212

- PAgP EtherChannel configuration, 213-215

- verifying, 212

#### Hierarchical Network Model, 191

#### security

- accounting, 321

- authentication, 317-320, 322

- authorization, 321

- autorecovery of error-disabled ports, 313-314

- DAI, 325-326

- DHCP snooping, 323-324

- IP Source Guard, 324-325
- PACL, 315-316
- PVLAN, 331-335
  - storm control, 316-317
  - switch port security, 313-315
  - switch security, 312
  - VACL, 327-330
  - VLAN hopping, 326-327
- trunk encapsulation, 201-202
- VLAN
  - allowed VLAN, 201-202
  - configuring, 206-209
  - defining, 198
  - erasing configurations, 203
  - port assignments, 199-200
  - range command, 200
  - saving configurations, 202
  - static VLAN, 198-199
  - verifying, 202-203
  - VTP configuration, 204-205
  - VTP verification, 206
- catalyst switch support matrix (PVLAN), 337
- CEF (Cisco Express Forwarding)
  - configuring, 111-112
  - verifying, 111
- Cisco Enterprise Composite Network Model, 2
- Cisco Hierarchical Network Model, 1
- clients (DHCPv6), configuring, 219
- clocks, setting on routers, 174
- commands
  - AD, 4
- configuring
  - AS\_PATH access lists, 149
  - BGP, 128-129
    - AS\_PATH access lists, 149
    - prefix lists, 149
  - CEF, 111-112
  - DAI, 325-326
  - default routes, redistribution with different metrics in dual-home Internet connectivity scenarios, 127
  - DHCP for IPv4
    - configuring basic DHCP server for IPv4, 216
    - configuring DHCP manual IP assignment for IPv4, 217
    - DHCP IPv4 addresses, 120-121
  - DHCP snooping, 323
  - distribute lists, route redistribution control, 103-104
  - DLS1 switches
    - IPv4 and GLBP configuration, 297
    - IPv4 and HSRP configuration, 292
  - DLS2 switches
    - IPv4 and GLBP configuration, 299
    - IPv4 and HSRP configuration, 294
    - IPv4 and VRRP configuration, 303
    - IPv6 and HSRP configuration, 307-309
  - dynamic NAT, 121-122
  - EIGRP, 14-15
    - configuration example using named address configuration, 37-39
    - configuration modes, 34-35
    - EIGRPv6 bandwidth, 32
  - EIGRP authentication, 184
  - GLBP, 288-290, 296-299
  - HSRP
    - basic configuration, 278-279
    - default settings, 279

- IPv4 and L3 switch configuration, 291-296
- IPv6 and router L3 switch configuration, 304-309
- IP SLA (Catalyst 3750), 260-261
  - authentication, 262
  - monitoring operations, 262
- IPv6
  - ACL, 126-127
  - basic IPv6 Internet connectivity, 125
- L3 switches
  - IPv4 and GLBP configuration, 296-299
  - IPv4 and HSRP configuration, 291-296
  - IPv4 and VRRP configuration, 303
  - IPv6 and HSRP configuration, 307-309
- Layer 2 link aggregation
  - configuration guidelines, 210-211
  - EtherChannel load balancing, 212
  - EtherChannel verification, 212
  - L2 EtherChannel configuration, 211
  - L3 EtherChannel configuration, 211
  - PAgP EtherChannel configuration, 213-215
- LLDP (802.1AB), 194
- MP-BGP, 151-153
- NetFlow, 168
- NTP, 169-171
  - ALSwitch1 routers, 181
  - ALSwitch2 routers, 182
  - core1 routers, 178-179
  - core2 routers, 180
  - DLSwitch1 routers, 181
  - DLSwitch2 routers, 181
- flat versus hierarchical design, 171
- security, 172-173
- OSPF protocol, 44
  - broadcast networks, 72-75
  - multiarea OSPF, 45, 65-68
  - NBMA networks, 69-72
  - OSPFv3 and IPv6, address families, 86-89
  - OSPFv3 and IPv6, configuring, 83-86
  - point-to-multipoint networks, 76-79
  - point-to-point networks with subinterfaces, 80-82
  - single-area OSPF, 64-65
  - verifying configuration, 61
  - virtual links, 52-57
- PACL, 315-316
- passwords, router passwords, 157-158
- PAT, 122-123
- PoE, 196
- prefix lists, BGP, 149
- PVLAN, 331, 333-335
- PVST+, 235-239
- R1 routers
  - IPv4 and VRRP configuration, 302
  - IPv6 and HSRP configuration, 305-306
- RADIUS authentication
  - legacy configuration, 318
  - modular configuration, 318-319
- RIPng, 9
  - Austin routers, 10
  - Houston routers, 11



- route filtering
  - controlling redistribution with outbound distribution lists, 100
  - inbound/outbound distribute list route filters, 99
  - route redistribution control via distribute lists with prefix list references, 103-104
  - verifying route filters, 100-101
- route maps, route redistribution, 105-106
- route redistribution
  - controlling via distribute lists with prefix list references, 103
  - default routes with different metrics in dual-home Internet connectivity scenarios, 127
  - IPv4, 95-96
  - IPv6, 97
- routers, security configuration backups, 165-166
- SDM templates, 192-193
- SPAN
  - Local SPAN configuration, 262-264
  - RSPAN configuration, 262, 267-269
- SSH, 159-160
- static IPv4 addresses, 120-121
- static NAT, 121, 124-125
- static VLAN
  - extended-range static VLAN configuration, 199
  - normal-range static VLAN configuration, 198
- STP
  - path costs, 224
  - port priority, 224
  - root switches, 223-224
  - timers, 225
  - VLAN switch priority, 225
- switch port security, 313
- Syslog, 166
- TACACS+ authentication, 319
  - legacy configuration, 320
  - modular configuration, 320
- VACL, 327-330
- virtual switches
  - StackWise virtual switches, 270-271
  - VSS, 272-275
- VLAN, 206
  - 2960 switch configuration, 208
  - 3560 switch configuration, 206, 209
  - erasing configurations, 203
  - inter-VLAN routing, 242, 244-250
  - IPv6 inter-VLAN communication configuration, 251-256
  - saving configurations, 202
- VRRP, 285, 300-303
- VTP, 204
- connected networks, redistributing, 92-93
- core switches (3560)
  - PVST+ configuration, 236
  - STP migration, 240
- core1 routers, NTP configuration, 178-179
- core2 routers, NTP configuration, 180
- CORP routers
  - inter-VLAN routing communication, configuring, 245
  - IPv6 inter-VLAN communication, configuring, 253

cost metrics, OSPF protocol, 47  
 costs of paths, configuring in STP, 224

## D

- DAI (Dynamic ARP Inspection)
  - configuring, 325-326
  - verifying, 326
- database authentication (local), 317
- debugging
  - GLBP, 291
  - HSRP, 285
  - router performance, 8
  - VRRP, 287
- default metrics, redistributing, 92-93
- default routes
  - BGP, 133-134
  - EIGRP
    - accepting default route information, 20
    - default routes, injecting into EIGRP, 19
    - injecting default routes into EIGRP, 18-19
    - IP default network, 18-19
    - summarizing default routes, 19
  - IPv6 creation, 6
  - OSPF protocol, 49
  - redistribution with different metrics in dual-home Internet connectivity scenarios, configuring, 127
- DHCP (Dynamic Host Configuration Protocol)
  - DHCP for IPv4
    - configuring basic DHCP server for IPv4, 216
    - configuring DHCP manual IP assignment for IPv4, 217
    - DHCP IPv4 addresses, 120-121
    - DHCP relay IPv4, 217-218
      - verifying, 218
    - DHCP for IPv6, 218
      - client configuration, 219
      - relay agent configuration, 220
      - server configuration, 219
      - verifying, 220
    - DHCP snooping
      - configuring, 323
      - verifying, 324
  - disabling unneeded services, 169
  - distribute lists
    - BGP route filtering, 147-148
    - route redistribution control via distribute lists with prefix list references, 103-104
      - controlling redistribution with outbound distribution lists, 100
      - inbound/outbound distribute list route filters, 99
      - verifying route filters, 100-101
  - distribute-list command and route filtering, 98
  - Distribution 1 switches (3560)
    - PVST+ configuration, 237
    - STP migration, 240
  - Distribution 2 switches (3560)
    - PVST+ configuration, 237
    - STP migration, 240
  - DLS1 switches
    - HSRP and IP SLA tracking, 296
    - IPv4 and GLBP configuration, 297
    - IPv4 and HSRP configuration, 292
  - DLS2 switches
    - IPv4 and GLBP configuration, 299
    - IPv4 and HSRP configuration, 294

- IPv4 and VRRP configuration, 303
- IPv6 and HSRP configuration, 307-309
- DLSwitch (3560) and PAgP EtherChannel configuration, 213
- DLSwitch1 routers, NTP configuration, 181
- DLSwitch2 routers, NTP configuration, 181
- Dot1Q encapsulation, inter-VLAN routing, 242
- DR (Designated Routers), OSPF DR elections, 46
- DTP (Dynamic Trunking Protocol), 200-201
- dual-home Internet connectivity, configuring redistribution of default routes with different metrics, 127
- dynamic mappings, EIGRP over Frame Relay, 23
- dynamic NAT (Network Address Translation), 121-122

## E

- E1/E2 routes, OSPF redistribution, 94
- eBGP (external Border Gateway Protocol) multihops, 130-131
- EGP (Exterior Gateway Protocol) routing protocols, 3
- EIGRP (Enhanced Interior Gateway Routing Protocol)
  - address families, 33
  - authentication, 182-185
  - autosummarization, 15-16
  - bandwidth usage, 21
  - configuring, 14-15
    - configuration example using named address configuration, 37-39
    - configuration modes, 34-35

- default routes
  - accepting default route information, 20
  - injecting into EIGRP, 18-19
- EIGRP over Frame Relay
  - dynamic mappings, 23
  - EIGRP over multipoint subinterfaces, 25-26
  - EIGRP over point-to-point subinterfaces, 26-28
  - static mappings, 24-25
- EIGRP over MPLS
  - Layer 2 VPN, 28-29
  - Layer 3 VPN, 30-31
- EIGRPv6, 31
  - configuration example using named address configuration, 37-39
  - configuring the percentage of link bandwidth used, 32
  - enabling on an interface, 31-32
  - logging neighbor adjacency changes, 33
  - metric weights, 33
  - stub routing, 32-33
  - summary addresses, 32
  - timers, 32
  - verifying, 35
- exterior routing information, accepting, 20
- floating static routes, 5
- load balancing
  - maximum paths, 20
  - variance, 20-21
- passive EIGRP interfaces, 16
- "pseudo" passive EIGRP interfaces, 17
- redistribution, 91-93
  - passive interfaces, 109
  - route tagging, 106-107

- route tagging, 106-107
  - router ID, 15
  - routing protocol comparison chart, 3
  - static routes, redistributing, 18
  - stub networks, 21-22
  - timers, 17, 32
  - troubleshooting, 37, 185
  - unicast neighbors, 22
  - verifying, 35, 185
- encryption
- OSPFv2 authentication
    - MD5 encryption, 186-187
    - SHA encryption, 187
  - OSPFv3 encryption, 187-188
  - router passwords, 158-159
- Enterprise Composite Network Model, 2
- enterprise internet connectivity
- BGP
    - AS\_PATH access list configuration, 149
    - AS\_PATH attribute prepending, 139-141
    - configuring, 128-129
    - default routes, 133-134
    - eBGP multihops, 130-131
    - iBGP next-hop behavior, 129-130
    - local preference attribute, 137-138
    - loopback addresses, 129
    - MED attribute, 142-144
    - MP-BGP, 151-153
    - peer groups, 150-151
    - prefix list configuration, 149
    - route aggregation, 144
    - route filtering, 147-148
    - route reflectors, 145
    - route selection process, 134
    - troubleshooting connections, 132-133
    - verifying connections, 132
    - weight attribute, 134-137
- DHCP IPv4 addresses, 120-121
- dynamic NAT, 121-122
- IPv6
- configuring basic IPv6 Internet connectivity, 125
  - IPv6 ACL configuration, 126-127
  - NDP, 126-127
- NAT
- static NAT and virtual interface configuration, 124-125
  - verifying, 124
  - virtual interface, 124
- PAT, 122-123
- regular expressions, 146-147
- static IPv4 addresses, 120-121
- static NAT
- configuring, 121
  - virtual interface configuration, 124-125
- erasing VLAN configurations, 203
- EtherChannel and Layer 2 link aggregation, 209
- configuring
    - configuration guidelines, 210-211
    - EtherChannel load balancing, 212
    - EtherChannel verification, 212
    - L2 EtherChannel configuration, 211

- L3 EtherChannel configuration, 211
- PAgP EtherChannel configuration, 213-215
- link aggregation interface modes, 210
- exam preparation strategies, xxi
- extended system ID and STP, 232
- exterior routing information (EIGRP), accepting, 20
- external routes
  - AD changes for redistribution, 108
  - OSPF protocol
    - redistribution, 95
    - summarizing routes, 52

## F

- FHRP (First-Hop Redundancy Protocol), 278
- filtering routes, 100-101
  - BGP, 147-148
  - distribute-list command, 98
    - controlling redistribution with outbound distribution lists, 100
    - inbound/outbound distribute list route filters, 99
    - verifying route filters, 100-101
  - OSPF protocol, 101
  - prefix lists, 101-102
    - redistribution control via distribute lists with prefix list references, 103-104
    - verifying, 104
- first-hop redundancy
  - FHRP, 278
  - GLBP, 287
    - configuring, 288-290, 296-299
    - debugging, 291
    - interface tracking, 290
  - IPv4 and L3 switch configuration, 296-299
  - verifying, 290
- HSRP, 278, 285
  - configuring, 278-279, 291-296, 304-309
  - debugging, 285
  - HSRPv2 for IPv6, 284
  - IP SLA tracking, 283, 296
  - IPv4 and L3 switch configuration, 291-296
  - IPv6 and router L3 switch configuration, 304-309
  - multigroup HSRP, 281-282
  - optimization, 279-281
  - verifying, 279
- VRRP, 285
  - configuring, 285, 300-303
  - debugging, 287
  - interface tracking, 287
  - IPv4 and router and L3 switch configuration, 300-303
  - verifying, 287
- FlexLinks, 231
- floating static routes, 5
- Frame Relay
  - EIGRP over Frame Relay
    - dynamic mappings, 23
  - EIGRP over multipoint subinterfaces, 25-26
  - EIGRP over point-to-point subinterfaces, 26-28
  - static mappings, 24-25
- full-mesh Frame Relay and OSPF protocol
  - broadcast on physical interfaces, 55
  - NBMA on physical interfaces, 54

- point-to-multipoint networks, 55
- point-to-point networks with subinterfaces, 56

## G

- Galveston routers and OSPF configuration
  - broadcast networks, 75
  - NBMA networks, 71
  - point-to-multipoint networks, 78
  - point-to-point networks with subinterfaces, 82
  - single-area OSPF, 65
- GLBP (Gateway Load Balancing Protocol), 287
  - configuring, 288-290, 296-299
  - debugging, 291
  - interface tracking, 290
  - verifying, 290
- global configuration mode, VTP, 204

## H

- Hierarchical Network Model, 1, 191
- high-availability networks
  - IP SLA (Catalyst 3750),
    - configuring, 260-261
    - authentication, 262
    - monitoring operations, 262
  - port mirroring, 262
    - Local SPAN configuration, 262-264
    - Local SPAN verification, 269
    - RSPAN configuration, 262, 267-269
    - RSPAN verification, 269
    - troubleshooting SPAN, 269
  - virtual switches, 269
    - StackWise virtual switches, 270-271
    - VSS, 271-275
- hops
  - eBGP multihops, 130-131
  - next-hop behaviors and iBGP, 129-130
- Houston routers
  - OSPF configuration
    - broadcast networks, 73
    - NBMA networks, 70
    - point-to-multipoint networks, 77
    - point-to-point networks with subinterfaces, 80
    - single-area OSPF, 65
  - RIPng configuration, 11
- HSRP (Hot Standby Router Protocol), 278, 285
  - configuring
    - basic configuration, 278-279
    - default settings, 279
    - IPv4 and L3 switch configuration, 291-296
    - IPv6 and router L3 switch configuration, 304-309
  - debugging, 285
  - HSRPv2 for IPv6, 284
  - IP SLA tracking, 283, 296
  - multigroup HSRP, 281-282
  - optimization, 279
    - authentication, 281
    - interface tracking, 281
    - message timers, 280
    - preempts, 280
  - verifying, 279

- I
- iBGP (internal Border Gateway Protocol)
  - next-hop behavior, 129-130
  - route reflectors, 145
- IGP (Interior Gateway Protocol) routing protocols, 3
- inbound/outbound distribute list route filters, 99
- infrastructures (networks), securing access via router ACL, 161
- interarea route summarization, OSPF protocol, 52
- interface tracking
  - GLBP, 290
  - HSRP, 281
  - VRRP, 287
- interface/address assignments, IPv6, 7
- internal routes
  - AD changes for redistribution, 108
  - multiarea OSPF configuration, 68
  - OSPF redistribution, 95
- Internet connectivity (basic IPv6), configuring, 125
- inter-VLAN routing
  - configuring, 242
    - inter-VLAN communication, 244-250
    - IPv6 inter-VLAN communication, 251-256
  - Dot1Q encapsulation, 242
  - external routers and inter-VLAN communication, 241-242
  - ISL, 242
  - L2 switch port capability, removing, 242
  - routers-on-a-stick and inter-VLAN communication, 241-242
  - subinterfaces, 242
- SVI
  - autostate configuration, 243
  - multilayer switch
    - communication through SVI, 243
- IOS IP SLA (Service-Level Agreements), 115-118
- IP default network, EIGRP, 18-19
- IP MTU (Maximum Transmission Units), OSPF protocol, 49
- IP SLA (Catalyst 3750)
  - configuring, 260-261
    - authentication, 262
  - HSRP and IP SLA tracking, 283, 296
  - monitoring operations, 262
- IP Source Guard, 324-325
- IPv4 (Internet Protocol version 4)
  - CEF, 111-112
  - DHCP for IPv4
    - configuring basic DHCP server for IPv4, 216
    - configuring DHCP manual IP assignment for IPv4, 217
    - DHCP IPv4 addresses, 120-121
    - DHCP relay IPv4, 217-218
    - verifying, 218
  - DHCP for IPv6, 218
    - client configuration, 219
    - relay agent configuration, 220
    - server configuration, 219
    - verifying, 220
  - route redistribution, 95-96
  - router ID, OSPFv3, 59
  - static IPv4 addresses, 120-121
- IPv6 (Internet Protocol version 6)
  - ACL
    - configuring, 126-127
    - verifying, 127

- address/interface assignments, 7
  - basic Internet connectivity,
    - configuring, 125
  - CEF, 112
  - default routes, 6
  - HSRPv2 for IPv6, 284
  - NDP, 126-127
  - OSPFv3, 57
    - address families, 60-61
    - configuring, 83-86
    - enabling on an interface, 58
    - interarea route summarization, 59
    - IPv4 router ID, 59
    - NBMA networks, 60
    - SPF calculations, 59
    - stub/NSSA areas, 58
  - ping command, 11-12
  - route redistribution, 97-98
  - traceroute command, 12
  - ISL (Inter-Switch Links) and inter-VLAN routing, 242
  - ISP (Internet Service Provider) routers
    - inter-VLAN routing
      - communication, configuring, 244
    - IPv6 inter-VLAN communication, configuring, 256
- L**
- L2Switch1 (Catalyst 2960) switches
    - inter-VLAN routing
      - communication, configuring, 250
    - IPv6 inter-VLAN communication, configuring, 256
  - L2Switch2 (Catalyst 2960) switches
    - inter-VLAN routing
      - communication, configuring, 247
    - IPv6 inter-VLAN communication, configuring, 254
  - L3 switches
    - DLS1 switches
      - HSRP and IP SLA tracking, 296
      - IPv4 and GLBP configuration, 297
      - IPv4 and HSRP configuration, 292
    - DLS2 switches
      - IPv4 and GLBP configuration, 299
      - IPv4 and HSRP configuration, 294
      - IPv4 and VRRP configuration, 303
      - IPv6 and HSRP configuration, 307-309
  - IPv4
    - GLBP configuration, 296-297
    - HSRP configuration, 291-292
    - VRRP configuration, 303
    - IPv6 and HSRP configuration, 307-309
  - L3Switch1 (Catalyst 3560) switches
    - inter-VLAN routing
      - communication, configuring, 249
    - IPv6 inter-VLAN communication, configuring, 255
  - LAN (Local Area Network) ports, storm control, 316-317
  - Laredo routers and OSPF configuration
    - broadcast networks, 75
    - NBMA networks, 72



- point-to-multipoint networks, 79
- point-to-point networks with subinterfaces, 82
- Layer 2 link aggregation, 209
  - configuring
    - configuration guidelines, 210-211
    - EtherChannel load balancing, 212
    - EtherChannel verification, 212
    - L2 EtherChannel configuration, 211
    - L3 EtherChannel configuration, 211
    - PAgP EtherChannel configuration, 213-215
  - link aggregation interface modes, 210
- Layer 2 VPN (Virtual Private Networks), EIGRP over MPLS, 28-29
- Layer 3 VPN (Virtual Private Networks), EIGRP over MPLS, 30-31
- link aggregation (Layer 2), 209
  - configuring
    - configuration guidelines, 210-211
    - EtherChannel load balancing, 212
    - EtherChannel verification, 212
    - L2 EtherChannel configuration, 211
    - L3 EtherChannel configuration, 211
    - PAgP EtherChannel configuration, 213-215
  - link aggregation interface modes, 210
- links
  - FlexLinks, 231
  - ISL and inter-VLAN routing, 242
  - LLDP (802.1AB), 194
    - configuring, 194
    - verifying, 195
  - load balancing
    - EIGRP
      - maximum paths, 20
      - variance, 20-21
    - EtherChannel load balancing, configuring, 212
  - local database authentication, 317
  - local preference attribute (BGP), 137
    - AS\_PATH access lists and local preference manipulation, 138
    - route maps and local preference manipulation, 138
  - Local SPAN (Switch Port Analyzer)
    - configuring, 262-264
    - troubleshooting, 269
    - verifying, 269
  - logging
    - NetFlow and router security, 168
    - NTP
      - clocks, setting on routers, 174-177
      - configuring, 169-171, 178-182
      - flat versus hierarchical design, 171
      - security, 172-173
      - SNTP, 174
      - time stamps, 178
      - verifying, 173
    - Syslog and router security
      - configuring, 166
      - message example, 167-168
      - message format, 166
      - severity levels, 167
  - Loop Guard command and STP, 229-230
  - loopback addresses, BGP, 129
  - loopback interfaces, OSPF protocol, 45

LSA (Link State Advertisements), OSPF protocol, 43  
 LSDB overload protection, OSPF protocol, 48

## M

MAC addresses  
     switch content-addressable memory, 192  
     switch port security, 313-314  
 MD5 encryption, OSPFv2 authentication, 186-187  
 MED attribute (BGP), 142-144  
 memory (switch content-addressable), configuring, 192  
 message timers, HSRP, 280  
 metric weights, EIGRPv6, 33  
 mirroring ports, 262  
     SPAN  
       Local SPAN configuration, 262-264  
       Local SPAN verification, 269  
       troubleshooting, 269  
     SPAN configuration  
       RSPAN configuration, 262, 267-269  
       RSPAN verification, 269  
       troubleshooting, 269  
 MISTP (Multiple Instance Spanning Tree Protocol), 222  
     enabling, 233  
     STP modes, changing, 232  
     verifying, 235  
 MP-BGP (Multiprotocol-Border Gateway Protocol), 151  
     configuring, 151-153  
     verifying, 153

MPLS (EIGRP over)  
     Layer 2 VPN, 28-29  
     Layer 3 VPN, 30-31  
 MTU (Maximum Transmission Units), IP  
     MTU and OSPF protocol, 49  
 multiarea OSPF (Open Shortest Path First), 45, 65-68  
 multigroup HSRP (Hot Standby Router Protocol), 281-282  
 multihops, eBGP, 130-131  
 multilayer switch communication through SVI, 243  
 multipoint subinterfaces (EIGRP over), 25-26

## N

NAT (Network Address Translation)  
     dynamic NAT, 121-122  
     NAT overload. *See* PAT  
     PAT, 122-123  
     static NAT  
       configuring, 121  
       virtual interface configuration, 124-125  
       verifying, 124  
     virtual interface, 124-125  
 NBMA networks  
     OSPF protocol  
       configuring, 69-72  
       OSPF over NBMA topology summary, 57  
       virtual links, 53-57  
     OSPFv3, 60  
 NDP (Neighbor Discovery Protocol), 126-127  
 neighbor adjacencies, EIGRPv6, 33  
 NetFlow  
     configuring, 168  
     verifying, 168-169

## network models

- Enterprise Composite Network Model, 2
- Hierarchical Network Model, 1

## networks

## campus networks

- accounting, 321
  - authentication, 317-320, 322
  - authorization, 321
  - autorecovery of error-disabled ports, 313-314
  - DAI, 325-326
  - DHCP snooping, 323-324
  - Hierarchical Network Model, 191
  - IP Source Guard, 324-325
  - PACL, 315-316
  - PVLAN, 331-335
  - storm control, 316-317
  - switch port security, 313-315
  - switch security, 312
  - VACL, 327-330
  - VLAN. *See* individual entry
- connected networks, redistributing, 92-93
- DHCP for IPv4
- configuring basic DHCP server for IPv4, 216
  - configuring DHCP manual IP assignment for IPv4, 217
  - DHCP relay IPv4, 217-218
  - verifying, 218
- DHCP for IPv6, 218
- client configuration, 219
  - relay agent configuration, 220
  - server configuration, 219
  - verifying, 220

## EtherChannel and Layer 2 link aggregation, 209

- configuration guidelines, 210-211
  - EtherChannel load balancing, 212
  - EtherChannel verification, 212
  - L2 EtherChannel configuration, 211
  - L3 EtherChannel configuration, 211
  - link aggregation interface modes, 210
  - PAgP EtherChannel configuration, 213-215
- Hierarchical Network Model, 191
- high-availability networks
- IP SLA (Catalyst 3750) configuration, 260-262
  - port mirroring, 262-269
  - virtual switches, 269-275
- infrastructure access, securing via router ACL, 161
- PVLAN
- catalyst switch support matrix, 337
  - configuring, 331, 333-335
  - verifying, 332
- PVRST+, 222
- securing infrastructure access via router ACL, 161
- static networks, redistributing, 92-93
- VLAN
- allowed VLAN, 201-202
  - configuring, 206-209
  - defining, 198
  - erasing configurations, 203
  - inter-VLAN routing. *See* individual entry

- port assignments, 199-200
- PVRST+, 232, 239-240
- PVST, 231
- PVST+, 222, 232, 235-240
- range command, 200
- saving configurations, 202
- security, 326-327
- static VLAN, 198-199
- switch content-addressable memory, 192
- verifying, 202
- verifying trunking, 203
- VLAN hopping, 326-327
- VTP configuration, 204-205
- VTP verification, 206
- next-hop behaviors, iBGP, 129-130
- NSF (Non-Stop Forwarding) and VSS, 272
- NSSA (Not-So-Stubby Areas)
  - OSPF protocol, 51
  - OSPFv3, 58
- NTP (Network Time Protocol)
  - clocks, setting on routers, 174-177
  - configuring, 169-171
    - ALSwitch1 routers, 181
    - ALSwitch2 routers, 182
    - core1 routers, 178-179
    - core2 routers, 180
    - DLSwitch1 routers, 181
    - DLSwitch2 routers, 181
  - flat versus hierarchical design, 171
  - security
    - authentication, 172
    - limiting access via ACL, 172-173
  - SNTP, 174
  - time stamps, 178
  - verifying, 173

## O

- OSPF (Open Shortest Path First) protocol
  - auto-cost reference-bandwidth, 47
  - bandwidth, 47
  - BDR elections, 46
  - broadcast networks, 72-75
  - configuring, 44
    - broadcast networks, 72-75
    - multiarea OSPF, 65-68
    - NBMA networks, 69-72
    - OSPFv3 and IPv6, address families, 86-89
    - OSPFv3 and IPv6, configuring, 83-86
    - point-to-multipoint networks, 76-79
    - point-to-point networks with subinterfaces, 80-82
    - single-area OSPF, 64-65
    - verifying configuration, 61
    - virtual links, 52-57
  - cost metrics, 47
  - default routes, propagating, 49
  - DR elections, 46
  - full-mesh Frame Relay
    - full-mesh Frame Relay:
      - broadcast on physical interfaces, 55
    - full-mesh Frame Relay: NBMA on physical interfaces, 54
    - full-mesh Frame Relay: point-to-multipoint networks, 55
    - full-mesh Frame Relay: point-to-point networks with subinterfaces, 56
  - IP MTU, 49
  - loopback interfaces, 45
  - LSA types, 43

- LSDB overload protection, 48
- message types, 42
- multiarea OSPF, 45, 65-68
- NBMA networks, 53-57, 69-72
- network types, 54
- NSSA, 51
- OSPFv2
  - authentication, 182-183, 185-187, 189
  - MD5 encryption, 186-187
  - SHA encryption, 187
- OSPFv3 and IPv6, 57
  - address families, 60-61, 86-89
  - authentication, 182, 187-189
  - configuring, 83-86
  - enabling on an interface, 58
  - interarea route summarization, 59
  - IPv4 router ID, 59
  - NBMA networks, 60
  - SPF calculations, 59
  - stub/NSSA areas, 58
- passive interfaces, 46
- point-to-multipoint networks, 76-79
- point-to-point networks with subinterfaces, 80-82
- redistribution, 92
  - E1/E2 route assignments, 94
  - internal/external routes, 95
  - passive interfaces, 109
  - route tagging, 106-107
  - subnet redistribution, 93
- route filtering, 101
- route summarization, 52
  - external route summarization, 52
  - interarea route summarization, 52

- route tagging, 106-107
- router ID, 46
- routing protocol comparison chart, 3
- single-area OSPF, 64-65
- stubby areas, 50
- timers, 48
- totally NSSA, 51
- totally stubby areas, 50
- troubleshooting, 63
- verifying configuration, 61
- virtual links, 52-53
  - full-mesh Frame Relay:
    - broadcast on physical interfaces, 55
  - full-mesh Frame Relay: NBMA on physical interfaces, 54
  - full-mesh Frame Relay: point-to-multipoint networks, 55
  - full-mesh Frame Relay: point-to-point networks with subinterfaces, 56
  - NBMA networks, 53-57
  - network types, 54
  - OSPF over NBMA topology summary, 57
- wildcard masks, 44-45
- outbound distribute lists
  - redistribution control, 100
  - route filtering, 99
- overload protection (LSDB) and OSPF protocol, 48

## P

- PACL (Port Access Control Lists), 315-316
- PAGP EtherChannel configuration, 213-215

- passive interfaces
  - EIGRP, 16
  - OSPF protocol, 46
  - redistribution, 108-109
- passwords (routers)
  - configuring, 157-158
  - encryption, 158-159
- PAT (Port Address Translation), 122-123
- path control
  - CEF
    - configuring, 111-112
    - verifying, 111
  - IOS IP SLA, 115-118
  - PBR, 112-113
    - route maps, 114
    - verifying, 113
- path costs, configuring in STP, 224
- PBR (Policy-Based Routing)
  - path control, 112-113
  - route maps, 114
- peer groups, BGP, 150-151
- performance (routers), debugging, 8
- permanent keyword, static routes, 4-5
- ping command, IPv6, 11-12
- PoE (Power over Ethernet), 192-196
  - configuring, 196
  - verifying, 196
- point-to-multipoint networks, OSPF protocol, 76-79
- point-to-point networks with subinterfaces
  - EIGRP over point-to-point subinterfaces, 26-28
  - OSPF protocol, 80-82
- PortFast command and STP, 226
- ports
  - 802.1x port-based authentication, 322
  - error-disabled ports, autorecovering, 315
  - L2 switch port capability, removing, 242
  - LAN ports, storm control, 316-317
  - mirroring, 262
    - Local SPAN configuration, 262-264
    - Local SPAN verification, 269
    - RSPAN configuration, 262, 267-269
    - RSPAN verification, 269
    - troubleshooting, 269
  - PACL configuration, 315-316
  - SPAN
    - Local SPAN configuration, 262-264
    - Local SPAN verification, 269
    - RSPAN configuration, 262, 267-269
    - RSPAN verification, 269
    - troubleshooting, 269
  - storm control, 316-317
  - STP
    - port error conditions, 231
    - port priority configuration, 224
  - switch port security
    - autorecovery of error-disabled ports, 315
    - configuring, 313
    - MAC addresses, 313-314
    - verifying, 314-315
  - VLAN
    - port assignments, 199-200
    - removing L2 switch port capability, 242
  - VSL port channels and ports, VSS configuration, 273-274
- preempts, HSRP, 280

## prefix lists

- BGP, prefix list configuration, 149
- route filtering, 101-104
- verifying, 104
- weight attribute (BGP)
  - manipulation, 136

## preparation strategies for exams, xxi

private autonomous systems, removing

- with AS\_PATH attribute prepending (BGP), 141

## "pseudo" passive EIGRP interfaces, 17

## PVLAN (Private Virtual Local Area Networks)

- catalyst switch support matrix, 337
- configuring, 331, 333-335
- verifying, 332

## PVRST+ (Per VLAN Rapid Spanning Tree+), 222

- enabling, 232
- migration example, 239-240
- STP modes, changing, 232

PVST (Per-VLAN Spanning Tree),

- changing STP modes, 231

## PVST+ (Per VLAN Spanning Tree+), 222

- configuring, 235-239
- migration example, 239-240
- STP modes, changing, 232

**R**

## R1 routers

- IPv4 and VRRP configuration, 302
- IPv6 and HSRP configuration, 305-306
- OSPF configuration
  - OSPFv3 and IPv6, address families, 87
  - OSPFv3 and IPv6, configuring, 85

- address families, 88
- configuring, 84

## R2 routers, OSPFv3 and IPv6

- R3 routers, OSPFv3 and IPv6
  - address families, 89
  - configuring, 84

- R4 routers, OSPFv3 and IPv6
  - configuration, 86

## RADIUS authentication, 318

- legacy configuration, 318
- modular configuration, 318-319

## range command and VLAN, 200

## recursive lookups, static routes, 5-6

## redistribution

- AD changes for internal/external routes, 108

## BGP, 92

## connected networks, 92-93

## default metrics, 92-93

- default routes with different metrics in dual-home Internet connectivity scenarios, configuring, 127

## EIGRP, 91-93

## IPv4 routes, 95-96

## IPv6 routes, 97-98

## OSPF protocol, 92

- E1/E2 route assignments, 94

- internal/external routes, 95

- subnet redistribution, 93

## passive interfaces, 108-109

## RIP, 91-92

## route filtering

- controlling redistribution with outbound distribution lists, 100

- distribute-list command, 98-101

- inbound distribute lists, 99

- inbound/outbound distribute list route filters, 99
- outbound distribute lists, 99
- prefix lists, 101-102
- redistribution control via distribute lists with prefix list references, 103-104
- route maps, 104-106
- route tagging, 106-107
- seed metrics, 91-93
- static networks, 92-93
- subnets, OSPF redistribution, 93
- redundancy (first-hop)
  - FHRP, 278
  - GLBP, 287
    - configuring, 288-290, 296-299
    - debugging, 291
    - interface tracking, 290
    - IPv4 and L3 switch configuration, 296-299
    - verifying, 290
  - HSRP, 278, 285
    - configuring, 278-279, 291-296, 304-309
    - debugging, 285
    - HSRPv2 for IPv6, 284
    - IP SLA tracking, 283, 296
    - IPv4 and L3 switch configuration, 291-296
    - IPv6 and router L3 switch configuration, 304-309
    - multigroup HSRP, 281-282
    - optimization, 279-281
    - verifying, 279
  - VRRP, 285
    - configuring, 285, 300-303
    - debugging, 287
    - interface tracking, 287
    - IPv4 and router and L3 switch configuration, 300-303
    - verifying, 287
- regular expressions, 146-147
- relay agents (DHCPv6), configuring, 220
- removing private autonomous systems with AS\_PATH attribute prepending (BGP), 141
- RIP (Routing Information Protocol), redistributing, 91-93, 108-109
- RIPng (RIP Next Generation), 7
  - authentication, 182-183
  - configuration example, 9
    - Austin routers, 10
    - Houston routers, 11
  - troubleshooting, 8-9
  - verifying, 8-9
- Root Guard command and STP, 228-229
- root switches, configuring in STP, 223-224
- route aggregation, BGP, 144
- route filtering, 100-101
  - BGP, 147-148
  - distribute-list command, 98
    - controlling redistribution with outbound distribution lists, 100
  - inbound/outbound distribute list route filters, 99
    - verifying route filters, 100-101
  - inbound distribute lists, 99
  - OSPF protocol, 101
  - outbound distribute lists, 99
  - prefix lists, 101-102
    - redistribution control via distribute lists with prefix list references, 103-104
    - verifying, 104



- route maps
  - configuring, route redistribution, 105-106
  - local preference attribute (BGP) manipulation, 138
  - PBR and route maps, 114
  - route redistribution, 104-106
  - weight attribute (BGP) manipulation, 136-137
- route reflectors, 145
- route selection process and BGP, 134
- route summarization
  - OSPF protocol, 52
    - external route summarization, 52
    - interarea route summarization, 52
  - OSPFv3, 59
- route tagging, redistributing, 106-107
- router ID
  - EIGRP, 15
  - OSPF protocol, 46
  - OSPFv3, IPv4 router ID, 59
- routers
  - ABR-1 routers, multiarea OSPF configuration, 67
  - ABR-2 routers, multiarea OSPF configuration, 68
  - ALSwitch1 routers, NTP configuration, 181
  - ALSwitch2 routers, NTP configuration, 182
  - ASBR routers
    - multiarea OSPF configuration, 66
    - OSPF redistribution, 94
  - Austin routers
    - OSPF and broadcast networks, 74
    - OSPF and NBMA networks, 70
    - OSPF and point-to-multipoint networks, 78
    - OSPF and point-to-point networks with subinterfaces, 81
    - RIPng configuration, 10
    - single-area OSPF configuration, 64
  - BDR, OSPF BDR elections, 46
  - clocks, setting, 174-177
  - configuring security backups, 165-166
  - core1 routers, NTP configuration, 178-179
  - core2 routers, NTP configuration, 180
  - CORP routers
    - inter-VLAN routing communication configuration, 245
    - IPv6 inter-VLAN communication configuration, 253
  - DLSwitch1 routers, NTP configuration, 181
  - DLSwitch2 routers, NTP configuration, 181
  - DR routers, OSPF DR elections, 46
  - Galveston routers
    - OSPF and broadcast networks, 75
    - OSPF and NBMA networks, 71
    - OSPF and point-to-multipoint networks, 78
    - OSPF and point-to-point networks with subinterfaces, 82
    - single-area OSPF configuration, 65

- Houston routers
  - OSPF and broadcast networks, 73
  - OSPF and NBMA networks, 70
  - OSPF and point-to-multipoint networks, 77
  - OSPF and point-to-point networks with subinterfaces, 80
  - RIPng configuration, 11
  - single-area OSPF configuration, 65
- ISP routers
  - inter-VLAN routing communication configuration, 244
  - IPv6 inter-VLAN communication configuration, 252
- Laredo routers
  - OSPF and broadcast networks, 75
  - OSPF and NBMA networks, 72
  - OSPF and point-to-multipoint networks, 79
  - OSPF and point-to-point networks with subinterfaces, 82
- local preference attribute (BGP)
  - AS\_PATH access lists and local preference manipulation, 138
  - route maps and local preference manipulation, 138
- NTP
  - clocks, setting on routers, 174-177
  - configuring, 169-171, 178-182
  - flat versus hierarchical design, 171
  - security, 172-173
  - SNTP, 174
  - time stamps, 178
  - verifying, 173
- OSPF protocol, broadcast networks, 72-75
- performance, debugging, 8
- R1 routers
  - IPv4 and VRRP configuration, 302
  - IPv6 and HSRP configuration, 305-306
  - OSPFv3 and IPv6, address families, 87
  - OSPFv3 and IPv6, configuring, 85
- R2 routers
  - OSPFv3 and IPv6, address families, 88
  - OSPFv3 and IPv6, configuring, 84
- R3 routers
  - OSPFv3 and IPv6, address families, 89
  - OSPFv3 and IPv6, configuring, 84
- R4 routers, OSPFv3 and IPv6 configuration, 86
- RIPng, 7
- security
  - checklist, 156
  - configuration backups, 165
  - disabling unneeded services, 169
  - infrastructure access, securing via router ACL, 161
  - NetFlow, 168-169
  - password configuration, 157-158
  - password encryption, 158-159
  - policies, 157

- SNMP, 162-165
- SSH configuration, 159-160
- Syslog, 166-168
- VT access restriction, 160-161
- weight attribute (BGP), 134-135
  - AS\_PATH access lists and weight manipulation, 136
  - prefix lists and weight manipulation, 136-137
  - route maps and weight manipulation, 136-137
- routing protocols
  - AD, 3
  - BGP
    - AS\_PATH access list configuration, 149
    - AS\_PATH attribute prepending, 139-141
    - authentication, 182, 189-190
    - configuring, 128-129
    - default routes, 133-134
    - eBGP multihops, 130-131
    - iBGP next-hop behavior, 129-130
    - local preference attribute, 137-138
    - loopback addresses, 129
    - MED attribute, 142-144
    - MP-BGP, 151-153
    - peer groups, 150-151
    - prefix list configuration, 149
    - redistribution, 92
    - route aggregation, 144
    - route filtering, 146-147
    - route reflectors, 145
    - route selection process, 134
    - routing protocol comparison chart, 3
    - troubleshooting connections, 132-133
    - verifying connections, 132
    - weight attribute, 134-137
  - EGP routing protocols, 3
  - EIGRP
    - accepting default route information, 20
    - accepting exterior routing information, 20
    - address families, 33
    - authentication, 182-185
    - autosummarization, 15-16
    - bandwidth usage, 21
    - configuration example using named address configuration, 37-39
    - configuration modes, 34-35
    - configuring, 14-15
    - default routes, injecting into EIGRP, 19
    - EIGRP over Frame Relay, dynamic mappings, 23
    - EIGRP over Frame Relay, EIGRP over multipoint subinterfaces, 25-26
    - EIGRP over Frame Relay, EIGRP over point-to-point subinterfaces, 26-28
    - EIGRP over Frame Relay, static mappings, 24-25
    - EIGRP over MPLS, Layer 2 VPN, 28-29
    - EIGRP over MPLS, Layer 3 VPN, 30-31
    - EIGRPv6, 31-33, 35, 37-39
    - floating static routes, 5
    - injecting default routes into EIGRP, 18-19
    - IP default network, 18-19
    - load balancing, 20-21

- passive EIGRP interfaces, 16
  - "pseudo" passive EIGRP interfaces, 17
  - redistributing static routes, 18
  - redistribution, 91-93, 106-107
  - redistribution and passive interfaces, 109
  - route tagging, 106-107
  - router ID, 15
  - routing protocol comparison chart, 3
  - stub networks, 21-22
  - summarizing default routes, 19
  - timers, 17
  - troubleshooting, 37, 185
  - unicast neighbors, 22
  - verifying, 35
  - verifying authentication, 185
- IGP routing protocols, 3
- OSPF protocol
- auto-cost reference-bandwidth, 47
  - bandwidth, 47
  - BDR elections, 46
  - broadcast networks, 72-75
  - configuring, 44
  - cost metrics, 47
  - DR elections, 46
  - IP MTU, 49
  - loopback interfaces, 45
  - LSA types, 43
  - LSDB overload protection, 48
  - message types, 42
  - multiarea OSPF, 45, 65-68
  - NBMA networks, 53-57, 69-72
  - network types, 54
  - NSSA, 51
  - OSPFv2 and MD5 encryption, 186-187
  - OSPFv2 and SHA encryption, 187
  - OSPFv2 authentication, 182-183, 185-187, 189
  - OSPFv3 and IPv6, 57-61
  - OSPFv3 and IPv6, address families, 86-89
  - OSPFv3 and IPv6, configuring, 83-86
  - OSPFv3 authentication, 182, 187-189
  - passive interfaces, 46
  - point-to-multipoint networks, 76-79
  - point-to-point networks with subinterfaces, 80-82
  - propagating default routes, 49
  - redistribution, 92-95
  - redistribution and passive interfaces, 109
  - route filtering, 101
  - route summarization, 52
  - route tagging, 106-107
  - router ID, 46
  - routing protocol comparison chart, 3
  - single-area OSPF, 64-65
  - stubby areas, 50
  - timers, 48
  - totally NSSA, 51
  - totally stubby areas, 50
  - troubleshooting, 63
  - verifying configuration, 61
  - virtual links, 52-57
  - wildcard masks, 44-45
- protocol comparison chart, 3
- RIP
- redistribution, 92
  - redistribution and passive interfaces, 108-109

- RIPng authentication, 182-183
- typically used routing protocols, 2

### RSPAN (Remote Switch Port Analyzer)

- configuring, 262, 267-269
- troubleshooting, 269
- verifying, 269

### RSTP (Rapid Spanning Tree Protocol), 222

## S

- saving VLAN configurations, 202

### SDM (Switching Database Manager)

- templates, 192
- configuring, 192-193
- platform options, 193
- verifying, 193

### security

- accounting, 321
- authentication
  - 802.1x port-based authentication, 322
  - local database authentication, 317
  - RADIUS authentication, 318-319
  - TACACS+ authentication, 319-320
- authorization, 321
- BGP authentication, 182, 189-190
- campus networks
  - accounting, 321
  - authentication, 317-320, 322
  - authorization, 321
  - autorecovery of error-disabled ports, 313-314
  - DAI, 325-326
  - IP Source Guard, 324-325
  - PACL, 315-316

- PVLAN, 331-335
- storm control, 316-317
- switch port security, 313-315
- switch security, 312
- VACL, 327-330
- VLAN hopping, 326-327

### DAI

- configuring, 325-326
- verifying, 326

### DHCP snooping

- configuring, 323
- verifying, 324

### EIGRP authentication, 182-185

- error-disabled ports, autorecovering, 315

### IP SLA (Catalyst 3750)

- authentication, 262

### IP Source Guard, 324-325

### LAN ports, storm control, 316-317

- MD5 encryption, OSPFv2 authentication, 186-187

- networks, securing infrastructure access via router ACL, 161

### NTP

- authentication, 172
- configuring, 169-171
- flat versus hierarchical design, 171
- limiting access via ACL, 172-173

### OSPF protocol

- OSPFv2 authentication, 182-183, 185-187, 189
- OSPFv3 authentication, 182, 187-189

### PACL, 315-316

- ports, 802.1x port-based authentication, 322

- RIPng authentication, 182-183
- routers
  - checklist, 156
  - configuration backups, 165-166
  - disabling unneeded services, 169
  - infrastructure access, securing via router ACL, 161
  - NetFlow, 168-169
  - password configuration, 157-158
  - password encryption, 158-159
  - policies, 157
  - SNMP, 162-165
  - SSH configuration, 159-160
  - Syslog, 166-168
  - VT access restriction, 160-161
- SHA encryption, OSPFv2 authentication, 187
- SNMP, 162
  - security levels, 163
  - security models, 162
  - SNMPv1, 163
  - SNMPv2, 163
  - SNMPv3, 163
  - verifying, 165
- storm control, 316-317
- switch ports
  - autorecovery of error-disabled ports, 315
  - configuring, 313
  - MAC addresses, 313-314
  - verifying, 314-315
- switches, 312
- VACL
  - configuring, 327-328
  - verifying, 329
- VLAN
  - VACL, 327-330
  - VLAN hopping, 326-327
  - VT access restriction, 160-161
- seed metrics, redistributing, 91-93
- selecting routes and BGP, 134
- servers (DHCPv6), configuring, 219
- SHA encryption, OSPFv2 authentication, 187
- single-area OSPF (Open Shortest Path First), 64-65
- SLA (Service-Level Agreements)
  - IOS IP SLA, 115-118
  - IP SLA (Catalyst 3750), 260-261
    - authentication, 262
    - HSRP and IP SLA tracking, 283, 296
    - monitoring operations, 262
- SNMP (Simple Network Management Protocol)
  - security, 162
    - security levels, 163
    - security models, 162
    - SNMPv1, 163
    - SNMPv2, 163
    - SNMPv3, 163
    - verifying, 165
- SNTP (Simple Network Time Protocol), 174
- SPAN (Switch Port Analyzer)
  - Local SPAN
    - configuring, 262-264
    - troubleshooting, 269
    - verifying, 269
  - RSPAN
    - configuring, 262, 267-269
    - troubleshooting, 269
    - verifying, 269

- SSH (Secure Shell)
  - configuring, 159-160
  - verifying, 160
- SSO (Stateful Switchover) and VSS, 272
- StackWise virtual switches, 270
  - configuring, 270-271
  - master switch selection, 270-271
  - verifying, 271
- static IPv4 addresses, 120-121
- static mappings, EIGRP over Frame Relay, 24-25
- static NAT (Network Address Translation)
  - configuring, 121
  - virtual interface configuration, 124-125
- static networks, redistributing, 92-93
- static routes
  - EIGRP, redistributing static routes, 18
  - floating static routes, 5
  - permanent keyword, 4-5
  - recursive lookups, 5-6
  - verifying, 6
- static VLAN (Virtual Local Area Networks), 198
  - extended-range static VLAN configuration, 199
  - normal-range static VLAN configuration, 198
- storm control, 316-317
- STP (Spanning Tree Protocol), 222
  - BackboneFast command, 228
  - BPDU Filter command, 227
  - BPDU Guard command, 227
  - enabling, 222-223
  - extended system ID, 232
  - FlexLinks, 231
  - Loop Guard command, 229-230
  - migration example, 239-240
  - MISTP, 222
    - changing STP modes, 232
    - enabling, 233
    - verifying, 235
  - modes, changing, 231-232
  - path costs, configuring, 224
  - PortFast command, 226
  - ports
    - error conditions, 231
    - priority, 224
  - PVRST+, 222
    - changing STP modes, 232
    - enabling, 232
    - migration example, 239-240
  - PVST, changing STP modes, 231
  - PVST+, 222
    - changing STP modes, 232
    - configuring, 235-239
    - migration example, 239-240
  - Root Guard command, 228-229
  - root switches, configuring, 223-224
  - RSTP, 222
  - STP toolkit, 226-230
  - timers, configuring, 225
  - troubleshooting, 235
  - Unidirectional Link Detection command, 230
  - UplinkFast command, 228
  - verifying, 226
  - VLAN switch priority, configuring, 225
- strategies (exam preparation), xxi
- stub networks, EIGRP, 21-22
- stub routing, EIGRPv6, 32-33
- stubby areas
  - OSPF protocol, 50
  - OSPFv3, 58

- subinterfaces
  - inter-VLAN routing, 242
  - multipoint subinterfaces (EIGRP over), 25-26
  - point-to-point subinterfaces (EIGRP over), 26-28
- subnets, OSPF redistribution, 93
- summarizing routes
  - EIGRP, 19
  - OSPF protocol, 52
    - external route summarization, 52
    - interarea route summarization, 52
  - OSPFv3, 59
- summary addresses, EIGRPv6, 32
- SVI (Switch Virtual Interface)
  - autostate configuration, 243
  - multilayer switch communication through SVI, 243
- SW1 switches, PVLAN configuration, 333
- SW2 switches, PVLAN configuration, 335
- switch content-addressable memory, 192
- switches
  - 2960 switches, VLAN configuration, 208
  - 3560 switches, VLAN configuration, 206, 209
  - Access 1 switches (2960)
    - PVST+ configuration, 238
    - STP migration, 240
  - Access 2 switches (2960)
    - PVST+ configuration, 239
    - STP migration, 240
  - converting to VSS, 272
  - core switches (3560)
    - PVST+ configuration, 236
    - STP migration, 240
  - Distribution 1 switches (3560)
    - PVST+ configuration, 237
    - STP migration, 240
  - Distribution 2 switches (3560)
    - PVST+ configuration, 237
    - STP migration, 240
  - DLS1 switches
    - HSRP and IP SLA tracking, 296
    - IPv4 and GLBP configuration, 297
    - IPv4 and HSRP configuration, 292
  - DLS2 switches
    - IPv4 and GLBP configuration, 299
    - IPv4 and HSRP configuration, 294
    - IPv4 and VRRP configuration, 303
    - IPv6 and HSRP configuration, 307-309
  - ISL, inter-VLAN routing, 242
  - L2 switch port capability, removing, 242
  - L2Switch1 (Catalyst 2960) switches
    - inter-VLAN routing communication configuration, 250
    - IPv6 inter-VLAN communication configuration, 256
  - L2Switch2 (Catalyst 2960) switches
    - inter-VLAN routing communication configuration, 247
    - IPv6 inter-VLAN communication configuration, 254



## L3 switches

- IPv4 and GLBP configuration, 296-299
- IPv4 and HSRP configuration, 291-296
- IPv4 and VRRP configuration, 303
- IPv6 and HSRP configuration, 307-309
- L3Switch1 (Catalyst 3560) switches
  - inter-VLAN routing communication configuration, 249
  - IPv6 inter-VLAN communication configuration, 255
- multilayer switch communication through SVI, 243
- root switches, configuring in STP, 223-224
- security, 312
- SW1 switches, PVLAN configuration, 333
- SW2 switches, PVLAN configuration, 335
- switch port security
  - autorecovery of error-disabled ports, 315
  - configuring, 313
  - MAC addresses, 313-314
  - verifying, 314-315
- virtual switches, 269
  - StackWise virtual switches, 270-271
  - VSS, 271-275
- VLAN switch priority, configuring in STP, 225

## Syslog

- configuring, 166
- message example, 167-168
- message format, 166
- severity levels, 167
- system ID (extended) and STP, 232

**T**

- TACACS+ authentication, 319
  - legacy configuration, 320
  - modular configuration, 320
    - configuring, 192-193
    - platform options, 193
    - verifying, 193
- templates (SDM), 192
- time stamps, NTP, 178
- timers
  - EIGRP, 17
  - EIGRPv6, 32
  - HSRP message timers, 280
  - OSPF protocol, 48
  - STP timers, 225
- totally NSSA (Not-So-Stubby Areas), OSPF protocol, 51
- totally stubby areas, OSPF protocol, 50
- traceroute command, IPv6, 12
- troubleshooting
  - BGP, 132-133
  - EIGRP, 37, 185
  - OSPF protocol, 63
  - RIPng, 8-9
  - SPAN, 269
  - STP, 235
- trunk encapsulation, campus networks, 201-202

**U**

- unicast neighbors, EIGRP, 22
- Unidirectional Link Detection command and STP, 230
- unnneeded services, disabling, 169
- UplinkFast command and STP, 228

**V**

## VACL (VLAN Access Control Lists)

- configuring, 327-328
- verifying, 329

## verifying, 275

- BGP, 132
- BGP authentication, 190
- CEF, 111
- DAI, 326
- DHCP for IPv4, 218
- DHCP for IPv6, 220
- DHCP snooping, 324
- EIGRP, 35, 185
- EIGRPv6, 35
- EtherChannel configuration, 212
- GLBP, 290
- HSRP, 279
- IOS IP SLA, 118
- IPv6
  - ACL configuration, 127
  - route redistribution, 98
- LLDP (802.1AB), 195
- MISTP, 235
- MP-BGP, 153
- NAT, 124
- NetFlow, 168-169
- NTP, 173

## OSPF protocol

- configuring, 61
- OSPFv2 authentication, 189
- OSPFv3 authentication, 189

## PBR, 113

## PoE, 196

## prefix lists, 104

## PVLAN, 332

## RIPng, 8-9

## route filtering, 100-101

## SDM templates, 193

## SNMP security, 165

## SPAN

- Local SPAN verification, 269
- RSPAN verification, 269

## SSH, 160

## static routes, 6

## STP, 226

## switch content-addressable memory, 192

## switch port security, 314-315

## VACL, 329

## virtual switches, 271

## VLAN, 202-203

## VRRP, 287

## virtual interfaces

## NAT, 124

## static NAT and virtual interface configuration, 124-125

## virtual links and OSPF protocol, 52-53

## full-mesh Frame Relay

- broadcast on physical interfaces, 55

- NBMA on physical interfaces, 54

- point-to-multipoint networks, 55

- point-to-point networks with subinterfaces, 56

- NBMA networks, 53-57
- network types, 54
- OSPF over NBMA topology
  - summary, 57
- virtual switches, 269
  - StackWise virtual switches, 270-271
    - configuring, 270-271
    - verifying, 271
  - VSS, 271
    - chassis conversion to Virtual Switch mode, 274
    - configuration backups, 272
    - converting switches to VSS, 272
    - NSF configuration, 272
    - SSO configuration, 272
    - switch number assignments, 272-273
    - verifying, 275
    - virtual switch domain assignments, 272-273
    - VSL port channels and ports, 273-274
    - VSS chassis standby modules, 274-275
- VLAN (Virtual Local Area Networks)
  - allowed VLAN, 201-202
  - configuring, 206
    - 2960 switch configuration, 208
    - 3560 switch configuration, 206, 209
  - erasing configurations, 203
  - saving configurations, 202
  - defining, 198
  - inter-VLAN routing
    - configuring, 242
    - Dot1Q encapsulation, 242
    - external routers and inter-VLAN communication, 241-242
    - inter-VLAN communication configuration, 244-250
  - IPv6 inter-VLAN communication configuration, 251-256
  - ISL, 242
  - multilayer switch communication through SVI, 243
  - removing L2 switch port capability, 242
  - routers-on-a-stick and inter-VLAN communication, 241-242
  - subinterfaces, 242
  - SVI autostate configuration, 243
- port assignments, 199-200
- PVLAN
  - catalyst switch support matrix, 337
  - configuring, 331, 333-335
  - verifying, 332
- PVRST+, 222
  - changing STP modes, 232
  - migration example, 239-240
- PVST, changing STP modes, 231
- PVST+, 222
  - changing STP modes, 232
  - configuring, 235-239
  - migration example, 239-240
- range command, 200
- security, VLAN hopping, 326-327
- static VLAN, 198
  - extended-range static VLAN configuration, 199
  - normal-range static VLAN configuration, 198
- switch content-addressable memory, 192

switch priority in STP, configuring, 225

#### VACL

configuring, 327-328

verifying, 329

verifying, 202-203

#### VTP

configuring, 204-205

VTP verification, 206

#### VPN

Layer 2 VPN, EIGRP over MPLS, 28-29

Layer 3 VPN, EIGRP over MPLS, 30-31

VRRP (Virtual Router Redundancy Protocol), 285

configuring, 285, 300-303

debugging, 287

interface tracking, 287

verifying, 287

VSL port channels and ports, VSS configuration, 273-274

VSS (Virtual Switching System), 271

configuring

chassis conversion to Virtual Switch mode, 274

configuration backups, 272

NSF configuration, 272

SSO configuration, 272

switch number assignments, 272-273

virtual switch domain assignments, 272-273

VSL port channels and ports, 273-274

VSS chassis standby modules, 274-275

converting switches to VSS, 272

verifying, 275

VT (Virtual Terminals), restricting access, 160-161

VTP (VLAN Trunking Protocol)

configuring, 204-205

verifying, 206

## W - X - Y - Z

weight attribute (BGP), 134-135

AS\_PATH access lists and weight manipulation, 136

prefix lists and weight manipulation, 136-137

route maps and weight manipulation, 136-137

wildcard masks, OSPF protocol, 44-45