

Contents

Introduction xviii

Chapter 1 CLI Usage 1

1-1: Cisco Internetwork Operating System (IOS) Software 1

Using Cisco IOS Software 2

1-2: ROM Monitor 9

Using the ROM Monitor Command Set 9

Chapter 2 Switch Functionality 13

2-1: Catalyst Switch Families 13

Catalyst 2000 Series 13

Catalyst 3000 Series 14

Catalyst 4500 Series 15

Catalyst 6500 16

2-2: Switched Campus Network Designs 17

Catalyst Switch Families 23

Cisco Validated Designs: Campus 23

Chapter 3 Supervisor Engine Configuration 25

3-1: Prompts and Banners 25

Configuration of Prompt 26

Configuration of Banner 26

Feature Example 26

3-2: IP Addressing and Services 27

Configuring an IP Management Address 27

Configuring a Default Gateway 28

Setting Up DNS Services or Host Tables 28

Configuring HTTP Services 29

Feature Example 29

3-3: Passwords and Password Recovery 30

Configuration of Passwords 30

Feature Example 30

Password Recovery: Procedure 1 31

Feature Example 32

Password Recovery on IOS Devices: Procedure 2 33

Feature Example 33

3-4: Managing Modules	34
Viewing Modules	34
Accessing Modules	34
Resetting Modules	34
Powering Modules Up and Down	35
3-5: File Management and Boot Parameters	35
Navigating File Systems	36
Deleting Files from Flash	38
Copying System Files	39
File System Boot Parameters	40
Alias Commands	41
3-6: Redundant Supervisors	42
Forcing a Change to the Standby Supervisor	43
Synchronizing IOS Images	44
Synchronizing Boot Parameters	45
3-7: Cisco Discovery Protocol	46
Configuration of CDP	46
Feature Example	47
3-8: Time and Calendar	47
System Time Configuration	48
<i>Setting the System Time Manually</i>	48
<i>Setting the System Time Through NTP</i>	49
Example	50
Chapter 4	Layer 2 Interface Configuration
	53
4-1: Switching Table	53
Configuration	53
Displaying Information About the Switching Table	54
Switching Table Example	54
4-2: Port Selection	56
Configuration	56
Port Selection Example	57
4-3: Ethernet	57
Configuration	57
Ethernet Example	60
Displaying Information About Layer 2 Interfaces	61

4-4: EtherChannel	62
Configuration	63
EtherChannel Example	67
Displaying Information About EtherChannels	68

Chapter 5 Layer 3 Interface Configuration 71

5-1: Layer 3 Switching	71
5-2: Layer 3 Ethernet Interfaces	72
Configuration	72
Verifying the Configuration	73
Feature Example	73
5-3: Layer 3 EtherChannels	74
Configuration	74
Verifying the Channel	76
Feature Example	77
5-4: WAN Interfaces	78
Configuration	78
Configuring an Enhanced FlexWAN Interface	78
Configuring a SPA Interface Processor (SIP) / Shared Port Adapter (SPA)	
WAN Interface	79
Configuring a Packet-over-SONET Interface	80
Verifying Configurations	81
Feature Example	81
5-5: Layer 3 Virtual Interfaces	82
Configuring a VLAN Interface	82
Configuring Subinterfaces	83
Verifying Configurations	84
Feature Example	84
5-6: Routing Tables	85
Configuration	85
Verifying Routes	86

Chapter 6 VLANs and Trunking 87

6-1: VLAN Configuration	87
Creation of an Ethernet VLAN	88
Feature Example	90

6-2: VLAN Port Assignments	91
Configuring Static VLANs	91
Configuring Dynamic VLANs	91
Verifying VLAN Assignments	93
6-3: Trunking	93
Enabling Trunking	93
Specifying VLANs to Trunk	96
Verifying Trunks	97
Feature Example	97
6-4: VLAN Trunking Protocol	98
Enabling VTP for Operation	98
Setting VTP Passwords	99
Changing VTP Modes	100
Enabling VTP Pruning	101
Changing VTP Versions	102
Verifying VTP Operation	102
Feature Example	103
6-5: Private VLANs	104
Configuring Private VLANs	105
Configuring Private Edge VLANs	106
Verifying Private VLAN Operation	107
Feature Example	107
Chapter 7	Spanning Tree Protocol (STP)
7-1: STP Operation	111
STP Process	112
STP Tiebreakers	113
Path Costs	113
STP Port States	114
STP Topology Changes	114
Improving STP Stability	115
STP Operation Example	115
7-2: STP Configuration	116
Displaying Information About STP	120
STP Configuration Examples	120
<i>Poor STP Root Placement</i>	120
<i>STP Load Balancing</i>	122

- 7-3: STP Convergence Tuning 124
 - Configuring STP Convergence Tuning 125
- 7-4: Navigating the Spanning-Tree Topology 126

Chapter 8 Configuring High Availability Features 131

- 8-1: Route Processor Redundancy (RPR/RPR+) 131
 - Configuration 132
 - Displaying Information About RPR 132
- 8-2: Non-Stop Forwarding/Supervisor Switchover (NSF/SSO) with Supervisor Redundancy 132
 - SSO/NSF Configuration 133
 - Displaying Information About SSO and NSF 135
- 8-3: Router Redundancy with HSRP 135
 - Configuration 136
 - HSRP Example 137
 - Displaying Information About HSRP 138
- 8-4: Fast Software Upgrade (FSU) and Enhanced Fast Software Upgrade (eFSU) 138

Chapter 9 Multicast 141

- 9-1: Multicast Addressing 141
- 9-2: IGMP Snooping 142
 - Configuration 143
 - IGMP Snooping Example 144
 - Displaying Information About IGMP Snooping 145

Chapter 10 Server Load Balancing (SLB) 147

- 10-1: SLB 147
 - Configuration 149
 - SLB Example 155
 - Displaying Information About SLB 157
- 10-2: SLB Firewall Load Balancing 158
 - Configuration 159
 - Firewall Load-Balancing Example 161
 - Displaying Information About Firewall Load Balancing 164
- 10-3: SLB Probes 164
 - Configuration 165
 - Displaying Information About SLB Probes 166

Chapter 11 Controlling Traffic and Switch Access 167

- 11-1: Broadcast Suppression 168
 - Configuring Broadcast Suppression 168
 - Verifying Configuration 170
 - Feature Example 170
- 11-2: Protocol Filtering 170
 - Configuration 171
 - Verification 171
 - Feature Example 172
- 11-3: Port Security 173
 - Configuration 173
 - Verification 175
 - Feature Example 175
- 11-4: VLAN Access Control Lists 175
 - IOS VACL Configuration 176
 - Verification 178
 - Feature Example 178
- 11-5: Switch Authentication 180
 - Configuration 180
 - Verification 182
 - Feature Example 182
- 11-6: Access Class 183
 - Configuration 183
 - Verification 184
 - Feature Example 184
- 11-7: SSH Telnet Configuration 184
 - Configuration 184
 - Verification 185
 - Feature Example 185
- 11-8: 802.1X Port Authentication 185
 - Configuration 186
 - Feature Example 186
- 11-9: Layer 2 Security 186
 - Port Security 188
 - Feature Example 188
 - Verification 188

DHCP Snooping	189
Feature Example	189
Verification	190
Dynamic ARP Inspection	191
Feature Example	191
Verification	192

Chapter 12 Switch Management 193

12-1: Logging	193
Configuration	194
Logging Example	198
Displaying Information About Logging	198
12-2: Simple Network Management Protocol	198
Configuration	199
SNMP Example	205
Displaying Information About SNMP	206
12-3: Switched Port Analyzer	206
SPAN Configuration	206
RSPAN Configuration	208
SPAN Examples	210
Displaying Information About SPAN	211
12-4: Power Management	213
Configuration	213
Displaying Information About Power Management	214
12-5: Environmental Monitoring	214
12-6: Packet Tracing	214
Configuration	215
Packet-Tracing Example	218

Chapter 13 Quality of Service 221

13-1: QoS Theory	221
Layer 2 QoS Classification and Marking	222
Layer 3 QoS Classification and Marking	223
Catalyst Switch Queuing	226
13-2: QoS Configuration	226
Catalyst 2000/3000 Configuration	228
All Other Catalyst Configuration	228
Displaying Information About QoS	245

13-3: QoS Data Export	246
Configuration	246
QoS Data Export Example	248
Displaying Information About QoS Data Export	248

Chapter 14 Voice 249

14-1: Voice Ports	249
Configuration	250
Example	253
Displaying Information About Voice Ports	253
14-2: Voice QoS	254
Access Layer Configuration	256
Distribution and Core Layer Configuration	259
Voice QoS Example	261

Appendix A Cabling Quick Reference 263

Back-to-Back Connections	267
Ethernet Connections	267
Asynchronous Serial Connections	268
T1/E1 CSU/DSU Connections	269

Appendix B Well-known Protocol, Port, and Other Numbers 271

Index	317
-------	-----