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GEL-1061

10-Port L2 Managed Gigabit Switch, 2 x SFP

GEP-1061

10-Port L2 Managed Gigabit PoE Switch, 2 x SFP,

802.3at PoE+, 125W

User Manual

V1.0

Digital Data Communications Asia Co., Ltd.

<http://www.level1.com>

User Manual

GEL-1061

10-Port L2 Managed Gigabit Switch
with 8 10/100/1000BASE-T (RJ-45) Ports
and 2 Gigabit SFP Ports

GEP-1061

10-Port L2 Managed Gigabit PoE Switch
with 8 10/100/1000BASE-T (RJ-45) 802.3 af/at PoE Ports
and 2 Gigabit SFP Ports
(PoE Power Budget: 125 W)

How to Use This Guide

This guide includes detailed information on the switch software, including how to operate and use the management functions of the switch. To deploy this switch effectively and ensure trouble-free operation, you should first read the relevant sections in this guide so that you are familiar with all of its software features.

Who Should Read this Guide? This guide is for network administrators who are responsible for operating and maintaining network equipment. The guide assumes a basic working knowledge of LANs (Local Area Networks), the Internet Protocol (IP), and Simple Network Management Protocol (SNMP).

How this Guide is Organized This guide provides detailed information about the switch's key features. It also describes the switch's web browser interface. For information on the command line interface refer to the *CLI Reference Guide*.

The guide includes these sections:

- ◆ Section I **"Getting Started"** — Includes an introduction to switch management, and the basic settings required to access the management interface.
- ◆ Section II **"Web Configuration"** — Includes all management options available through the web browser interface.
- ◆ Section III **"Appendices"** — Includes information on troubleshooting switch management access.

Related Documentation This guide focuses on switch software configuration through the web browser.

For information on how to manage the switch through the command line interface, see the following guide:

CLI Reference Guide



Note: For a description of how to initialize the switch for management access via the CLI, web interface or SNMP, refer to "Initial Switch Configuration" in the *CLI Reference Guide*.

For information on how to install the switch, see the following guide:

Installation Guide

For all safety information and regulatory statements, see the following documents:

Quick Start Guide

Safety and Regulatory Information

Conventions The following conventions are used throughout this guide to show information:



Note: Emphasizes important information or calls your attention to related features or instructions.



Caution: Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.



Warning: Alerts you to a potential hazard that could cause personal injury.

Revision History This section summarizes the changes in each revision of this guide.

March 2016 Revision

This is the first version of this guide. This guide is valid for software release v1.1.2.0.

Contents

How to Use This Guide	3
Contents	5
Figures	15
Tables	25

Section I	Getting Started	27
	1 Introduction	29
	Key Features	29
	Description of Software Features	30
	Address Resolution Protocol	34
	System Defaults	35
Section II	Web Configuration	39
	2 Using the Web Interface	41
	Connecting to the Web Interface	41
	Navigating the Web Browser Interface	42
	Dashboard	42
	Home Page	44
	Configuration Options	44
	Panel Display	45
	Main Menu	46
	3 Basic Management Tasks	61
	Displaying System Information	62
	Displaying Hardware/Software Versions	63
	Configuring Support for Jumbo Frames	64

Displaying Bridge Extension Capabilities	65
Managing System Files	67
Copying Files via FTP/ TFTP or HTTP	67
Saving the Running Configuration to a Local File	69
Setting the Start-up File	70
Showing System Files	71
Automatic Operation Code Upgrade	71
Setting the System Clock	75
Setting the Time Manually	76
Setting the SNTP Polling Interval	77
Configuring NTP	77
Configuring Time Servers	78
Setting the Time Zone	82
Configuring Summer Time	83
Configuring the Console Port	85
Configuring Telnet Settings	87
Displaying CPU Utilization	88
Configuring CPU Guard	89
Displaying Memory Utilization	90
Resetting the System	91
4 Interface Configuration	95
Port Configuration	96
Configuring by Port List	96
Configuring by Port Range	98
Displaying Connection Status	99
Showing Port or Trunk Statistics	100
Displaying Statistical History	104
Displaying Transceiver Data	108
Configuring Transceiver Thresholds	109
Trunk Configuration	111
Configuring a Static Trunk	113
Configuring a Dynamic Trunk	115
Displaying LACP Port Counters	121
Displaying LACP Settings and Status for the Local Side	122

Displaying LACP Settings and Status for the Remote Side	124
Configuring Load Balancing	125
Saving Power	127
Configuring Local Port Mirroring	129
Configuring Remote Port Mirroring	130
Traffic Segmentation	135
Enabling Traffic Segmentation	135
Configuring Uplink and Downlink Ports	136
5 VLAN Configuration	139
IEEE 802.1Q VLANs	139
Configuring VLAN Groups	142
Adding Static Members to VLANs	144
Protocol VLANs	148
Configuring Protocol VLAN Groups	149
Mapping Protocol Groups to Interfaces	150
Configuring MAC-based VLANs	152
6 Address Table Settings	155
Configuring MAC Address Learning	155
Setting Static Addresses	157
Changing the Aging Time	159
Displaying the Dynamic Address Table	159
Clearing the Dynamic Address Table	161
Issuing MAC Address Traps	162
7 Spanning Tree Algorithm	165
Overview	165
Configuring Loopback Detection	167
Configuring Global Settings for STA	169
Displaying Global Settings for STA	174
Configuring Interface Settings for STA	175
Displaying Interface Settings for STA	180
Configuring Multiple Spanning Trees	183
Configuring Interface Settings for MSTP	187
8 Congestion Control	189

Rate Limiting	189
Storm Control	190
9 Class of Service	193
Layer 2 Queue Settings	193
Setting the Default Priority for Interfaces	193
Selecting the Queue Mode	194
Layer 3/4 Priority Settings	197
Setting Priority Processing to DSCP or CoS	198
Mapping Ingress DSCP Values to Internal DSCP Values	199
Mapping CoS Priorities to Internal DSCP Values	201
10 Quality of Service	205
Overview	205
Configuring a Class Map	206
Creating QoS Policies	210
Attaching a Policy Map to a Port	214
11 VoIP Traffic Configuration	217
Overview	217
Configuring VoIP Traffic	218
Configuring Telephony OUI	219
Configuring VoIP Traffic Ports	220
12 Security Measures	223
AAA (Authentication, Authorization and Accounting)	224
Configuring Local/Remote Logon Authentication	225
Configuring Remote Logon Authentication Servers	226
Configuring AAA Accounting	231
Configuring AAA Authorization	237
Configuring User Accounts	241
Network Access (MAC Address Authentication)	243
Configuring Global Settings for Network Access	245
Configuring Network Access for Ports	246
Configuring a MAC Address Filter	248
Displaying Secure MAC Address Information	249
Configuring HTTPS	251

Configuring Global Settings for HTTPS	251
Replacing the Default Secure-site Certificate	252
Configuring the Secure Shell	254
Configuring the SSH Server	256
Generating the Host Key Pair	258
Importing User Public Keys	259
Access Control Lists	261
Showing TCAM Utilization	262
Setting the ACL Name and Type	264
Configuring a Standard IPv4 ACL	266
Configuring an Extended IPv4 ACL	267
Configuring a Standard IPv6 ACL	269
Configuring an Extended IPv6 ACL	271
Configuring a MAC ACL	273
Configuring an ARP ACL	275
Binding a Port to an Access Control List	277
Showing ACL Hardware Counters	278
ARP Inspection	279
Configuring Global Settings for ARP Inspection	280
Configuring VLAN Settings for ARP Inspection	282
Configuring Interface Settings for ARP Inspection	284
Displaying ARP Inspection Statistics	285
Displaying the ARP Inspection Log	286
Filtering IP Addresses for Management Access	287
Configuring Port Security	289
Configuring 802.1X Port Authentication	291
Configuring 802.1X Global Settings	293
Configuring Port Authenticator Settings for 802.1X	294
Displaying 802.1X Statistics	298
DHCP Snooping	299
DHCP Snooping Global Configuration	302
DHCP Snooping VLAN Configuration	303
Configuring Ports for DHCP Snooping	304
Displaying DHCP Snooping Binding Information	306
DoS Protection	307

IPv4 Source Guard	308
Configuring Ports for IPv4 Source Guard	308
Configuring Static Bindings for IPv4 Source Guard	311
Displaying Information for Dynamic IPv4 Source Guard Bindings	313
13 Basic Administration Protocols	315
Configuring Event Logging	316
System Log Configuration	316
Remote Log Configuration	318
Sending Simple Mail Transfer Protocol Alerts	319
Link Layer Discovery Protocol	321
Setting LLDP Timing Attributes	321
Configuring LLDP Interface Attributes	323
Configuring LLDP Interface Civic-Address	327
Displaying LLDP Local Device Information	329
Displaying LLDP Remote Device Information	333
Displaying Device Statistics	341
Power over Ethernet	343
Setting the Switch's Overall PoE Power Budget	344
Setting the Port PoE Power Budget	345
Simple Network Management Protocol	347
Configuring Global Settings for SNMP	349
Setting the Local Engine ID	350
Specifying a Remote Engine ID	351
Setting SNMPv3 Views	353
Configuring SNMPv3 Groups	355
Setting Community Access Strings	362
Configuring Local SNMPv3 Users	363
Configuring Remote SNMPv3 Users	365
Specifying Trap Managers	368
Creating SNMP Notification Logs	372
Showing SNMP Statistics	374
Remote Monitoring	376
Configuring RMON Alarms	377
Configuring RMON Events	379

Configuring RMON History Samples	381
Configuring RMON Statistical Samples	384
Setting a Time Range	387
LBD Configuration	389
Configuring Global Settings for LBD	390
Configuring Interface Settings for LBD	392
14 Multicast Filtering	393
Overview	393
Layer 2 IGMP (Snooping and Query for IPv4)	394
Configuring IGMP Snooping and Query Parameters	396
Specifying Static Interfaces for a Multicast Router	400
Assigning Interfaces to Multicast Services	402
Setting IGMP Snooping Status per Interface	404
Filtering IGMP Query Packets and Multicast Data	410
Displaying Multicast Groups Discovered by IGMP Snooping	411
Displaying IGMP Snooping Statistics	412
Filtering and Throttling IGMP Groups	416
Enabling IGMP Filtering and Throttling	416
Configuring IGMP Filter Profiles	417
Configuring IGMP Filtering and Throttling for Interfaces	419
MLD Snooping (Snooping and Query for IPv4)	421
Configuring MLD Snooping and Query Parameters	421
Setting Immediate Leave Status for MLD Snooping per Interface	423
Specifying Static Interfaces for an IPv6 Multicast Router	424
Assigning Interfaces to IPv6 Multicast Services	426
Showing MLD Snooping Groups and Source List	428
15 IP Tools	431
Using the Ping Function	431
Using the Trace Route Function	432
Address Resolution Protocol	434
Displaying Dynamic or Local ARP Entries	435
16 IP Services	437
Domain Name Service	437

Configuring General DNS Service Parameters	437	
Configuring a List of Domain Names	438	
Configuring a List of Name Servers	440	
Configuring Static DNS Host to Address Entries	441	
Displaying the DNS Cache	442	
Dynamic Host Configuration Protocol	443	
Specifying a DHCP Client Identifier	444	
Configuring DHCP Relay Service	445	
Enabling DHCP Dynamic Provision	449	
17 IP Configuration	451	
Setting the Switch's IP Address (IP Version 4)	451	
Configuring the IPv4 Default Gateway	451	
Configuring IPv4 Interface Settings	452	
Setting the Switch's IP Address (IP Version 6)	455	
Configuring the IPv6 Default Gateway	456	
Configuring IPv6 Interface Settings	457	
Configuring an IPv6 Address	461	
Showing IPv6 Addresses	464	
Showing the IPv6 Neighbor Cache	465	
Showing IPv6 Statistics	466	
Showing the MTU for Responding Destinations	472	
<hr/>		
Section III	Appendices	473
A	Software Specifications	475
Software Features		475
Management Features		476
Standards		477
Management Information Bases		477
B	Troubleshooting	479
Problems Accessing the Management Interface		479
Using System Logs		480
C	License Information	481

The GNU General Public License	481
Glossary	485
Index	493

Figures

Figure 1: Dashboard	42
Figure 2: Home Page	44
Figure 3: Front Panel Indicators	45
Figure 4: System Information	62
Figure 5: General Switch Information	64
Figure 6: Configuring Support for Jumbo Frames	65
Figure 7: Displaying Bridge Extension Configuration	66
Figure 8: Copy Firmware	68
Figure 9: Saving the Running Configuration	70
Figure 10: Setting Start-Up Files	70
Figure 11: Displaying System Files	71
Figure 12: Configuring Automatic Code Upgrade	75
Figure 13: Manually Setting the System Clock	76
Figure 14: Setting the Polling Interval for SNTP	77
Figure 15: Configuring NTP	78
Figure 16: Specifying SNTP Time Servers	79
Figure 17: Adding an NTP Time Server	80
Figure 18: Showing the NTP Time Server List	80
Figure 19: Adding an NTP Authentication Key	81
Figure 20: Showing the NTP Authentication Key List	82
Figure 21: Setting the Time Zone	83
Figure 22: Configuring Summer Time	85
Figure 23: Console Port Settings	86
Figure 24: Telnet Connection Settings	88
Figure 25: Displaying CPU Utilization	89
Figure 26: Configuring CPU Guard	90
Figure 27: Displaying Memory Utilization	91
Figure 28: Restarting the Switch (Immediately)	93
Figure 29: Restarting the Switch (In)	93

Figure 30: Restarting the Switch (At)	94
Figure 31: Restarting the Switch (Regularly)	94
Figure 32: Configuring Connections by Port List	98
Figure 33: Configuring Connections by Port Range	99
Figure 34: Displaying Port Information	100
Figure 35: Showing Port Statistics (Table)	103
Figure 36: Showing Port Statistics (Chart)	104
Figure 37: Configuring a History Sample	106
Figure 38: Showing Entries for History Sampling	106
Figure 39: Showing Status of Statistical History Sample	107
Figure 40: Showing Current Statistics for a History Sample	107
Figure 41: Showing Ingress Statistics for a History Sample	108
Figure 42: Displaying Transceiver Data	109
Figure 43: Configuring Transceiver Thresholds	111
Figure 44: Configuring Static Trunks	113
Figure 45: Creating Static Trunks	114
Figure 46: Adding Static Trunks Members	114
Figure 47: Configuring Connection Parameters for a Static Trunk	115
Figure 48: Showing Information for Static Trunks	115
Figure 49: Configuring Dynamic Trunks	115
Figure 50: Configuring the LACP Aggregator Admin Key	118
Figure 51: Enabling LACP on a Port	119
Figure 52: Configuring LACP Parameters on a Port	120
Figure 53: Showing Members of a Dynamic Trunk	120
Figure 54: Configuring Connection Settings for a Dynamic Trunk	121
Figure 55: Showing Connection Parameters for Dynamic Trunks	121
Figure 56: Displaying LACP Port Counters	122
Figure 57: Displaying LACP Port Internal Information	124
Figure 58: Displaying LACP Port Remote Information	125
Figure 59: Configuring Load Balancing	127
Figure 60: Enabling Power Savings	128
Figure 61: Configuring Local Port Mirroring	129
Figure 62: Configuring Local Port Mirroring	130
Figure 63: Displaying Local Port Mirror Sessions	130
Figure 64: Configuring Remote Port Mirroring	131

Figure 65: Configuring Remote Port Mirroring (Source)	134
Figure 66: Configuring Remote Port Mirroring (Intermediate)	134
Figure 67: Configuring Remote Port Mirroring (Destination)	134
Figure 68: Enabling Traffic Segmentation	136
Figure 69: Configuring Members for Traffic Segmentation	137
Figure 70: Showing Traffic Segmentation Members	138
Figure 71: VLAN Compliant and VLAN Non-compliant Devices	140
Figure 72: Creating Static VLANs	143
Figure 73: Modifying Settings for Static VLANs	143
Figure 74: Showing Static VLANs	144
Figure 75: Configuring Static Members by VLAN Index	146
Figure 76: Configuring Static VLAN Members by Interface	147
Figure 77: Configuring Static VLAN Members by Interface Range	148
Figure 78: Configuring Protocol VLANs	150
Figure 79: Displaying Protocol VLANs	150
Figure 80: Assigning Interfaces to Protocol VLANs	152
Figure 81: Showing the Interface to Protocol Group Mapping	152
Figure 82: Configuring MAC-Based VLANs	154
Figure 83: Showing MAC-Based VLANs	154
Figure 84: Configuring MAC Address Learning	156
Figure 85: Configuring Static MAC Addresses	158
Figure 86: Displaying Static MAC Addresses	158
Figure 87: Setting the Address Aging Time	159
Figure 88: Displaying the Dynamic MAC Address Table	160
Figure 89: Clearing Entries in the Dynamic MAC Address Table	161
Figure 90: Issuing MAC Address Traps (Global Configuration)	162
Figure 91: Issuing MAC Address Traps (Interface Configuration)	163
Figure 92: STP Root Ports and Designated Ports	166
Figure 93: MSTP Region, Internal Spanning Tree, Multiple Spanning Tree	166
Figure 94: Spanning Tree – Common Internal, Common, Internal	167
Figure 95: Configuring Port Loopback Detection	169
Figure 96: Configuring Global Settings for STA (STP)	173
Figure 97: Configuring Global Settings for STA (RSTP)	173
Figure 98: Configuring Global Settings for STA (MSTP)	174
Figure 99: Displaying Global Settings for STA	175

Figure 100: Determining the Root Port	177
Figure 101: Configuring Interface Settings for STA	180
Figure 102: STA Port Roles	181
Figure 103: Displaying Interface Settings for STA	182
Figure 104: Creating an MST Instance	184
Figure 105: Displaying MST Instances	184
Figure 106: Modifying the Priority for an MST Instance	185
Figure 107: Displaying Global Settings for an MST Instance	185
Figure 108: Adding a VLAN to an MST Instance	186
Figure 109: Displaying Members of an MST Instance	186
Figure 110: Configuring MSTP Interface Settings	188
Figure 111: Displaying MSTP Interface Settings	188
Figure 112: Configuring Rate Limits	190
Figure 113: Configuring Storm Control	191
Figure 114: Setting the Default Port Priority	194
Figure 115: Setting the Queue Mode (Strict)	196
Figure 116: Setting the Queue Mode (WRR)	196
Figure 117: Setting the Queue Mode (Strict and WRR)	197
Figure 118: Setting the Trust Mode	199
Figure 119: Configuring DSCP to DSCP Internal Mapping	200
Figure 120: Showing DSCP to DSCP Internal Mapping	201
Figure 121: Configuring CoS to DSCP Internal Mapping	202
Figure 122: Showing CoS to DSCP Internal Mapping	203
Figure 123: Configuring a Class Map	207
Figure 124: Showing Class Maps	208
Figure 125: Adding Rules to a Class Map	209
Figure 126: Showing the Rules for a Class Map	209
Figure 127: Configuring a Policy Map	212
Figure 128: Showing Policy Maps	212
Figure 129: Adding Rules to a Policy Map	213
Figure 130: Showing the Rules for a Policy Map	214
Figure 131: Attaching a Policy Map to a Port	215
Figure 132: Configuring a Voice VLAN	219
Figure 133: Configuring an OUI Telephony List	220
Figure 134: Showing an OUI Telephony List	220

Figure 135: Configuring Port Settings for a Voice VLAN	222
Figure 136: Configuring the Authentication Sequence	226
Figure 137: Authentication Server Operation	226
Figure 138: Configuring Remote Authentication Server (RADIUS)	229
Figure 139: Configuring Remote Authentication Server (TACACS+)	230
Figure 140: Configuring AAA Server Groups	230
Figure 141: Showing AAA Server Groups	231
Figure 142: Configuring Global Settings for AAA Accounting	233
Figure 143: Configuring AAA Accounting Methods	234
Figure 144: Showing AAA Accounting Methods	235
Figure 145: Configuring AAA Accounting Service for 802.1X Service	235
Figure 146: Configuring AAA Accounting Service for Command Service	236
Figure 147: Configuring AAA Accounting Service for Exec Service	236
Figure 148: Displaying a Summary of Applied AAA Accounting Methods	237
Figure 149: Displaying Statistics for AAA Accounting Sessions	237
Figure 150: Configuring AAA Authorization Methods	239
Figure 151: Showing AAA Authorization Methods	239
Figure 152: Configuring AAA Authorization Methods for Exec Service	240
Figure 153: Displaying the Applied AAA Authorization Method	240
Figure 154: Configuring User Accounts	242
Figure 155: Showing User Accounts	243
Figure 156: Configuring Global Settings for Network Access	246
Figure 157: Configuring Interface Settings for Network Access	247
Figure 158: Configuring a MAC Address Filter for Network Access	248
Figure 159: Showing the MAC Address Filter Table for Network Access	249
Figure 160: Showing Addresses Authenticated for Network Access	250
Figure 161: Configuring HTTPS	252
Figure 162: Downloading the Secure-Site Certificate	254
Figure 163: Configuring the SSH Server	257
Figure 164: Generating the SSH Host Key Pair	258
Figure 165: Showing the SSH Host Key Pair	259
Figure 166: Copying the SSH User's Public Key	260
Figure 167: Showing the SSH User's Public Key	261
Figure 168: Showing TCAM Utilization	264
Figure 169: Creating an ACL	265

Figure 170: Showing a List of ACLs	265
Figure 171: Configuring a Standard IPv4 ACL	267
Figure 172: Configuring an Extended IPv4 ACL	269
Figure 173: Configuring a Standard IPv6 ACL	270
Figure 174: Configuring an Extended IPv6 ACL	273
Figure 175: Configuring a MAC ACL	275
Figure 176: Configuring a ARP ACL	277
Figure 177: Binding a Port to an ACL	278
Figure 178: Showing ACL Statistics	279
Figure 179: Configuring Global Settings for ARP Inspection	282
Figure 180: Configuring VLAN Settings for ARP Inspection	283
Figure 181: Configuring Interface Settings for ARP Inspection	284
Figure 182: Displaying Statistics for ARP Inspection	286
Figure 183: Displaying the ARP Inspection Log	287
Figure 184: Creating an IP Address Filter for Management Access	288
Figure 185: Showing IP Addresses Authorized for Management Access	289
Figure 186: Configuring Port Security	291
Figure 187: Configuring Port Authentication	292
Figure 188: Configuring Global Settings for 802.1X Port Authentication	293
Figure 189: Configuring Interface Settings for 802.1X Port Authenticator	297
Figure 190: Showing Statistics for 802.1X Port Authenticator	299
Figure 191: Configuring Global Settings for DHCP Snooping	303
Figure 192: Configuring DHCP Snooping on a VLAN	304
Figure 193: Configuring the Port Mode for DHCP Snooping	305
Figure 194: Displaying the Binding Table for DHCP Snooping	307
Figure 195: Protecting Against DoS Attacks	308
Figure 196: Setting the Filter Type for IPv4 Source Guard	310
Figure 197: Configuring Static Bindings for IPv4 Source Guard	313
Figure 198: Configuring Static Bindings for IPv4 Source Guard	313
Figure 199: Showing the IPv4 Source Guard Binding Table	314
Figure 200: Configuring Settings for System Memory Logs	317
Figure 201: Showing Error Messages Logged to System Memory	318
Figure 202: Configuring Settings for Remote Logging of Error Messages	319
Figure 203: Configuring SMTP Alert Messages	320
Figure 204: Configuring LLDP Timing Attributes	323

Figure 205: Configuring LLDP Interface Attributes	327
Figure 206: Configuring the Civic Address for an LLDP Interface	328
Figure 207: Showing the Civic Address for an LLDP Interface	329
Figure 208: Displaying Local Device Information for LLDP (General)	332
Figure 209: Displaying Local Device Information for LLDP (Port)	332
Figure 210: Displaying Local Device Information for LLDP (Port Details)	332
Figure 211: Displaying Remote Device Information for LLDP (Port)	339
Figure 212: Displaying Remote Device Information for LLDP (Port Details)	340
Figure 213: Displaying Remote Device Information for LLDP (End Node)	341
Figure 214: Displaying LLDP Device Statistics (General)	343
Figure 215: Displaying LLDP Device Statistics (Port)	343
Figure 216: Setting the Switch's PoE Budget	345
Figure 217: Setting a Port's PoE Budget	347
Figure 218: Configuring Global Settings for SNMP	350
Figure 219: Configuring the Local Engine ID for SNMP	351
Figure 220: Configuring a Remote Engine ID for SNMP	352
Figure 221: Showing Remote Engine IDs for SNMP	352
Figure 222: Creating an SNMP View	354
Figure 223: Showing SNMP Views	354
Figure 224: Adding an OID Subtree to an SNMP View	355
Figure 225: Showing the OID Subtree Configured for SNMP Views	355
Figure 226: Creating an SNMP Group	361
Figure 227: Showing SNMP Groups	361
Figure 228: Setting Community Access Strings	362
Figure 229: Showing Community Access Strings	363
Figure 230: Configuring Local SNMPv3 Users	364
Figure 231: Showing Local SNMPv3 Users	365
Figure 232: Changing a Local SNMPv3 User Group	365
Figure 233: Configuring Remote SNMPv3 Users	367
Figure 234: Showing Remote SNMPv3 Users	368
Figure 235: Configuring Trap Managers (SNMPv1)	371
Figure 236: Configuring Trap Managers (SNMPv2c)	371
Figure 237: Configuring Trap Managers (SNMPv3)	372
Figure 238: Showing Trap Managers	372
Figure 239: Creating SNMP Notification Logs	374

Figure 240: Showing SNMP Notification Logs	374
Figure 241: Showing SNMP Statistics	376
Figure 242: Configuring an RMON Alarm	378
Figure 243: Showing Configured RMON Alarms	379
Figure 244: Configuring an RMON Event	381
Figure 245: Showing Configured RMON Events	381
Figure 246: Configuring an RMON History Sample	383
Figure 247: Showing Configured RMON History Samples	383
Figure 248: Showing Collected RMON History Samples	384
Figure 249: Configuring an RMON Statistical Sample	385
Figure 250: Showing Configured RMON Statistical Samples	386
Figure 251: Showing Collected RMON Statistical Samples	386
Figure 252: Setting the Name of a Time Range	388
Figure 253: Showing a List of Time Ranges	388
Figure 254: Add a Rule to a Time Range	389
Figure 255: Showing the Rules Configured for a Time Range	389
Figure 256: Configuring Global Settings for LBD	391
Figure 257: Configuring Interface Settings for LBD	392
Figure 258: Multicast Filtering Concept	393
Figure 259: Configuring General Settings for IGMP Snooping	399
Figure 260: Configuring a Static Interface for a Multicast Router	401
Figure 261: Showing Static Interfaces Attached a Multicast Router	401
Figure 262: Showing Current Interfaces Attached a Multicast Router	402
Figure 263: Assigning an Interface to a Multicast Service	403
Figure 264: Showing Static Interfaces Assigned to a Multicast Service	404
Figure 265: Configuring IGMP Snooping on a VLAN	409
Figure 266: Showing Interface Settings for IGMP Snooping	409
Figure 267: Dropping IGMP Query or Multicast Data Packets	410
Figure 268: Showing Multicast Groups Learned by IGMP Snooping	411
Figure 269: Displaying IGMP Snooping Statistics – Query	414
Figure 270: Displaying IGMP Snooping Statistics – VLAN	415
Figure 271: Displaying IGMP Snooping Statistics – Port	415
Figure 272: Enabling IGMP Filtering and Throttling	417
Figure 273: Creating an IGMP Filtering Profile	418
Figure 274: Showing the IGMP Filtering Profiles Created	418

Figure 275: Adding Multicast Groups to an IGMP Filtering Profile	419
Figure 276: Showing the Groups Assigned to an IGMP Filtering Profile	419
Figure 277: Configuring IGMP Filtering and Throttling Interface Settings	421
Figure 278: Configuring General Settings for MLD Snooping	423
Figure 279: Configuring Immediate Leave for MLD Snooping	424
Figure 280: Configuring a Static Interface for an IPv6 Multicast Router	425
Figure 281: Showing Static Interfaces Attached an IPv6 Multicast Router	425
Figure 282: Showing Current Interfaces Attached an IPv6 Multicast Router	425
Figure 283: Assigning an Interface to an IPv6 Multicast Service	427
Figure 284: Showing Static Interfaces Assigned to an IPv6 Multicast Service	427
Figure 285: Showing Current Interfaces Assigned to an IPv6 Multicast Service	428
Figure 286: Showing IPv6 Multicast Services and Corresponding Sources	429
Figure 287: Pinging a Network Device	432
Figure 288: Tracing the Route to a Network Device	434
Figure 289: Displaying ARP Entries	435
Figure 290: Configuring General Settings for DNS	438
Figure 291: Configuring a List of Domain Names for DNS	439
Figure 292: Showing the List of Domain Names for DNS	440
Figure 293: Configuring a List of Name Servers for DNS	441
Figure 294: Showing the List of Name Servers for DNS	441
Figure 295: Configuring Static Entries in the DNS Table	442
Figure 296: Showing Static Entries in the DNS Table	442
Figure 297: Showing Entries in the DNS Cache	443
Figure 298: Specifying a DHCP Client Identifier	445
Figure 299: Layer 3 DHCP Relay Service	446
Figure 300: Configuring DHCP Relay Service	449
Figure 301: Enabling Dynamic Provisioning via DHCP	450
Figure 302: Configuring the IPv4 Default Gateway	452
Figure 303: Configuring a Static IPv4 Address	454
Figure 304: Configuring a Dynamic IPv4 Address	454
Figure 305: Showing the Configured IPv4 Address for an Interface	455
Figure 306: Configuring the IPv6 Default Gateway	456
Figure 307: Configuring General Settings for an IPv6 Interface	461
Figure 308: Configuring an IPv6 Address	463
Figure 309: Showing Configured IPv6 Addresses	465

Figure 310: Showing IPv6 Neighbors	466
Figure 311: Showing IPv6 Statistics (IPv6)	470
Figure 312: Showing IPv6 Statistics (ICMPv6)	471
Figure 313: Showing IPv6 Statistics (UDP)	471
Figure 314: Showing Reported MTU Values	472

Tables

Table 1: Key Features	29
Table 2: System Defaults	35
Table 3: Web Page Configuration Buttons	44
Table 4: Switch Main Menu	46
Table 5: Predefined Summer-Time Parameters	84
Table 6: Port Statistics	100
Table 7: LACP Port Counters	121
Table 8: LACP Internal Configuration Information	122
Table 9: LACP Remote Device Configuration Information	124
Table 10: Traffic Segmentation Forwarding	136
Table 11: Recommended STA Path Cost Range	176
Table 12: Default STA Path Costs	177
Table 13: Default Mapping of DSCP Values to Internal PHB/Drop Values	200
Table 14: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence	202
Table 15: Dynamic QoS Profiles	244
Table 16: HTTPS System Support	251
Table 17: ARP Inspection Statistics	285
Table 18: ARP Inspection Log	286
Table 19: 802.1X Statistics	298
Table 20: Logging Levels	316
Table 21: LLDP MED Location CA Types	327
Table 22: Chassis ID Subtype	329
Table 23: System Capabilities	330
Table 24: Port ID Subtype	331
Table 25: Remote Port Auto-Negotiation Advertised Capability	334
Table 26: Maximum Number of Ports Providing Simultaneous Power	345
Table 27: SNMPv3 Security Models and Levels	348
Table 28: Supported Notification Messages	357
Table 29: Address Resolution Protocol	434

Table 30: Options 60, 66 and 67 Statements	444
Table 31: Options 55 and 124 Statements	444
Table 32: Show IPv6 Neighbors - display description	465
Table 33: Show IPv6 Statistics - display description	467
Table 34: Show MTU - display description	472
Table 35: Troubleshooting Chart	479

Section I

Getting Started

This section provides an overview of the switch, and introduces some basic concepts about network switches. It also describes the basic settings required to access the management interface.

This section includes these chapters:

- ◆ ["Introduction" on page 29](#)

1

Introduction

This switch provides a broad range of features for Layer 2 switching and Layer 3 routing. It includes a management agent that allows you to configure the features listed in this manual. The default configuration can be used for most of the features provided by this switch. However, there are many options that you should configure to maximize the switch's performance for your particular network environment.

Key Features

Table 1: Key Features

Feature	Description
Configuration Backup and Restore	Using management station or TFTP server
Authentication	Console, Telnet, web – user name/password, RADIUS, TACACS+ Port – IEEE 802.1X, MAC address filtering SNMP v1/2c - Community strings SNMP version 3 – MD5 or SHA password Telnet – SSH Web – HTTPS
General Security Measures	AAA ARP Inspection DHCP Snooping (with Option 82 relay information) DoS Protection IP Source Guard Port Authentication – IEEE 802.1X Port Security – MAC address filtering
Access Control Lists	Supports up to 256 ACLs, 128 rules per ACL, and 512 rules per system
DHCP/DHCPv6	Client, Relay, Relay Option 82
Port Configuration	Speed, duplex mode, and flow control
Port Trunking	Supports up to 8 trunks – static or dynamic trunking (LACP)
Port Mirroring	3 sessions, one or more source ports to an analysis port
Congestion Control	Rate Limiting Throttling for broadcast, multicast, unknown unicast storms
Address Table	8K MAC addresses in the forwarding table (shared with L2 unicast, L2 multicast, IPv4 multicast, IPv6 multicast); 1K static MAC addresses; 512 L2 IPv4 multicast groups (shared with MAC address table)
IP Version 4 and 6	Supports IPv4 and IPv6 addressing and management

Table 1: Key Features (Continued)

Feature	Description
IEEE 802.1D Bridge	Supports dynamic data switching and addresses learning
Store-and-Forward Switching	Supported to ensure wire-speed switching while eliminating bad frames
Spanning Tree Algorithm	Supports standard STP, Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Trees (MSTP)
Virtual LANs	Up to 4094 using IEEE 802.1Q, port-based, protocol-based, voice VLANs, and QinQ tunnel
Traffic Prioritization	Default port priority, traffic class map, queue scheduling, IP Precedence, or Differentiated Services Code Point (DSCP)
Quality of Service	Supports Differentiated Services (DiffServ)
Link Layer Discovery Protocol	Used to discover basic information about neighboring devices
Multicast Filtering	Supports IGMP snooping and query for Layer 2

Description of Software Features

The switch provides a wide range of advanced performance enhancing features. Flow control eliminates the loss of packets due to bottlenecks caused by port saturation. Storm suppression prevents broadcast, multicast, and unknown unicast traffic storms from engulfing the network. Untagged (port-based), tagged, and protocol-based VLANs, plus support for automatic GVRP VLAN registration provide traffic security and efficient use of network bandwidth. CoS priority queueing ensures the minimum delay for moving real-time multimedia data across the network. While multicast filtering provides support for real-time network applications.

Some of the management features are briefly described below.

Configuration Backup and Restore You can save the current configuration settings to a file on the management station (using the web interface) or an TFTP server (using the web or console interface), and later download this file to restore the switch configuration settings.

Authentication This switch authenticates management access via the console port, Telnet, or a web browser. User names and passwords can be configured locally or can be verified via a remote authentication server (i.e., RADIUS or TACACS+). Port-based authentication is also supported via the IEEE 802.1X protocol. This protocol uses Extensible Authentication Protocol over LANs (EAPOL) to request user credentials from the 802.1X client, and then uses the EAP between the switch and the authentication server to verify the client's right to access the network via an authentication server (i.e., RADIUS or TACACS+ server).

Other authentication options include HTTPS for secure management access via the web, SSH for secure management access over a Telnet-equivalent connection, SNMP Version 3, IP address filtering for SNMP/Telnet/web management access. MAC address filtering and IP source guard also provide authenticated port access. While DHCP snooping is provided to prevent malicious attacks from insecure ports.

Access Control Lists ACLs provide packet filtering for IP frames (based on address, protocol, TCP/UDP port number or TCP control code) or any frames (based on MAC address or Ethernet type). ACLs can be used to improve performance by blocking unnecessary network traffic or to implement security controls by restricting access to specific network resources or protocols.

Port Configuration You can manually configure the speed, duplex mode, and flow control used on specific ports, or use auto-negotiation to detect the connection settings used by the attached device. Use full-duplex mode on ports whenever possible to double the throughput of switch connections. Flow control should also be enabled to control network traffic during periods of congestion and prevent the loss of packets when port buffer thresholds are exceeded. The switch supports flow control based on the IEEE 802.3x standard (now incorporated in IEEE 802.3-2002).

Rate Limiting This feature controls the maximum rate for traffic transmitted or received on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into or out of the network. Packets that exceed the acceptable amount of traffic are dropped.

Port Mirroring The switch can unobtrusively mirror traffic from any port to a monitor port. You can then attach a protocol analyzer or RMON probe to this port to perform traffic analysis and verify connection integrity.

Port Trunking Ports can be combined into an aggregate connection. Trunks can be manually set up or dynamically configured using Link Aggregation Control Protocol (LACP – IEEE 802.3-2005). The additional ports dramatically increase the throughput across any connection, and provide redundancy by taking over the load if a port in the trunk should fail. The switch supports up to 8 trunks.

Storm Control Broadcast, multicast and unknown unicast storm suppression prevents traffic from overwhelming the network. When enabled on a port, the level of traffic passing through the port is restricted. If traffic rises above a pre-defined threshold, it will be throttled until the level falls back beneath the threshold.

Static MAC Addresses A static address can be assigned to a specific interface on this switch. Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table. Static addresses can be used to provide network security by restricting access for a known host to a specific port.

IP Address Filtering Access to insecure ports can be controlled using DHCP Snooping which filters ingress traffic based on static IP addresses and addresses stored in the DHCP Snooping table. Traffic can also be restricted to specific source IP addresses or source IP/MAC address pairs based on static entries or entries stored in the DHCP Snooping table.

IEEE 802.1D Bridge The switch supports IEEE 802.1D transparent bridging. The address table facilitates data switching by learning addresses, and then filtering or forwarding traffic based on this information. The address table supports up to 16K addresses.

Store-and-Forward Switching The switch copies each frame into its memory before forwarding them to another port. This ensures that all frames are a standard Ethernet size and have been verified for accuracy with the cyclic redundancy check (CRC). This prevents bad frames from entering the network and wasting bandwidth.

To avoid dropping frames on congested ports, the switch provides 12 Mbits for frame buffering. This buffer can queue packets awaiting transmission on congested networks.

Spanning Tree Algorithm The switch supports these spanning tree protocols:

- ◆ Spanning Tree Protocol (STP, IEEE 802.1D) – This protocol provides loop detection. When there are multiple physical paths between segments, this protocol will choose a single path and disable all others to ensure that only one route exists between any two stations on the network. This prevents the creation of network loops. However, if the chosen path should fail for any reason, an alternate path will be activated to maintain the connection.
- ◆ Rapid Spanning Tree Protocol (RSTP, IEEE 802.1w) – This protocol reduces the convergence time for network topology changes to about 3 to 5 seconds, compared to 30 seconds or more for the older IEEE 802.1D STP standard. It is intended as a complete replacement for STP, but can still interoperate with switches running the older standard by automatically reconfiguring ports to STP-compliant mode if they detect STP protocol messages from attached devices.
- ◆ Multiple Spanning Tree Protocol (MSTP, IEEE 802.1s) – This protocol is a direct extension of RSTP. It can provide an independent spanning tree for different VLANs. It simplifies network management, provides for even faster convergence than RSTP by limiting the size of each region, and prevents VLAN

members from being segmented from the rest of the group (as sometimes occurs with IEEE 802.1D STP).

Virtual LANs The switch supports up to 4094 VLANs. A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. The switch supports tagged VLANs based on the IEEE 802.1Q standard. Members of VLAN groups can be dynamically learned via GVRP, or ports can be manually assigned to a specific set of VLANs. This allows the switch to restrict traffic to the VLAN groups to which a user has been assigned. By segmenting your network into VLANs, you can:

- ◆ Eliminate broadcast storms which severely degrade performance in a flat network.
- ◆ Simplify network management for node changes/moves by remotely configuring VLAN membership for any port, rather than having to manually change the network connection.
- ◆ Provide data security by restricting all traffic to the originating VLAN, except where a connection is explicitly defined via the switch's routing service.
- ◆ Use private VLANs to restrict traffic to pass only between data ports and the uplink ports, thereby isolating adjacent ports within the same VLAN, and allowing you to limit the total number of VLANs that need to be configured.
- ◆ Use protocol VLANs to restrict traffic to specified interfaces based on protocol type.

Traffic Prioritization This switch prioritizes each packet based on the required level of service, using eight priority queues with strict priority, Weighted Round Robin (WRR) scheduling, or a combination of strict and weighted queuing. It uses IEEE 802.1p and 802.1Q tags to prioritize incoming traffic based on input from the end-station application. These functions can be used to provide independent priorities for delay-sensitive data and best-effort data.

This switch also supports several common methods of prioritizing layer 3/4 traffic to meet application requirements. Traffic can be prioritized based on the priority bits in the IP frame's Type of Service (ToS) octet using DSCP, or IP Precedence. When these services are enabled, the priorities are mapped to a Class of Service value by the switch, and the traffic then sent to the corresponding output queue.

Quality of Service Differentiated Services (DiffServ) provides policy-based management mechanisms used for prioritizing network resources to meet the requirements of specific traffic types on a per-hop basis. Each packet is classified upon entry into the network based on access lists, IP Precedence or DSCP values, or VLAN lists. Using access lists

allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding.

Address Resolution Protocol The switch uses ARP to convert between IP addresses and MAC (hardware) addresses. This switch supports conventional ARP, which locates the MAC address corresponding to a given IP address. This allows the switch to use IP addresses for routing decisions and the corresponding MAC addresses to forward packets from one hop to the next.

Multicast Filtering Specific multicast traffic can be assigned to its own VLAN to ensure that it does not interfere with normal network traffic and to guarantee real-time delivery by setting the required priority level for the designated VLAN. The switch uses IGMP Snooping and Query for IPv4, and MLD Snooping and Query for IPv6 to manage multicast group registration.

Link Layer Discovery Protocol LLDP is used to discover basic information about neighboring devices within the local broadcast domain. LLDP is a Layer 2 protocol that advertises information about the sending device and collects information gathered from neighboring network nodes it discovers.

Advertised information is represented in Type Length Value (TLV) format according to the IEEE 802.1ab standard, and can include details such as device identification, capabilities and configuration settings. Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. The LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

System Defaults

The switch's system defaults are provided in the configuration file "Factory_Default_Config.cfg." To reset the switch defaults, this file should be set as the startup configuration file.

The following table lists some of the basic system defaults.

Table 2: System Defaults

Function	Parameter	Default
Console Port Connection	Baud Rate	115200 bps
	Data bits	8
	Stop bits	1
	Parity	none
	Local Console Timeout	600 seconds
Authentication and Security Measures	Privileged Exec Level	Username "admin" Password "admin"
	Normal Exec Level	Username "guest" Password "guest"
	Enable Privileged Exec from Normal Exec Level	Password "super"
	RADIUS Authentication	Disabled
	TACACS+ Authentication	Disabled
	802.1X Port Authentication	Disabled
	MAC Authentication	Disabled
	HTTPS	Enabled
	SSH	Disabled
	Port Security	Disabled
	IP Filtering	Disabled
	DHCP Snooping	Disabled
	IP Source Guard	Disabled (all ports)
Web Management	HTTP Server	Enabled
	HTTP Port Number	80
	HTTP Secure Server	Enabled
	HTTP Secure Server Port	443

Table 2: System Defaults (Continued)

Function	Parameter	Default
SNMP	SNMP Agent	Enabled
	Community Strings	"public" (read only) "private" (read/write)
	Traps	Authentication traps: enabled Link-up-down events: enabled
	SNMP V3	View: defaultview Group: public (read only); private (read/write)
Port Configuration	Admin Status	Enabled
	Auto-negotiation	Enabled
	Flow Control	Disabled
Port Trunking	Static Trunks	None
	LACP (all ports)	Disabled
Congestion Control	Rate Limiting	Disabled
	Storm Control	Broadcast: Enabled (64 kbits/sec) Multicast: Disabled Unknown Unicast: Disabled
Address Table	Aging Time	300 seconds
Spanning Tree Algorithm	Status	Enabled, RSTP (Defaults: RSTP standard)
	Edge Ports	Auto
LLDP	Status	Enabled
Virtual LANs	Default VLAN	1
	PVID	1
	Acceptable Frame Type	All
	Ingress Filtering	Disabled
	Switchport Mode (Egress Mode)	Hybrid
	GVRP (global)	Disabled
	GVRP (port interface)	Disabled
	QinQ Tunneling	Disabled
Traffic Prioritization	Ingress Port Priority	0
	Queue Mode	WRR
	Queue Weight	Queue: 0 1 2 3 4 5 6 7 Weight: 1 2 4 6 8 10 12 14
	Class of Service	Enabled
	IP DSCP Priority	Disabled

Table 2: System Defaults (Continued)

Function	Parameter	Default
IP Settings	Management. VLAN	VLAN 1
	IP Address	192.168.1.1
	Subnet Mask	255.255.255.0
	Default Gateway	Not configured
	DHCP	Client: Enabled
	BOOTP	Disabled
	ARP	Enabled Cache Timeout: 20 minutes
Multicast Filtering	IGMP Snooping (Layer 2)	Snooping: Enabled Querier: Disabled
	MLD Snooping (Layer 2 IPv6)	Snooping: Enabled Querier: Disabled
	IGMP Proxy Reporting	Disabled
System Log	Status	Enabled
	Messages Logged to RAM	Levels 0-7 (all)
	Messages Logged to Flash	Levels 0-3
SMTP Email Alerts	Event Handler	Enabled (but no server defined)
SNTP	Clock Synchronization	Disabled

Section II

Web Configuration

This section describes the basic switch features, along with a detailed description of how to configure each feature via a web browser.

This section includes these chapters:

- ◆ "Using the Web Interface" on page 41
- ◆ "Basic Management Tasks" on page 61
- ◆ "Interface Configuration" on page 95
- ◆ "VLAN Configuration" on page 139
- ◆ "Address Table Settings" on page 155
- ◆ "Spanning Tree Algorithm" on page 165
- ◆ "Congestion Control" on page 189
- ◆ "Class of Service" on page 193
- ◆ "Quality of Service" on page 205
- ◆ "VoIP Traffic Configuration" on page 217
- ◆ "Security Measures" on page 223
- ◆ "Basic Administration Protocols" on page 315
- ◆ "Multicast Filtering" on page 393
- ◆ "IP Tools" on page 431
- ◆ "IP Services" on page 437
- ◆ "IP Configuration" on page 451

2

Using the Web Interface

This switch provides an embedded HTTP web agent. Using a web browser you can configure the switch and view statistics to monitor network activity. The web agent can be accessed by any computer on the network using a standard web browser (Internet Explorer 9, Mozilla Firefox 39, or Google Chrome 44, or more recent versions).



Note: You can also use the Command Line Interface (CLI) to manage the switch over a serial connection to the console port or via Telnet. For more information on using the CLI, refer to the *CLI Reference Guide*.

Connecting to the Web Interface

Prior to accessing the switch from a web browser, be sure you have first performed the following tasks:

1. Configure the switch with a valid IP address, subnet mask, and default gateway using an out-of-band serial connection, BOOTP or DHCP protocol. (See “Initial Switch Configuration” in the *CLI Reference Guide*.)
2. Set user names and passwords using an out-of-band serial connection. Access to the web agent is controlled by the same user names and passwords as the onboard configuration program. (See “[Configuring User Accounts](#)” on [page 241](#).)
3. After you enter a user name and password, you will have access to the system configuration program.



Note: You are allowed three attempts to enter the correct password; on the third failed attempt the current connection is terminated.

Note: If you log into the web interface as guest (Normal Exec level), you can view the configuration settings or change the guest password. If you log in as “admin” (Privileged Exec level), you can change the settings on any page.

Note: If the path between your management station and this switch does not pass through any device that uses the Spanning Tree Algorithm, then you can set the switch port attached to your management station to fast forwarding (i.e., enable Admin Edge Port) to improve the switch’s response time to management

commands issued through the web interface. See [“Configuring Interface Settings for STA” on page 175.](#)

Note: Users are automatically logged off of the HTTP server or HTTPS server if no input is detected for 600 seconds.

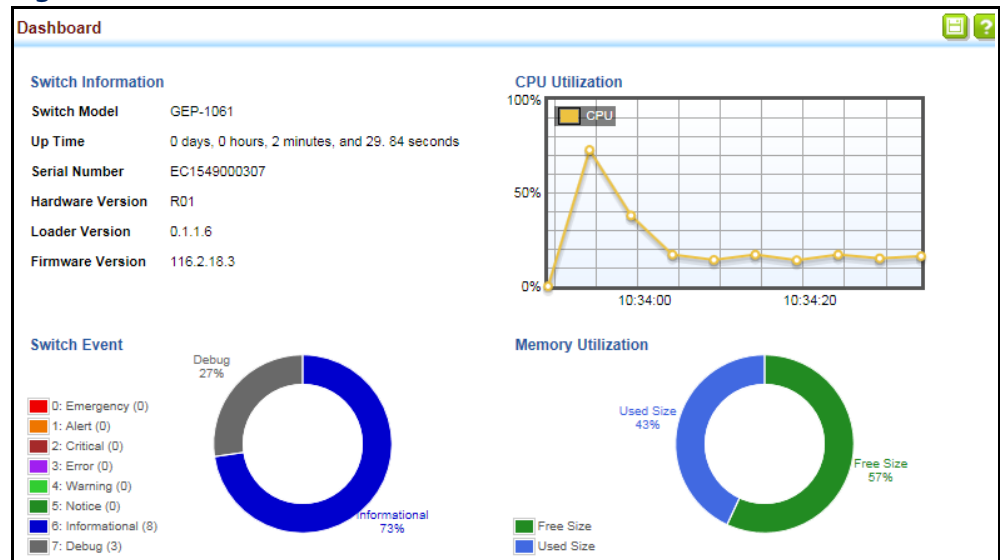
Note: Connection to the web interface is not supported for HTTPS using an IPv6 link local address.

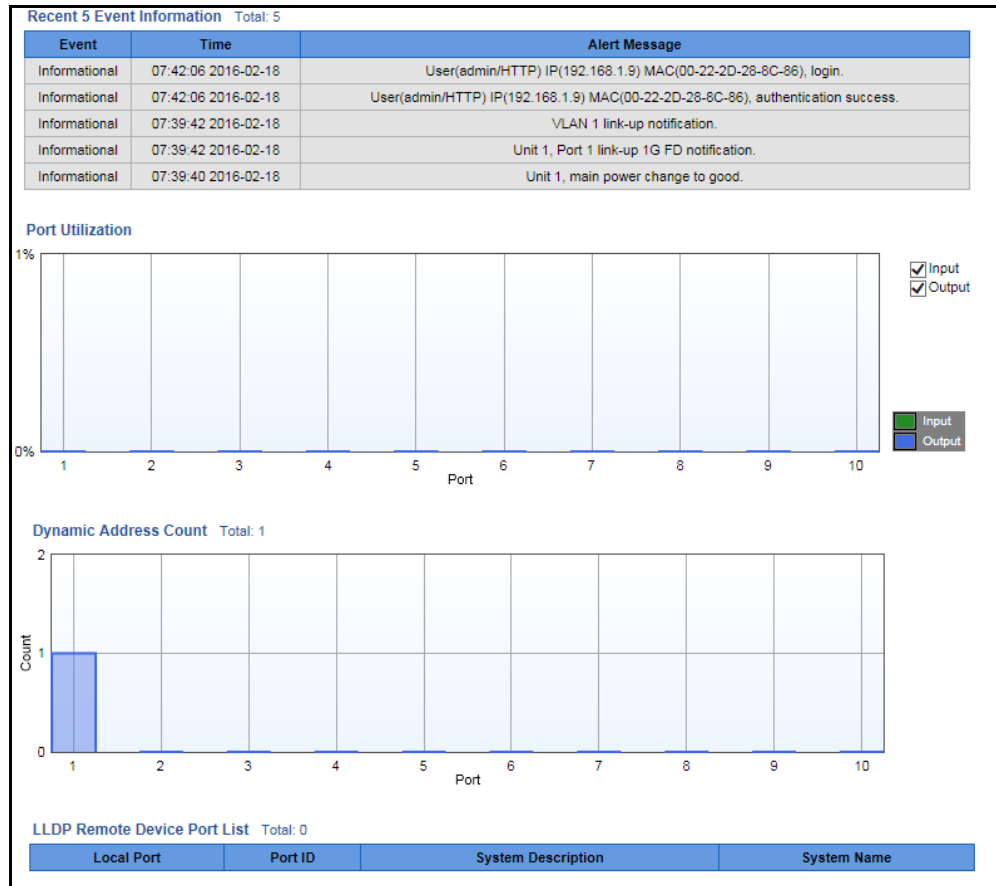
Navigating the Web Browser Interface

To access the web-browser interface you must first enter a user name and password. The administrator has Read/Write access to all configuration parameters and statistics. The default user name and password for the administrator is “admin.” The administrator has full access privileges to configure any parameters in the web interface. The default user name and password for guest access is “guest.” The guest only has read access for most configuration parameters. Refer to [“Configuring User Accounts” on page 241](#) for more details.

Dashboard When your web browser connects with the switch’s web agent, the Dashboard is displayed as shown below. The Dashboard displays the main menu on the left side of the screen. Switch Information, CPU Utilization, Switch Events, Memory Utilization, Recent 5 Event Information, Port Utilization, Dynamic Address Count, and LLDP Remote Device Port List are displayed on the right side. The main menu links are used to navigate to other menus, and display configuration parameters and statistics.

Figure 1: Dashboard

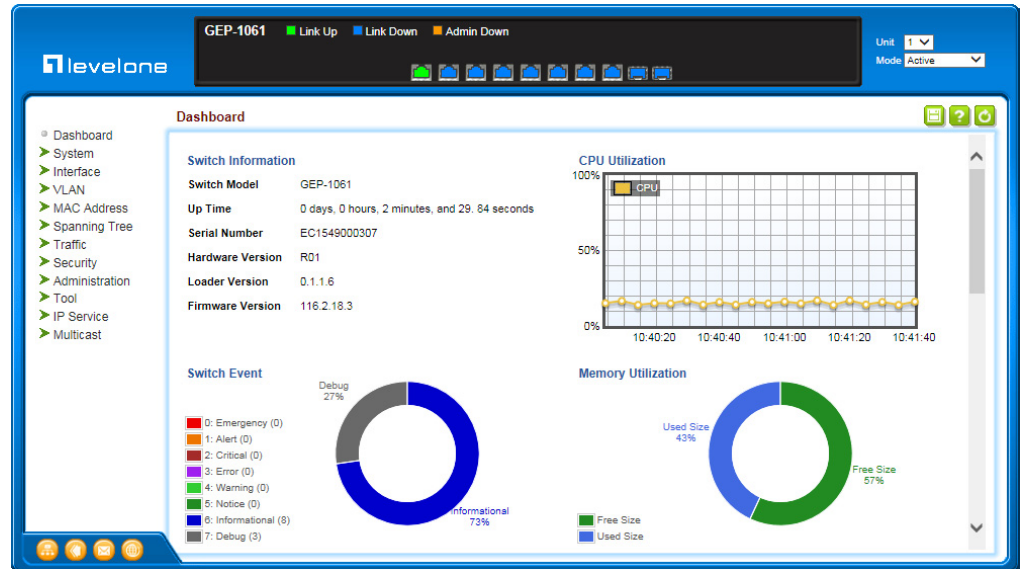




Note: You can open a connection to the vendor’s web site by clicking on the Level 1 logo.

Home Page When your web browser connects with the switch’s web agent, the home page is displayed as shown below. The home page displays the Main Menu on the left side of the screen and System Information on the right side. The Main Menu links are used to navigate to other menus, and display configuration parameters and statistics.

Figure 2: Home Page



Note: This manual covers the GEL-1061 and the GEP-1061 Gigabit Ethernet switches. Other than the difference in port types, and support for PoE, there are no significant differences. Therefore most of the screen display examples are based on the GEP-1061.








Note: You can open a connection to the vendor’s web site by clicking on the Level 1 logo.

Configuration Options Configurable parameters have a dialog box or a drop-down list. Once a configuration change has been made on a page, be sure to click on the Apply button to confirm the new setting. The following table summarizes the web page configuration buttons.

Table 3: Web Page Configuration Buttons

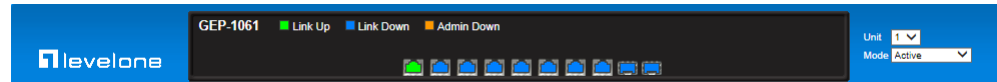
Button	Action
Apply	Sets specified values to the system.
Revert	Cancels specified values and restores current values prior to pressing “Apply.”

Table 3: Web Page Configuration Buttons (Continued)

Button	Action
	Saves current configuration settings
	Displays help for the selected page.
	Refreshes the current page.
	Displays the site map.
	Logs out of the management interface.
	Sends mail to the vendor.
	Links to the vendor's web site.

Panel Display The web agent displays an image of the switch's ports. The Mode can be set to display different information for the ports, including Active (i.e., up or down), Duplex (i.e., half or full duplex), or Flow Control (i.e., with or without flow control).

Figure 3: Front Panel Indicators



Main Menu Using the onboard web agent, you can define system parameters, manage and control the switch, and all its ports, or monitor network conditions. The following table briefly describes the selections available from this program.

Table 4: Switch Main Menu

Menu	Description	Page
Dashboard	Display switch Information, CPU utilization, switch events, memory utilization, recent 5 event information, port utilization, dynamic address count, and LLDP remote device port list	42
System		
General	Provides basic system description, including contact information	62
Switch	Shows the number of ports, hardware version, power status, and firmware version numbers	63
IP	Sets IPv4 address for management interface and gateway	451
Configure Global	Sets IP address of the gateway router between this device and management stations that exist on other network segments	451
Configure Interface	Configures IP address for management access	452
Add Address	Sets the IPv4 address for management access	452
Show Address	Shows the IPv4 address for management access	452
IPv6 Configuration		455
Configure Global	Sets an IPv6 default gateway for traffic with no known next hop	456
Configure Interface	Configures IPv6 interface address using auto-configuration or link-local address, and sets related protocol settings	457
Add IPv6 Address	Adds an global unicast, EUI-64, or link-local IPv6 address to an interface	461
Show IPv6 Address	Show the IPv6 addresses assigned to an interface	464
Show IPv6 Neighbor Cache	Displays information in the IPv6 neighbor discovery cache	465
Show Statistics		466
IPv6	Shows statistics about IPv6 traffic	466
ICMPv6	Shows statistics about ICMPv6 messages	466
UDP	Shows statistics about UDP messages	466
Show MTU	Shows the maximum transmission unit (MTU) cache for destinations that have returned an ICMP packet-too-big message along with an acceptable MTU to this switch	472
Capability	Enables support for jumbo frames; shows the bridge extension parameters	64, 65
File		67
Copy	Allows the transfer and copying files	67
Set Startup	Sets the startup file	70
Show	Shows the files stored in flash memory; allows deletion of files	71

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Time		75
Configure General		
Manual	Manually sets the current time	76
SNTP	Configures SNTP polling interval	77
NTP	Configures NTP authentication parameters	77
Configure Time Server	Configures a list of SNTP servers	78
Configure SNTP Server	Sets the IP address for SNTP time servers	78
Add NTP Server	Adds NTP time server and index of authentication key	79
Show NTP Server	Shows list of configured NTP time servers	79
Add NTP Authentication Key	Adds key index and corresponding MD5 key	81
Show NTP Authentication Key	Shows list of configured authentication keys	81
Configure Time Zone	Sets the local time zone for the system clock	82
Configure Summer Time	Configures summer time settings	83
Console	Sets console port connection parameters	85
Telnet	Sets Telnet connection parameters	87
CPU Utilization	Displays information on CPU utilization	88
CPU Guard	Sets the CPU utilization watermark and threshold	89
Memory Status	Shows memory utilization parameters	90
Reset	Restarts the switch immediately, at a specified time, after a specified delay, or at a periodic interval	91
Interface		95
Port		96
General		96
Configure by Port List	Configures connection settings per port	96
Configure by Port Range	Configures connection settings for a range of ports	98
Show Information	Displays port connection status	99
Statistics	Shows Interface, Etherlike, and RMON port statistics	100
Chart	Shows Interface, Etherlike, and RMON port statistics	100
History	Shows statistical history for specified interfaces	104
Transceiver	Shows identifying information and operational parameters for optical transceivers which support Digital Diagnostic Monitoring (DDM), and configures thresholds for alarm and warning messages for optical transceivers which support DDM	108 109

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Trunk		111
Static		113
Configure Trunk		113
Add	Creates a trunk, along with the first port member	113
Show	Shows the configured trunk identifiers	113
Add Member	Specifies ports to group into static trunks	113
Show Member	Shows the port members for the selected trunk	113
Configure General		113
Configure	Configures trunk connection settings	113
Show Information	Displays trunk connection settings	113
Dynamic		115
Configure Aggregator	Configures administration key and timeout for specific LACP groups	115
Configure Aggregation Port		115
Configure		115
General	Allows ports to dynamically join trunks	115
Actor	Configures parameters for link aggregation group members on the local side	115
Partner	Configures parameters for link aggregation group members on the remote side	115
Show Information		121
Counters	Displays statistics for LACP protocol messages	121
Internal	Displays configuration settings and operational state for the local side of a link aggregation	122
Neighbors	Displays configuration settings and operational state for the remote side of a link aggregation	124
Configure Trunk		115
Configure	Configures connection settings	115
Show	Displays port connection status	115
Show Member	Shows the active members in a trunk	115
Statistics	Shows Interface, Etherlike, and RMON port statistics	100
Chart	Shows Interface, Etherlike, and RMON port statistics	100
Load Balance	Sets the load-distribution method among ports in aggregated links	125
History	Shows statistical history for specified interfaces	104
Green Ethernet	Adjusts the power provided to ports based on the length of the cable used to connect to other devices	127

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Mirror		129
Add	Sets the source and target ports for mirroring	129
Show	Shows the configured mirror sessions	129
RSPAN	Mirrors traffic from remote switches for analysis at a destination port on the local switch	130
Traffic Segmentation		135
Configure Global	Enables traffic segmentation globally	135
Configure Session	Configures the uplink and down-link ports for a segmented group of ports	136
VLAN	Virtual LAN	139
Static		142
Add	Creates VLAN groups	142
Show	Displays configured VLAN groups	142
Modify	Configures group name and administrative status	142
Edit Member by VLAN	Specifies VLAN attributes per VLAN	144
Edit Member by Interface	Specifies VLAN attributes per interface	144
Edit Member by Interface Range	Specifies VLAN attributes per interface range	144
Protocol		148
Configure Protocol		149
Add	Creates a protocol group, specifying supported protocols	149
Show	Shows configured protocol groups	149
Configure Interface		150
Add	Maps a protocol group to a VLAN	150
Show	Shows the protocol groups mapped to each VLAN	150
MAC-Based		152
Add	Maps traffic with specified source MAC address to a VLAN	152
Show	Shows source MAC address to VLAN mapping	152
MAC Address		155
Dynamic		
Configure Aging	Sets timeout for dynamically learned entries	159
Show Dynamic MAC	Displays dynamic entries in the address table	159
Clear Dynamic MAC	Removes any learned entries from the forwarding database and clears the transmit and receive counts for any static or system configured entries	161
Learning Status	Enables MAC address learning on selected interfaces	155

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Static		157
Add	Configures static entries in the address table	157
Show	Displays static entries in the address table	157
MAC Notification		162
Configure Global	Issues a trap when a dynamic MAC address is added or removed	162
Configure Interface	Enables MAC authentication traps on the current interface	162
Spanning Tree		165
Loopback Detection	Configures Loopback Detection parameters	167
STA	Spanning Tree Algorithm	
Configure Global		
Configure	Configures global bridge settings for STP, RSTP and MSTP	169
Show Information	Displays STA values used for the bridge	174
Configure Interface		
Configure	Configures interface settings for STA	175
Show Information	Displays interface settings for STA	180
MSTP	Multiple Spanning Tree Algorithm	183
Configure Global		183
Add	Configures initial VLAN and priority for an MST instance	183
Modify	Configures the priority or an MST instance	183
Show	Configures global settings for an MST instance	183
Add Member	Adds VLAN members for an MST instance	183
Show Member	Adds or deletes VLAN members for an MST instance	183
Show Information	Displays MSTP values used for the bridge	
Configure Interface		187
Configure	Configures interface settings for an MST instance	187
Show Information	Displays interface settings for an MST instance	187
Traffic		
Rate Limit	Sets the input and output rate limits for a port	189
Storm Control	Sets the broadcast storm threshold for each interface	190
Priority		
Default Priority	Sets the default priority for each port or trunk	193
Queue	Sets queue mode for the switch; sets the service weight for each queue that will use a weighted or hybrid mode	194
Trust Mode	Selects DSCP or CoS priority processing	198

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
DSCP to DSCP		199
Add	Maps DSCP values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	199
Show	Shows the DSCP to DSCP mapping list	199
CoS to DSCP		201
Add	Maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for priority processing	201
Show	Shows the CoS to DSCP mapping list	201
DiffServ		205
Configure Class		206
Add	Creates a class map for a type of traffic	206
Show	Shows configured class maps	206
Modify	Modifies the name of a class map	206
Add Rule	Configures the criteria used to classify ingress traffic	206
Show Rule	Shows the traffic classification rules for a class map	206
Configure Policy		210
Add	Creates a policy map to apply to multiple interfaces	210
Show	Shows configured policy maps	210
Modify	Modifies the name of a policy map	210
Add Rule	Sets the boundary parameters used for monitoring inbound traffic, and the action to take for conforming and non-conforming traffic	210
Show Rule	Shows the rules used to enforce bandwidth policing for a policy map	210
Configure Interface	Applies a policy map to an ingress port	214
VoIP	Voice over IP	217
Configure Global	Configures auto-detection of VoIP traffic, sets the Voice VLAN, and VLAN aging time	218
Configure OUI		219
Add	Maps the OUI in the source MAC address of ingress packets to the VoIP device manufacturer	219
Show	Shows the OUI telephony list	219
Configure Interface	Configures VoIP traffic settings for ports, including the way in which a port is added to the Voice VLAN, filtering of non-VoIP packets, the method of detecting VoIP traffic, and the priority assigned to the voice traffic	220
Security		223
AAA	Authentication, Authorization and Accounting	224
System Authentication	Configures authentication sequence – local, RADIUS, and TACACS	225

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Server		226
Configure Server	Configures RADIUS and TACACS server message exchange settings	226
Configure Group		226
Add	Specifies a group of authentication servers and sets the priority sequence	226
Show	Shows the authentication server groups and priority sequence	226
Accounting	Enables accounting of requested services for billing or security purposes	231
Configure Global	Specifies the interval at which the local accounting service updates information to the accounting server	231
Configure Method		231
Add	Configures accounting for various service types	231
Show	Shows the accounting settings used for various service types	231
Configure Service	Sets the accounting method applied to specific interfaces for 802.1X, CLI command privilege levels for the console port, and for Telnet	231
Show Information		231
Summary	Shows the configured accounting methods, and the methods applied to specific interfaces	231
Statistics	Shows basic accounting information recorded for user sessions	231
Authorization	Enables authorization of requested services	237
Configure Method		237
Add	Configures authorization for various service types	237
Show	Shows the authorization settings used for various service types	237
Configure Service	Sets the authorization method applied used for the console port, and for Telnet	237
Show Information	Shows the configured authorization methods, and the methods applied to specific interfaces	237
User Accounts		241
Add	Configures user names, passwords, and access levels	241
Show	Shows authorized users	241
Modify	Modifies user attributes	241
Network Access	MAC address-based network access authentication	243
Configure Global	Enables aging for authenticated MAC addresses, and sets the time period after which a connected MAC address must be reauthenticated	245
Configure Interface		246
General	Enables MAC authentication on a port; sets the maximum number of address that can be authenticated, the guest VLAN, dynamic VLAN and dynamic QoS	246

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Configure MAC Filter		248
Add	Specifies MAC addresses exempt from authentication	248
Show	Shows the list of exempt MAC addresses	248
Show Information	Shows the authenticated MAC address list	249
HTTPS	Secure HTTP	251
Configure Global	Enables HTTPS, and specifies the UDP port to use	251
Copy Certificate	Replaces the default secure-site certificate	252
SSH	Secure Shell	254
Configure Global	Configures SSH server settings	256
Configure Host Key		258
Generate	Generates the host key pair (public and private)	258
Show	Displays RSA and DSA host keys; deletes host keys	258
Configure User Key		259
Copy	Imports user public keys from a TFTP server	259
Show	Displays RSA and DSA user keys; deletes user keys	259
ACL	Access Control Lists	261
Configure ACL		264
Show TCAM	Shows utilization parameters for TCAM	262
Add	Adds an ACL based on IP or MAC address filtering	264
Show	Shows the name and type of configured ACLs	264
Add Rule	Configures packet filtering based on IP or MAC addresses and other packet attributes	264
Show Rule	Shows the rules specified for an ACL	264
Configure Interface	Binds a port to the specified ACL and time range	
Configure	Binds a port to the specified ACL and time range	277
Show Hardware Counters	Shows statistics for ACL hardware counters	278
ARP Inspection		279
Configure General	Enables inspection globally, configures validation of additional address components, and sets the log rate for packet inspection	280
Configure VLAN	Enables ARP inspection on specified VLANs	282
Configure Interface	Sets the trust mode for ports, and sets the rate limit for packet inspection	284
Show Information		285
Show Statistics	Displays statistics on the inspection process	285
Show Log	Shows the inspection log list	286

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
IP Filter		287
Add	Sets IP addresses of clients allowed management access via the web, SNMP, and Telnet	287
Show	Shows the addresses to be allowed management access	287
Port Security	Configures per port security, including status, response for security breach, and maximum allowed MAC addresses	289
Port Authentication	IEEE 802.1X	291
Configure Global	Enables authentication and EAPOL pass-through	293
Configure Interface	Sets authentication parameters for individual ports	294
Show Statistics	Displays protocol statistics for the selected port	298
DoS Protection	Protects against Denial-of-Service attacks	307
DHCP Snooping		299
Configure Global	Enables DHCP snooping globally, MAC-address verification, information option; and sets the information policy	302
Configure VLAN	Enables DHCP snooping on a VLAN	303
Configure Interface	Sets the trust mode for an interface	304
Show Information	Displays the DHCP Snooping binding information	306
IP Source Guard	Filters IP traffic based on static entries in the IP Source Guard table, or dynamic entries in the DHCP Snooping table	308
General	Enables IP source guard and selects filter type per port	308
Static Binding		311
Configure ACL Table		311
Add	Adds static addresses to the source guard ACL binding table	311
Show	Shows static addresses in the source guard ACL binding table	311
Configure MAC Table		311
Add	Adds static addresses to the source guard MAC address binding table	311
Show	Shows static addresses in the source guard MAC address binding table	311
Dynamic Binding	Displays the source-guard binding table for a selected interface	313
Administration		315
Log		316
System		316
Configure Global	Stores error messages in local memory	316
Show System Logs	Shows logged error messages	316
Remote	Configures the logging of messages to a remote logging process	318
SMTP	Sends an SMTP client message to a participating server	319

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
LLDP		321
Configure Global	Configures global LLDP timing parameters	321
Configure Interface		323
Configure General	Sets the message transmission mode; enables SNMP notification; and sets the LLDP attributes to advertise	323
Add CA-Type	Specifies the physical location of the device attached to an interface	327
Show Local Device Information		329
General	Displays general information about the local device	329
Port/Trunk	Displays information about each interface	329
Show Remote Device Information		333
Port/Trunk	Displays information about a remote device connected to a port on this switch	333
Port/Trunk Details	Displays detailed information about a remote device connected to this switch	333
Show Device Statistics		341
General	Displays statistics for all connected remote devices	341
Port/Trunk	Displays statistics for remote devices on a selected port or trunk	341
PoE*	Power over Ethernet	343
PSE	Power sourcing equipment	343
Configure Global	Set the maximum PoE power budget for the switch (power available to all Gigabit Ethernet ports)	
Configure Interface	Configures port power parameters	
SNMP	Simple Network Management Protocol	347
Configure Global	Enables SNMP agent status, and sets related trap functions	349
Configure Community		362
Add	Configures community strings and access mode	362
Show	Shows community strings and access mode	362
Configure Engine		350
Set Engine ID	Sets the SNMP v3 engine ID on this switch	350
Add Remote Engine	Sets the SNMP v3 engine ID for a remote device	351
Show Remote Engine	Shows configured engine ID for remote devices	351
Configure View		353
Add View	Adds an SNMP v3 view of the OID MIB	353
Show View	Shows configured SNMP v3 views	353
Add OID Subtree	Specifies a part of the subtree for the selected view	353
Show OID Subtree	Shows the subtrees assigned to each view	353

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Configure Group		355
Add	Adds a group with access policies for assigned users	355
Show	Shows configured groups and access policies	355
Configure User		
Add SNMPv3 Local User	Configures SNMPv3 users on this switch	363
Show SNMPv3 Local User	Shows SNMPv3 users configured on this switch	363
Change SNMPv3 Local User Group	Assign a local user to a new group	363
Add SNMPv3 Remote User	Configures SNMPv3 users from a remote device	365
Show SNMPv3 Remote User	Shows SNMPv3 users set from a remote device	363
Configure Trap		368
Add	Configures trap managers to receive messages on key events that occur on this switch	368
Show	Shows configured trap managers	368
Configure Notify Filter		
Add	Creates an SNMP notification log	372
Show	Shows the configured notification logs	372
Show Statistics	Shows the status of SNMP communications	374
RMON	Remote Monitoring	376
Configure Global		
Add		
Alarm	Sets threshold bounds for a monitored variable	377
Event	Creates a response event for an alarm	379
Show		
Alarm	Shows all configured alarms	377
Event	Shows all configured events	379
Configure Interface		
Add		
History	Periodically samples statistics on a physical interface	381
Statistics	Enables collection of statistics on a physical interface	384
Show		
History	Shows sampling parameters for each entry in the history group	381
Statistics	Shows sampling parameters for each entry in the statistics group	384
Show Details		
History	Shows sampled data for each entry in the history group	381
Statistics	Shows sampled data for each entry in the history group	384

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Time Range	Configures the time to apply an ACL or PoE port	387
Add	Specifies the name of a time range	387
Show	Shows the name of configured time ranges	387
Add Rule		387
Absolute	Sets exact time or time range	387
Periodic	Sets a recurrent time	387
LDB	Loopback Detection	389
Configure Global	Enables loopback detection globally, specifies the interval at which to transmit control frames, specifies the interval to wait before releasing an interface from shutdown state, specifies response to detect loopback, and traps to send	390
Configure Interface	Enables loopback detection per interface	392
Tools		431
Ping	Sends ICMP echo request packets to another node on the network	431
Trace Route	Shows the route packets take to the specified destination	432
ARP	Shows entries in the Address Resolution Protocol cache	434
Show Information	Shows entries in the Address Resolution Protocol (ARP) cache	435
IP Service		437
DNS	Domain Name Service	437
General		437
Configure Global	Enables DNS lookup; defines the default domain name appended to incomplete host names	438
Add Domain Name	Defines a list of domain names that can be appended to incomplete host names	438
Show Domain Names	Shows the configured domain name list	438
Add Name Server	Specifies IP address of name servers for dynamic lookup	440
Show Name Servers	Shows the name server address list	440
Static Host Table		441
Add	Configures static entries for domain name to address mapping	441
Show	Shows the list of static mapping entries	441
Modify	Modifies the static address mapped to the selected host name	441
Cache	Displays cache entries discovered by designated name servers	442
DHCP	Dynamic Host Configuration Protocol	443
Client	Specifies the DHCP client identifier for an interface	444
Relay	Specifies DHCP relay servers	445

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Dynamic Provision	Enables dynamic provisioning via DHCP	449
Multicast		393
IGMP Snooping		394
General	Enables multicast filtering; configures parameters for multicast snooping	396
Multicast Router		400
Add Static Multicast Router	Assigns ports that are attached to a neighboring multicast router	400
Show Static Multicast Router	Displays ports statically configured as attached to a neighboring multicast router	400
Show Current Multicast Router	Displays ports attached to a neighboring multicast router, either through static or dynamic configuration	400
IGMP Member		402
Add Static Member	Statically assigns multicast addresses to the selected VLAN	402
Show Static Member	Shows multicast addresses statically configured on the selected VLAN	402
Interface		404
Configure VLAN	Configures IGMP snooping per VLAN interface	404
Show VLAN Information	Shows IGMP snooping settings per VLAN interface	404
Configure Port	Configures the interface to drop IGMP query packets or all multicast data packets	410
Configure Trunk	Configures the interface to drop IGMP query packets or all multicast data packets	410
Forwarding Entry	Displays the current multicast groups learned through IGMP Snooping	411
Filter		416
Configure General	Enables IGMP filtering for the switch	416
Configure Profile		417
Add	Adds IGMP filter profile; and sets access mode	417
Show	Shows configured IGMP filter profiles	417
Add Multicast Group Range	Assigns multicast groups to selected profile	417
Show Multicast Group Range	Shows multicast groups assigned to a profile	417
Configure Interface	Assigns IGMP filter profiles to port interfaces and sets throttling action	419
Statistics		412
Show Query Statistics	Shows statistics for query-related messages	412
Show VLAN Statistics	Shows statistics for protocol messages, number of active groups	412
Show Port Statistics	Shows statistics for protocol messages, number of active groups	412
Show Trunk Statistics	Shows statistics for protocol messages, number of active groups	412

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
MLD Snooping		421
General	Enables multicast filtering; configures parameters for IPv6 multicast snooping	421
Interface	Configures Immediate Leave status for a VLAN	423
Multicast Router		424
Add Static Multicast Router	Assigns ports that are attached to a neighboring multicast router	424
Show Static Multicast Router	Displays ports statically configured as attached to a neighboring multicast router	424
Show Current Multicast Router	Displays ports attached to a neighboring multicast router, either through static or dynamic configuration	424
MLD Member		426
Add Static Member	Statically assigns multicast addresses to the selected VLAN	426
Show Static Member	Shows multicast addresses statically configured on the selected VLAN	426
Show Current Member	Shows multicast addresses associated with the selected VLAN, either through static or dynamic configuration	426
Group Information	Displays known multicast groups, member ports, the means by which each group was learned, and the corresponding source list	428

* GEP-1061

3

Basic Management Tasks

This chapter describes the following topics:

- ◆ [Displaying System Information](#) – Provides basic system description, including contact information.
- ◆ [Displaying Hardware/Software Versions](#) – Shows the hardware version, power status, and firmware versions
- ◆ [Configuring Support for Jumbo Frames](#) – Enables support for jumbo frames.
- ◆ [Displaying Bridge Extension Capabilities](#) – Shows the bridge extension parameters.
- ◆ [Managing System Files](#) – Describes how to upgrade operating software or configuration files, and set the system start-up files.
- ◆ [Setting the System Clock](#) – Sets the current time manually or through specified NTP or SNTP servers.
- ◆ [Configuring the Console Port](#) – Sets console port connection parameters.
- ◆ [Configuring Telnet Settings](#) – Sets Telnet connection parameters.
- ◆ [Displaying CPU Utilization](#) – Displays information on CPU utilization.
- ◆ [Configuring CPU Guard](#) – Sets thresholds in terms of CPU usage time and number of packets processed per second.
- ◆ [Displaying Memory Utilization](#) – Shows memory utilization parameters.
- ◆ [Resetting the System](#) – Restarts the switch immediately, at a specified time, after a specified delay, or at a periodic interval.

Displaying System Information

Use the System > General page to identify the system by displaying information such as the device name, location and contact information.

Parameters

These parameters are displayed:

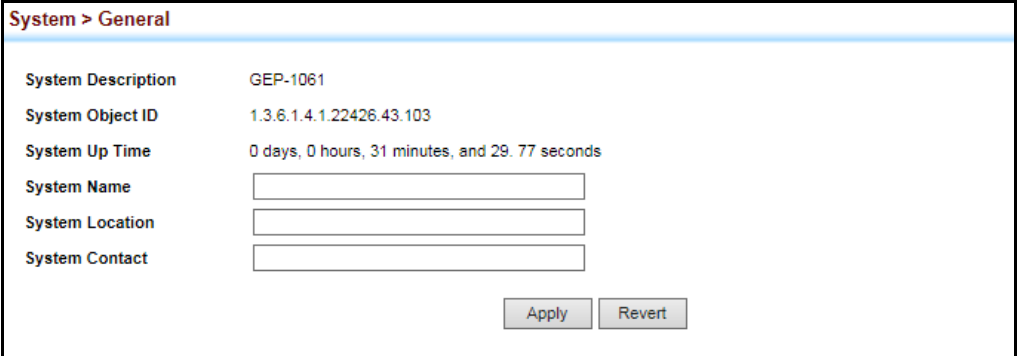
- ◆ **System Description** – Brief description of device type.
- ◆ **System Object ID** – MIB II object ID for switch's network management subsystem.
- ◆ **System Up Time** – Length of time the management agent has been up.
- ◆ **System Name** – Name assigned to the switch system.
- ◆ **System Location** – Specifies the system location.
- ◆ **System Contact** – Administrator responsible for the system.

Web Interface

To configure general system information:

1. Click System, General.
2. Specify the system name, location, and contact information for the system administrator.
3. Click Apply.

Figure 4: System Information



The screenshot shows the 'System > General' configuration page. It displays the following information and fields:

System Description	GEP-1061
System Object ID	1.3.6.1.4.1.22426.43.103
System Up Time	0 days, 0 hours, 31 minutes, and 29.77 seconds
System Name	<input type="text"/>
System Location	<input type="text"/>
System Contact	<input type="text"/>

At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

Displaying Hardware/Software Versions

Use the System > Switch page to display hardware/firmware version numbers for the main board and management software, as well as the power status of the system.

Parameters

The following parameters are displayed:

Main Board Information

- ◆ **Serial Number** – The serial number of the switch.
- ◆ **Number of Ports** – Number of built-in ports.
- ◆ **Hardware Version** – Hardware version of the main board.
- ◆ **Main Power Status** – Displays the status of the internal power supply.

Management Software Information

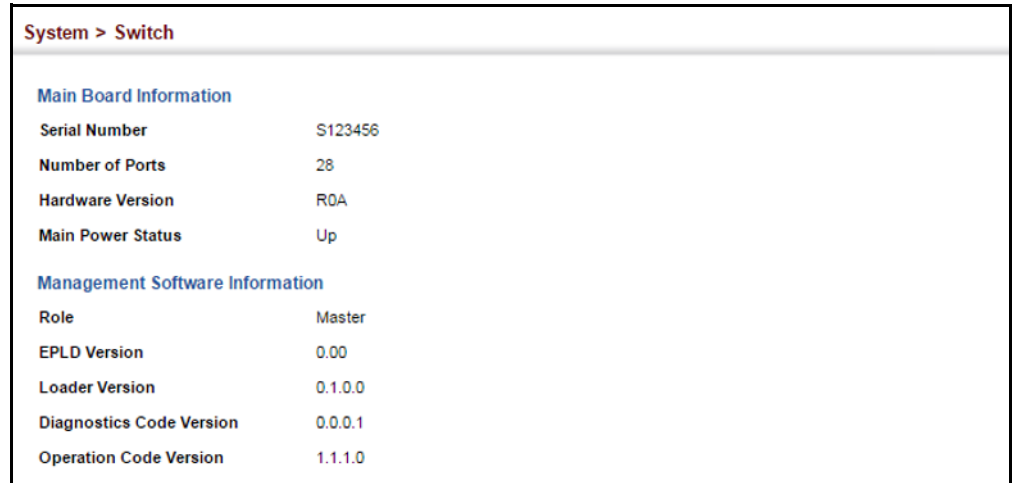
- ◆ **Role** – Shows that this switch is operating as Master or Slave.
- ◆ **EPLD Version** – Version number of EEPROM Programmable Logic Device.
- ◆ **Loader Version** – Version number of loader code.
- ◆ **Diagnostics Code Version** – Version of Power-On Self-Test (POST) and boot code.
- ◆ **Operation Code Version** – Version number of runtime code.

Web Interface

To view hardware and software version information.

1. Click System, then Switch.

Figure 5: General Switch Information



System > Switch	
Main Board Information	
Serial Number	S123456
Number of Ports	28
Hardware Version	R0A
Main Power Status	Up
Management Software Information	
Role	Master
EPLD Version	0.00
Loader Version	0.1.0.0
Diagnostics Code Version	0.0.0.1
Operation Code Version	1.1.1.0

Configuring Support for Jumbo Frames

Use the System > Capability page to configure support for layer 2 jumbo frames. The switch provides more efficient throughput for large sequential data transfers by supporting jumbo frames up to 10240 bytes for Gigabit Ethernet and 10 Gigabit Ethernet ports or trunks. Compared to standard Ethernet frames that run only up to 1.5 KB, using jumbo frames significantly reduces the per-packet overhead required to process protocol encapsulation fields.

Usage Guidelines

To use jumbo frames, both the source and destination end nodes (such as a computer or server) must support this feature. Also, when the connection is operating at full duplex, all switches in the network between the two end nodes must be able to accept the extended frame size. And for half-duplex connections, all devices in the collision domain would need to support jumbo frames.

Parameters

The following parameters are displayed:

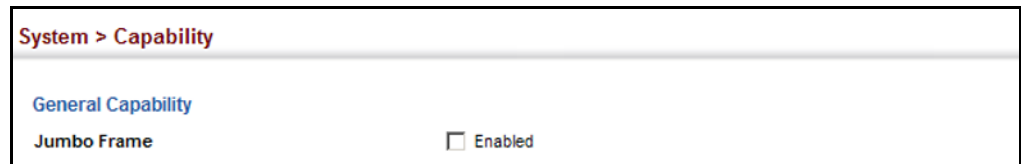
- ◆ **Jumbo Frame** – Configures support for jumbo frames. (Default: Disabled)

Web Interface

To configure support for jumbo frames:

1. Click System, then Capability.
2. Enable or disable support for jumbo frames.
3. Click Apply.

Figure 6: Configuring Support for Jumbo Frames



Displaying Bridge Extension Capabilities

Use the System > Capability page to display settings based on the Bridge MIB. The Bridge MIB includes extensions for managed devices that support Multicast Filtering, Traffic Classes, and Virtual LANs. You can access these extensions to display default settings for the key variables.

Parameters

The following parameters are displayed:

- ◆ **Extended Multicast Filtering Services** – This switch does not support the filtering of individual multicast addresses based on GMRP (GARP Multicast Registration Protocol).
- ◆ **Traffic Classes** – This switch provides mapping of user priorities to multiple traffic classes. (Refer to [“Class of Service” on page 193.](#))
- ◆ **Static Entry Individual Port** – This switch allows static filtering for unicast and multicast addresses. (Refer to [“Setting Static Addresses” on page 157.](#))
- ◆ **VLAN Version Number** – Based on IEEE 802.1Q, “1” indicates Bridges that support only single spanning tree (SST) operation, and “2” indicates Bridges that support multiple spanning tree (MST) operation.
- ◆ **VLAN Learning** – This switch uses Independent VLAN Learning (IVL), where each port maintains its own filtering database.
- ◆ **Local VLAN Capable** – This switch does not support multiple local bridges outside of the scope of 802.1Q defined VLANs.

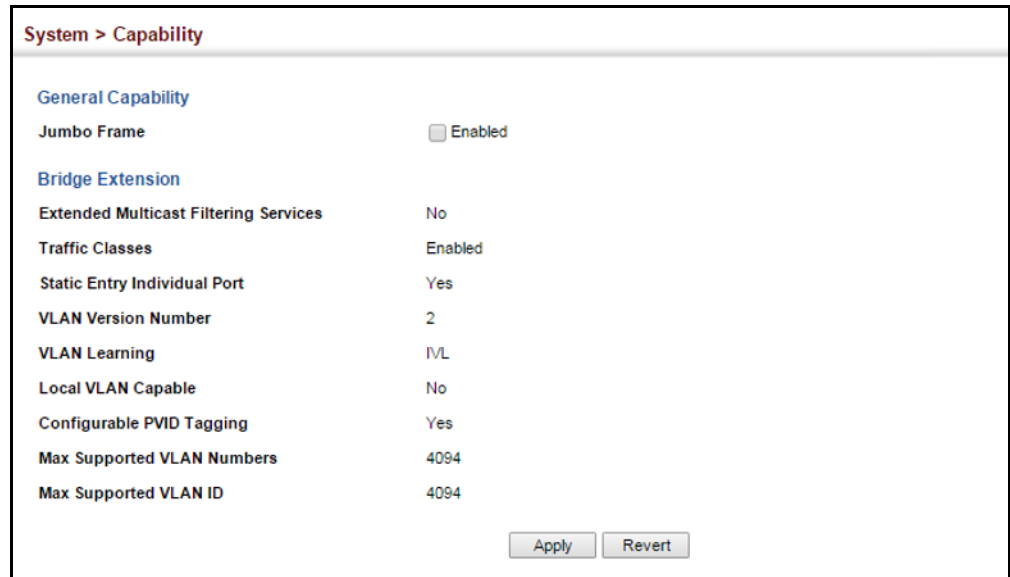
- ◆ **Configurable PVID Tagging** – This switch allows you to override the default Port VLAN ID (PVID used in frame tags) and egress status (VLAN-Tagged or Untagged) on each port. (Refer to “VLAN Configuration” on page 139.)
- ◆ **Max Supported VLAN Numbers** – The maximum number of VLANs supported on this switch.
- ◆ **Max Supported VLAN ID** – The maximum configurable VLAN identifier supported on this switch.

Web Interface

To view Bridge Extension information:

1. Click System, then Capability.

Figure 7: Displaying Bridge Extension Configuration



Managing System Files

This section describes how to upgrade the switch operating software or configuration files, and set the system start-up files.

Copying Files via FTP/TFTP or HTTP Use the System > File (Copy) page to upload/download firmware or configuration settings using FTP, TFTP or HTTP. By backing up a file to an FTP/TFTP server or management station, that file can later be downloaded to the switch to restore operation. Specify the method of file transfer, along with the file type and file names as required.

You can also set the switch to use new firmware or configuration settings without overwriting the current version. Just download the file using a different name from the current version, and then set the new file as the startup file.

Command Usage

- ◆ When logging into an FTP server, the interface prompts for a user name and password configured on the remote server. Note that “Anonymous” is set as the default user name.
- ◆ The reset command will not be accepted during copy operations to flash memory.

Parameters

The following parameters are displayed:

- ◆ **Copy Type** – The firmware copy operation includes these options:
 - HTTP Upload – Copies a file from a management station to the switch.
 - HTTP Download – Copies a file from the switch to a management station
 - TFTP Upload – Copies a file from a TFTP server to the switch.
 - TFTP Download – Copies a file from the switch to a TFTP server.
 - FTP Upload – Copies a file from an FTP server to the switch.
 - FTP Download – Copies a file from the switch to an FTP server.
- ◆ **FTP/TFTP Server IP Address** – The IP address of an FTP/TFTP server.
- ◆ **User Name** – The user name for FTP server access.
- ◆ **Password** – The password for FTP server access.
- ◆ **File Type** – Specify Operation Code to copy firmware or Config File to copy configuration settings.
- ◆ **File Name** – The file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file

names is 32 characters for files on the switch or 127 characters for files on the server. (Valid characters: A-Z, a-z, 0-9, ",", "-", "_")



Note: Up to two copies of the system software (i.e., the runtime firmware) can be stored in the file directory on the switch.

Note: The maximum number of user-defined configuration files is limited only by available flash memory space.

Note: The file "Factory_Default_Config.cfg" can be copied to a file server or management station, but cannot be used as the destination file name on the switch.

Web Interface

To copy firmware files:

1. Click System, then File.
2. Select Copy from the Action list.
3. Select FTP Upload, HTTP Upload or TFTP Upload as the file transfer method.
4. If FTP or TFTP Upload is used, enter the IP address of the file server.
5. If FTP Upload is used, enter the user name and password for your account on the FTP server.
6. Set the file type to Operation Code.
7. Enter the name of the file to download.
8. Select a file on the switch to overwrite or specify a new file name.
9. Click Apply.

Figure 8: Copy Firmware

The screenshot shows the 'System > File' web interface. At the top, there is a breadcrumb 'System > File'. Below it, the 'Action' dropdown is set to 'Copy'. The 'Copy Type' dropdown is set to 'TFTP Upload'. The 'TFTP Server IP Address' text field contains '192.168.1.9'. The 'File Type' dropdown is set to 'Operation Code'. The 'Source File Name' text field contains 'GEL-1061_V116.2.18.3.bix'. The 'Destination File Name' section has two radio buttons: one for 'ECS2100_V1.1.2.0.bix' (unselected) and one for 'GEL-1061_V116.2.18.3.bix' (selected). At the bottom right, there are 'Apply' and 'Revert' buttons.

If you replaced a file currently used for startup and want to start using the new file, reboot the system via the System > Reset menu.

Saving the Running Configuration to a Local File

Use the System > File (Copy) page to save the current configuration settings to a local file on the switch. The configuration settings are not automatically saved by the system for subsequent use when the switch is rebooted. You must save these settings to the current startup file, or to another file which can be subsequently set as the startup file.

Parameters

The following parameters are displayed:

- ◆ **Copy Type** – The copy operation includes this option:
 - Running-Config – Copies the current configuration settings to a local file on the switch.
- ◆ **Destination File Name** – Copy to the currently designated startup file, or to a new file. The file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names is 32 characters. (Valid characters: A-Z, a-z, 0-9, “”, “-”, “_”)



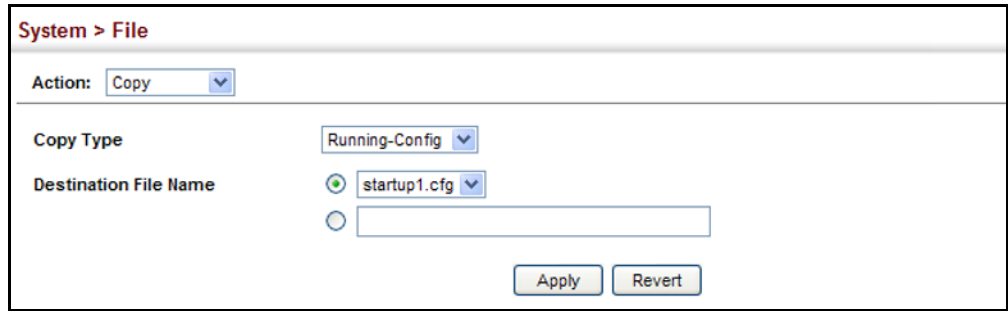
Note: The maximum number of user-defined configuration files is limited only by available flash memory space.

Web Interface

To save the running configuration file:

1. Click System, then File.
2. Select Copy from the Action list.
3. Select Running-Config from the Copy Type list.
4. Select the current startup file on the switch to overwrite or specify a new file name.
5. Then click Apply.

Figure 9: Saving the Running Configuration



The screenshot shows the 'System > File' configuration page. The 'Action' dropdown is set to 'Copy'. The 'Copy Type' dropdown is set to 'Running-Config'. The 'Destination File Name' section has a radio button selected next to 'startup1.cfg' and an empty text input field below it. At the bottom right, there are 'Apply' and 'Revert' buttons.

If you replaced a file currently used for startup and want to start using the new file, reboot the system via the System > Reset menu.

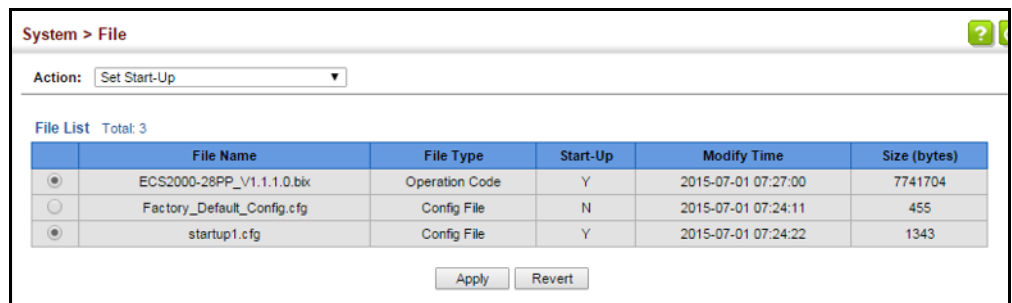
Setting the Start-up File Use the System > File (Set Start-Up) page to specify the firmware or configuration file to use for system initialization.

Web Interface

To set a file to use for system initialization:

1. Click System, then File.
2. Select Set Start-Up from the Action list.
3. Mark the operation code or configuration file to be used at startup
4. Then click Apply.

Figure 10: Setting Start-Up Files



The screenshot shows the 'System > File' configuration page with the 'Action' dropdown set to 'Set Start-Up'. Below the dropdown is a 'File List' table with 3 files. The table has columns for File Name, File Type, Start-Up, Modify Time, and Size (bytes). The 'start1.cfg' file is selected with a radio button.

	File Name	File Type	Start-Up	Modify Time	Size (bytes)
<input checked="" type="radio"/>	ECS2000-28PP_V1.1.1.0.bik	Operation Code	Y	2015-07-01 07:27:00	7741704
<input type="radio"/>	Factory_Default_Config.cfg	Config File	N	2015-07-01 07:24:11	455
<input checked="" type="radio"/>	startup1.cfg	Config File	Y	2015-07-01 07:24:22	1343

At the bottom right, there are 'Apply' and 'Revert' buttons.

To start using the new firmware or configuration settings, reboot the system via the System > Reset menu.

Showing System Files Use the System > File (Show) page to show the files in the system directory, or to delete a file.



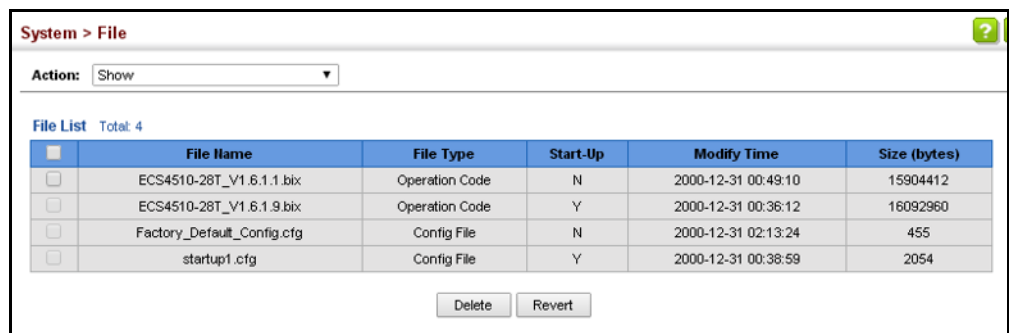
Note: Files designated for start-up, and the Factory_Default_Config.cfg file, cannot be deleted.

Web Interface

To show the system files:

1. Click System, then File.
2. Select Show from the Action list.
3. To delete a file, mark it in the File List and click Delete.

Figure 11: Displaying System Files



Automatic Operation Code Upgrade Use the System > File (Automatic Operation Code Upgrade) page to automatically download an operation code file when a file newer than the currently installed one is discovered on the file server. After the file is transferred from the server and successfully written to the file system, it is automatically set as the startup file, and the switch is rebooted.

Usage Guidelines

- ◆ If this feature is enabled, the switch searches the defined URL once during the bootup sequence.
- ◆ FTP (port 21) and TFTP (port 69) are both supported. Note that the TCP/UDP port bindings cannot be modified to support servers listening on non-standard ports.
- ◆ The host portion of the upgrade file location URL must be a valid IPv4 IP address. DNS host names are not recognized. Valid IP addresses consist of four numbers, 0 to 255, separated by periods.

- ◆ The path to the directory must also be defined. If the file is stored in the root directory for the FTP/TFTP service, then use the "/" to indicate this (e.g., ftp://192.168.0.1/).
- ◆ The file name must not be included in the upgrade file location URL. The file name of the code stored on the remote server must be *GEL-1061-series.bix* (using upper case and lower case letters exactly as indicated here). Enter the file name for other switches described in this manual exactly as shown on the web interface.
- ◆ The FTP connection is made with PASV mode enabled. PASV mode is needed to traverse some fire walls, even if FTP traffic is not blocked. PASV mode cannot be disabled.
- ◆ The switch-based search function is case-insensitive in that it will accept a file name in upper or lower case (i.e., the switch will accept *GEL-1061-Series.BIX* from the server even though *GEL-1061-series.bix* was requested). However, keep in mind that the file systems of many operating systems such as Unix and most Unix-like systems (FreeBSD, NetBSD, OpenBSD, and most Linux distributions, etc.) are case-sensitive, meaning that two files in the same directory, *gel-1061-series.bix* and *GEL-1061-Series.bix* are considered to be unique files. Thus, if the upgrade file is stored as *GEL-1061-Series.bix* (or even *GeL-1061-Series.bix*) on a case-sensitive server, then the switch (requesting *gel-1061-series.bix*) will not be upgraded because the server does not recognize the requested file name and the stored file name as being equal. A notable exception in the list of case-sensitive Unix-like operating systems is Mac OS X, which by default is case-insensitive. Please check the documentation for your server's operating system if you are unsure of its file system's behavior.
- ◆ Note that the switch itself does not distinguish between upper and lower-case file names, and only checks to see if the file stored on the server is more recent than the current runtime image.
- ◆ If two operation code image files are already stored on the switch's file system, then the non-startup image is deleted before the upgrade image is transferred.
- ◆ The automatic upgrade process will take place in the background without impeding normal operations (data switching, etc.) of the switch.
- ◆ During the automatic search and transfer process, the administrator cannot transfer or update another operation code image, configuration file, public key, or HTTPS certificate (i.e., no other concurrent file management operations are possible).
- ◆ The upgrade operation code image is set as the startup image after it has been successfully written to the file system.
- ◆ The switch will send an SNMP trap and make a log entry upon all upgrade successes and failures.

- ◆ The switch will immediately restart after the upgrade file is successfully written to the file system and set as the startup image.

Parameters

The following parameters are displayed:

- ◆ **Automatic Opcode Upgrade** – Enables the switch to search for an upgraded operation code file during the switch bootup process. (Default: Disabled)
- ◆ **Automatic Upgrade Location URL** – Defines where the switch should search for the operation code upgrade file. The last character of this URL must be a forward slash (“/”). The *GEL-1061-series.bix* filename must not be included since it is automatically appended by the switch. (Options: ftp, tftp)

The following syntax must be observed:

tftp://host[/filedir]/

- **tftp://** – Defines TFTP protocol for the server connection.
- *host* – Defines the IP address of the TFTP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. DNS host names are not recognized.
- *filedir* – Defines the directory, relative to the TFTP server root, where the upgrade file can be found. Nested directory structures are accepted. The directory name must be separated from the host, and in nested directory structures, from the parent directory, with a prepended forward slash “/”.
- / – The forward slash must be the last character of the URL.

ftp://[username[:password@]]host[/filedir]/

- **ftp://** – Defines FTP protocol for the server connection.
- *username* – Defines the user name for the FTP connection. If the user name is omitted, then “anonymous” is the assumed user name for the connection.

If no user name nor password is required for the connection, then the “@” character cannot be used in the path name.

- *password* – Defines the password for the FTP connection. To differentiate the password from the user name and host portions of the URL, a colon (:) must precede the password, and an “at” symbol (@), must follow the password. If the password is omitted, then "" (an empty string) is the assumed password for the connection.
- *host* – Defines the IP address of the FTP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. DNS host names are not recognized.
- *filedir* – Defines the directory, relative to the FTP server root, where the upgrade file can be found. Nested directory structures are accepted. The

directory name must be separated from the host, and in nested directory structures, from the parent directory, with a prepended forward slash “/”.

- / – The forward slash must be the last character of the URL.

Examples

The following examples demonstrate the URL syntax for a TFTP server at IP address 192.168.0.1 with the operation code image stored in various locations:

- `tftp://192.168.0.1/`
The image file is in the TFTP root directory.
- `tftp://192.168.0.1/switch-opcode/`
The image file is in the “switch-opcode” directory, relative to the TFTP root.
- `tftp://192.168.0.1/switches/opcode/`
The image file is in the “opcode” directory, which is within the “switches” parent directory, relative to the TFTP root.

The following examples demonstrate the URL syntax for an FTP server at IP address 192.168.0.1 with various user name, password and file location options presented:

- `ftp://192.168.0.1/`
The user name and password are empty, so “anonymous” will be the user name and the password will be blank. The image file is in the FTP root directory.
- `ftp://switches:upgrade@192.168.0.1/`
The user name is “switches” and the password is “upgrade”. The image file is in the FTP root.
- `ftp://switches:upgrade@192.168.0.1/switches/opcode/`
The user name is “switches” and the password is “upgrade”. The image file is in the “opcode” directory, which is within the “switches” parent directory, relative to the FTP root.

Web Interface

To configure automatic code upgrade:

1. Click System, then File.
2. Select Automatic Operation Code Upgrade from the Action list.
3. Mark the check box to enable Automatic Opcode Upgrade.

4. Enter the URL of the FTP or TFTP server, and the path and directory containing the operation code.
5. Click Apply.

Figure 12: Configuring Automatic Code Upgrade

The screenshot shows a configuration window titled "System > File". At the top, there is an "Action:" dropdown menu set to "Copy". Below this, the "Copy Type" is set to "TFTP Upload". The "TFTP Server IP Address" field contains "192.168.0.99". The "File Type" dropdown is set to "Operation Code". The "Source File Name" field contains "ECS2100_V1.0.0.1.bix". Under "Destination File Name", there are two radio button options: "ECS2100_V1.1.1.31.bix" (which is unselected) and "ECS2100_V1.0.0.1.bix" (which is selected). At the bottom right of the form are "Apply" and "Revert" buttons.

If a new image is found at the specified location, the following type of messages will be displayed during bootup.

```

:
:
Automatic Upgrade is looking for a new image
New image detected: current version 1.2.1.3; new version 1.2.1.6
Image upgrade in progress
The switch will restart after upgrade succeeds
Downloading new image

Flash programming started
Flash programming completed
The switch will now restart
:
:

```

Setting the System Clock

Simple Network Time Protocol (SNTP) allows the switch to set its internal clock based on periodic updates from a time server (SNTP or NTP). Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. You can also manually set the clock. If the clock is not set manually or via SNTP, the switch will only record the time from the factory default set at the last bootup.

When the SNTP client is enabled, the switch periodically sends a request for a time update to a configured time server. You can configure up to three time server IP addresses. The switch will attempt to poll each server in the configured sequence.

Setting the Time Manually Use the System > Time (Configure General - Manual) page to set the system time on the switch manually without using SNTP.

Parameters

The following parameters are displayed:

- ◆ **Current Time** – Shows the current time set on the switch.
- ◆ **Hours** – Sets the hour. (Range: 0-23)
- ◆ **Minutes** – Sets the minute value. (Range: 0-59)
- ◆ **Seconds** – Sets the second value. (Range: 0-59)
- ◆ **Month** – Sets the month. (Range: 1-12)
- ◆ **Day** – Sets the day of the month. (Range: 1-31)
- ◆ **Year** – Sets the year. (Range: 1970-2037)

Web Interface

To manually set the system clock:

1. Click System, then Time.
2. Select Configure General from the Step list.
3. Select Manual from the Maintain Type list.
4. Enter the time and date in the appropriate fields.
5. Click Apply

Figure 13: Manually Setting the System Clock

The screenshot shows a web interface for configuring the system time. At the top, it says "System > Time". Below that is a "Step:" dropdown menu set to "1. Configure General". The "Current Time" is displayed as "2014-5-30 9:59:20". The "Maintain Type" is set to "Manual" via a dropdown menu. There are input fields for "Hours" (9), "Minutes" (59), "Seconds" (20), "Month" (5), "Day" (30), and "Year" (2014). At the bottom right, there are "Apply" and "Revert" buttons.

Setting the SNTP Polling Interval Use the System > Time (Configure General - SNTP) page to set the polling interval at which the switch will query the specified time servers.

Parameters

The following parameters are displayed:

- ◆ **Current Time** – Shows the current time set on the switch.
- ◆ **SNTP Polling Interval** – Sets the interval between sending requests for a time update from a time server. (Range: 16-16384 seconds; Default: 16 seconds)

Web Interface

To set the polling interval for SNTP:

1. Click System, then Time.
2. Select Configure General from the Step list.
3. Select SNTP from the Maintain Type list.
4. Modify the polling interval if required.
5. Click Apply

Figure 14: Setting the Polling Interval for SNTP

The screenshot shows a web interface for configuring system time. At the top, it says "System > Time". Below that, there is a "Step:" dropdown menu set to "1. Configure General". The "Current Time" is displayed as "2014-5-30 9:59:20". The "Maintain Type" is set to "SNTP" via a dropdown menu. Under the "SNTP Configuration" section, the "SNTP Polling Interval (16-16384)" is set to "16" seconds. At the bottom right, there are "Apply" and "Revert" buttons.

Configuring NTP Use the System > Time (Configure General - NTP) page to configure NTP authentication and show the polling interval at which the switch will query the specified time servers.

Parameters

The following parameters are displayed:

- ◆ **Current Time** – Shows the current time set on the switch.
- ◆ **Authentication Status** – Enables authentication for time requests and updates between the switch and NTP servers. (Default: Disabled)

You can enable NTP authentication to ensure that reliable updates are received from only authorized NTP servers. The authentication keys and their associated key number must be centrally managed and manually distributed to NTP servers and clients. The key numbers and key values must match on both the server and client.

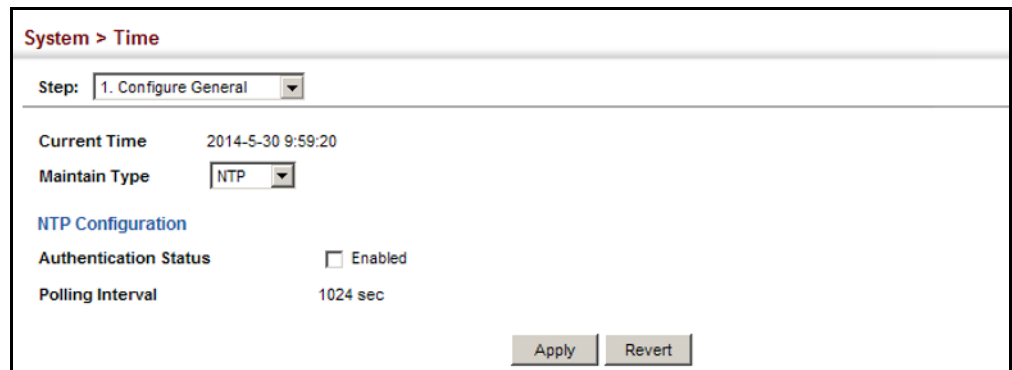
- ◆ **Polling Interval** – Shows the interval between sending requests for a time update from NTP servers. (Fixed: 1024 seconds)

Web Interface

To set the clock maintenance type to NTP:

1. Click System, then Time.
2. Select Configure General from the Step list.
3. Select NTP from the Maintain Type list.
4. Enable authentication if required.
5. Click Apply

Figure 15: Configuring NTP



The screenshot shows the 'System > Time' configuration page. At the top, there is a breadcrumb 'System > Time' and a 'Step:' dropdown menu set to '1. Configure General'. Below this, the 'Current Time' is displayed as '2014-5-30 9:59:20'. The 'Maintain Type' is set to 'NTP' via a dropdown menu. Under the 'NTP Configuration' section, the 'Authentication Status' is 'Enabled' with an unchecked checkbox, and the 'Polling Interval' is '1024 sec'. At the bottom right, there are 'Apply' and 'Revert' buttons.

Configuring Time Servers Use the System > Time (Configure Time Server) pages to specify the IP address for NTP/SNTP time servers, or to set the authentication key for NTP time servers.

Specifying SNTP Time Servers

Use the System > Time (Configure Time Server – Configure SNTP Server) page to specify the IP address for up to three SNTP time servers.

Parameters

The following parameters are displayed:

- ◆ **SNTP Server IP Address** – Sets the IPv4 or IPv6 address for up to three time servers. The switch attempts to update the time from the first server, if this fails it attempts an update from the next server in the sequence.

Web Interface

To set the SNTP time servers:

1. Click System, then Time.
2. Select Configure Time Server from the Step list.
3. Select Configure SNTP Server from the Action list.
4. Enter the IP address of up to three time servers.
5. Click Apply.

Figure 16: Specifying SNTP Time Servers

The screenshot shows the 'System > Time' configuration page. At the top, there is a breadcrumb 'System > Time'. Below it, there are two dropdown menus: 'Step' set to '2. Configure Time Server' and 'Action' set to 'Configure SNTP Server'. The main area contains three input fields for SNTP Server IP addresses: 'SNTP Server IP Address 1' with the value '10.1.0.19', 'SNTP Server IP Address 2' with the value '137.62.140.80', and 'SNTP Server IP Address 3' with the value '128.250.36.2'. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

Specifying NTP Time Servers

Use the System > Time (Configure Time Server – Add NTP Server) page to add the IP address for up to 50 NTP time servers.

Parameters

The following parameters are displayed:

- ◆ **NTP Server IP Address** – Adds the IPv4 or IPv6 address for up to 50 time servers. The switch will poll the specified time servers for updates when the clock maintenance type is set to NTP on the System > Time (Configure General) page. It issues time synchronization requests at a fixed interval of 1024 seconds. The switch will poll all the time servers configured, the responses received are filtered and compared to determine the most reliable and accurate time update for the switch.
- ◆ **Version** – Specifies the NTP version supported by the server. (Fixed: Version 3)

- ◆ **Authentication Key** – Specifies the number of the key in the NTP Authentication Key List to use for authentication with the configured server. NTP authentication is optional. If enabled on the System > Time (Configure General) page, you must also configure at least one key on the System > Time (Add NTP Authentication Key) page. (Range: 1-65535)

Web Interface

To add an NTP time server to the server list:

1. Click System, then Time.
2. Select Configure Time Server from the Step list.
3. Select Add NTP Server from the Action list.
4. Enter the IP address of an NTP time server, and specify the index of the authentication key if authentication is required.
5. Click Apply.

Figure 17: Adding an NTP Time Server

System > Time

Step: 2. Configure Time Server Action: Add NTP Server

NTP Server IP Address: 192.168.3.20

Version: 3

Authentication Key (1-65535): 3 (optional)

Apply Revert

To show the list of configured NTP time servers:

1. Click System, then Time.
2. Select Configure Time Server from the Step list.
3. Select Show NTP Server from the Action list.

Figure 18: Showing the NTP Time Server List

System > Time

Step: 2. Configure Time Server Action: Show NTP Server

NTP Server List Total: 1

<input type="checkbox"/>	Server IP Address	Version	Authentication Key
<input type="checkbox"/>	192.168.3.20	3	3

Delete Revert

Specifying NTP Authentication Keys

Use the System > Time (Configure Time Server – Add NTP Authentication Key) page to add an entry to the authentication key list.

Parameters

The following parameters are displayed:

- ◆ **Authentication Key** – Specifies the number of the key in the NTP Authentication Key List to use for authentication with a configured server. NTP authentication is optional. When enabled on the System > Time (Configure General) page, you must also configure at least one key on this page. Up to 255 keys can be configured on the switch. (Range: 1-65535)
- ◆ **Key Context** – An MD5 authentication key string. The key string can be up to 32 case-sensitive printable ASCII characters (no spaces).

NTP authentication key numbers and values must match on both the server and client.

Web Interface

To add an entry to NTP authentication key list:

1. Click System, then Time.
2. Select Configure Time Server from the Step list.
3. Select Add NTP Authentication Key from the Action list.
4. Enter the index number and MD5 authentication key string.
5. Click Apply.

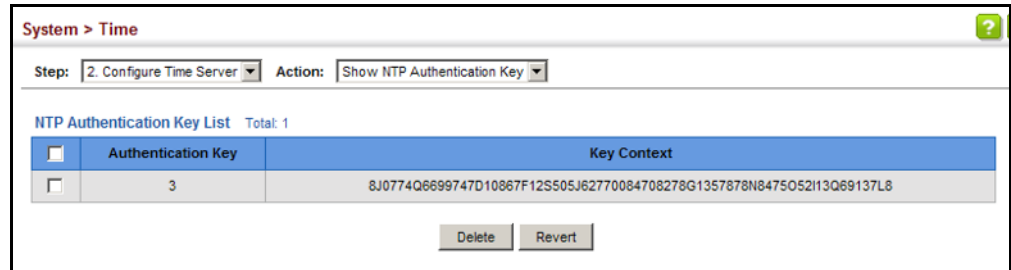
Figure 19: Adding an NTP Authentication Key

The screenshot shows a web interface for configuring NTP authentication keys. At the top, it says 'System > Time'. Below that, there are two dropdown menus: 'Step: 2. Configure Time Server' and 'Action: Add NTP Authentication Key'. The main form has two input fields: 'Authentication Key (1-65535)' with the value '3' and 'Key Context (1-32)' with the value 'S1507N122103J068173M'. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show the list of configured NTP authentication keys:

1. Click System, then Time.
2. Select Configure Time Server from the Step list.
3. Select Show NTP Authentication Key from the Action list.

Figure 20: Showing the NTP Authentication Key List



Setting the Time Zone

Use the System > Time (Configure Time Zone) page to set the time zone. SNTP uses Coordinated Universal Time (or UTC, formerly Greenwich Mean Time, or GMT) based on the time at the Earth's prime meridian, zero degrees longitude, which passes through Greenwich, England. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC. You can choose one of the 80 predefined time zone definitions, or you can manually configure the parameters for your local time zone.

Parameters

The following parameters are displayed:

- ◆ **Predefined Configuration** – A drop-down box provides access to the 80 predefined time zone configurations. Each choice indicates its offset from UTC and lists at least one major city or location covered by the time zone.
- ◆ **User-defined Configuration** – Allows the user to define all parameters of the local time zone.
 - **Direction** – Configures the time zone to be before (east of) or after (west of) UTC.
 - **Name** – Assigns a name to the time zone. (Range: 1-30 characters)
 - **Hours** (0-13) – The number of hours before or after UTC. The maximum value before UTC is 12. The maximum value after UTC is 13.
 - **Minutes** (0-59) – The number of minutes before/after UTC.

Web Interface

To set your local time zone:

1. Click System, then Time.
2. Select Configure Time Zone from the Step list.
3. Set the offset for your time zone relative to the UTC in hours and minutes.
4. Click Apply.

Figure 21: Setting the Time Zone

System > Time

Step: 3. Configure Time Zone ▼

Predefined Configuration

User Defined Configuration

Direction: After UTC ▼

Name: UTC

Hours (0-13): 0

Minutes (0-59): 0

Note: The maximum value before UTC is 12:00.
The maximum value after UTC is 13:00.

Apply Revert

Configuring Summer Time Use the Summer Time page to set the system clock forward during the summer months (also known as daylight savings time).

In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.

Parameters

The following parameters are displayed in the web interface:

General Configuration

- ◆ **Summer Time in Effect** – Shows if the system time has been adjusted.
- ◆ **Status** – Shows if summer time is set to take effect during the specified period.
- ◆ **Name** – Name of the time zone while summer time is in effect, usually an acronym. (Range: 1-30 characters)
- ◆ **Mode** – Selects one of the following configuration modes. (The Mode option can only be managed when the Summer Time Status option has been set to enabled for the switch.)

Predefined Mode – Configures the summer time status and settings for the switch using predefined configurations for several major regions of the world. To specify the time corresponding to your local time when summer time is in effect, select the predefined summer-time zone appropriate for your location.

Table 5: Predefined Summer-Time Parameters

Region	Start Time, Day, Week, & Month	End Time, Day, Week, & Month	Rel. Offset
Australia	00:00:00, Sunday, Week 5 of October	23:59:59, Sunday, Week 5 of March	60 min
Europe	00:00:00, Sunday, Week 5 of March	23:59:59, Sunday, Week 5 of October	60 min
New Zealand	00:00:00, Sunday, Week 1 of October	23:59:59, Sunday, Week 3 of March	60 min
USA	02:00:00, Sunday, Week 2 of March	02:00:00, Sunday, Week 1 of November	60 min

Date Mode – Sets the start, end, and offset times of summer time for the switch on a one-time basis. This mode sets the summer-time zone relative to the currently configured time zone. To specify a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time zone deviates from your regular time zone.

- ◆ **Offset** – Summer-time offset from the regular time zone, in minutes.
(Range: 1-120 minutes)
- ◆ **From** – Start time for summer-time offset.
- ◆ **To** – End time for summer-time offset.

Recurring Mode – Sets the start, end, and offset times of summer time for the switch on a recurring basis. This mode sets the summer-time zone relative to the currently configured time zone. To specify a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time zone deviates from your regular time zone.

- ◆ **Offset** – Summer-time offset from the regular time zone, in minutes.
(Range: 1-120 minutes)
- ◆ **From** – Start time for summer-time offset.
- ◆ **To** – End time for summer-time offset.

Web Interface

To specify summer time settings:

1. Click SNTP, Summer Time.
2. Select one of the configuration modes, configure the relevant attributes, enable summer time status.
3. Click Apply.

Figure 22: Configuring Summer Time

The screenshot shows a web-based configuration interface for 'System > Time'. The current step is '4. Configure Summer Time'. The configuration options are as follows:

- Summer Time in Effect:** No
- Status:** Enabled
- Name:** [Empty text input field]
- Mode:** Predefined (dropdown menu)
- Predefined Mode Configuration:**
 - Daylight Savings:** Australia (dropdown menu)

At the bottom right, there are two buttons: 'Apply' and 'Revert'.

Configuring the Console Port

Use the System > Console menu to configure connection parameters for the switch's console port. You can access the onboard configuration program by attaching a VT100 compatible device to the switch's serial console port. Management access through the console port is controlled by various parameters, including a password (only configurable through the CLI), time outs, and basic communication settings. Note that these parameters can be configured via the web or CLI interface.

Parameters

The following parameters are displayed:

- ◆ **Login Timeout** – Sets the interval that the system waits for a user to log into the CLI. If a login attempt is not detected within the timeout interval, the connection is terminated for the session. (Range: 10-300 seconds; Default: 300 seconds)
- ◆ **Exec Timeout** – Sets the interval that the system waits until user input is detected. If user input is not detected within the timeout interval, the current session is terminated. (Range: 60-65535 seconds; Default: 600 seconds)
- ◆ **Password Threshold** – Sets the password intrusion threshold, which limits the number of failed logon attempts. When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time (set by the Silent Time parameter) before allowing the next logon attempt. (Range: 1-120; Default: 3 attempts)
- ◆ **Silent Time** – Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts has been exceeded. (Range: 1-65535 seconds; Default: Disabled)
- ◆ **Data Bits** – Sets the number of data bits per character that are interpreted and generated by the console port. If parity is being generated, specify 7 data bits

per character. If no parity is required, specify 8 data bits per character.
(Default: 8 bits)

- ◆ **Stop Bits** – Sets the number of the stop bits transmitted per byte.
(Range: 1-2; Default: 1 stop bit)
- ◆ **Parity** – Defines the generation of a parity bit. Communication protocols provided by some terminals can require a specific parity bit setting. Specify Even, Odd, or None. (Default: None)
- ◆ **Speed** – Sets the terminal line’s baud rate for transmit (to terminal) and receive (from terminal). Set the speed to match the baud rate of the device connected to the serial port. (Range: 9600, 19200, 38400, 57600, or 115200 baud; Default: 115200 baud)



Note: The password for the console connection can only be configured through the CLI (see the “password” command in the *CLI Reference Guide*).

Note: Password checking can be enabled or disabled for logging in to the console connection (see the “login” command in the *CLI Reference Guide*). You can select authentication by a single global password as configured for the password command, or by passwords set up for specific user-name accounts. The default is for local passwords configured on the switch.

Web Interface

To configure parameters for the console port:

1. Click System, then Console.
2. Specify the connection parameters as required.
3. Click Apply

Figure 23: Console Port Settings

The screenshot shows the 'System > Console' configuration page. It contains the following settings:

Login Timeout (10-300)	<input type="text" value="300"/> sec
Exec Timeout (60-65535)	<input checked="" type="checkbox"/> <input type="text" value="600"/> sec
Password Threshold (1-120)	<input checked="" type="checkbox"/> <input type="text" value="3"/>
Silent Time (1-65535)	<input type="checkbox"/> <input type="text"/> sec
Data Bits	<input type="text" value="8"/>
Stop Bits	<input type="text" value="1"/>
Parity	<input type="text" value="None"/>
Speed	<input type="text" value="115200"/> baud

Buttons: Apply, Revert

Configuring Telnet Settings

Use the System > Telnet menu to configure parameters for accessing the CLI over a Telnet connection. You can access the onboard configuration program over the network using Telnet (i.e., a virtual terminal). Management access via Telnet can be enabled/disabled and other parameters set, including the TCP port number, time outs, and a password. Note that the password is only configurable through the CLI.) These parameters can be configured via the web or CLI interface.

Parameters

The following parameters are displayed:

- ◆ **Telnet Status** – Enables or disables Telnet access to the switch. (Default: Enabled)
- ◆ **TCP Port** – Sets the TCP port number for Telnet on the switch. (Range: 1-65535; Default: 23)
- ◆ **Max Sessions** – Sets the maximum number of Telnet sessions that can simultaneously connect to this system. (Range: 0-8; Default: 8)

A maximum of eight sessions can be concurrently opened for Telnet and Secure Shell (i.e., both Telnet and SSH share a maximum number of eight sessions).
- ◆ **Login Timeout** – Sets the interval that the system waits for a user to log into the CLI. If a login attempt is not detected within the timeout interval, the connection is terminated for the session. (Range: 10-300 seconds; Default: 300 seconds)
- ◆ **Exec Timeout** – Sets the interval that the system waits until user input is detected. If user input is not detected within the timeout interval, the current session is terminated. (Range: 60-65535 seconds; Default: 600 seconds)
- ◆ **Password Threshold** – Sets the password intrusion threshold, which limits the number of failed logon attempts. When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time (set by the Silent Time parameter) before allowing the next logon attempt. (Range: 1-120; Default: 3 attempts)
- ◆ **Silent Time** – Sets the amount of time the management interface is inaccessible after the number of unsuccessful logon attempts has been exceeded. (Range: 1-65535 seconds; Default: Disabled)



Note: The password for the Telnet connection can only be configured through the CLI (see the “password” command in the *CLI Reference Guide*).

Note: Password checking can be enabled or disabled for login to the console connection (see the “login” command in the *CLI Reference Guide*). You can select

authentication by a single global password as configured for the password command, or by passwords set up for specific user-name accounts. The default is for local passwords configured on the switch.

Web Interface

To configure parameters for the console port:

1. Click System, then Telnet.
2. Specify the connection parameters as required.
3. Click Apply

Figure 24: Telnet Connection Settings

Telnet Status	<input checked="" type="checkbox"/> Enabled
TCP Port (1-65535)	<input type="text" value="23"/>
Max Sessions (0-8)	<input type="text" value="8"/>
Login Timeout (10-300)	<input type="text" value="300"/> sec
Exec Timeout (60-65535)	<input type="text" value="600"/> sec
Password Threshold (1-120)	<input checked="" type="checkbox"/> <input type="text" value="3"/>
Silent Time (1-65535)	<input type="checkbox"/> <input type="text"/> sec

Apply Revert

Displaying CPU Utilization

Use the System > CPU Utilization page to display information on CPU utilization.

Parameters

The following parameters are displayed:

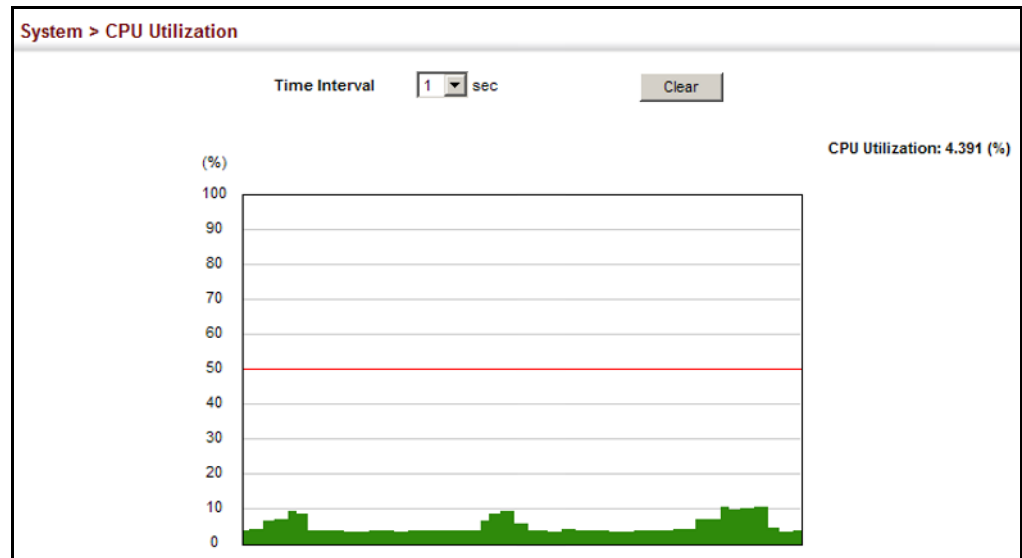
- ◆ **Time Interval** – The interval at which to update the displayed utilization rate. (Options: 1, 5, 10, 30, 60 seconds; Default: 1 second)
- ◆ **CPU Utilization** – CPU utilization over specified interval.

Web Interface

To display CPU utilization:

1. Click System, then CPU Utilization.
2. Change the update interval if required. Note that the interval is changed as soon as a new setting is selected.

Figure 25: Displaying CPU Utilization



Configuring CPU Guard

Use the System > CPU Guard page to set the CPU utilization high and low watermarks in percentage of CPU time utilized and the CPU high and low thresholds in the number of packets being processed per second.

Parameters

The following parameters are displayed:

- ◆ **CPU Guard Status** – Enables CPU Guard. (Default: Disabled)
- ◆ **High Watermark** – If the percentage of CPU usage time is higher than the high-watermark, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until usage time falls below the low watermark. (Range: 40-100%; Default: 90%)
- ◆ **Low Watermark** – If packet flow has been stopped after exceeding the high watermark, normal flow will be restored after usage falls beneath the low watermark. (Range: 40-100%; Default: 70%)
- ◆ **Maximum Threshold** – If the number of packets being processed by the CPU is higher than the maximum threshold, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until the number of packets being processed falls below the minimum threshold. (Range: 50-500 pps; Default: 500 pps)
- ◆ **Minimum Threshold** – If packet flow has been stopped after exceeding the maximum threshold, normal flow will be restored after usage falls beneath the minimum threshold. (Range: 50-500 pps; Default: 50 pps)

- ◆ **Trap Status** – If enabled, an alarm message will be generated when utilization exceeds the high watermark or exceeds the maximum threshold. (Default: Disabled)

Once the high watermark is exceeded, utilization must drop beneath the low watermark before the alarm is terminated, and then exceed the high watermark again before another alarm is triggered.

Once the maximum threshold is exceeded, utilization must drop beneath the minimum threshold before the alarm is terminated, and then exceed the maximum threshold again before another alarm is triggered.

- ◆ **Current Threshold** – Shows the configured threshold in packets per second.

Web Interface

To configure CPU Guard:

1. Click System, CPU Guard.
2. Set CPU guard status, configure the watermarks or threshold parameter, enable traps if required.
3. Click Apply.

Figure 26: Configuring CPU Guard

The screenshot shows the configuration page for CPU Guard. The title is "System > CPU Guard". The settings are as follows:

CPU Guard Status	<input type="checkbox"/> Enabled
High Watermark (40-100)	90 %
Low Watermark (40-100)	70 %
Maximum Threshold (50-500)	500 packets/sec
Minimum Threshold (50-500)	50 packets/sec
Trap Status	<input type="checkbox"/> Enabled
Current Threshold	500 packets/sec

At the bottom right, there are two buttons: "Apply" and "Revert".

Displaying Memory Utilization

Use the System > Memory Status page to display memory utilization parameters.

Parameters

The following parameters are displayed:

- ◆ **Free Size** – The amount of memory currently free for use.
- ◆ **Used Size** – The amount of memory allocated to active processes.

- ◆ **Total** – The total amount of system memory.

Web Interface

To display memory utilization:

1. Click System, then Memory Status.

Figure 27: Displaying Memory Utilization

System > Memory Status		
Memory Status		
Free Size	45,416,448 bytes	16%
Used Size	223,019,008 bytes	84%
Total	268,435,456 bytes	

Resetting the System

Use the System > Reset menu to restart the switch immediately, at a specified time, after a specified delay, or at a periodic interval.

Command Usage

- ◆ This command resets the entire system.
- ◆ When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory. (See [“Saving the Running Configuration to a Local File”](#) on page 69).

Parameters

The following parameters are displayed:

System Reload Information

- ◆ **Reload Settings** – Displays information on the next scheduled reload and selected reload mode as shown in the following example:
 “The switch will be rebooted at March 9 12:00:00 2012. Remaining Time: 0 days, 2 hours, 46 minutes, 5 seconds.
 Reloading switch regularly time: 12:00 everyday.”
- ◆ **Refresh** – Refreshes reload information. Changes made through the console or to system time may need to be refreshed to display the current settings.
- ◆ **Cancel** – Cancels the current settings shown in this field.

System Reload Configuration

- ◆ **Reset Mode** – Restarts the switch immediately or at the specified time(s).

- **Immediately** – Restarts the system immediately.
- **In** – Specifies an interval after which to reload the switch. (The specified time must be equal to or less than 24 days.)
 - *hours* – The number of hours, combined with the minutes, before the switch resets. (Range: 0-576)
 - *minutes* – The number of minutes, combined with the hours, before the switch resets. (Range: 0-59)
- **At** – Specifies a time at which to reload the switch.
 - DD - The day of the month at which to reload. (Range: 01-31)
 - MM - The month at which to reload. (Range: 01-12)
 - YYYY - The year at which to reload. (Range: 1970-2037)
 - HH - The hour at which to reload. (Range: 00-23)
 - MM - The minute at which to reload. (Range: 00-59)
- **Regularly** – Specifies a periodic interval at which to reload the switch.

Time

- HH - The hour at which to reload. (Range: 00-23)
- MM - The minute at which to reload. (Range: 00-59)

Period

- Daily - Every day.
- Weekly - Day of the week at which to reload. (Range: Sunday ... Saturday)
- Monthly - Day of the month at which to reload. (Range: 1-31)

Web Interface

To restart the switch:

1. Click System, then Reset.
2. Select the required reset mode.
3. For any option other than to reset immediately, fill in the required parameters
4. Click Apply.

5. When prompted, confirm that you want reset the switch.

Figure 28: Restarting the Switch (Immediately)

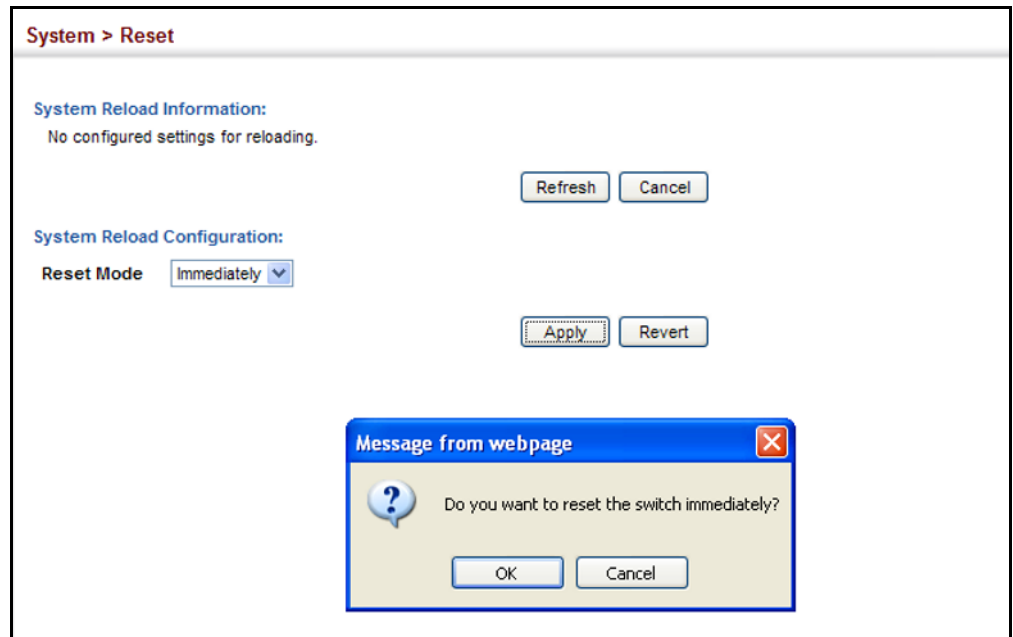


Figure 29: Restarting the Switch (In)

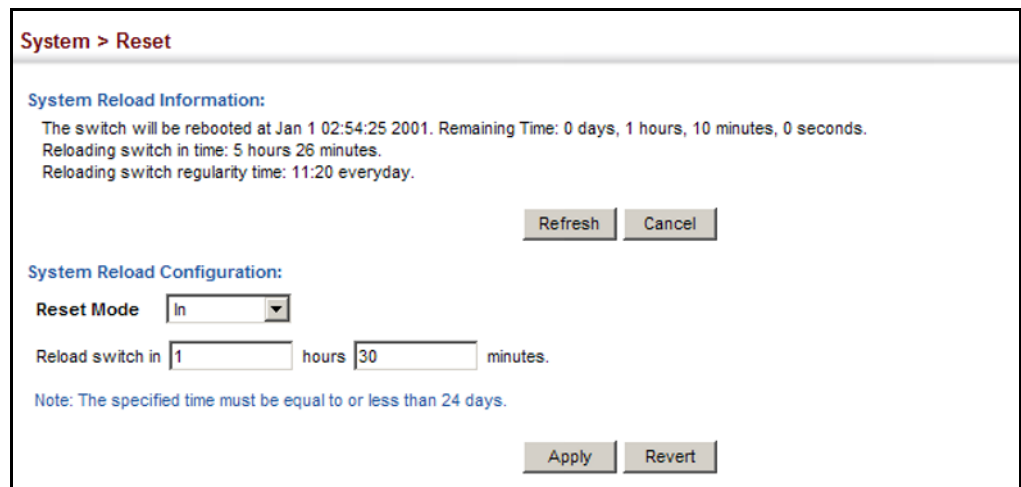


Figure 30: Restarting the Switch (At)

System > Reset

System Reload Information:
The switch will be rebooted at Jan 1 02:54:25 2001. Remaining Time: 0 days, 1 hours, 10 minutes, 0 seconds.
Reloading switch in time: 5 hours 26 minutes.
Reloading switch regularity time: 11:20 everyday.

System Reload Configuration:
Reset Mode
Reload switch at (DD/MM/YYYY) (HH:MM)
Warning: You have to setup system time first. Otherwise this function won't work.

Figure 31: Restarting the Switch (Regularly)

System > Reset

System Reload Information:
No configured settings for reloading.

System Reload Configuration:
Reset Mode
Time (HH:MM)
Period Daily
 Weekly
 Monthly

Warning: You have to setup system time first. Otherwise this function won't work.

4

Interface Configuration

This chapter describes the following topics:

- ◆ [Port Configuration](#) – Configures connection settings, including auto-negotiation, or manual setting of speed, duplex mode, and flow control.
- ◆ [Displaying Statistics](#) – Shows Interface, Etherlike, and RMON port statistics in table or chart form.
- ◆ [Displaying Statistical History](#) – Displays statistical history for the specified interfaces.
- ◆ [Displaying Transceiver Data](#) – Displays identifying information, and operational parameters for optical transceivers which support DDM.
- ◆ [Configuring Transceiver Thresholds](#) – Configures thresholds for alarm and warning messages for optical transceivers which support DDM.
- ◆ [Trunk Configuration](#) – Configures static or dynamic trunks.
- ◆ [Saving Power](#) – Adjusts the power provided to ports based on the length of the cable used to connect to other devices.
- ◆ [Local Port Mirroring](#) – Sets the source and target ports for mirroring on the local switch.
- ◆ [Remote Port Mirroring](#) – Configures mirroring of traffic from remote switches for analysis at a destination port on the local switch.
- ◆ [Traffic Segmentation](#) – Configures the uplinks and down links to a segmented group of ports.

Port Configuration

This section describes how to configure port connections, mirror traffic from one port to another, and run cable diagnostics.

Configuring by Port List Use the Interface > Port > General (Configure by Port List) page to enable/disable an interface, set auto-negotiation and the interface capabilities to advertise, or manually fix the speed, duplex mode, and flow control.

Command Usage

- ◆ Auto-negotiation must be disabled before you can configure or force a Gigabit RJ-45 interface to use the Speed/Duplex mode or Flow Control options.
- ◆ When using auto-negotiation, the optimal settings will be negotiated between the link partners based on their advertised capabilities. To set the speed, duplex mode, or flow control under auto-negotiation, the required operation modes must be specified in the capabilities list for an interface.
- ◆ The 1000BASE-T standard does not support forced mode. Auto-negotiation should always be used to establish a connection over any 1000BASE-T port or trunk. If not used, the success of the link process cannot be guaranteed when connecting to other types of switches.



Note: Auto-negotiation is not supported for 1000BASE SFP transceivers.

Parameters

These parameters are displayed:

- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Type** – Indicates the port type. (1000BASE-T or 1000BASE SFP)
- ◆ **Name** – Allows you to label an interface. (Range: 1-64 characters)
- ◆ **Admin** – Allows you to manually disable an interface. You can disable an interface due to abnormal behavior (e.g., excessive collisions), and then re-enable it after the problem has been resolved. You may also disable an interface for security reasons. (Default: Enabled)
- ◆ **Autonegotiation (Port Capabilities)** – Allows auto-negotiation to be enabled/disabled. When auto-negotiation is enabled, you need to specify the capabilities to be advertised. When auto-negotiation is disabled, you can force the settings for speed, mode, and flow control. The following capabilities are supported.
 - **10h** - Supports 10 Mbps half-duplex operation.

- **10f** - Supports 10 Mbps full-duplex operation.
- **100h** - Supports 100 Mbps half-duplex operation.
- **100f** - Supports 100 Mbps full-duplex operation.
- **1000f** - Supports 1000 Mbps full-duplex operation.
- **Sym** - Symmetric exchange of transmit and receive pause frames.
- **FC** - Flow control can eliminate frame loss by “blocking” traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3-2005 (formally IEEE 802.3x) for full-duplex operation.

Default: Autonegotiation enabled;

Advertised capabilities for

100BASE-FX (SFP) – 100full

1000BASE-T – 10half, 10full, 100half, 100full, 1000full

1000BASE-SX/LX/ZX (SFP) – 1000full

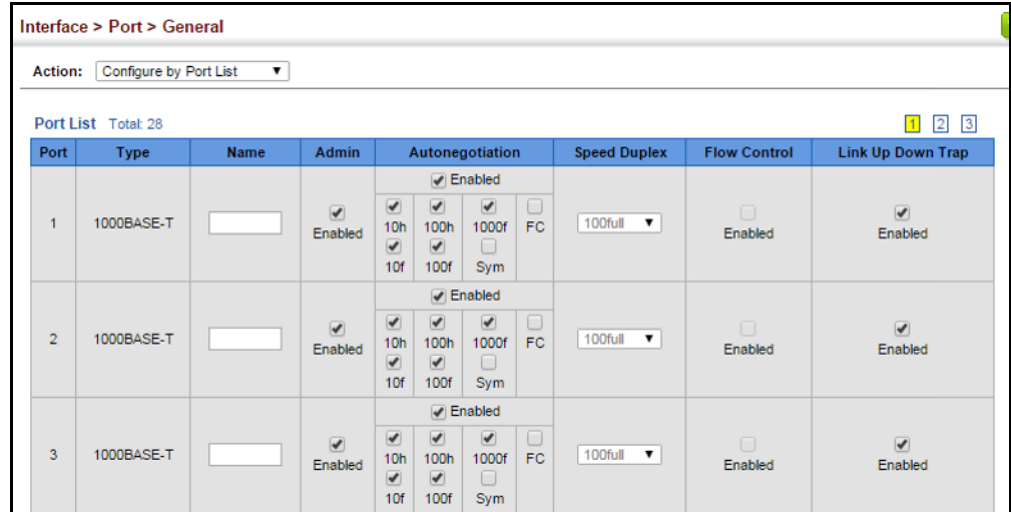
- ◆ **Speed/Duplex** – Allows you to manually set the port speed and duplex mode. (i.e., with auto-negotiation disabled)
- ◆ **Flow Control** – Allows automatic or manual selection of flow control. (Default: Enabled)
- ◆ **Link Up Down Trap** – Issues a notification message whenever a port link is established or broken. (Default: Disabled)

Web Interface

To configure port connection parameters:

1. Click Interface, Port, General.
2. Select Configure by Port List from the Action List.
3. Modify the required interface settings.
4. Click Apply.

Figure 32: Configuring Connections by Port List



Port	Type	Name	Admin	Autonegotiation	Speed Duplex	Flow Control	Link Up Down Trap
1	1000BASE-T		Enabled	<input checked="" type="checkbox"/> Enabled <input checked="" type="checkbox"/> 10h <input checked="" type="checkbox"/> 100h <input checked="" type="checkbox"/> 1000f <input type="checkbox"/> FC <input checked="" type="checkbox"/> 10f <input checked="" type="checkbox"/> 100f <input type="checkbox"/> Sym	100full	Enabled	Enabled
2	1000BASE-T		Enabled	<input checked="" type="checkbox"/> Enabled <input checked="" type="checkbox"/> 10h <input checked="" type="checkbox"/> 100h <input checked="" type="checkbox"/> 1000f <input type="checkbox"/> FC <input checked="" type="checkbox"/> 10f <input checked="" type="checkbox"/> 100f <input type="checkbox"/> Sym	100full	Enabled	Enabled
3	1000BASE-T		Enabled	<input checked="" type="checkbox"/> Enabled <input checked="" type="checkbox"/> 10h <input checked="" type="checkbox"/> 100h <input checked="" type="checkbox"/> 1000f <input type="checkbox"/> FC <input checked="" type="checkbox"/> 10f <input checked="" type="checkbox"/> 100f <input type="checkbox"/> Sym	100full	Enabled	Enabled

Configuring by Port Range Use the Interface > Port > General (Configure by Port Range) page to enable/disable an interface, set auto-negotiation and the interface capabilities to advertise, or manually fix the speed, duplex mode, and flow control.

Parameters

Except for the trap command, refer to [“Configuring by Port List” on page 96](#) for more information on command usage and a description of the parameters.

Web Interface

To configure port connection parameters:

1. Click Interface, Port, General.
2. Select Configure by Port Range from the Action List.
3. Enter a range of ports to which your configuration changes apply.
4. Modify the required interface settings.
5. Click Apply.

Figure 33: Configuring Connections by Port Range

The screenshot shows the 'Interface > Port > General' configuration page. At the top, the breadcrumb 'Interface > Port > General' is visible. Below it, the 'Action' dropdown menu is set to 'Configure by Port Range'. The main configuration area includes several fields and checkboxes: 'Port Range (1-28)' with two empty input boxes separated by a hyphen; 'Admin' with a checked checkbox; 'Autonegotiation' with a checked checkbox and two rows of radio button options: the first row has '10h' selected and '100h', '1000f', and 'FC' unselected; the second row has '10f' selected and '100f' and 'Sym' unselected. Below these is a 'Speed Duplex' dropdown menu set to '10half'. 'Flow Control' and 'Link Up Down Trap' both have checked checkboxes. At the bottom right, there are 'Apply' and 'Revert' buttons.

Displaying Connection Status Use the Interface > Port > General (Show Information) page to display the current connection status, including link state, speed/duplex mode, flow control, and auto-negotiation.

Parameters

These parameters are displayed:

- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Type** – Indicates the port type. (1000BASE-T or 1000BASE SFP)
- ◆ **Name** – Interface label.
- ◆ **Admin** – Shows if the port is enabled or disabled.
- ◆ **Oper Status** – Indicates if the link is Up or Down.
- ◆ **Shutdown Reason** – Shows the reason this interface has been shut down if applicable. Some of the reasons for shutting down an interface include being administratively disabled, or exceeding traffic boundary limits set by auto traffic control.
- ◆ **Autonegotiation** – Shows if auto-negotiation is enabled or disabled.
- ◆ **Oper Speed Duplex** – Shows the current speed and duplex mode.
- ◆ **Oper Flow Control** – Shows the flow control type used.
- ◆ **Link Up Down Trap** – Shows if a notification message will be sent whenever a port link is established or broken. (Default: Enabled)

Web Interface

To display port connection parameters:

1. Click Interface, Port, General.
2. Select Show Information from the Action List.

Figure 34: Displaying Port Information

Port	Type	Name	Admin	Oper Status	Shutdown Reason	Autonegotiation	Oper Speed Duplex	Oper Flow Control	Link Up Down Trap
1	1000BASE-T		Enabled	Up		Enabled	100full	None	Enabled
2	1000BASE-T		Enabled	Down		Enabled	1000full	None	Enabled
3	1000BASE-T		Enabled	Down		Enabled	1000full	None	Enabled
4	1000BASE-T		Enabled	Down		Enabled	1000full	None	Enabled
5	1000BASE-T		Enabled	Down		Enabled	1000full	None	Enabled

Showing Port or Trunk Statistics

Use the Interface > Port/Trunk > Statistics or Chart page to display standard statistics on network traffic from the Interfaces Group and Ethernet-like MIBs, as well as a detailed breakdown of traffic based on the RMON MIB. Interfaces and Ethernet-like statistics display errors on the traffic passing through each port. This information can be used to identify potential problems with the switch (such as a faulty port or unusually heavy loading). RMON statistics provide access to a broad range of statistics, including a total count of different frame types and sizes passing through each port. All values displayed have been accumulated since the last system reboot, and are shown as counts per second. Statistics are refreshed every 60 seconds by default.



Note: RMON groups 2, 3 and 9 can only be accessed using SNMP management software.

Parameters

These parameters are displayed:

Table 6: Port Statistics

Parameter	Description
<i>Interface Statistics</i>	
Received Octets	The total number of octets received on the interface, including framing characters.
Transmitted Octets	The total number of octets transmitted out of the interface, including framing characters.

Table 6: Port Statistics (Continued)

Parameter	Description
Received Errors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Transmitted Errors	The number of outbound packets that could not be transmitted because of errors.
Received Unicast Packets	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
Transmitted Unicast Packets	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Received Discarded Packets	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Transmitted Discarded Packets	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Received Multicast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
Transmitted Multicast Packets	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent.
Received Broadcast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
Transmitted Broadcast Packets	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.
Received Unknown Packets	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
<i>Etherlike Statistics</i>	
Single Collision Frames	The number of successfully transmitted frames for which transmission is inhibited by exactly one collision.
Multiple Collision Frames	A count of successfully transmitted frames for which transmission is inhibited by more than one collision.
Late Collisions	The number of times that a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	A count of frames for which transmission on a particular interface fails due to excessive collisions. This counter does not increment when the interface is operating in full-duplex mode.
Deferred Transmissions	A count of frames for which the first transmission attempt on a particular interface is delayed because the medium was busy.
Frames Too Long	A count of frames received on a particular interface that exceed the maximum permitted frame size.
Alignment Errors	The number of alignment errors (missynchronized data packets).
FCS Errors	A count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check. This count does not include frames received with frame-too-long or frame-too-short error.

Table 6: Port Statistics (Continued)

Parameter	Description
SQE Test Errors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface.
Carrier Sense Errors	The number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Internal MAC Receive Errors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error.
Internal MAC Transmit Errors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error.
<i>RMON Statistics</i>	
Drop Events	The total number of events in which packets were dropped due to lack of resources.
Jabbers	The total number of frames received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS or alignment error.
Fragments	The total number of frames received that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS or alignment error.
Collisions	The best estimate of the total number of collisions on this Ethernet segment.
Received Octets	Total number of octets of data received on the network. This statistic can be used as a reasonable indication of Ethernet utilization.
Received Packets	The total number of packets (bad, broadcast and multicast) received.
Broadcast Packets	The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Packets	The total number of good packets received that were directed to this multicast address.
Undersize Packets	The total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
Oversize Packets	The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.
64 Bytes Packets	The total number of packets (including bad packets) received and transmitted that were 64 octets in length (excluding framing bits but including FCS octets).
65-127 Byte Packets	The total number of packets (including bad packets) received and transmitted where the number of octets fall within the specified range (excluding framing bits but including FCS octets).
128-255 Byte Packets	
256-511 Byte Packets	
512-1023 Byte Packets	
1024-1518 Byte Packets	
1519-1536 Byte Packets	
<i>Utilization Statistics</i>	
Input Octets in kbits per second	Number of octets entering this interface in kbits/second.
Input Packets per second	Number of packets entering this interface per second.
Input Utilization	The input utilization rate for this interface.

Table 6: Port Statistics (Continued)

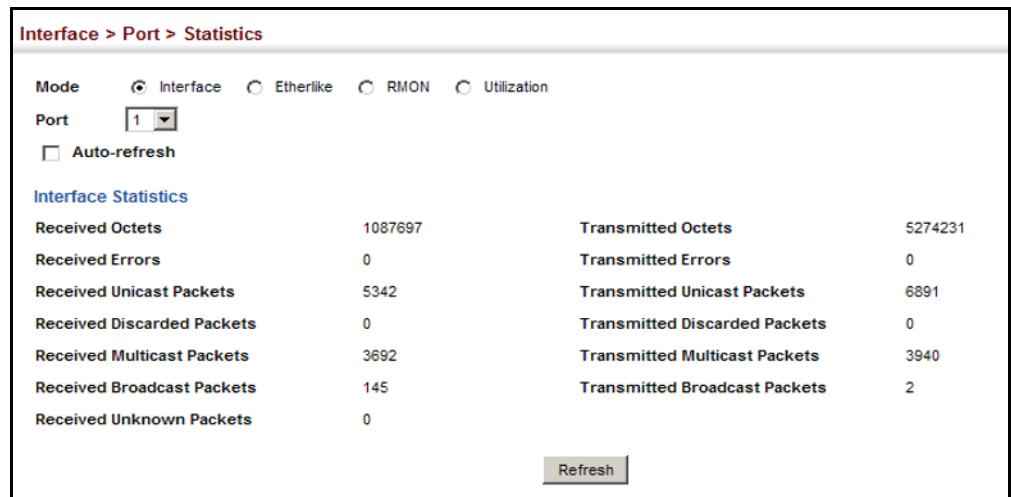
Parameter	Description
Output Octets in kbits per second	Number of octets leaving this interface in kbits/second.
Output Packets per second	Number of packets leaving this interface per second.
Output Utilization	The output utilization rate for this interface.

Web Interface

To show a list of port statistics:

1. Click Interface, Port, Statistics.
2. Select the statistics mode to display (Interface, Etherlike, RMON or Utilization).
3. Select a port from the drop-down list.
4. Use the Refresh button to update the screen.

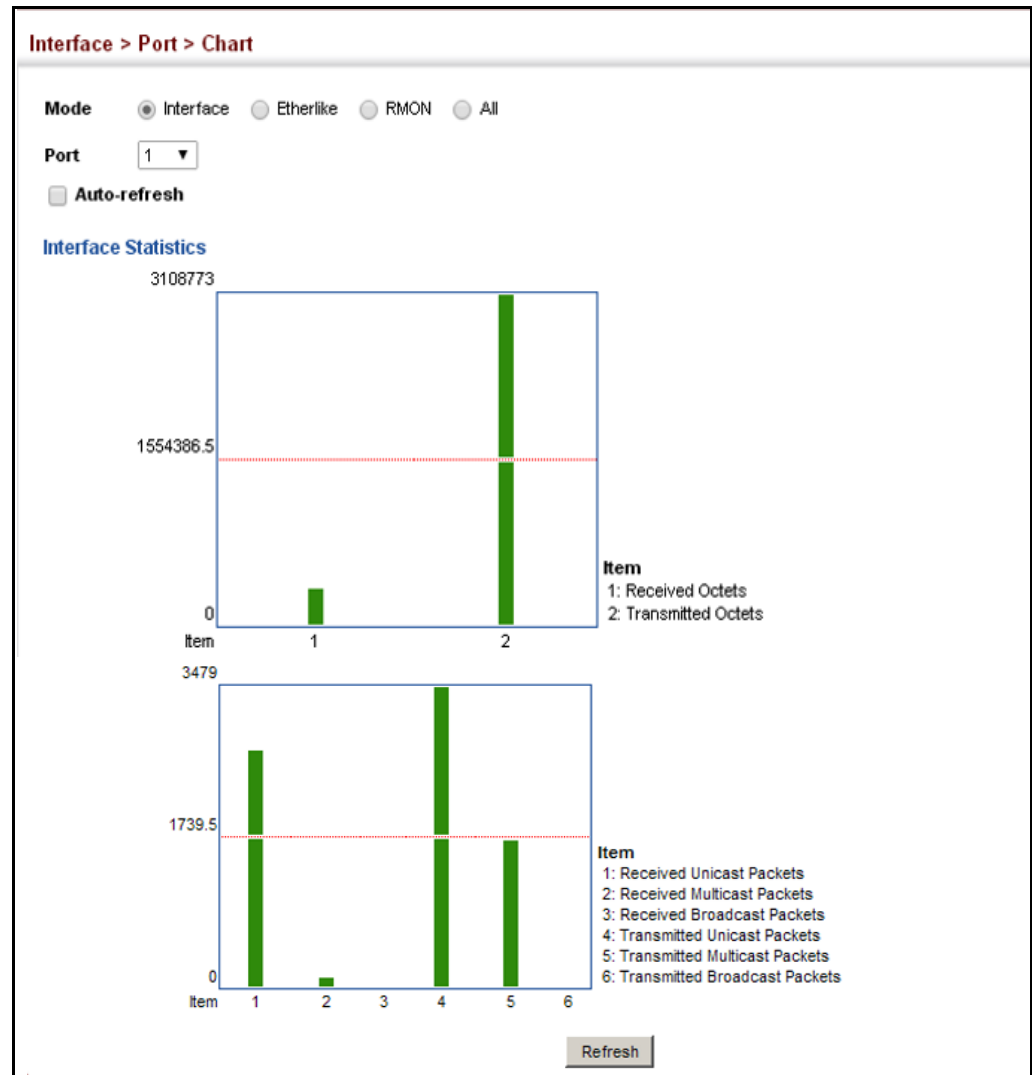
Figure 35: Showing Port Statistics (Table)



To show a chart of port statistics:

1. Click Interface, Port, Chart.
2. Select the statistics mode to display (Interface, Etherlike, RMON or All).
3. If Interface, Etherlike, RMON statistics mode is chosen, select a port from the drop-down list. If All (ports) statistics mode is chosen, select the statistics type to display.

Figure 36: Showing Port Statistics (Chart)



Displaying Statistical History Use the Interface > Port > History or Interface > Trunk > History page to display statistical history for the specified interfaces.

Command Usage

- ◆ For a description of the statistics displayed on these pages, see ["Showing Port or Trunk Statistics" on page 100](#).
- ◆ To configure statistical history sampling, use the ["Displaying Statistical History" on page 104](#).

Parameters

These parameters are displayed:

Add

- ◆ **Port** – Port number. (Range: 1-10)

- ◆ **History Name** – Name of sample interval. (Range: 1-32 characters)
- ◆ **Interval** - The interval for sampling statistics. (Range: 1-86400 minutes)
- ◆ **Requested Buckets** - The number of samples to take. (Range: 1-96)

Show

- ◆ **Port** – Port number. (Range: 1-10)
- ◆ **History Name** – Name of sample interval. (Default settings: 15min, 1day)
- ◆ **Interval** - The interval for sampling statistics.
- ◆ **Requested Buckets** - The number of samples to take.

Show Details

- ◆ **Mode**
 - **Status** – Shows the sample parameters.
 - **Current Entry** – Shows current statistics for the specified port and named sample.
 - **Input Previous Entries** – Shows statistical history for ingress traffic.
 - **Output Previous Entries** – Shows statistical history for egress traffic.
- ◆ **Port** – Port number. (Range: 1-10)
- ◆ **Name** – Name of sample interval.

Web Configuration

To configure a periodic sample of statistics:

1. Click Interface, Port, Statistics, or Interface, Trunk, Statistics.
2. Select Add from the Action menu.
3. Select an interface from the Port or Trunk list.
4. Enter the sample name, the interval, and the number of buckets requested.
5. Click Apply.

Figure 37: Configuring a History Sample

Interface > Port > History

Action: Add

Port: 1

History Name: rd#1

Interval (1-86400): 60

Requested Buckets (1-96): 50

Apply Revert

To show the configured entries for a history sample:

1. Click Interface, Port, Statistics, or Interface, Trunk, Statistics.
2. Select Show from the Action menu.
3. Select an interface from the Port or Trunk list.

Figure 38: Showing Entries for History Sampling

Interface > Port > History

Action: Show

Port: 1

History Name List Total: 3

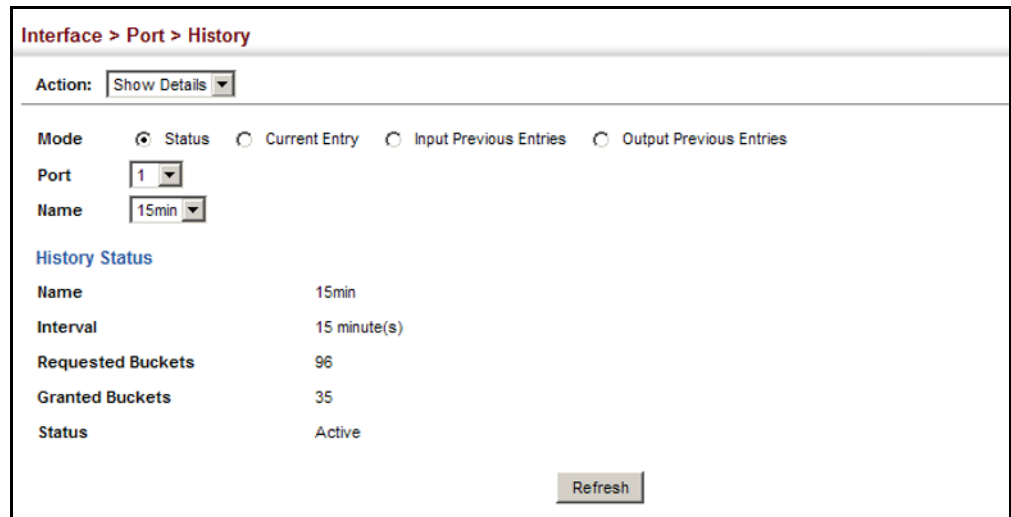
<input type="checkbox"/>	History Name	Interval	Requested Buckets
<input type="checkbox"/>	15min	900	96
<input type="checkbox"/>	1day	86400	7
<input type="checkbox"/>	rd#1	60	50

Delete Revert

To show the configured parameters for a sampling entry:

1. Click Interface, Port, Statistics, or Interface, Trunk, Statistics.
2. Select Show Details from the Action menu.
3. Select Status from the options for Mode.
4. Select an interface from the Port or Trunk list.
5. Select an sampling entry from the Name list.

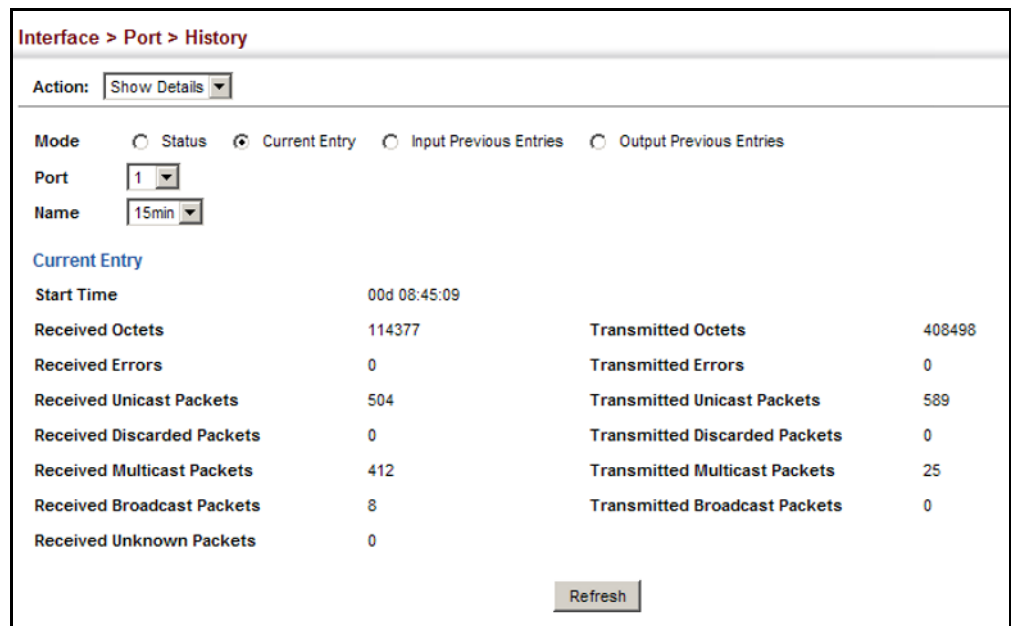
Figure 39: Showing Status of Statistical History Sample



To show statistics for the current interval of a sample entry:

1. Click Interface, Port, Statistics, or Interface, Trunk, Statistics.
2. Select Show Details from the Action menu.
3. Select Current Entry from the options for Mode.
4. Select an interface from the Port or Trunk list.
5. Select an sampling entry from the Name list.

Figure 40: Showing Current Statistics for a History Sample



To show ingress or egress traffic statistics for a sample entry:

1. Click Interface, Port, Statistics, or Interface, Trunk, Statistics.
2. Select Show Details from the Action menu.
3. Select Input Previous Entry or Output Previous Entry from the options for Mode.
4. Select an interface from the Port or Trunk list.
5. Select an sampling entry from the Name list.

Figure 41: Showing Ingress Statistics for a History Sample

Interface > Port > History

Action: Show Details

Mode: Status Current Entry Input Previous Entries Output Previous Entries

Port: 1

Name: 15min

Input Previous Entry List Total: 16

Start Time	%	Octets	Unicast	Multicast	Broadcast	Discarded	Errors	Unknown Proto
00d 00:00:0	0.00	9401	0	40	36	24	0	0
00d 00:15:0	0.00	3246	0	30	9	9	0	0
00d 00:30:0	0.00	2999	0	30	8	8	0	0
00d 00:45:0	0.00	3863	0	30	17	17	0	0
00d 01:00:0	0.00	3511	0	29	14	14	0	0
00d 01:15:0	0.00	3246	0	30	9	9	0	0
00d 01:30:0	0.00	2999	0	30	8	8	0	0
00d 01:45:0	0.00	2999	0	30	8	8	0	0
00d 02:00:0	0.00	3575	0	30	14	14	0	0
00d 02:15:0	0.00	3246	0	30	9	9	0	0

Refresh

Displaying Transceiver Data

Use the Interface > Port > Transceiver page to display identifying information, and operational for optical transceivers which support Digital Diagnostic Monitoring (DDM).

Parameters

These parameters are displayed:

- ◆ **Port** – Port number. (Range: 9-10/23-26/25-28/49-52)
- ◆ **General** – Information on connector type and vendor-related parameters.
- ◆ **DDM Information** – Information on temperature, supply voltage, laser bias current, laser power, and received optical power.

The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose

problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) provides information on transceiver parameters.

Web Interface

To display identifying information and functional parameters for optical transceivers:

1. Click Interface, Port, Transceiver.
2. Select a port from the scroll-down list.

Figure 42: Displaying Transceiver Data

Interface > Port > Transceiver	
Port	11
General	
Connector Type	LC
Fiber Type	Multimode 50um (M5), Multimode 62.5um (M6)
Eth Compliance Codes	1000BASE-SX
Baud Rate	2100 MBd
Vendor OUI	00-90-65
Vendor Name	FINISAR CORP.
Vendor PN	FTLF8519P3BTL
Vendor Rev	A
Vendor SN	PKM1XUU
Date Code	11-05-25
DDM Information	
Temperature	33.85 °C
Vcc	3.28 V
Bias Current	5.50 mA
TX Power	-5.50 dBm
RX Power	-35.23 dBm

Configuring Transceiver Thresholds Use the Interface > Port > Transceiver page to configure thresholds for alarm and warning messages for optical transceivers which support Digital Diagnostic Monitoring (DDM). This page also displays identifying information for supported transceiver types, and operational parameters for transceivers which support DDM.

Parameters

These parameters are displayed:

- ◆ **Port** – Port number. (Range: 9-10/23-26/25-28/49-52)
- ◆ **General** – Information on connector type and vendor-related parameters.
- ◆ **DDM Information** – Information on temperature, supply voltage, laser bias current, laser power, and received optical power.

The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) provides information on transceiver parameters.

- ◆ **Trap** – Sends a trap when any of the transceiver’s operation values falls outside of specified thresholds. (Default: Disabled)
- ◆ **Auto Mode** – Uses default threshold settings obtained from the transceiver to determine when an alarm or trap message should be sent. (Default: Enabled)
- ◆ **DDM Thresholds** – Information on alarm and warning thresholds. The switch can be configured to send a trap when the measured parameter falls outside of the specified thresholds.

The following alarm and warning parameters are supported:

- **High Alarm** – Sends an alarm message when the high threshold is crossed.
- **High Warning** – Sends a warning message when the high threshold is crossed.
- **Low Warning** – Sends a warning message when the low threshold is crossed.
- **Low Alarm** – Sends an alarm message when the low threshold is crossed.

The configurable ranges are:

- **Temperature:** -128.00-128.00 °C
- **Voltage:** 0.00-6.55 Volts
- **Current:** 0.00-131.00 mA
- **Power:** -40.00-8.20 dBm

The threshold value for Rx and Tx power is calculated as the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).

Threshold values for alarm and warning messages can be configured as described below.

- A high-threshold alarm or warning message is sent if the current value is greater than or equal to the threshold, and the last sample value was less than the threshold. After a rising event has been generated, another such event will not be generated until the sampled value has fallen below the high threshold and reaches the low threshold.
- A low-threshold alarm or warning message is sent if the current value is less than or equal to the threshold, and the last sample value was greater than the threshold. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the low threshold and reaches the high threshold.

- Threshold events are triggered as described above to avoid a hysteresis effect which would continuously trigger event messages if the power level were to fluctuate just above and below either the high threshold or the low threshold.
- Trap messages configured by this command are sent to any management station configured as an SNMP trap manager using the Administration > SNMP (Configure Trap) page.

Web Interface

To configure threshold values for optical transceivers:

1. Click Interface, Port, Transceiver.
2. Select a port from the scroll-down list.
3. Set the switch to send a trap based on default or manual settings.
4. Set alarm and warning thresholds if manual configuration is used.
5. Click Apply.

Figure 43: Configuring Transceiver Thresholds

DDM Thresholds

Trap

Auto Mode

	High Alarm	High Warning	Low Warning	Low Alarm
Temperature(°C)	75.00	70.00	0.00	-123.00
Voltage(Volts)	3.50	3.45	3.15	3.10
Current(mA)	100.00	90.00	7.00	6.00
Tx Power(dBm)	-9.00	-9.50	-11.50	-12.00
Rx Power(dBm)	-3.00	-3.50	-21.00	-21.50

[Click this button to restore default DDM thresholds values.](#)

Trunk Configuration

This section describes how to configure static and dynamic trunks.

You can create multiple links between devices that work as one virtual, aggregate link. A port trunk offers a dramatic increase in bandwidth for network segments where bottlenecks exist, as well as providing a fault-tolerant link between two devices. You can create up to 16 trunks at a time on the switch, or up to 32 across the stack.

The switch supports both static trunking and dynamic Link Aggregation Control Protocol (LACP). Static trunks have to be manually configured at both ends of the link, and the switches must comply with the Cisco EtherChannel standard. On the other hand, LACP configured ports can automatically negotiate a trunked link with LACP-configured ports on another device. You can configure any number of ports on the switch as LACP, as long as they are not already configured as part of a static trunk. If ports on another device are also configured as LACP, the switch and the other device will negotiate a trunk link between them. If an LACP trunk consists of more than eight ports, all other ports will be placed in standby mode. Should one link in the trunk fail, one of the standby ports will automatically be activated to replace it.

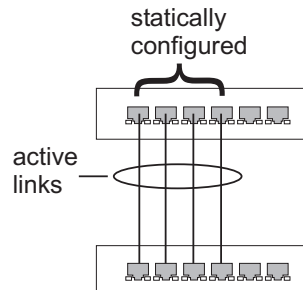
Command Usage

Besides balancing the load across each port in the trunk, the other ports provide redundancy by taking over the load if a port in the trunk fails. However, before making any physical connections between devices, use the web interface or CLI to specify the trunk on the devices at both ends. When using a trunk, take note of the following points:

- ◆ Finish configuring trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- ◆ You can create up to 16 trunks on a switch or 32 trunks in the stack, with up to eight ports per trunk.
- ◆ The ports at both ends of a connection must be configured as trunk ports.
- ◆ When configuring static trunks on switches of different types, they must be compatible with the Cisco EtherChannel standard.
- ◆ The ports at both ends of a trunk must be configured in an identical manner, including communication mode (i.e., speed, duplex mode and flow control), VLAN assignments, and CoS settings.
- ◆ Any of the Gigabit ports on the front panel can be trunked together, including ports of different media types.
- ◆ All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN.
- ◆ STP, VLAN, and IGMP settings can only be made for the entire trunk.

Configuring a Static Trunk Use the Interface > Trunk > Static page to create a trunk, assign member ports, and configure the connection parameters.

Figure 44: Configuring Static Trunks



Command Usage

- ◆ When configuring static trunks, you may not be able to link switches of different types, depending on the vendor’s implementation. However, note that the static trunks on this switch are Cisco EtherChannel compatible.
- ◆ To avoid creating a loop in the network, be sure you add a static trunk via the configuration interface before connecting the ports, and also disconnect the ports before removing a static trunk via the configuration interface.

Parameters

These parameters are displayed:

- ◆ **Trunk ID** – Trunk identifier. (Range: 1-8)
- ◆ **Member** – The initial trunk member. Use the Add Member page to configure additional members.
 - **Unit** – Unit identifier. (Range: 1)
 - **Port** – Port identifier. (Range: 1-10)

Web Interface

To create a static trunk:

1. Click Interface, Trunk, Static.
2. Select Configure Trunk from the Step list.
3. Select Add from the Action list.
4. Enter a trunk identifier.
5. Set the unit and port for the initial trunk member.
6. Click Apply.

Figure 45: Creating Static Trunks

The screenshot shows a web-based configuration interface for creating static trunks. At the top, the breadcrumb navigation reads "Interface > Trunk > Static". Below this, there are two dropdown menus: "Step:" set to "1. Configure Trunk" and "Action:" set to "Add". Underneath, there is a text input field for "Trunk ID (1-8)". Below that, there is a "Member" section with two dropdown menus: "Unit" set to "1" and "Port" set to "1". At the bottom right of the form, there are two buttons: "Apply" and "Revert".

To add member ports to a static trunk:

1. Click Interface, Trunk, Static.
2. Select Configure Trunk from the Step list.
3. Select Add Member from the Action list.
4. Select a trunk identifier.
5. Set the unit and port for an additional trunk member.
6. Click Apply.

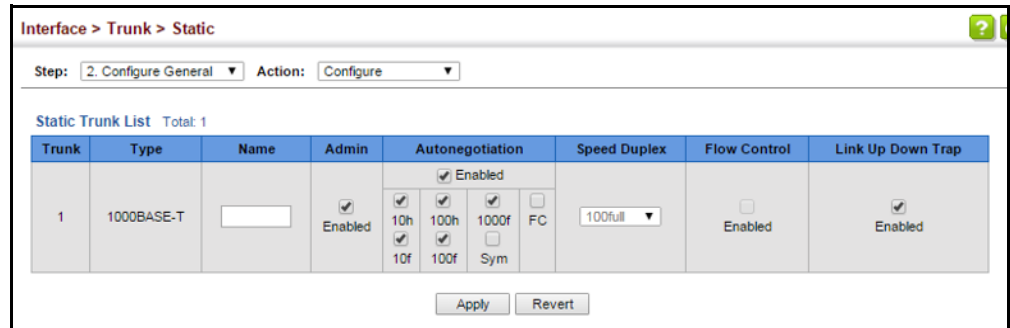
Figure 46: Adding Static Trunks Members

This screenshot is identical to Figure 45, showing the "Interface > Trunk > Static" configuration page. The "Step:" dropdown is "1. Configure Trunk" and the "Action:" dropdown is "Add". The "Trunk ID (1-8)" field is empty. The "Member" section shows "Unit" set to "1" and "Port" set to "1". The "Apply" and "Revert" buttons are visible at the bottom right.

To configure connection parameters for a static trunk:

1. Click Interface, Trunk, Static.
2. Select Configure General from the Step list.
3. Select Configure from the Action list.
4. Modify the required interface settings. (Refer to [“Configuring by Port List”](#) on page 96 for a description of the parameters.)
5. Click Apply.

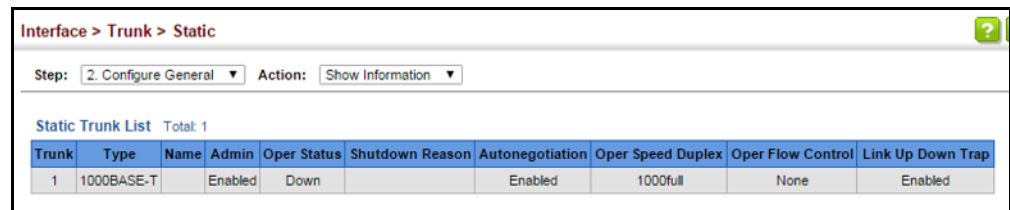
Figure 47: Configuring Connection Parameters for a Static Trunk



To display trunk connection parameters:

1. Click Interface, Trunk, Static.
2. Select Configure General from the Step list.
3. Select Show Information from the Action list.

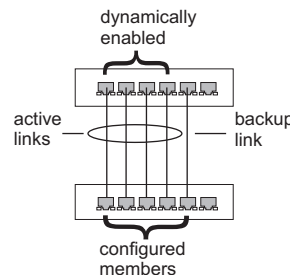
Figure 48: Showing Information for Static Trunks



Configuring a Dynamic Trunk

Use the Interface > Trunk > Dynamic pages to set the administrative key for an aggregation group, enable LACP on a port, configure protocol parameters for local and partner ports, or to set Ethernet connection parameters.

Figure 49: Configuring Dynamic Trunks



Command Usage

- ◆ To avoid creating a loop in the network, be sure you enable LACP before connecting the ports, and also disconnect the ports before disabling LACP.

- ◆ If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- ◆ A trunk formed with another switch using LACP will automatically be assigned the next available trunk ID.
- ◆ If more than eight ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.
- ◆ All ports on both ends of an LACP trunk must be configured for full duplex, and auto-negotiation.
- ◆ Ports are only allowed to join the same Link Aggregation Group (LAG) if (1) the LACP port system priority matches, (2) the LACP port admin key matches, and (3) the LAG admin key matches (if configured). However, if the LAG admin key is set, then the port admin key must be set to the same value for a port to be allowed to join that group.



Note: If the LACP admin key is not set when a channel group is formed (i.e., it has a null value of 0), the operational value of this key is set to the same value as the port admin key used by the interfaces that joined the group (see the “show lacp internal” command in the *CLI Reference Guide*).

Parameters

These parameters are displayed:

Configure Aggregator

- ◆ **Admin Key** – LACP administration key is used to identify a specific link aggregation group (LAG) during local LACP setup on the switch. (Range: 0-65535)

If the port channel admin key is not set when a channel group is formed (i.e., it has the null value of 0), this key is set to the same value as the port admin key (see *Configure Aggregation Port - Actor/Partner*) used by the interfaces that joined the group. Note that when the LAG is no longer used, the port channel admin key is reset to 0.

If the port channel admin key is set to a non-default value, the operational key is based upon LACP PDUs received from the partner, and the channel admin key is reset to the default value. The trunk identifier will also be changed by this process.

- ◆ **Timeout Mode** – The timeout to wait for the next LACP data unit (LACPDU):
 - **Long Timeout** – Specifies a slow timeout of 90 seconds. (This is the default setting.)

- **Short Timeout** – Specifies a fast timeout of 3 seconds.

The timeout is set in the LACP timeout bit of the Actor State field in transmitted LACPDU. When the partner switch receives an LACPDU set with a short timeout from the actor switch, the partner adjusts the transmit LACPDU interval to 1 second. When it receives an LACPDU set with a long timeout from the actor, it adjusts the transmit LACPDU interval to 30 seconds.

If the actor does not receive an LACPDU from its partner before the configured timeout expires, the partner port information will be deleted from the LACP group.

When a dynamic port-channel member leaves a port-channel, the default timeout value will be restored on that port.

When a dynamic port-channel is torn down, the configured timeout value will be retained. When the dynamic port-channel is constructed again, that timeout value will be used.

- ◆ **System Priority** – LACP system priority is used to determine link aggregation group (LAG) membership, and to identify this device to other switches during LAG negotiations.
- ◆ **System MAC Address** – The device MAC address assigned to each trunk.

Configure Aggregation Port - General

- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **LACP Status** – Enables or disables LACP on a port.

Configure Aggregation Port - Actor/Partner

- ◆ **Port** – Port number. (Range: 1-10)
- ◆ **Admin Key** – The LACP administration key must be set to the same value for ports that belong to the same LAG. (Range: 0-65535; Default – Actor: 1, Partner: 0)

Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state.



Note: Configuring the partner admin-key does not affect remote or local switch operation. The local switch just records the partner admin-key for user reference.

By default, the actor's operational key is determined by port's link speed (1000f - 4, 100f - 3, 10f - 2), and copied to the admin key.

- ◆ **System Priority** – LACP system priority is used to determine link aggregation group (LAG) membership, and to identify this device to other switches during LAG negotiations. (Range: 0-65535; Default: 32768)

System priority is combined with the switch's MAC address to form the LAG identifier. This identifier is used to indicate a specific LAG during LACP negotiations with other systems.

- ◆ **Port Priority** – If a link goes down, LACP port priority is used to select a backup link. (Range: 0-65535; Default: 32768)
 - Setting a lower value indicates a higher effective priority.
 - If an active port link goes down, the backup port with the highest priority is selected to replace the downed link. However, if two or more ports have the same LACP port priority, the port with the lowest physical port number will be selected as the backup port.
 - If an LAG already exists with the maximum number of allowed port members, and LACP is subsequently enabled on another port using a higher priority than an existing member, the newly configured port will replace an existing port member that has a lower priority.



Note: Configuring LACP settings for a port only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with that port.

Note: Configuring the port partner sets the remote side of an aggregate link; i.e., the ports on the attached device. The command attributes have the same meaning as those used for the port actor.

Web Interface

To configure the admin key for a dynamic trunk:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregator from the Step list.
3. Set the Admin Key and timeout mode for the required LACP group.
4. Click Apply.

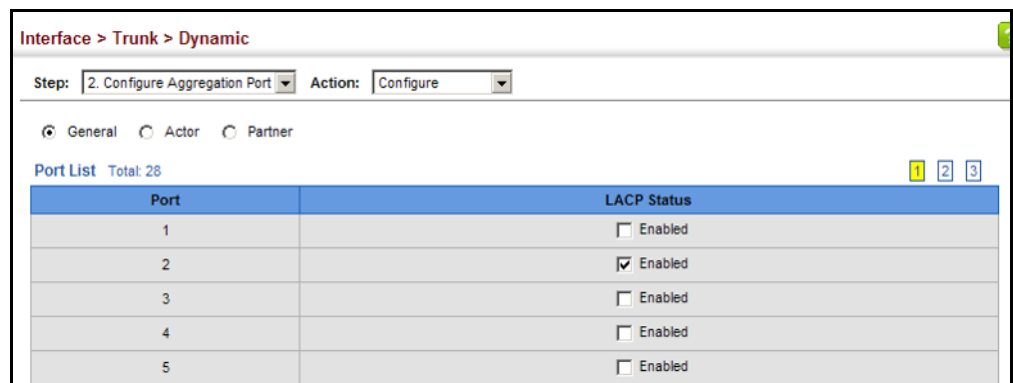
Figure 50: Configuring the LACP Aggregator Admin Key

Trunk	Admin Key (0-65535)	Timeout Mode	System Priority	System MAC Address
1	0	Long Timeout	32768	00-E0-0C-00-00-FD
2	0	Long Timeout	32768	00-E0-0C-00-00-FD
3	0	Long Timeout	32768	00-E0-0C-00-00-FD
4	0	Long Timeout	32768	00-E0-0C-00-00-FD
5	0	Long Timeout	32768	00-E0-0C-00-00-FD

To enable LACP for a port:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregation Port from the Step list.
3. Select Configure from the Action list.
4. Click General.
5. Enable LACP on the required ports.
6. Click Apply.

Figure 51: Enabling LACP on a Port



To configure LACP parameters for group members:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregation Port from the Step list.
3. Select Configure from the Action list.
4. Click Actor or Partner.
5. Configure the required settings.
6. Click Apply.

Figure 52: Configuring LACP Parameters on a Port

The screenshot shows the configuration page for a dynamic trunk. The breadcrumb is "Interface > Trunk > Dynamic". The "Step" dropdown is set to "2. Configure Aggregation Port" and the "Action" dropdown is set to "Configure". There are three tabs: "General", "Actor" (which is selected), and "Partner". Below the tabs is a "Port List" section with a "Total: 28" and three numbered tabs (1, 2, 3). The main table has four columns: "Port", "Admin Key (0-65535)", "System Priority (0-65535)", and "Port Priority (0-65535)".

Port	Admin Key (0-65535)	System Priority (0-65535)	Port Priority (0-65535)
1	3	32768	32768
2	3	32768	32768
3	1	32768	32768
4	1	32768	32768
5	1	32768	32768

To show the active members of a dynamic trunk:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Trunk from the Step list.
3. Select Show Member from the Action list.
4. Select a Trunk.

Figure 53: Showing Members of a Dynamic Trunk

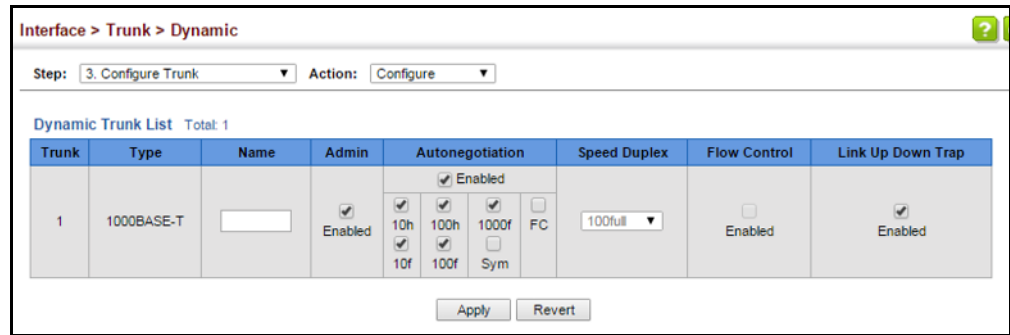
The screenshot shows the configuration page for a dynamic trunk. The breadcrumb is "Interface > Trunk > Dynamic". The "Step" dropdown is set to "3. Configure Trunk" and the "Action" dropdown is set to "Show Member". There is a "Trunk" dropdown menu with "1" selected. Below is a "Member List" section with a "Total: 2". The table has one column: "Member (Unit/Port)".

Member (Unit/Port)
1/1
1/2

To configure connection parameters for a dynamic trunk:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Trunk from the Step list.
3. Select Configure from the Action list.
4. Modify the required interface settings. (See ["Configuring by Port List" on page 96](#) for a description of the interface settings.)
5. Click Apply.

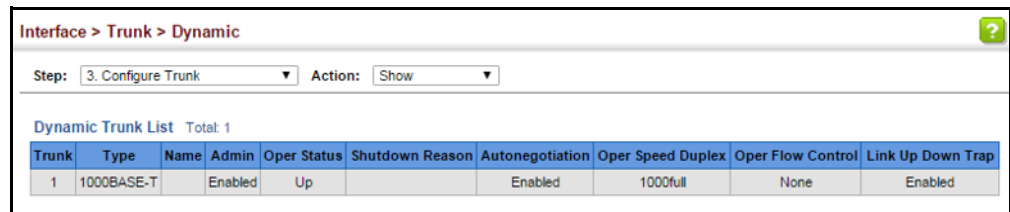
Figure 54: Configuring Connection Settings for a Dynamic Trunk



To show connection parameters for a dynamic trunk:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Trunk from the Step list.
3. Select Show from the Action list.

Figure 55: Showing Connection Parameters for Dynamic Trunks



Displaying LACP Port Counters Use the Interface > Trunk > Dynamic (Configure Aggregation Port - Show Information - Counters) page to display statistics for LACP protocol messages.

Parameters

These parameters are displayed:

Table 7: LACP Port Counters

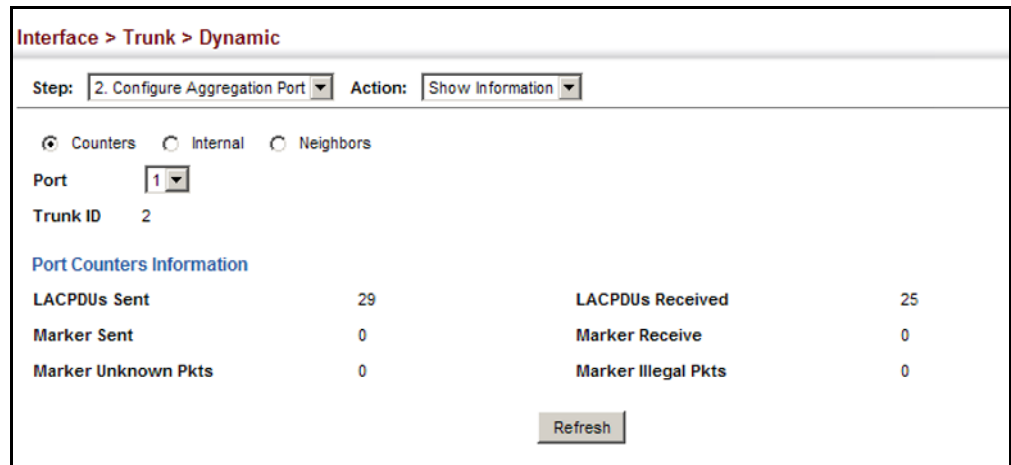
Parameter	Description
LACPDU Sent	Number of valid LACPDUs transmitted from this channel group.
LACPDU Received	Number of valid LACPDUs received on this channel group.
Marker Sent	Number of valid Marker PDUs transmitted from this channel group.
Marker Received	Number of valid Marker PDUs received by this channel group.
Marker Unknown Pkts	Number of frames received that either (1) Carry the Slow Protocols Ethernet Type value, but contain an unknown PDU, or (2) are addressed to the Slow Protocols group MAC Address, but do not carry the Slow Protocols Ethernet Type.
Marker Illegal Pkts	Number of frames that carry the Slow Protocols Ethernet Type value, but contain a badly formed PDU or an illegal value of Protocol Subtype.

Web Interface

To display LACP port counters:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregation Port from the Step list.
3. Select Show Information from the Action list.
4. Click Counters.
5. Select a group member from the Port list.

Figure 56: Displaying LACP Port Counters



Displaying LACP Settings and Status for the Local Side

Use the Interface > Trunk > Dynamic (Configure Aggregation Port - Show Information - Internal) page to display the configuration settings and operational state for the local side of a link aggregation.

Parameters

These parameters are displayed:

Table 8: LACP Internal Configuration Information

Parameter	Description
LACP System Priority	LACP system priority assigned to this port channel.
LACP Port Priority	LACP port priority assigned to this interface within the channel group.
Admin Key	Current administrative value of the key for the aggregation port.
Oper Key	Current operational value of the key for the aggregation port.
LACPDUs Interval	Number of seconds before invalidating received LACPDU information.

Table 8: LACP Internal Configuration Information (Continued)

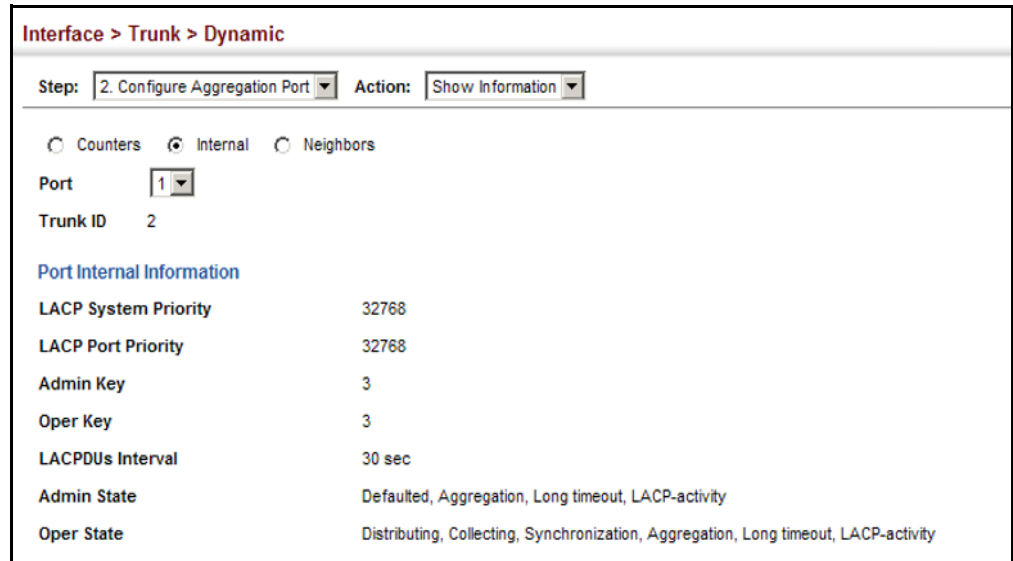
Parameter	Description
Admin State, Oper State	<p>Administrative or operational values of the actor's state parameters:</p> <ul style="list-style-type: none"> ◆ Expired – The actor's receive machine is in the expired state; ◆ Defaulted – The actor's receive machine is using defaulted operational partner information, administratively configured for the partner. ◆ Distributing – If false, distribution of outgoing frames on this link is disabled; i.e., distribution is currently disabled and is not expected to be enabled in the absence of administrative changes or changes in received protocol information. ◆ Collecting – Collection of incoming frames on this link is enabled; i.e., collection is currently enabled and is not expected to be disabled in the absence of administrative changes or changes in received protocol information. ◆ Synchronization – The System considers this link to be IN_SYNC; i.e., it has been allocated to the correct Link Aggregation Group, the group has been associated with a compatible Aggregator, and the identity of the Link Aggregation Group is consistent with the System ID and operational Key information transmitted.
Admin State, Oper State (continued)	<ul style="list-style-type: none"> ◆ Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation. ◆ Long timeout – Periodic transmission of LACPDU's uses a slow transmission rate. ◆ LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)

Web Interface

To display LACP settings and status for the local side:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregation Port from the Step list.
3. Select Show Information from the Action list.
4. Click Internal.
5. Select a group member from the Port list.

Figure 57: Displaying LACP Port Internal Information



Displaying LACP Settings and Status for the Remote Side

Use the Interface > Trunk > Dynamic (Configure Aggregation Port - Show Information - Neighbors) page to display the configuration settings and operational state for the remote side of a link aggregation.

Parameters

These parameters are displayed:

Table 9: LACP Remote Device Configuration Information

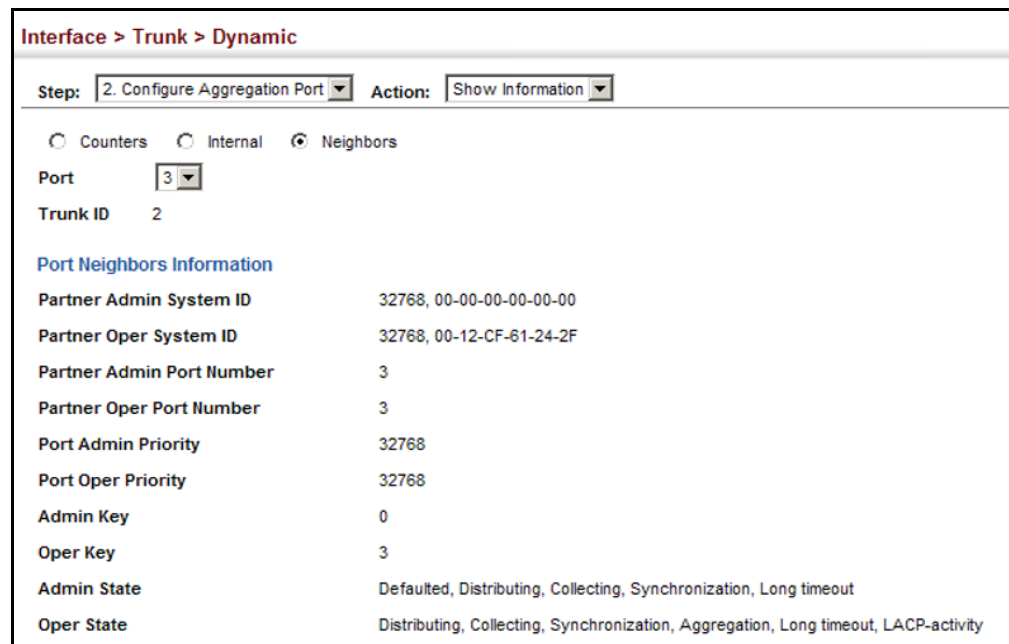
Parameter	Description
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.
Partner Admin Port Number	Current administrative value of the port number for the protocol Partner.
Partner Oper Port Number	Operational port number assigned to this aggregation port by the port's protocol partner.
Port Admin Priority	Current administrative value of the port priority for the protocol partner.
Port Oper Priority	Priority value assigned to this aggregation port by the partner.
Admin Key	Current administrative value of the Key for the protocol partner.
Oper Key	Current operational value of the Key for the protocol partner.
Admin State	Administrative values of the partner's state parameters. (See preceding table.)
Oper State	Operational values of the partner's state parameters. (See preceding table.)

Web Interface

To display LACP settings and status for the remote side:

1. Click Interface, Trunk, Dynamic.
2. Select Configure Aggregation Port from the Step list.
3. Select Show Information from the Action list.
4. Click Neighbors.
5. Select a group member from the Port list.

Figure 58: Displaying LACP Port Remote Information



Configuring Load Balancing

Use the Interface > Trunk > Load Balance page to set the load-distribution method used among ports in aggregated links.

Command Usage

- ◆ This command applies to all static and dynamic trunks on the switch.
- ◆ To ensure that the switch traffic load is distributed evenly across all links in a trunk, select the source and destination addresses used in the load-balance calculation to provide the best result for trunk connections:
 - **Destination IP Address:** All traffic with the same destination IP address is output on the same link in a trunk. This mode works best for switch-to-router trunk links where traffic through the switch is destined for many

different hosts. Do not use this mode for switch-to-server trunk links where the destination IP address is the same for all traffic.

- **Destination MAC Address:** All traffic with the same destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is destined for many different hosts. Do not use this mode for switch-to-router trunk links where the destination MAC address is the same for all traffic.
- **Source and Destination IP Address:** All traffic with the same source and destination IP address is output on the same link in a trunk. This mode works best for switch-to-router trunk links where traffic through the switch is received from and destined for many different hosts.
- **Source and Destination MAC Address:** All traffic with the same source and destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from and destined for many different hosts.
- **Source IP Address:** All traffic with the same source IP address is output on the same link in a trunk. This mode works best for switch-to-router or switch-to-server trunk links where traffic through the switch is received from many different hosts.
- **Source MAC Address:** All traffic with the same source MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from many different hosts.

Parameters

These parameters are displayed for the load balance mode:

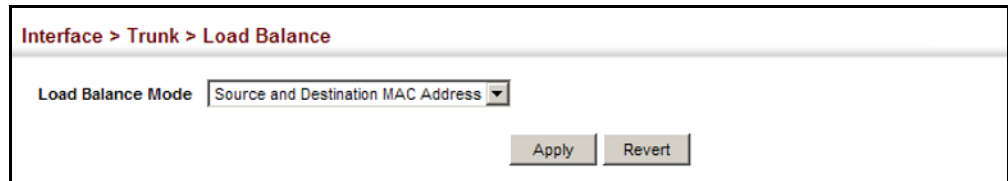
- ◆ **Destination IP Address** - Load balancing based on destination IP address.
- ◆ **Destination MAC Address** - Load balancing based on destination MAC address.
- ◆ **Source and Destination IP Address** - Load balancing based on source and destination IP address.
- ◆ **Source and Destination MAC Address** - Load balancing based on source and destination MAC address.
- ◆ **Source IP Address** - Load balancing based on source IP address.
- ◆ **Source MAC Address** - Load balancing based on source MAC address.

Web Interface

To display the load-distribution method used by ports in aggregated links:

1. Click Interface, Trunk, Load Balance.
2. Select the required method from the Load Balance Mode list.
3. Click Apply.

Figure 59: Configuring Load Balancing



Saving Power

Use the Interface > Green Ethernet page to enable power savings mode on the selected port.

Command Usage

- ◆ IEEE 802.3 defines the Ethernet standard and subsequent power requirements based on cable connections operating at 100 meters. Enabling power saving mode can reduce power used for cable lengths of 60 meters or less, with more significant reduction for cables of 20 meters or less, and continue to ensure signal integrity.
- ◆ The power-saving methods provided by this switch include:
 - Power saving when there is no link partner:

Under normal operation, the switch continuously auto-negotiates to find a link partner, keeping the MAC interface powered up even if no link connection exists. When using power-savings mode, the switch checks for energy on the circuit to determine if there is a link partner. If none is detected, the switch automatically turns off the transmitter, and most of the receive circuitry (entering Sleep Mode). In this mode, the low-power energy-detection circuit continuously checks for energy on the cable. If none is detected, the MAC interface is also powered down to save additional energy. If energy is detected, the switch immediately turns on both the transmitter and receiver functions, and powers up the MAC interface.
 - Power saving when there is a link partner:

Traditional Ethernet connections typically operate with enough power to support at least 100 meters of cable even though average network cable length is shorter. When cable length is shorter, power consumption can be reduced since signal attenuation is proportional to cable length. When power-savings mode is enabled, the switch analyzes cable length to

determine whether or not it can reduce the signal amplitude used on a particular link.



Note: Power savings can only be implemented on Gigabit Ethernet ports when using twisted-pair cabling. Power-savings mode on a active link only works when connection speed is 1 Gbps, and line length is less than 60 meters.

Parameters

These parameters are displayed:

- ◆ **Port** – Power saving mode only applies to the Gigabit Ethernet ports using copper media. (Range: 1-8)
- ◆ **Power Saving Status** – Adjusts the power provided to ports based on the length of the cable used to connect to other devices. Only sufficient power is used to maintain connection requirements. (Default: Enabled on Gigabit Ethernet RJ-45 ports)

Web Interface

To enable power savings:

1. Click Interface, Green Ethernet.
2. Mark the Enabled check box for a port.
3. Click Apply.

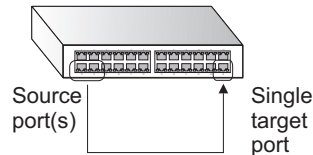
Figure 60: Enabling Power Savings

Port	Power Saving Status
21	<input checked="" type="checkbox"/> Enabled
22	<input checked="" type="checkbox"/> Enabled
23	<input checked="" type="checkbox"/> Enabled
24	<input checked="" type="checkbox"/> Enabled
25	<input type="checkbox"/> Enabled
26	<input type="checkbox"/> Enabled
27	<input type="checkbox"/> Enabled
28	<input type="checkbox"/> Enabled

Configuring Local Port Mirroring

Use the Interface > Mirror page to mirror traffic from any source port to a target port for real-time analysis. You can then attach a logic analyzer or RMON probe to the target port and study the traffic crossing the source port in a completely unobtrusive manner.

Figure 61: Configuring Local Port Mirroring



Command Usage

- ◆ Traffic can be mirrored from one or more source ports to a destination port on the same switch (local port mirroring as described in this section), or from one or more source ports on remote switches to a destination port on this switch (remote port mirroring as described in [“Configuring Remote Port Mirroring” on page 130](#)).
- ◆ Monitor port speed should match or exceed source port speed, otherwise traffic may be dropped from the monitor port.
- ◆ The destination port cannot be a trunk or trunk member port.
- ◆ Note that Spanning Tree BPDU packets are not mirrored to the target port.

Parameters

These parameters are displayed:

- ◆ **Source Port** – The port whose traffic will be monitored.
- ◆ **Target Port** – The port that will mirror the traffic on the source port.
- ◆ **Type** – Allows you to select which traffic to mirror to the target port, Rx (receive), Tx (transmit), or Both. (Default: Both)

Web Interface

To configure a local mirror session:

1. Click Interface, Mirror.
2. Select Add from the Action List.
3. Specify the source port.
4. Specify the monitor port.

5. Specify the traffic type to be mirrored.
6. Click Apply.

Figure 62: Configuring Local Port Mirroring

Interface > Mirror

Action: Show ▾

Source Port Unit 1 ▾ Port 1 ▾

Target Port Unit 1 ▾ Port 1 ▾

Type Both ▾

Apply Revert

To display the configured mirror sessions:

1. Click Interface, Port, Mirror.
2. Select Show from the Action List.

Figure 63: Displaying Local Port Mirror Sessions

Interface > Mirror

Action: Show ▾

Mirror Session List Total: 2

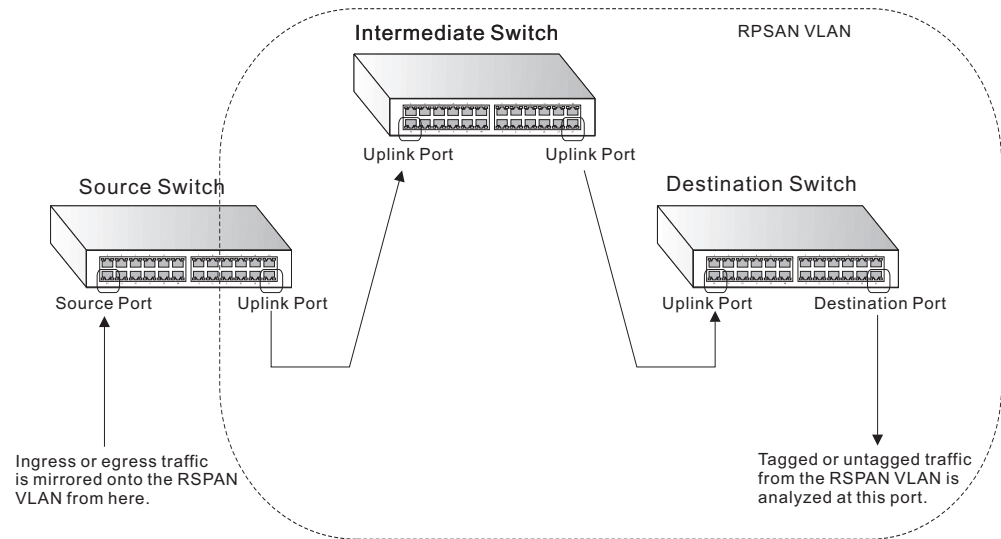
	Source (Unit/Port)	Target (Unit/Port)	Type
<input type="checkbox"/>	1 / 7	1 / 8	Both
<input type="checkbox"/>	1 / 9	1 / 10	Both

Delete Revert

Configuring Remote Port Mirroring

Use the Interface > RSPAN page to mirror traffic from remote switches for analysis at a destination port on the local switch. This feature, also called Remote Switched Port Analyzer (RSPAN), carries traffic generated on the specified source ports for each session over a user-specified VLAN dedicated to that RSPAN session in all participating switches. Monitored traffic from one or more sources is copied onto the RSPAN VLAN through IEEE 802.1Q trunk or hybrid ports that carry it to any RSPAN destination port monitoring the RSPAN VLAN as shown in the figure below.

Figure 64: Configuring Remote Port Mirroring



Command Usage

- ◆ Traffic can be mirrored from one or more source ports to a destination port on the same switch (local port mirroring as described in [“Configuring Local Port Mirroring” on page 129](#)), or from one or more source ports on remote switches to a destination port on this switch (remote port mirroring as described in this section).
- ◆ *Configuration Guidelines*

Take the following step to configure an RSPAN session:

1. Use the VLAN Static List (see [“Configuring VLAN Groups” on page 142](#)) to reserve a VLAN for use by RSPAN (marking the “Remote VLAN” field on this page. (Default VLAN 1 is prohibited.)
2. Set up the source switch on the RSPAN configuration page by specifying the mirror session, the switch’s role (Source), the RSPAN VLAN, and the uplink port¹. Then specify the source port(s), and the traffic type to monitor (Rx, Tx or Both).
3. Set up all intermediate switches on the RSPAN configuration page, entering the mirror session, the switch’s role (Intermediate), the RSPAN VLAN, and the uplink port(s).
4. Set up the destination switch on the RSPAN configuration page by specifying the mirror session, the switch’s role (Destination), the destination port¹, whether or not the traffic exiting this port will be tagged or untagged, and the RSPAN VLAN. Then specify each uplink port where the mirrored traffic is being received.

1. Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN uplink or destination ports – access ports are not allowed (see [“Adding Static Members to VLANs” on page 144](#)).

◆ *RSPAN Limitations*

The following limitations apply to the use of RSPAN on this switch:

- *RSPAN Ports* – Only ports can be configured as an RSPAN source, destination, or uplink; static and dynamic trunks are not allowed. A port can only be configured as one type of RSPAN interface – source, destination, or uplink. Also, note that the source port and destination port cannot be configured on the same switch.
- *Local/Remote Mirror* – The destination of a local mirror session (created on the Interface > Port > Mirror page) cannot be used as the destination for RSPAN traffic.
- *Spanning Tree* – If the spanning tree is disabled, BPDUs will not be flooded onto the RSPAN VLAN.
- *MAC address learning* is not supported on RSPAN uplink ports when RSPAN is enabled on the switch. Therefore, even if spanning tree is enabled after RSPAN has been configured, MAC address learning will still not be re-started on the RSPAN uplink ports.
- *IEEE 802.1X* – RSPAN and 802.1X are mutually exclusive functions. When 802.1X is enabled globally, RSPAN uplink ports cannot be configured, even though RSPAN source and destination ports can still be configured. When RSPAN uplink ports are enabled on the switch, 802.1X cannot be enabled globally.
- *Port Security* – If port security is enabled on any port, that port cannot be set as an RSPAN uplink port, even though it can still be configured as an RSPAN source or destination port. Also, when a port is configured as an RSPAN uplink port, port security cannot be enabled on that port.

Parameters

These parameters are displayed:

- ◆ **Session** – A number identifying this RSPAN session. (Range: 1-3)
Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.
- ◆ **Operation Status** – Indicates whether or not RSPAN is currently functioning.
- ◆ **Switch Role** – Specifies the role this switch performs in mirroring traffic.
 - **None** – This switch will not participate in RSPAN.
 - **Source** – Specifies this device as the source of remotely mirrored traffic.

- **Intermediate** - Specifies this device as an intermediate switch, transparently passing mirrored traffic from one or more sources to one or more destinations.
- **Destination** - Specifies this device as a switch configured with a destination port which is to receive mirrored traffic for this session.
- ◆ **Remote VLAN** – The VLAN to which traffic mirrored from the source port will be flooded. The VLAN specified in this field must first be reserved for the RSPAN application using the VLAN > Static page (see [page 142](#)).
- ◆ **Uplink Port** – A port on any switch participating in RSPAN through which mirrored traffic is passed on to or received from the RSPAN VLAN.

Only one uplink port can be configured on a source switch, but there is no limitation on the number of uplink ports¹ configured on an intermediate or destination switch.

Only destination and uplink ports will be assigned by the switch as members of the RSPAN VLAN. Ports cannot be manually assigned to an RSPAN VLAN through the VLAN > Static page. Nor can GVRP dynamically add port members to an RSPAN VLAN. Also, note that the VLAN > Static (Show) page will not display any members for an RSPAN VLAN, but will only show configured RSPAN VLAN identifiers.
- ◆ **Type** – Specifies the traffic type to be mirrored remotely. (Options: Rx, Tx, Both)
- ◆ **Destination Port** – Specifies the destination port¹ to monitor the traffic mirrored from the source ports. Only one destination port can be configured on the same switch per session, but a destination port can be configured on more than one switch for the same session. Also note that a destination port can still send and receive switched traffic, and participate in any Layer 2 protocols to which it has been assigned.
- ◆ **Tag** – Specifies whether or not the traffic exiting the destination port to the monitoring device carries the RSPAN VLAN tag.

Web Interface

To configure a remote mirror session:

1. Click Interface, RSPAN.
2. Set the Switch Role to None, Source, Intermediate, or Destination.
3. Configure the required settings for each switch participating in the RSPAN VLAN.
4. Click Apply.

Figure 65: Configuring Remote Port Mirroring (Source)

Interface > RSPAN

Session

Operation Status Up

Switch Role

Remote VLAN

Uplink Port

Source Port Configuration List Total: 28

Source Port	Type
1	<input type="text" value="Rx"/>
2	<input type="text" value="Rx"/>
3	<input type="text" value="None"/>
4	<input type="text" value="None"/>
5	<input type="text" value="Tx"/>

Figure 66: Configuring Remote Port Mirroring (Intermediate)

Interface > RSPAN

Session

Operation Status Up

Switch Role

Remote VLAN

Uplink Port List Total: 28

Port	Uplink
1	<input type="checkbox"/>
2	<input type="checkbox"/>
3	<input type="checkbox"/>
4	<input checked="" type="checkbox"/>
5	<input type="checkbox"/>

Figure 67: Configuring Remote Port Mirroring (Destination)

Interface > RSPAN

Session

Operation Status Up

Switch Role

Destination Port

Tag

Remote VLAN

Uplink Port List Total: 28

Port	Uplink
1	<input type="checkbox"/>
2	<input type="checkbox"/>
3	<input type="checkbox"/>
4	<input checked="" type="checkbox"/>
5	<input type="checkbox"/>

Traffic Segmentation

If tighter security is required for passing traffic from different clients through downlink ports on the local network and over uplink ports to the service provider, port-based traffic segmentation can be used to isolate traffic for individual clients. Data traffic on downlink ports is only forwarded to, and from, uplink ports.

Traffic belonging to each client is isolated to the allocated downlink ports. But the switch can be configured to either isolate traffic passing across a client's allocated uplink ports from the uplink ports assigned to other clients, or to forward traffic through the uplink ports used by other clients, allowing different clients to share access to their uplink ports where security is less likely to be compromised.

Enabling Traffic Segmentation Use the Interface > Traffic Segmentation (Configure Global) page to enable traffic segmentation.

Parameters

These parameters are displayed:

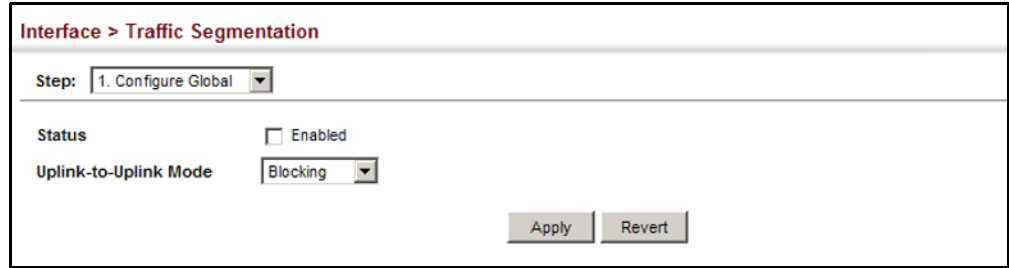
- ◆ **Status** – Enables port-based traffic segmentation. (Default: Disabled)
- ◆ **Uplink-to-Uplink Mode** – Specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions.
 - **Blocking** – Blocks traffic between uplink ports assigned to different sessions.
 - **Forwarding** – Forwards traffic between uplink ports assigned to different sessions.

Web Interface

To enable traffic segmentation:

1. Click Interface, Traffic Segmentation.
2. Select Configure Global from the Step list.
3. Mark the Status check box, and set the required uplink-to-uplink mode.
4. Click Apply.

Figure 68: Enabling Traffic Segmentation



Configuring Uplink and Downlink Ports

Use the Interface > Traffic Segmentation (Configure Session) page to assign the downlink and uplink ports to use in the segmented group. Ports designated as downlink ports can not communicate with any other ports on the switch except for the uplink ports. Uplink ports can communicate with any other ports on the switch and with any designated downlink ports.

Command Usage

- ◆ When traffic segmentation is enabled, the forwarding state for the uplink and downlink ports assigned to different client sessions is shown below.

Table 10: Traffic Segmentation Forwarding

Destination Source	Session #1 Downlinks	Session #1 Uplinks	Session #2 Downlinks	Session #2 Uplinks	Normal Ports
Session #1 Downlink Ports	Blocking	Forwarding	Blocking	Blocking	Blocking
Session #1 Uplink Ports	Forwarding	Forwarding	Blocking	Blocking/Forwarding*	Forwarding
Session #2 Downlink Ports	Blocking	Blocking	Blocking	Forwarding	Blocking
Session #2 Uplink Ports	Blocking	Blocking/Forwarding*	Forwarding	Forwarding	Forwarding
Normal Ports	Forwarding	Forwarding	Forwarding	Forwarding	Forwarding

* The forwarding state for uplink-to-uplink ports is configured on the Configure Global page (see [page 135](#)).

- ◆ When traffic segmentation is disabled, all ports operate in normal forwarding mode based on the settings specified by other functions such as VLANs and spanning tree protocol.
- ◆ A port cannot be configured in both an uplink and downlink list.
- ◆ A port can only be assigned to one traffic-segmentation session.
- ◆ A downlink port can only communicate with an uplink port in the same session. Therefore, if an uplink port is not configured for a session, the assigned downlink ports will not be able to communicate with any other ports.

- ◆ If a downlink port is not configured for the session, the assigned uplink ports will operate as normal ports.

Parameters

These parameters are displayed:

- ◆ **Session ID** – Traffic segmentation session. (Range: 1-4)
- ◆ **Direction** – Adds an interface to the segmented group by setting the direction to uplink or downlink. (Default: Uplink)
- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Port** – Port Identifier. (Range: 1-10)
- ◆ **Trunk** – Trunk Identifier. (Range: 1-8)

Web Interface

To configure the members of the traffic segmentation group:

1. Click Interface, Traffic Segmentation.
2. Select Configure Session from the Step list.
3. Select Add from the Action list.
4. Enter the session ID, set the direction to uplink or downlink, and select the interface to add.
5. Click Apply.

Figure 69: Configuring Members for Traffic Segmentation

The screenshot shows a web interface titled "Interface > Traffic Segmentation". At the top, there are two dropdown menus: "Step: 2. Configure Session" and "Action: Add". Below these, there are four main configuration fields:

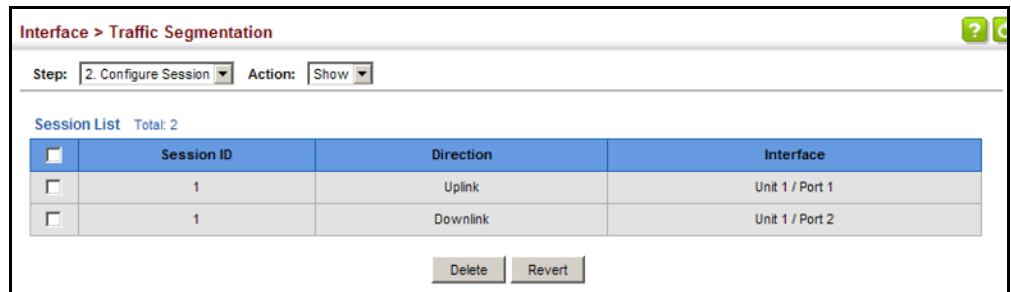
- Session ID (1-4)**: A text input field.
- Direction**: A dropdown menu with "Uplink" selected.
- Interface**: Two radio buttons. The first is "Port (1-28)" with a selected radio button and two adjacent text input fields. The second is "Trunk (1-8)" with an unselected radio button and two adjacent text input fields.

At the bottom right of the form, there are two buttons: "Apply" and "Revert".

To show the members of the traffic segmentation group:

1. Click Interface, Traffic Segmentation.
2. Select Configure Session from the Step list.
3. Select Show from the Action list.

Figure 70: Showing Traffic Segmentation Members



5

VLAN Configuration

This chapter includes the following topics:

- ◆ [IEEE 802.1Q VLANs](#) – Configures static and dynamic VLANs.
- ◆ [Protocol VLANs²](#) – Configures VLAN groups based on specified protocols.
- ◆ [MAC-based VLANs²](#) – Maps untagged ingress frames to a specified VLAN if the source MAC address is found in the IP MAC address-to-VLAN mapping table.

IEEE 802.1Q VLANs

In large networks, routers are used to isolate broadcast traffic for each subnet into separate domains. This switch provides a similar service at Layer 2 by using VLANs to organize any group of network nodes into separate broadcast domains. VLANs confine broadcast traffic to the originating group, and can eliminate broadcast storms in large networks. This also provides a more secure and cleaner network environment.

An IEEE 802.1Q VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment.

VLANs help to simplify network management by allowing you to move devices to a new VLAN without having to change any physical connections. VLANs can be easily organized to reflect departmental groups (such as Marketing or R&D), usage groups (such as e-mail), or multicast groups (used for multimedia applications such as video conferencing).

VLANs provide greater network efficiency by reducing broadcast traffic, and allow you to make network changes without having to update IP addresses or IP subnets. VLANs inherently provide a high level of network security since traffic must pass through a configured Layer 3 link to reach a different VLAN.

2. If a packet matches the rules defined by more than one of these functions, only one of them is applied, with the precedence being MAC-based, protocol-based, and then native port-based.

This switch supports the following VLAN features:

- ◆ Up to 4094 VLANs based on the IEEE 802.1Q standard
- ◆ Distributed VLAN learning across multiple switches using explicit or implicit tagging and GVRP protocol
- ◆ Port overlapping, allowing a port to participate in multiple VLANs
- ◆ End stations can belong to multiple VLANs
- ◆ Passing traffic between VLAN-aware and VLAN-unaware devices
- ◆ Priority tagging

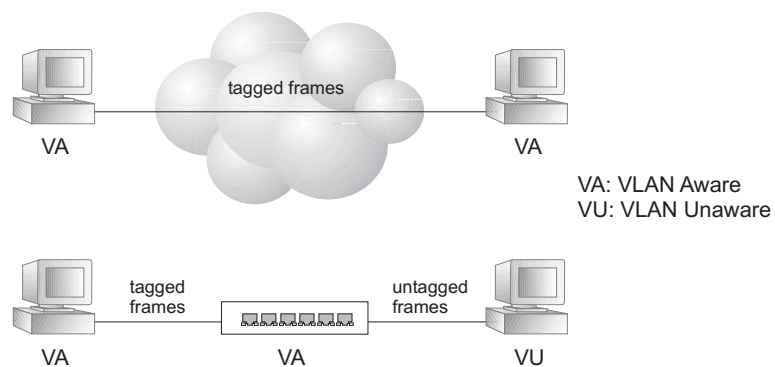
Assigning Ports to VLANs

Before enabling VLANs for the switch, you must first assign each port to the VLAN group(s) in which it will participate. By default all ports are assigned to VLAN 1 as untagged ports. Add a port as a tagged port if you want it to carry traffic for one or more VLANs, and any intermediate network devices or the host at the other end of the connection supports VLANs. Then assign ports on the other VLAN-aware network devices along the path that will carry this traffic to the same VLAN(s), either manually or dynamically using GVRP. However, if you want a port on this switch to participate in one or more VLANs, but none of the intermediate network devices nor the host at the other end of the connection supports VLANs, then you should add this port to the VLAN as an untagged port.



Note: VLAN-tagged frames can pass through VLAN-aware or VLAN-unaware network interconnection devices, but the VLAN tags should be stripped off before passing it on to any end-node host that does not support VLAN tagging.

Figure 71: VLAN Compliant and VLAN Non-compliant Devices



VLAN Classification – When the switch receives a frame, it classifies the frame in one of two ways. If the frame is untagged, the switch assigns the frame to an associated VLAN (based on the default VLAN ID of the receiving port). But if the frame is tagged, the switch uses the tagged VLAN ID to identify the port broadcast domain of the frame.

Port Overlapping – Port overlapping can be used to allow access to commonly shared network resources among different VLAN groups, such as file servers or printers. Note that if you implement VLANs which do not overlap, but still need to communicate, you can connect them by enabled routing on this switch.

Untagged VLANs – Untagged VLANs are typically used to reduce broadcast traffic and to increase security. A group of network users assigned to a VLAN form a broadcast domain that is separate from other VLANs configured on the switch. Packets are forwarded only between ports that are designated for the same VLAN. Untagged VLANs can be used to manually isolate user groups or subnets. However, you should use IEEE 802.3 tagged VLANs with GVRP whenever possible to fully automate VLAN registration.

Forwarding Tagged/Untagged Frames

If you want to create a small port-based VLAN for devices attached directly to a single switch, you can assign ports to the same untagged VLAN. However, to participate in a VLAN group that crosses several switches, you should create a VLAN for that group and enable tagging on all ports.

Ports can be assigned to multiple tagged or untagged VLANs. Each port on the switch is therefore capable of passing tagged or untagged frames. When forwarding a frame from this switch along a path that contains any VLAN-aware devices, the switch should include VLAN tags. When forwarding a frame from this switch along a path that does not contain any VLAN-aware devices (including the destination host), the switch must first strip off the VLAN tag before forwarding the frame. When the switch receives a tagged frame, it will pass this frame onto the VLAN(s) indicated by the frame tag. However, when this switch receives an untagged frame from a VLAN-unaware device, it first decides where to forward the frame, and then inserts a VLAN tag reflecting the ingress port's default VID.

Configuring VLAN Groups Use the VLAN > Static (Add) page to create or remove VLAN groups, set administrative status, or specify Remote VLAN type (see [“Configuring Remote Port Mirroring” on page 130](#)). To propagate information about VLAN groups used on this switch to external network devices, you must specify a VLAN ID for each of these groups.

Parameters

These parameters are displayed:

Add

- ◆ **VLAN ID** – ID of VLAN or range of VLANs (1-4094).
VLAN 1 is the default untagged VLAN.
- ◆ **Status** – Enables or disables the specified VLAN.
- ◆ **Remote VLAN** – Reserves this VLAN for RSPAN (see [“Configuring Remote Port Mirroring” on page 130](#)).

Modify

- ◆ **VLAN ID** – ID of configured VLAN (1-4094).
- ◆ **VLAN Name** – Name of the VLAN (1 to 32 characters).
- ◆ **Status** – Enables or disables the specified VLAN.

Show

- ◆ **VLAN ID** – ID of configured VLAN.
- ◆ **VLAN Name** – Name of the VLAN.
- ◆ **Status** – Operational status of configured VLAN.
- ◆ **Remote VLAN** – Shows if RSPAN is enabled on this VLAN (see [“Configuring Remote Port Mirroring” on page 130](#)).

Web Interface

To create VLAN groups:

1. Click VLAN, Static.
2. Select Add from the Action list.
3. Enter a VLAN ID or range of IDs.
4. Check Status to configure the VLAN as operational.
5. Specify whether the VLANs are to be used for remote port mirroring.

6. Click Apply.

Figure 72: Creating Static VLANs

The screenshot shows the 'VLAN > Static' configuration page. At the top, the title is 'VLAN > Static'. Below the title, there is a dropdown menu for 'Action' set to 'Add'. Underneath, there are three fields: 'VLAN ID (1-4094)' with a value of '2' and a range indicator, 'Status' with a checked 'Enabled' checkbox, and 'Remote VLAN' with an unchecked 'Enabled' checkbox. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To modify the configuration settings for VLAN groups:

1. Click VLAN, Static.
2. Select Modify from the Action list.
3. Select the identifier of a configured VLAN.
4. Modify the VLAN name or operational status as required.
5. Enable the L3 Interface field to specify that a VLAN will be used as a Layer 3 interface.
6. Click Apply.

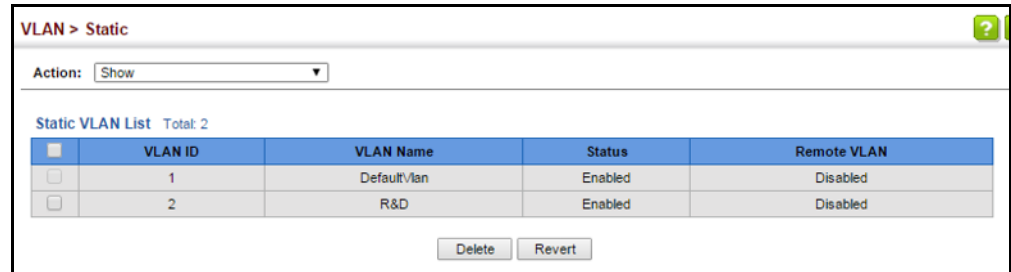
Figure 73: Modifying Settings for Static VLANs

The screenshot shows the 'VLAN > Static' configuration page. At the top, the title is 'VLAN > Static'. Below the title, there is a dropdown menu for 'Action' set to 'Modify'. Underneath, there are three fields: 'VLAN ID (1-4094)' with a value of '1' and a dropdown arrow, 'VLAN Name' with a text input field containing 'DefaultVlan', and 'Status' with a checked 'Enabled' checkbox. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show the configuration settings for VLAN groups:

1. Click VLAN, Static.
2. Select Show from the Action list.

Figure 74: Showing Static VLANs



Adding Static Members to VLANs

Use the VLAN > Static (Edit Member by VLAN, Edit Member by Interface, or Edit Member by Interface Range) pages to configure port members for the selected VLAN index, interface, or a range of interfaces. Use the menus for editing port members to configure the VLAN behavior for specific interfaces, including the mode of operation (Hybrid or 1Q Trunk), the default VLAN identifier (PVID), accepted frame types, and ingress filtering. Assign ports as tagged if they are connected to 802.1Q VLAN compliant devices, or untagged they are not connected to any VLAN-aware devices. Or configure a port as forbidden to prevent the switch from automatically adding it to a VLAN via the GVRP protocol.

Parameters

These parameters are displayed:

Edit Member by VLAN

- ◆ **VLAN** – ID of configured VLAN (1-4094).
- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Port** – Port Identifier. (Range: 1-10)
- ◆ **Trunk** – Trunk Identifier. (Range: 1-8)
- ◆ **Mode** – Indicates VLAN membership mode for an interface. (Default: Hybrid)
 - **Access** - Sets the port to operate as an untagged interface. The port transmits and receives untagged frames on a single VLAN only.
 - **Hybrid** – Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.
 - **1Q Trunk** – Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that

identify the source VLAN. Note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are also transmitted as tagged frames.

- ◆ **PVID** – VLAN ID assigned to untagged frames received on the interface. (Default: 1)

When using Access mode, and an interface is assigned to a new VLAN, its PVID is automatically set to the identifier for that VLAN. When using Hybrid mode, the PVID for an interface can be set to any VLAN for which it is an untagged member.

- ◆ **Acceptable Frame Type** – Sets the interface to accept all frame types, including tagged or untagged frames, or only tagged frames. When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN. (Options: All, Tagged; Default: All)
- ◆ **Ingress Filtering** – Determines how to process frames tagged for VLANs for which the ingress port is not a member. (Default: Enabled)
 - Ingress filtering only affects tagged frames.
 - If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port).
 - If ingress filtering is enabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be discarded.
 - Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STP. However, they do affect VLAN dependent BPDU frames, such as GMRP.
- ◆ **Membership Type** – Select VLAN membership for each interface by marking the appropriate radio button for a port or trunk:
 - **Tagged:** Interface is a member of the VLAN. All packets transmitted by the port will be tagged, that is, carry a tag and therefore carry VLAN or CoS information.
 - **Untagged:** Interface is a member of the VLAN. All packets transmitted by the port will be untagged, that is, not carry a tag and therefore not carry VLAN or CoS information. Note that an interface must be assigned to at least one group as an untagged port.
 - **Forbidden:** Interface cannot be included as a member of the VLAN.
 - **None:** Interface is not a member of the VLAN. Packets associated with this VLAN will not be transmitted by the interface.



Note: VLAN 1 is the default untagged VLAN containing all ports on the switch using Hybrid mode.

Edit Member by Interface

All parameters are the same as those described under the preceding section for Edit Member by VLAN.

Edit Member by Interface Range

All parameters are the same as those described under the earlier section for Edit Member by VLAN, except for the items shown below.

- ◆ **Port Range** – Displays a list of ports. (Range: 1-10)
- ◆ **Trunk Range** – Displays a list of ports. (Range: 1-8)



Note: The PVID, acceptable frame type, and ingress filtering parameters for each interface within the specified range must be configured on either the Edit Member by VLAN or Edit Member by Interface page.

Web Interface

To configure static members by the VLAN index:

1. Click VLAN, Static.
2. Select Edit Member by VLAN from the Action list.
3. Select a VLAN from the scroll-down list.
4. Set the Interface type to display as Port or Trunk.
5. Modify the settings for any interface as required.
6. Click Apply.

Figure 75: Configuring Static Members by VLAN Index

Port	Mode	PVID (1-4094)	Acceptable Frame Type	Ingress Filtering	Membership Type			
					Tagged	Untagged	Forbidden	None
1	Hybrid	1	All	Enabled	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	Hybrid	1	All	Enabled	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	Hybrid	1	All	Enabled	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	Hybrid	1	All	Enabled	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	Hybrid	1	All	Enabled	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

To configure static members by interface:

1. Click VLAN, Static.
2. Select Edit Member by Interface from the Action list.
3. Select a port or trunk configure.
4. Modify the settings for any interface as required.
5. Click Apply.

Figure 76: Configuring Static VLAN Members by Interface

The screenshot shows the 'VLAN > Static' configuration page. The 'Action' dropdown is set to 'Edit Member by Interface'. The 'Interface' section has 'Port 1' selected. The 'Mode' is 'Hybrid', 'PVID' is '1', and 'Acceptable Frame Type' is 'All'. 'Ingress Filtering' is disabled. Below these settings is a table titled 'Static VLAN Membership List' with a total of 4 members.

VLAN	Membership Type			
	Tagged	Untagged	Forbidden	None
1	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

At the bottom of the table are 'Apply' and 'Revert' buttons.

To configure static members by interface range:

1. Click VLAN, Static.
2. Select Edit Member by Interface Range from the Action list.
3. Set the Interface type to display as Port or Trunk.
4. Enter an interface range.
5. Modify the VLAN parameters as required. Remember that the PVID, acceptable frame type, and ingress filtering parameters for each interface within the specified range must be configured on either the Edit Member by VLAN or Edit Member by Interface page.
6. Click Apply.

Figure 77: Configuring Static VLAN Members by Interface Range

The screenshot shows the 'VLAN > Static' configuration page. At the top, there is a breadcrumb 'VLAN > Static' and an 'Action:' dropdown menu set to 'Edit Member by Interface Range'. Below this, there are several configuration fields: 'Interface' with radio buttons for 'Port' (selected) and 'Trunk'; 'Port Range (1-28)' with two input boxes separated by a hyphen; 'Mode' with a dropdown menu set to 'Hybrid'; 'VLAN ID (1-4093)' with two input boxes separated by a hyphen; and 'Membership Type' with radio buttons for 'Tagged' (selected), 'Untagged', 'Forbidden', and 'None'. At the bottom right, there are 'Apply' and 'Revert' buttons.

Protocol VLANs

The network devices required to support multiple protocols cannot be easily grouped into a common VLAN. This may require non-standard devices to pass traffic between different VLANs in order to encompass all the devices participating in a specific protocol. This kind of configuration deprives users of the basic benefits of VLANs, including security and easy accessibility.

To avoid these problems, you can configure this switch with protocol-based VLANs that divide the physical network into logical VLAN groups for each required protocol. When a frame is received at a port, its VLAN membership can then be determined based on the protocol type being used by the inbound packets.

Command Usage

- ◆ To configure protocol-based VLANs, follow these steps:
 1. First configure VLAN groups for the protocols you want to use (see [“Configuring VLAN Groups” on page 142](#)). Although not mandatory, we suggest configuring a separate VLAN for each major protocol running on your network. Do not add port members at this time.
 2. Create a protocol group for each of the protocols you want to assign to a VLAN using the Configure Protocol (Add) page.
 3. Then map the protocol for each interface to the appropriate VLAN using the Configure Interface (Add) page.
- ◆ When MAC-based, IP subnet-based, or protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.

Configuring Protocol VLAN Groups Use the VLAN > Protocol (Configure Protocol - Add) page to create protocol groups.

Parameters

These parameters are displayed:

- ◆ **Frame Type** – Choose either Ethernet, RFC 1042, or LLC Other as the frame type used by this protocol.
- ◆ **Protocol Type** – Specifies the protocol type to match. The available options are IP, ARP, RARP and IPv6. If LLC Other is chosen for the Frame Type, the only available Protocol Type is IPX Raw.
- ◆ **Protocol Group ID** – Protocol Group ID assigned to the Protocol VLAN Group. (Range: 1-2147483647)



Note: Traffic which matches IP Protocol Ethernet Frames is mapped to the VLAN (VLAN 1) that has been configured with the switch's administrative IP. IP Protocol Ethernet traffic must not be mapped to another VLAN or you will lose administrative network connectivity to the switch. If lost in this manner, network access can be regained by removing the offending Protocol VLAN rule via the console. Alternately, the switch can be power-cycled, however all unsaved configuration changes will be lost.

Web Interface

To configure a protocol group:

1. Click VLAN, Protocol.
2. Select Configure Protocol from the Step list.
3. Select Add from the Action list.
4. Select an entry from the Frame Type list.
5. Select an entry from the Protocol Type list.
6. Enter an identifier for the protocol group.
7. Click Apply.

Figure 78: Configuring Protocol VLANs

VLAN > Protocol

Step: 1. Configure Protocol Action: Add

Frame Type: Ethernet

Protocol Type: 08 06 (ARP)

Protocol Group ID (1-2147483647): 1

Apply Revert

To configure a protocol group:

1. Click VLAN, Protocol.
2. Select Configure Protocol from the Step list.
3. Select Show from the Action list.

Figure 79: Displaying Protocol VLANs

VLAN > Protocol

Step: 1. Configure Protocol Action: Show

Protocol to Group Mapping Table Total: 5

<input type="checkbox"/>	Frame Type	Protocol Type	Protocol Group ID
<input type="checkbox"/>	Ethernet	08 06	1
<input type="checkbox"/>	Ethernet	80 35	2
<input type="checkbox"/>	RFC 1042	08 00	1
<input type="checkbox"/>	RFC 1042	80 35	3
<input type="checkbox"/>	LLC Other	FF FF	5

Delete Revert

Mapping Protocol Groups to Interfaces

Use the VLAN > Protocol (Configure Interface - Add) page to map a protocol group to a VLAN for each interface that will participate in the group.

Command Usage

- ◆ When creating a protocol-based VLAN, only assign interfaces using this configuration screen. If you assign interfaces using any of the other VLAN menus such as the VLAN Static table (page 144), these interfaces will admit traffic of any protocol type into the associated VLAN.
- ◆ When a frame enters a port that has been assigned to a protocol VLAN, it is processed in the following manner:
 - If the frame is tagged, it will be processed according to the standard rules applied to tagged frames.

- If the frame is untagged and the protocol type matches, the frame is forwarded to the appropriate VLAN.
- If the frame is untagged but the protocol type does not match, the frame is forwarded to the default VLAN for this interface.

Parameters

These parameters are displayed:

- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Port** – Port Identifier. (Range: 1-10)
- ◆ **Trunk** – Trunk Identifier. (Range: 1-8)
- ◆ **Protocol Group ID** – Protocol Group ID assigned to the Protocol VLAN Group. (Range: 1-2147483647)
- ◆ **VLAN ID** – VLAN to which matching protocol traffic is forwarded. (Range: 1-4094)
- ◆ **Priority** – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

Web Interface

To map a protocol group to a VLAN for a port or trunk:

1. Click VLAN, Protocol.
2. Select Configure Interface from the Step list.
3. Select Add from the Action list.
4. Select a port or trunk.
5. Enter the identifier for a protocol group.
6. Enter the corresponding VLAN to which the protocol traffic will be forwarded.
7. Set the priority to assign to untagged ingress frames.
8. Click Apply.

Figure 80: Assigning Interfaces to Protocol VLANs

VLAN > Protocol

Step: 2. Configure Interface Action: Add

Interface Port 1 Trunk

Protocol Group ID 1

VLAN ID (1-4093)

Priority (0-7)

Apply Revert

To show the protocol groups mapped to a port or trunk:

1. Click VLAN, Protocol.
2. Select Configure Interface from the Step list.
3. Select Show from the Action list.
4. Select a port or trunk.

Figure 81: Showing the Interface to Protocol Group Mapping

VLAN > Protocol

Step: 2. Configure Interface Action: Show

Interface Port 1 Trunk

Port To Protocol Group Mapping Table Total: 1

	Protocol Group ID	VLAN ID	Priority
<input type="checkbox"/>	1	2	0

Delete Revert

Configuring MAC-based VLANs

Use the VLAN > MAC-Based page to configure VLAN based on MAC addresses. The MAC-based VLAN feature assigns VLAN IDs to ingress untagged frames according to source MAC addresses.

When MAC-based VLAN classification is enabled, untagged frames received by a port are assigned to the VLAN which is mapped to the frame's source MAC address. When no MAC address is matched, untagged frames are assigned to the receiving port's native VLAN ID (PVID).

Command Usage

- ◆ The MAC-to-VLAN mapping applies to all ports on the switch.

- ◆ Source MAC addresses can be mapped to only one VLAN ID.
- ◆ Configured MAC addresses cannot be broadcast or multicast addresses.
- ◆ When MAC-based, IP subnet-based, or protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.

Parameters

These parameters are displayed:

- ◆ **MAC Address** – A source MAC address which is to be mapped to a specific VLAN. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx.
- ◆ **Mask** – Identifies a range of MAC addresses. (Range: 00-00-00-00-00-00 to ff-ff-ff-ff-ff-ff)

The binary equivalent mask matching the characters in the front of the first non-zero character must all be 1s (e.g., 111, i.e., it cannot be 101 or 001...). A mask for the MAC address: 00-50-6e-00-5f-b1 translated into binary:

MAC: 00000000-01010000-01101110-00000000-01011111-10110001

could be: 11111111-11xxxxxx-xxxxxxxx-xxxxxxxx-xxxxxxxx-xxxxxxxx

So the mask in hexadecimal for this example could be:

ff-fx-xx-xx-xx-xx/ff-c0-00-00-00-00/ff-e0-00-00-00-00

- ◆ **VLAN** – VLAN to which ingress traffic matching the specified source MAC address is forwarded. (Range: 1-4094)
- ◆ **Priority** – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority; Default: 0)

Web Interface

To map a MAC address to a VLAN:

1. Click VLAN, MAC-Based.
2. Select Add from the Action list.
3. Enter an address in the MAC Address field, and a mask to indicate a range of addresses if required.
4. Enter an identifier in the VLAN field. Note that the specified VLAN need not already be configured.
5. Enter a value to assign to untagged frames in the Priority field.
6. Click Apply.

Figure 82: Configuring MAC-Based VLANs

VLAN > MAC-Based

Action: Add ▾

MAC Address: 00-ab-cd-11-22-33

Mask:

VLAN (1-4093): 10

Priority (0-7):

Apply Revert

To show the MAC addresses mapped to a VLAN:

1. Click VLAN, MAC-Based.
2. Select Show from the Action list.

Figure 83: Showing MAC-Based VLANs

VLAN > MAC-Based

Action: Show ▾

MAC-Based VLAN List Total: 1

<input type="checkbox"/>	MAC Address	Mask	VLAN	Priority
<input type="checkbox"/>	00-AB-CD-11-22-33	FF-FF-FF-FF-FF-FF	10	0

Delete Revert

6

Address Table Settings

Switches store the addresses for all known devices. This information is used to pass traffic directly between the inbound and outbound ports. All the addresses learned by monitoring traffic are stored in the dynamic address table. You can also manually configure static addresses that are bound to a specific port.

This chapter describes the following topics:

- ◆ [MAC Address Learning](#) – Enables or disables address learning on an interface.
- ◆ [Static MAC Addresses](#) – Configures static entries in the address table.
- ◆ [Address Aging Time](#) – Sets timeout for dynamically learned entries.
- ◆ [Dynamic Address Cache](#) – Shows dynamic entries in the address table.
- ◆ [MAC Notification Traps](#) – Issue trap when a dynamic MAC address is added or removed.

Configuring MAC Address Learning

Use the [MAC Address > Learning Status](#) page to enable or disable MAC address learning on an interface.

Command Usage

- ◆ When MAC address learning is disabled, the switch immediately stops learning new MAC addresses on the specified interface. Only incoming traffic with source addresses stored in the static address table (see [“Setting Static Addresses” on page 157](#)) will be accepted as authorized to access the network through that interface.
- ◆ Dynamic addresses stored in the address table when MAC address learning is disabled are flushed from the system, and no dynamic addresses are subsequently learned until MAC address learning has been re-enabled. Any device not listed in the static address table that attempts to use the interface after MAC learning has been disabled will be prevented from accessing the switch.

- ◆ Also note that MAC address learning cannot be disabled if any of the following conditions exist:
 - 802.1X Port Authentication has been globally enabled on the switch (see “Configuring 802.1X Global Settings” on page 293).
 - Security Status (see “Configuring Port Security” on page 289) is enabled on the same interface.

Parameters

These parameters are displayed:

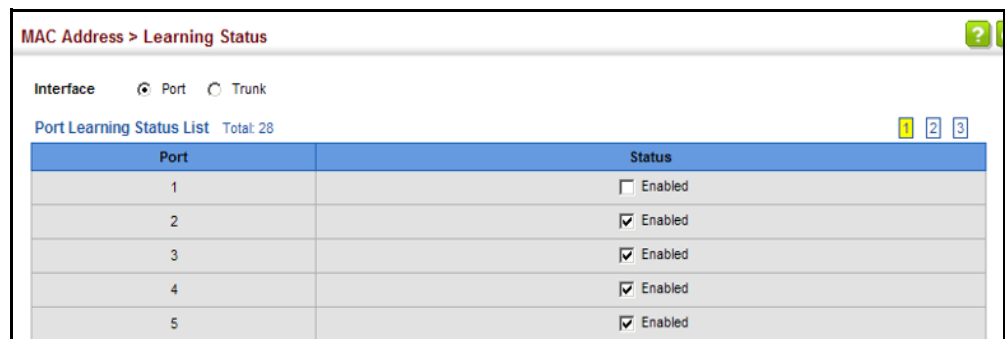
- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Port** – Port Identifier. (Range: 1-10)
- ◆ **Trunk** – Trunk Identifier. (Range: 1-8)
- ◆ **Status** – The status of MAC address learning. (Default: Enabled)

Web Interface

To enable or disable MAC address learning:

1. Click MAC Address, Learning Status.
2. Set the learning status for any interface.
3. Click Apply.

Figure 84: Configuring MAC Address Learning



The screenshot shows the 'MAC Address > Learning Status' web interface. At the top, there are radio buttons for 'Interface', 'Port', and 'Trunk', with 'Port' selected. Below this is a 'Port Learning Status List' with a 'Total: 28' and three pagination buttons (1, 2, 3). The table has two columns: 'Port' and 'Status'. The 'Status' column contains a checkbox followed by the text 'Enabled'. The first row (Port 1) has an unchecked checkbox, while rows 2 through 5 have checked checkboxes.

Port	Status
1	<input type="checkbox"/> Enabled
2	<input checked="" type="checkbox"/> Enabled
3	<input checked="" type="checkbox"/> Enabled
4	<input checked="" type="checkbox"/> Enabled
5	<input checked="" type="checkbox"/> Enabled

Setting Static Addresses

Use the MAC Address > Static page to configure static MAC addresses. A static address can be assigned to a specific interface on this switch. Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.

Command Usage

The static address for a host device can be assigned to a specific port within a specific VLAN. Use this command to add static addresses to the MAC Address Table. Static addresses have the following characteristics:

- ◆ Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.
- ◆ Static addresses will not be removed from the address table when a given interface link is down.
- ◆ A static address cannot be learned on another port until the address is removed from the table.

Parameters

These parameters are displayed:

Add Static Address

- ◆ **VLAN** – ID of configured VLAN. (Range: 1-4094)
- ◆ **Interface** – Port or trunk associated with the device assigned a static address.
- ◆ **MAC Address** – Physical address of a device mapped to this interface. Enter an address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.
- ◆ **Static Status** – Sets the time to retain the specified address.
 - Delete-on-reset - Assignment lasts until the switch is reset.
 - Permanent - Assignment is permanent. (This is the default.)

Show Static Address

The following additional fields are displayed on this web page:

Type – Displays the address configuration method. (Values: CPU, Config, or Security, the last of which indicates Port Security)

Life Time – The duration for which this entry applies. (Values: Delete On Reset, Delete On Timeout, Permanent)

Web Interface

To configure a static MAC address:

1. Click MAC Address, Static.
2. Select Add from the Action list.
3. Specify the VLAN, the port or trunk to which the address will be assigned, the MAC address, and the time to retain this entry.
4. Click Apply.

Figure 85: Configuring Static MAC Addresses

MAC Address > Static

Action: Add

VLAN: 1

Interface: Port 1 Trunk

MAC Address: 00-12-cf-94-34-da

Static Status: Permanent

Apply Revert

To show the static addresses in MAC address table:

1. Click MAC Address, Static.
2. Select Show from the Action list.

Figure 86: Displaying Static MAC Addresses

MAC Address > Static

Action: Show

Static MAC Address to Interface Mapping Table Total: 2

<input type="checkbox"/>	MAC Address	VLAN	Interface	Type	Life Time
<input type="checkbox"/>	00-00-0C-00-00-FD	1	CPU	CPU	Delete on Reset
<input type="checkbox"/>	00-12-CF-94-34-DA	1	Unit 1 / Port 1	Config	Permanent

Delete Revert

Changing the Aging Time

Use the MAC Address > Dynamic (Configure Aging) page to set the aging time for entries in the dynamic address table. The aging time is used to age out dynamically learned forwarding information.

Parameters

These parameters are displayed:

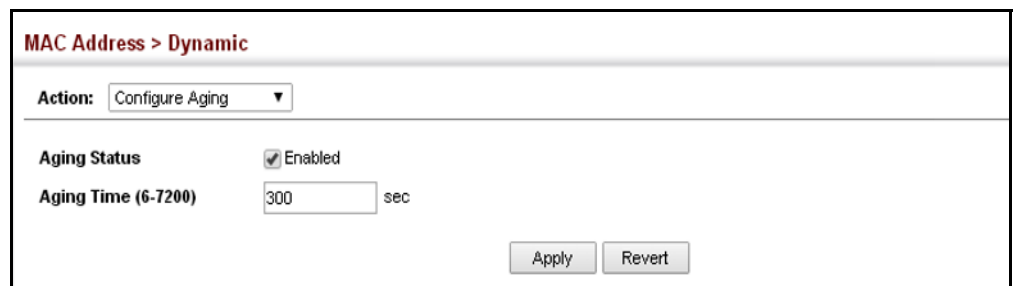
- ◆ **Aging Status** – Enables/disables the function.
- ◆ **Aging Time** – The time after which a learned entry is discarded. (Range: 6-7200 seconds; Default: 300 seconds)

Web Interface

To set the aging time for entries in the dynamic address table:

1. Click MAC Address, Dynamic.
2. Select Configure Aging from the Action list.
3. Modify the aging status if required.
4. Specify a new aging time.
5. Click Apply.

Figure 87: Setting the Address Aging Time



The screenshot shows a web interface for configuring MAC address aging. At the top, it says "MAC Address > Dynamic". Below that, there is a dropdown menu for "Action" with "Configure Aging" selected. Underneath, there are two settings: "Aging Status" which is checked and labeled "Enabled", and "Aging Time (6-7200)" which is set to "300" with "sec" next to it. At the bottom right, there are two buttons: "Apply" and "Revert".

Displaying the Dynamic Address Table

Use the MAC Address > Dynamic (Show Dynamic MAC) page to display the MAC addresses learned by monitoring the source address for traffic entering the switch. When the destination address for inbound traffic is found in the database, the packets intended for that address are forwarded directly to the associated port. Otherwise, the traffic is flooded to all ports.

Parameters

These parameters are displayed:

- ◆ **Sort Key** - You can sort the information displayed based on MAC address, VLAN or interface (port or trunk).
- ◆ **MAC Address** – Physical address associated with this interface.
- ◆ **VLAN** – ID of configured VLAN (1-4094).
- ◆ **Interface** – Indicates a port or trunk.
- ◆ **Type** – Shows that the entries in this table are learned.
(Values: Learned or Security, the last of which indicates Port Security)
- ◆ **Life Time** – Shows the time to retain the specified address.

Web Interface

To show the dynamic address table:

1. Click MAC Address, Dynamic.
2. Select Show Dynamic MAC from the Action list.
3. Select the Sort Key (MAC Address, VLAN, or Interface).
4. Enter the search parameters (MAC Address, VLAN, or Interface).
5. Click Query.

Figure 88: Displaying the Dynamic MAC Address Table

MAC Address	VLAN	Interface	Type	Life Time
00-E0-29-94-34-64	1	Unit 1 / Port 1	Learn	Delete on Timeout
70-72-CF-32-DD-FF	1	Unit 1 / Port 1	Learn	Delete on Timeout

Clearing the Dynamic Address Table

Use the MAC Address > Dynamic (Clear Dynamic MAC) page to remove any learned entries from the forwarding database.

Parameters

These parameters are displayed:

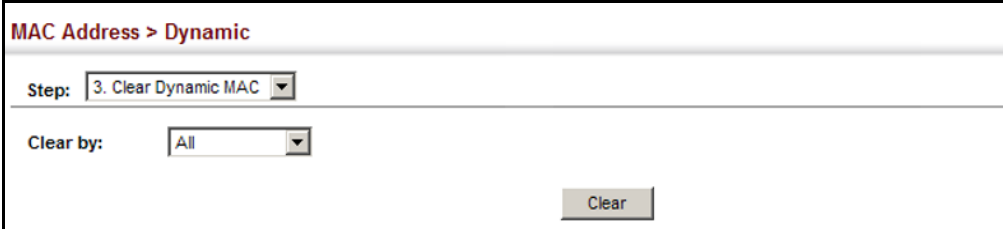
- ◆ **Clear by** – All entries can be cleared; or you can clear the entries for a specific MAC address, all the entries in a VLAN, or all the entries associated with a port or trunk.

Web Interface

To clear the entries in the dynamic address table:

1. Click MAC Address, Dynamic.
2. Select Clear Dynamic MAC from the Action list.
3. Select the method by which to clear the entries (i.e., All, MAC Address, VLAN, or Interface).
4. Enter information in the additional fields required for clearing entries by MAC Address, VLAN, or Interface.
5. Click Clear.

Figure 89: Clearing Entries in the Dynamic MAC Address Table



The screenshot shows a web interface for clearing dynamic MAC entries. At the top, it says "MAC Address > Dynamic". Below that, there is a "Step:" label followed by a dropdown menu showing "3. Clear Dynamic MAC". Underneath, there is a "Clear by:" label followed by a dropdown menu showing "All". At the bottom right of the form area, there is a "Clear" button.

Issuing MAC Address Traps

Use the MAC Address > MAC Notification pages to send SNMP traps (i.e., SNMP notifications) when a dynamic MAC address is added or removed.

Parameters

These parameters are displayed:

Configure Global

- ◆ **MAC Notification Traps** – Issues a trap when a dynamic MAC address is added or removed. (Default: Disabled)
- ◆ **MAC Notification Trap Interval** – Specifies the interval between issuing two consecutive traps. (Range: 1-3600 seconds; Default: 1 second)

Configure Interface

- ◆ **Port** – Port Identifier. (Range: 1-10)
- ◆ **MAC Notification Trap** – Enables MAC authentication traps on the current interface. (Default: Disabled)

MAC authentication traps must be enabled at the global level for this attribute to take effect.

Web Interface

To enable MAC address traps at the global level:

1. Click MAC Address, MAC Notification.
2. Select Configure Global from the Step list.
3. Configure MAC notification traps and the transmission interval.
4. Click Apply.

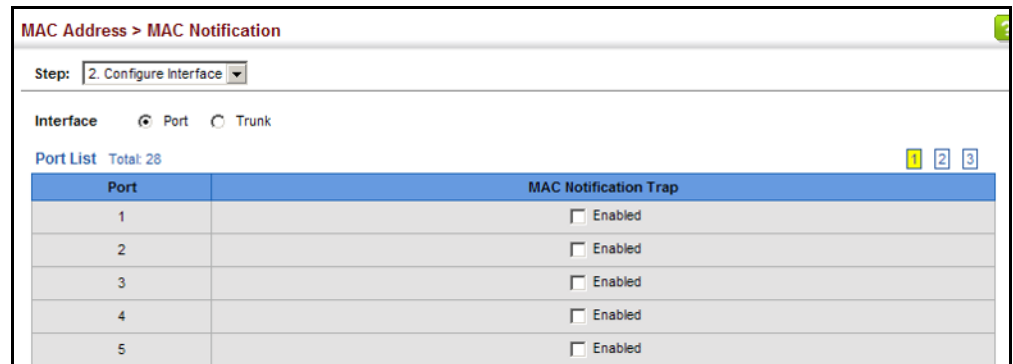
Figure 90: Issuing MAC Address Traps (Global Configuration)

The screenshot shows a web interface titled "MAC Address > MAC Notification". At the top, there is a "Step:" dropdown menu with "1. Configure Global" selected. Below this, there are two configuration options: "MAC Notification Traps" with an unchecked checkbox labeled "Enabled", and "MAC Notification Trap Interval (1-3600)" with a text input field containing the number "1" followed by "sec". At the bottom right of the form, there are two buttons: "Apply" and "Revert".

To enable MAC address traps at the interface level:

1. Click MAC Address, MAC Notification.
2. Select Configure Interface from the Step list.
3. Enable MAC notification traps for the required ports.
4. Click Apply.

Figure 91: Issuing MAC Address Traps (Interface Configuration)



7

Spanning Tree Algorithm

This chapter describes the following basic topics:

- ◆ [Loopback Detection](#) – Configures detection and response to loopback BPDUs.
- ◆ [Global Settings for STA](#) – Configures global bridge settings for STP, RSTP and MSTP.
- ◆ [Interface Settings for STA](#) – Configures interface settings for STA, including priority, path cost, link type, and designation as an edge port.
- ◆ [Global Settings for MSTP](#) – Sets the VLANs and associated priority assigned to an MST instance
- ◆ [Interface Settings for MSTP](#) – Configures interface settings for MSTP, including priority and path cost.

Overview

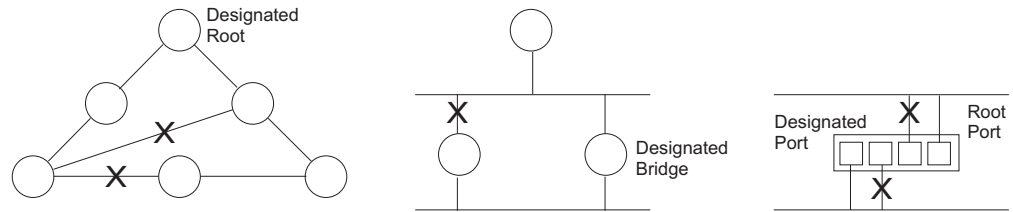
The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only one route exists between any two stations on the network, and provide backup links which automatically take over when a primary link goes down.

The spanning tree algorithms supported by this switch include these versions:

- ◆ STP – Spanning Tree Protocol (IEEE 802.1D)
- ◆ RSTP – Rapid Spanning Tree Protocol (IEEE 802.1w)
- ◆ MSTP – Multiple Spanning Tree Protocol (IEEE 802.1s)

STP – STP uses a distributed algorithm to select a bridging device (STP-compliant switch, bridge or router) that serves as the root of the spanning tree network. It selects a root port on each bridging device (except for the root device) which incurs the lowest path cost when forwarding a packet from that device to the root device. Then it selects a designated bridging device from each LAN which incurs the lowest path cost when forwarding a packet from that LAN to the root device. All ports connected to designated bridging devices are assigned as designated ports. After determining the lowest cost spanning tree, it enables all root ports and designated ports, and disables all other ports. Network packets are therefore only forwarded between root ports and designated ports, eliminating any possible network loops.

Figure 92: STP Root Ports and Designated Ports

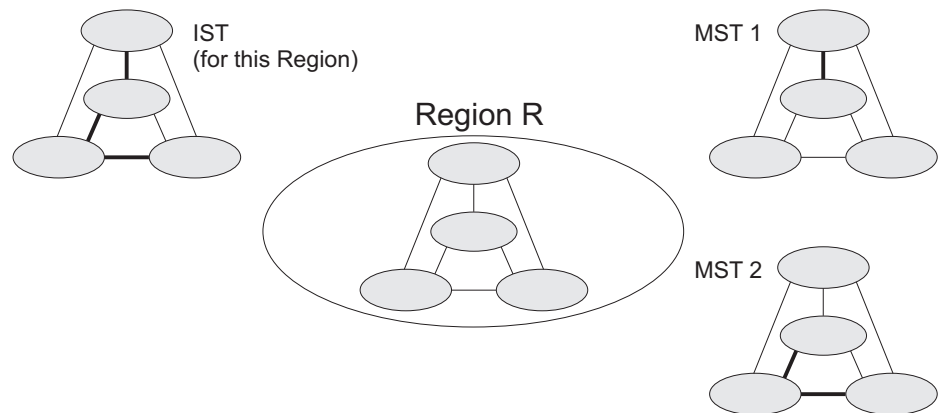


Once a stable network topology has been established, all bridges listen for Hello BPDUs (Bridge Protocol Data Units) transmitted from the Root Bridge. If a bridge does not get a Hello BPDU after a predefined interval (Maximum Age), the bridge assumes that the link to the Root Bridge is down. This bridge will then initiate negotiations with other bridges to reconfigure the network to reestablish a valid network topology.

RSTP – RSTP is designed as a general replacement for the slower, legacy STP. RSTP is also incorporated into MSTP. RSTP achieves much faster reconfiguration (i.e., around 1 to 3 seconds, compared to 30 seconds or more for STP) by reducing the number of state changes before active ports start learning, predefining an alternate route that can be used when a node or port fails, and retaining the forwarding database for ports insensitive to changes in the tree structure when reconfiguration occurs.

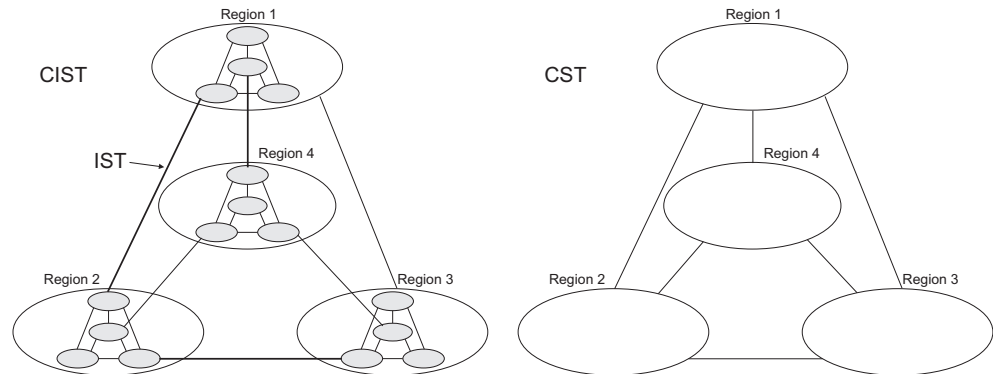
MSTP – When using STP or RSTP, it may be difficult to maintain a stable path between all VLAN members. Frequent changes in the tree structure can easily isolate some of the group members. MSTP (which is based on RSTP for fast convergence) is designed to support independent spanning trees based on VLAN groups. Using multiple spanning trees can provide multiple forwarding paths and enable load balancing. One or more VLANs can be grouped into a Multiple Spanning Tree Instance (MSTI). MSTP builds a separate Multiple Spanning Tree (MST) for each instance to maintain connectivity among each of the assigned VLAN groups. MSTP then builds an Internal Spanning Tree (IST) for the Region containing all commonly configured MSTP bridges.

Figure 93: MSTP Region, Internal Spanning Tree, Multiple Spanning Tree



An MST Region consists of a group of interconnected bridges that have the same MST Configuration Identifiers (including the Region Name, Revision Level and Configuration Digest – see “Configuring Multiple Spanning Trees” on page 183). An MST Region may contain multiple MSTP Instances. An Internal Spanning Tree (IST) is used to connect all the MSTP switches within an MST region. A Common Spanning Tree (CST) interconnects all adjacent MST Regions, and acts as a virtual bridge node for communications with STP or RSTP nodes in the global network.

Figure 94: Spanning Tree – Common Internal, Common, Internal



MSTP connects all bridges and LAN segments with a single Common and Internal Spanning Tree (CIST). The CIST is formed as a result of the running spanning tree algorithm between switches that support the STP, RSTP, MSTP protocols.

Once you specify the VLANs to include in a Multiple Spanning Tree Instance (MSTI), the protocol will automatically build an MSTI tree to maintain connectivity among each of the VLANs. MSTP maintains contact with the global network because each instance is treated as an RSTP node in the Common Spanning Tree (CST).

Configuring Loopback Detection

Use the Spanning Tree > Loopback Detection page to configure loopback detection on an interface. When loopback detection is enabled and a port or trunk receives its own BPDU, the detection agent drops the loopback BPDU, sends an SNMP trap, and places the interface in discarding mode. This loopback state can be released manually or automatically. If the interface is configured for automatic loopback release, then the port will only be returned to the forwarding state if one of the following conditions is satisfied:

- ◆ The interface receives any other BPDU except for its own, or;
- ◆ The interface's link status changes to link down and then link up again, or;
- ◆ The interface ceases to receive its own BPDUs in a forward delay interval.



Note: If loopback detection is not enabled and an interface receives its own BPDU, then the interface will drop the loopback BPDU according to IEEE Standard 802.1w-2001 9.3.4 (Note 1).

Note: Loopback detection will not be active if Spanning Tree is disabled on the switch.

Note: When configured for manual release mode, then a link down/up event will not release the port from the discarding state.

Parameters

These parameters are displayed:

- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Status** – Enables loopback detection on this interface. (Default: Enabled)
- ◆ **Trap** – Enables SNMP trap notification for loopback events on this interface. (Default: Disabled)
- ◆ **Release Mode** – Configures the interface for automatic or manual loopback release. (Default: Auto)
- ◆ **Release** – Allows an interface to be manually released from discard mode. This is only available if the interface is configured for manual release mode.
- ◆ **Action** – Sets the response for loopback detection to shut down the interface. (Default: Shutdown)
- ◆ **Shutdown Interval** – The duration to shut down the interface. (Range: 60-86400 seconds; Default: 60 seconds)

If an interface is shut down due to a detected loopback, and the release mode is set to “Auto,” the selected interface will be automatically enabled when the shutdown interval has expired.

If an interface is shut down due to a detected loopback, and the release mode is set to “Manual,” the interface can be re-enabled using the Release button.

Web Interface

To configure loopback detection:

1. Click Spanning Tree, Loopback Detection.
2. Click Port or Trunk to display the required interface type.
3. Modify the required loopback detection attributes.
4. Click Apply

Figure 95: Configuring Port Loopback Detection

Port	Status	Trap	Release Mode	Release	Action	Shutdown Interval (60-86400 sec)
1	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	Auto	Release	Shutdown	60
2	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	Auto	Release	Shutdown	60
3	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	Auto	Release	Shutdown	60
4	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	Manual	Release	Shutdown	60
5	<input type="checkbox"/> Enabled	<input type="checkbox"/> Enabled	Auto	Release	Shutdown	60

Configuring Global Settings for STA

Use the Spanning Tree > STA (Configure Global - Configure) page to configure global settings for the spanning tree that apply to the entire switch.

Command Usage

◆ Spanning Tree Protocol³

This option uses RSTP set to STP forced compatibility mode. It uses RSTP for the internal state machine, but sends only 802.1D BPDUs. This creates one spanning tree instance for the entire network. If multiple VLANs are implemented on a network, the path between specific VLAN members may be inadvertently disabled to prevent network loops, thus isolating group members. When operating multiple VLANs, we recommend selecting the MSTP option.

◆ Rapid Spanning Tree Protocol³

RSTP supports connections to either STP or RSTP nodes by monitoring the incoming protocol messages and dynamically adjusting the type of protocol messages the RSTP node transmits, as described below:

- STP Mode – If the switch receives an 802.1D BPDU (i.e., STP BPDU) after a port’s migration delay timer expires, the switch assumes it is connected to an 802.1D bridge and starts using only 802.1D BPDUs.
- RSTP Mode – If RSTP is using 802.1D BPDUs on a port and receives an RSTP BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.

◆ Multiple Spanning Tree Protocol

MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load,

3. STP and RSTP BPDUs are transmitted as untagged frames, and will cross any VLAN boundaries.

preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

- To allow multiple spanning trees to operate over the network, you must configure a related set of bridges with the same MSTP configuration, allowing them to participate in a specific set of spanning tree instances.
- A spanning tree instance can exist only on bridges that have compatible VLAN instance assignments.
- Be careful when switching between spanning tree modes. Changing modes stops all spanning-tree instances for the previous mode and restarts the system in the new mode, temporarily disrupting user traffic.

Parameters

These parameters are displayed:

Basic Configuration of Global Settings

- ◆ **Spanning Tree Status** – Enables/disables STA on this switch.
(Default: Disabled)

When spanning tree is enabled globally or enabled on an interface ([Configuring Interface Settings for STA](#)), loopback detection is disabled.
- ◆ **Spanning Tree Type** – Specifies the type of spanning tree used on this switch:
 - **STP**: Spanning Tree Protocol (IEEE 802.1D); i.e., when this option is selected, the switch will use RSTP set to STP forced compatibility mode).
 - **RSTP**: Rapid Spanning Tree (IEEE 802.1w); RSTP is the default.
 - **MSTP**: Multiple Spanning Tree (IEEE 802.1s)
- ◆ **Priority** – Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device. (Note that lower numeric values indicate higher priority.)
 - Default: 32768
 - Range: 0-61440, in steps of 4096
 - Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440
- ◆ **BPDU Flooding** – Configures the system to flood BPDUs to all other ports on the switch or just to all other ports in the same VLAN when spanning tree is disabled globally on the switch or disabled on a specific port.
 - To VLAN: Floods BPDUs to all other ports within the receiving port's native VLAN (i.e., as determined by port's PVID). This is the default.
 - To All: Floods BPDUs to all other ports on the switch.

The setting has no effect if BPDU flooding is disabled on a port (see ["Configuring Interface Settings for STA"](#)).

- ◆ **Cisco Prestandard Status** – Configures spanning tree operation to be compatible with Cisco prestandard versions. (Default: Disabled)

Cisco prestandard versions prior to Cisco IOS Release 12.2(25)SEC do not fully follow the IEEE standard, causing some state machine procedures to function incorrectly. This command forces the spanning tree protocol to function in a manner compatible with Cisco prestandard versions.

Advanced Configuration Settings

The following attributes are based on RSTP, but also apply to STP since the switch uses a backwards-compatible subset of RSTP to implement STP, and also apply to MSTP which is based on RSTP according to the standard:

- ◆ **Path Cost Method** – The path cost is used to determine the best path between devices. The path cost method is used to determine the range of values that can be assigned to each interface.
 - Long: Specifies 32-bit based values that range from 1-200,000,000. (This is the default.)
 - Short: Specifies 16-bit based values that range from 1-65535.
- ◆ **Transmission Limit** – The maximum transmission rate for BPDUs is specified by setting the minimum interval between the transmission of consecutive protocol messages. (Range: 1-10; Default: 3)

When the Switch Becomes Root

- ◆ **Hello Time** – Interval (in seconds) at which the root device transmits a configuration message.
 - Default: 2
 - Minimum: 1
 - Maximum: The lower of 10 or $[(\text{Max. Message Age} / 2) - 1]$
- ◆ **Maximum Age** – The maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconverge. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network. (References to "ports" in this section mean "interfaces," which includes both ports and trunks.)
 - Default: 20
 - Minimum: The higher of 6 or $[2 \times (\text{Hello Time} + 1)]$
 - Maximum: The lower of 40 or $[2 \times (\text{Forward Delay} - 1)]$

- ◆ **Forward Delay** – The maximum time (in seconds) this device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result.
 - Default: 15
 - Minimum: The higher of 4 or $[(\text{Max. Message Age} / 2) + 1]$
 - Maximum: 30

RSTP does not depend on the forward delay timer in most cases. It is able to confirm that a port can transition to the forwarding state without having to rely on any timer configuration. To achieve fast convergence, RSTP relies on the use of edge ports, and automatic detection of point-to-point link types, both of which allow a port to directly transition to the forwarding state.

Configuration Settings for MSTP

- ◆ **Max Instance Numbers** – The maximum number of MSTP instances to which this switch can be assigned.
- ◆ **Configuration Digest** – An MD5 signature key that contains the VLAN ID to MST ID mapping table. In other words, this key is a mapping of all VLANs to the CIST.
- ◆ **Region Revision**⁴ – The revision for this MSTI. (Range: 0-65535; Default: 0)
- ◆ **Region Name**⁴ – The name for this MSTI. (Maximum length: 32 characters; Default: switch's MAC address)
- ◆ **Max Hop Count** – The maximum number of hops allowed in the MST region before a BPDU is discarded. (Range: 1-40; Default: 20)



NOTE: Region Revision and Region Name and are both required to uniquely identify an MST region.

Web Interface

To configure global STA settings:

1. Click Spanning Tree, STA.
 2. Select Configure Global from the Step list.
 3. Select Configure from the Action list.
-
4. The MST name and revision number are both required to uniquely identify an MST region.

4. Modify any of the required attributes. Note that the parameters displayed for the spanning tree types (STP, RSTP, MSTP) varies as described in the preceding section.
5. Click Apply

Figure 96: Configuring Global Settings for STA (STP)

Spanning Tree > STA

Step: 1. Configure Global Action: Configure

Spanning Tree Status Enabled

Spanning Tree Type STP

Priority (0-61440, in steps of 4096)

BPDU Flooding To VLAN

Cisco Prestandard Status Enabled

Advanced:

Path Cost Method Long

Transmission Limit (1-10)

When the Switch Becomes Root:

Hello Time (1-10) sec

Maximum Age (6-40) sec

Forward Delay (4-30) sec

Note: $2 * (\text{Hello Time} + 1) \leq \text{Max Age} \leq 2 * (\text{Forward Delay} - 1)$

Apply Revert

Figure 97: Configuring Global Settings for STA (RSTP)

Spanning Tree > STA

Step: 1. Configure Global Action: Configure

Spanning Tree Status Enabled

Spanning Tree Type RSTP

Priority (0-61440, in steps of 4096)

BPDU Flooding To VLAN

Cisco Prestandard Status Enabled

Advanced:

Path Cost Method Long

Transmission Limit (1-10)

When the Switch Becomes Root:

Hello Time (1-10) sec

Maximum Age (6-40) sec

Forward Delay (4-30) sec

Note: $2 * (\text{Hello Time} + 1) \leq \text{Max Age} \leq 2 * (\text{Forward Delay} - 1)$

Apply Revert

Figure 98: Configuring Global Settings for STA (MSTP)

The screenshot shows the 'Spanning Tree > STA' configuration page. At the top, there is a breadcrumb 'Spanning Tree > STA'. Below it, a 'Step' dropdown is set to '1. Configure Global' and an 'Action' dropdown is set to 'Configure'. The main configuration area is divided into several sections:

- Spanning Tree Status:** 'Spanning Tree Status' is checked 'Enabled'. 'Spanning Tree Type' is set to 'MSTP'. 'Priority (0-61440, in steps of 4096)' is set to '32768'. 'BPDU Flooding' is set to 'To VLAN'. 'Cisco Prestandard Status' is unchecked.
- Advanced:** 'Path Cost Method' is set to 'Long'. 'Transmission Limit (1-10)' is set to '3'.
- When the Switch Becomes Root:** 'Hello Time (1-10)' is set to '2' sec. 'Maximum Age (6-40)' is set to '20' sec. 'Forward Delay (4-30)' is set to '15' sec.
- Note:** $2 * (\text{Hello Time} + 1) \leq \text{Max Age} \leq 2 * (\text{Forward Delay} - 1)$
- MSTP Configuration:** 'Max Instance Numbers' is set to '64'. 'Configuration Digest' is '0xAC36177F50283CD4B83821D8AB26DE62'. 'Region Revision (0-65535)' is set to '0'. 'Region Name' is '00 E0 0C 00 00 FD'. 'Max Hop Count (1-40)' is set to '20'.

At the bottom right, there are 'Apply' and 'Revert' buttons.

Displaying Global Settings for STA

Use the Spanning Tree > STA (Configure Global - Show Information) page to display a summary of the current bridge STA information that applies to the entire switch.

Parameters

The parameters displayed are described in the preceding section, except for the following items:

- ◆ **Bridge ID** – A unique identifier for this bridge, consisting of the bridge priority, the MST Instance ID 0 for the Common Spanning Tree when spanning tree type is set to MSTP, and MAC address (where the address is taken from the switch system).
- ◆ **Designated Root** – The priority and MAC address of the device in the Spanning Tree that this switch has accepted as the root device.
- ◆ **Root Port** – The number of the port on this switch that is closest to the root. This switch communicates with the root device through this port. If there is no root port, then this switch has been accepted as the root device of the Spanning Tree network.

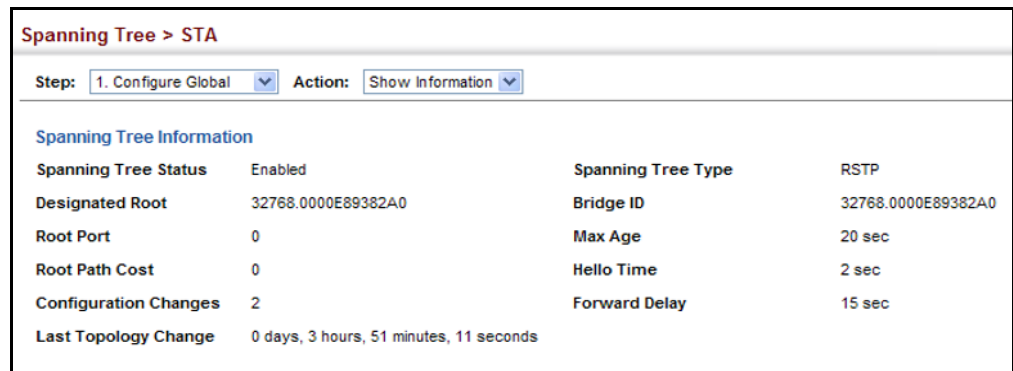
- ◆ **Root Path Cost** – The path cost from the root port on this switch to the root device.
- ◆ **Configuration Changes** – The number of times the Spanning Tree has been reconfigured.
- ◆ **Last Topology Change** – Time since the Spanning Tree was last reconfigured.

Web Interface

To display global STA settings:

1. Click Spanning Tree, STA.
2. Select Configure Global from the Step list.
3. Select Show Information from the Action list.

Figure 99: Displaying Global Settings for STA



The screenshot shows the 'Spanning Tree > STA' configuration page. At the top, there are two dropdown menus: 'Step: 1. Configure Global' and 'Action: Show Information'. Below these is a section titled 'Spanning Tree Information' containing a table of settings.

Spanning Tree Information			
Spanning Tree Status	Enabled	Spanning Tree Type	RSTP
Designated Root	32768.0000E89382A0	Bridge ID	32768.0000E89382A0
Root Port	0	Max Age	20 sec
Root Path Cost	0	Hello Time	2 sec
Configuration Changes	2	Forward Delay	15 sec
Last Topology Change	0 days, 3 hours, 51 minutes, 11 seconds		

Configuring Interface Settings for STA

Use the Spanning Tree > STA (Configure Interface - Configure) page to configure RSTP and MSTP attributes for specific interfaces, including port priority, path cost, link type, and edge port. You may use a different priority or path cost for ports of the same media type to indicate the preferred path, link type to indicate a point-to-point connection or shared-media connection, and edge port to indicate if the attached device can support fast forwarding. (References to “ports” in this section means “interfaces,” which includes both ports and trunks.)

Parameters

These parameters are displayed:

- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Spanning Tree** – Enables/disables STA on this interface. (Default: Enabled)
When spanning tree is enabled globally ([Configuring Global Settings for STA](#)) or enabled on an interface by this command, loopback detection is disabled.
- ◆ **BPDU Flooding** – Enables/disables the flooding of BPDUs to other ports when global spanning tree is disabled ([page 169](#)) or when spanning tree is disabled on a specific port. When flooding is enabled, BPDUs are flooded to all other ports on the switch or to all other ports within the receiving port’s native VLAN as specified by the Spanning Tree BPDU Flooding attribute ([page 169](#)). (Default: Enabled)
- ◆ **Priority** – Defines the priority used for this port in the Spanning Tree Protocol. If the path cost for all ports on a switch are the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Protocol is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.
 - Default: 128
 - Range: 0-240, in steps of 16
- ◆ **Admin Path Cost** – This parameter is used by the STA to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Note that path cost takes precedence over port priority. (Range: 0 for auto-configuration, 1-65535 for the short path cost method⁵, 1-200,000,000 for the long path cost method)

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost “0” is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

Table 11: Recommended STA Path Cost Range

Port Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Ethernet	50-600	200,000-20,000,000
Fast Ethernet	10-60	20,000-2,000,000

5. Refer to [“Configuring Global Settings for STA” on page 169](#) for information on setting the path cost method. The range displayed on the STA interface configuration page shows the maximum value for path cost. However, note that the switch still enforces the rules for path cost based on the specified path cost method (long or short)

Table 11: Recommended STA Path Cost Range (Continued)

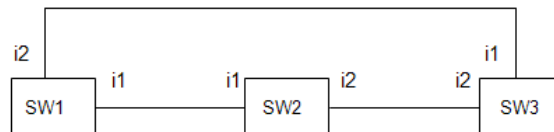
Port Type	IEEE 802.1D-1998	IEEE 802.1w-2001
Gigabit Ethernet	3-10	2,000-200,000
10G Ethernet	1-5	200-20,000

Table 12: Default STA Path Costs

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Ethernet	65,535	1,000,000
Fast Ethernet	65,535	100,000
Gigabit Ethernet	10,000	10,000
10G Ethernet	1,000	1,000

Administrative path cost cannot be used to directly determine the root port on a switch. Connections to other devices use IEEE 802.1Q-2005 to determine the root port as in the following example.

Figure 100: Determining the Root Port



For BPDU messages received by i1 on SW3, the path cost is 0.

For BPDU messages received by i2 on SW3, the path cost is that of i1 on SW2.

The root path cost for i1 on SW3 used to compete for the role of root port is 0 + path cost of i1 on SW3; 0 since i1 is directly connected to the root bridge.

If the path cost of i1 on SW2 is never configured/changed, it is 10000.

Then the root path cost for i2 on SW3 used to compete for the role of root port is 10000 + path cost of i2 on SW3.

The path cost of i1 on SW3 is also 10000 if not configured/changed.

Then even if the path cost of i2 on SW3 is configured/changed to 0, these ports will still have the same root path cost, and it will be impossible for i2 to become the root port just by changing its path cost on SW3.

For RSTP mode, the root port can be determined simply by adjusting the path cost of i1 on SW2. However, for MSTP mode, it is impossible to achieve this only by changing the path cost because external path cost is not added in the same region, and the regional root for i1 is SW1, but for i2 is SW2.

- ◆ **Admin Link Type** – The link type attached to this interface.
 - Point-to-Point – A connection to exactly one other bridge.
 - Shared – A connection to two or more bridges.

- Auto – The switch automatically determines if the interface is attached to a point-to-point link or to shared media. (This is the default setting.)
- ◆ **Root Guard** – STA allows a bridge with a lower bridge identifier (or same identifier and lower MAC address) to take over as the root bridge at any time. Root Guard can be used to ensure that the root bridge is not formed at a suboptimal location. Root Guard should be enabled on any designated port connected to low-speed bridges which could potentially overload a slower link by taking over as the root port and forming a new spanning tree topology. It could also be used to form a border around part of the network where the root bridge is allowed. (Default: Disabled)
- ◆ **Admin Edge Port** – Since end nodes **cannot** cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device. (Default: Auto)
 - **Enabled** – Manually configures a port as an Edge Port.
 - **Disabled** – Disables the Edge Port setting.
 - **Auto** – The port will be automatically configured as an edge port if the edge delay time expires without receiving any RSTP or MSTP BPDUs. Note that edge delay time (802.1D-2004 17.20.4) equals the protocol migration time if a port's link type is point-to-point (which is 3 seconds as defined in IEEE 802.3D-2004 17.20.4); otherwise it equals the spanning tree's maximum age for configuration messages (see maximum age under ["Configuring Global Settings for STA" on page 169](#)).

An interface cannot function as an edge port under the following conditions:

- If spanning tree mode is set to STP ([page 169](#)), edge-port mode cannot automatically transition to operational edge-port state using the automatic setting.
- If loopback detection is enabled ([page 167](#)) and a loopback BPDU is detected, the interface cannot function as an edge port until the loopback state is released.
- If an interface is in forwarding state and its role changes, the interface cannot continue to function as an edge port even if the edge delay time has expired.
- If the port does not receive any BPDUs after the edge delay timer expires, its role changes to designated port and it immediately enters forwarding state (see ["Displaying Interface Settings for STA" on page 180](#)).

When edge port is set as auto, the operational state is determined automatically by the Bridge Detection State Machine described in 802.1D-2004, where the edge port state may change dynamically based on environment changes (e.g., receiving a BPDU or not within the required interval).

- ◆ **BPDU Guard** – This feature protects edge ports from receiving BPDUs. It prevents loops by shutting down an edge port when a BPDU is received instead of putting it into the spanning tree discarding state. In a valid configuration, configured edge ports should not receive BPDUs. If an edge port receives a BPDU an invalid configuration exists, such as a connection to an unauthorized device. The BPDU guard feature provides a secure response to invalid configurations because an administrator must manually enable the port. (Default: Disabled)

BPDU guard can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto).

- ◆ **BPDU Guard Auto Recovery** – Automatically re-enables an interface after the specified interval. (Range: 30-86400 seconds; Default: Disabled)
- ◆ **BPDU Guard Auto Recovery Interval** – The time to wait before re-enabling an interface. (Range: 30-86400 seconds; Default: 300 seconds)
- ◆ **BPDU Filter** – BPDU filtering allows you to avoid transmitting BPDUs on configured edge ports that are connected to end nodes. By default, STA sends BPDUs to all ports regardless of whether administrative edge is enabled on a port. BPDU filtering is configured on a per-port basis. (Default: Disabled)

BPDU filter can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto).

- ◆ **Migration** – If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the Protocol Migration button to manually re-check the appropriate BPDU format (RSTP or STP-compatible) to send on the selected interfaces. (Default: Disabled)
- ◆ **TC Propagate Stop** – Stops the propagation of topology change notifications (TCN). (Default: Disabled)

Web Interface

To configure interface settings for STA:

1. Click Spanning Tree, STA.
2. Select Configure Interface from the Step list.
3. Select Configure from the Action list.
4. Modify any of the required attributes.

5. Click Apply.

Figure 101: Configuring Interface Settings for STA

The screenshot shows the 'Spanning Tree > STA' configuration page. At the top, there is a breadcrumb 'Spanning Tree > STA' and a navigation bar with 'Step: 2. Configure Interface' and 'Action: Configure'. Below this, there are radio buttons for 'Interface' with 'Port' selected and 'Trunk' unselected. A 'Port List' section shows 'Total: 28' ports. The main table displays settings for 5 ports. Each row represents a port with columns for various STP parameters.

Port	Spanning Tree	BPDU Flooding	Priority (0-240, in steps of 16)	Admin Path Cost (0-200000000, 0: Auto)	Admin Link Type	Root Guard	Admin Edge Port	BPDU Guard	BPDU Guard Auto Recovery	BPDU Guard Auto Recovery Interval (30-86400)	BPDU Filter	Migration	TC Propagate Stop
1	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	128	0	Auto	<input checked="" type="checkbox"/> Enabled	Auto	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	300	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled
2	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	128	0	Auto	<input checked="" type="checkbox"/> Enabled	Auto	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	300	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled
3	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	128	0	Auto	<input checked="" type="checkbox"/> Enabled	Auto	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	300	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled
4	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	128	0	Auto	<input checked="" type="checkbox"/> Enabled	Auto	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	300	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled
5	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	128	0	Auto	<input checked="" type="checkbox"/> Enabled	Auto	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	300	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Enabled

Displaying Interface Settings for STA

Use the Spanning Tree > STA (Configure Interface - Show Information) page to display the current status of ports or trunks in the Spanning Tree.

Parameters

These parameters are displayed:

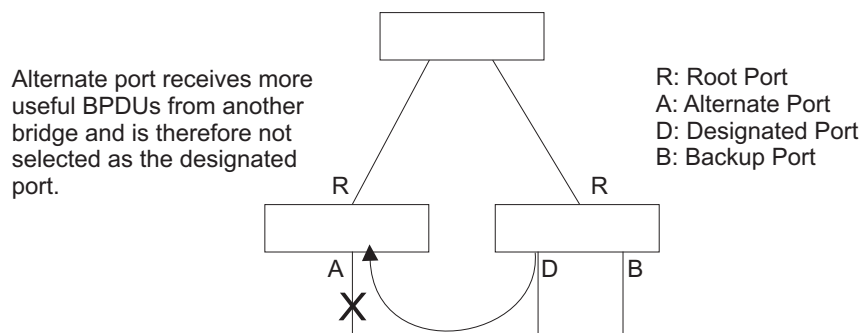
- ◆ **Spanning Tree** – Shows if STA has been enabled on this interface.
- ◆ **BPDU Flooding** – Shows if BPDUs will be flooded to other ports when spanning tree is disabled globally on the switch or disabled on a specific port.
- ◆ **STA Status** – Displays current state of this port within the Spanning Tree:
 - **Discarding** - Port receives STA configuration messages, but does not forward packets.
 - **Learning** - Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses.
 - **Forwarding** - Port forwards packets, and continues learning addresses.

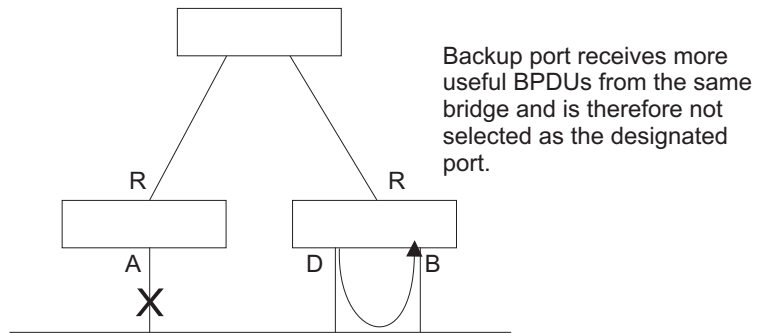
The rules defining port status are:

- A port on a network segment with no other STA compliant bridging device is always forwarding.
- If two ports of a switch are connected to the same segment and there is no other STA device attached to this segment, the port with the smaller ID forwards packets and the other is discarding.

- All ports are discarding when the switch is booted, then some of them change state to learning, and then to forwarding.
- ◆ **Forward Transitions** – The number of times this port has transitioned from the Learning state to the Forwarding state.
- ◆ **Designated Cost** – The cost for a packet to travel from this port to the root in the current Spanning Tree configuration. The slower the media, the higher the cost.
- ◆ **Designated Bridge** – The bridge priority and MAC address of the device through which this port must communicate to reach the root of the Spanning Tree.
- ◆ **Designated Port** – The port priority and number of the port on the designated bridging device through which this switch must communicate with the root of the Spanning Tree.
- ◆ **Oper Path Cost** – The contribution of this port to the path cost of paths towards the spanning tree root which include this port.
- ◆ **Oper Link Type** – The operational point-to-point status of the LAN segment attached to this interface. This parameter is determined by manual configuration or by auto-detection, as described for Admin Link Type in STA Port Configuration on [page 175](#).
- ◆ **Oper Edge Port** – This parameter is initialized to the setting for Admin Edge Port in STA Port Configuration on [page 175](#) (i.e., true or false), but will be set to false if a BPDU is received, indicating that another bridge is attached to this port.
- ◆ **Port Role** – Roles are assigned according to whether the port is part of the active topology, that is the best port connecting a non-root bridge to the root bridge (i.e., **root** port), connecting a LAN through the bridge to the root bridge (i.e., **designated** port), is the MSTI regional root (i.e., **master** port), or is an **alternate** or **backup** port that may provide connectivity if other bridges, bridge ports, or LANs fail or are removed. The role is set to disabled (i.e., **disabled** port) if a port has no role within the spanning tree.

Figure 102: STA Port Roles





The criteria used for determining the port role is based on root bridge ID, root path cost, designated bridge, designated port, port priority, and port number, in that order and as applicable to the role under question.

Web Interface

To display interface settings for STA:

1. Click Spanning Tree, STA.
2. Select Configure Interface from the Step list.
3. Select Show Information from the Action list.

Figure 103: Displaying Interface Settings for STA

Spanning Tree > STA

Step: 2. Configure Interface Action: Show Information

Interface Port Trunk

Spanning Tree Port List Total: 28

Port	Spanning Tree	BPDU Flooding	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Path Cost	Oper Link Type	Oper Edge Port	Port Role
1	Enabled	Enabled	Forwarding	3	0	32768.00000C0000FD	128.1	10000	Point-to-Point	Disabled	Designated
2	Enabled	Enabled	Discarding	0	0	32768.00000C0000FD	128.2	10000	Point-to-Point	Disabled	Disabled
3	Enabled	Enabled	Discarding	0	0	32768.00000C0000FD	128.3	10000	Point-to-Point	Disabled	Disabled
4	Enabled	Enabled	Discarding	0	0	32768.00000C0000FD	128.4	10000	Point-to-Point	Disabled	Disabled
5	Enabled	Enabled	Discarding	0	0	32768.00000C0000FD	128.5	10000	Point-to-Point	Disabled	Disabled

Configuring Multiple Spanning Trees

Use the Spanning Tree > MSTP (Configure Global) page to create an MSTP instance, or to add VLAN groups to an MSTP instance.

Command Usage

MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

By default all VLANs are assigned to the Internal Spanning Tree (MST Instance 0) that connects all bridges and LANs within the MST region. This switch supports up to 33 instances. You should try to group VLANs which cover the same general area of your network. However, remember that you must configure all bridges within the same MSTI Region ([page 169](#)) with the same set of instances, and the same instance (on each bridge) with the same set of VLANs. Also, note that RSTP treats each MSTI region as a single node, connecting all regions to the Common Spanning Tree.

To use multiple spanning trees:

1. Set the spanning tree type to MSTP ([page 169](#)).
2. Enter the spanning tree priority for the selected MST instance on the Spanning Tree > MSTP (Configure Global - Add) page.
3. Add the VLANs that will share this MSTI on the Spanning Tree > MSTP (Configure Global - Add Member) page.



Note: All VLANs are automatically added to the IST (Instance 0).

To ensure that the MSTI maintains connectivity across the network, you must configure a related set of bridges with the same MSTI settings.

Parameters

These parameters are displayed:

- ◆ **MST ID** – Instance identifier to configure. (Range: 0-4094)
- ◆ **VLAN ID** – VLAN to assign to this MST instance. (Range: 1-4094)
- ◆ **Priority** – The priority of a spanning tree instance. (Range: 0-61440 in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440; Default: 32768)

Web Interface

To create instances for MSTP:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Add from the Action list.
4. Specify the MST instance identifier and the initial VLAN member. Additional member can be added using the Spanning Tree > MSTP (Configure Global - Add Member) page. If the priority is not specified, the default value 32768 is used.
5. Click Apply.

Figure 104: Creating an MST Instance

The screenshot shows the 'Spanning Tree > MSTP' configuration page. At the top, there is a breadcrumb 'Spanning Tree > MSTP'. Below it, there are two dropdown menus: 'Step: 1. Configure Global' and 'Action: Add'. The main form contains three input fields: 'MST ID (0-4094)' with the value '1', 'VLAN ID (1-4094)' with the value '1', and 'Priority (0-61440, in steps of 4096)' which is empty. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show the MSTP instances:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Show from the Action list.

Figure 105: Displaying MST Instances

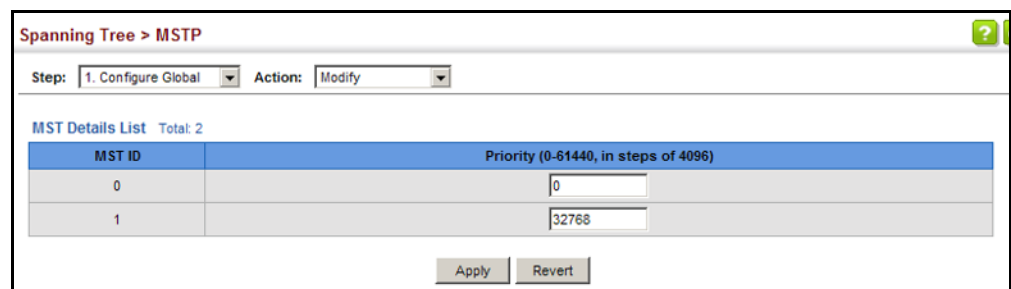
The screenshot shows the 'Spanning Tree > MSTP' configuration page with the 'Action' dropdown set to 'Show'. Below the dropdowns, there is a table titled 'MST List Total: 2'. The table has two columns: a checkbox column and an 'MST ID' column. The table contains two rows: one for MST ID 0 and one for MST ID 1. At the bottom right, there are two buttons: 'Delete' and 'Revert'.

	MST ID
<input type="checkbox"/>	0
<input type="checkbox"/>	1

To modify the priority for an MST instance:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Modify from the Action list.
4. Modify the priority for an MSTP Instance.
5. Click Apply.

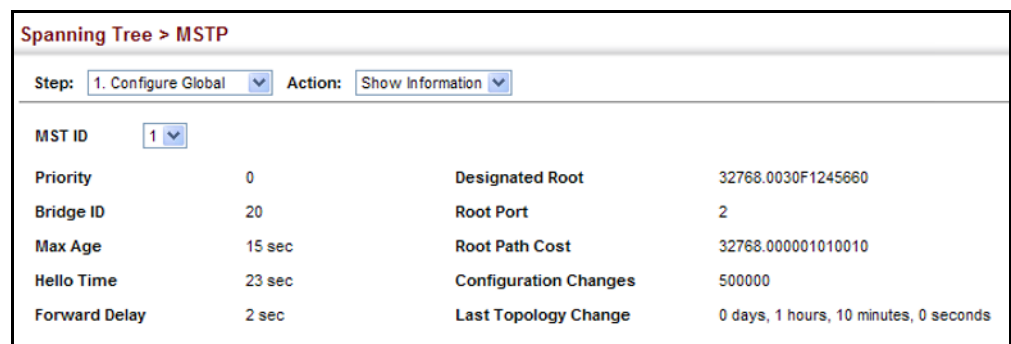
Figure 106: Modifying the Priority for an MST Instance



To display list global settings for MSTP:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Show Information from the Action list.
4. Select an MST ID. The attributes displayed on this page are described under ["Displaying Global Settings for STA"](#) on page 174.

Figure 107: Displaying Global Settings for an MST Instance



To add additional VLAN groups to an MSTP instance:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Add Member from the Action list.
4. Select an MST instance from the MST ID list.
5. Enter the VLAN group to add to the instance in the VLAN ID field. Note that the specified member does not have to be a configured VLAN.
6. Click Apply

Figure 108: Adding a VLAN to an MST Instance

Spanning Tree > MSTP

Step: 1. Configure Global Action: Add Member

MST ID 1

VLAN ID (1-4094) 1

Apply Revert

To show the VLAN members of an MSTP instance:

1. Click Spanning Tree, MSTP.
2. Select Configure Global from the Step list.
3. Select Show Member from the Action list.

Figure 109: Displaying Members of an MST Instance

Spanning Tree > MSTP

Step: 1. Configure Global Action: Show Member

MST ID 0

Member List Total: 4094

	VLAN
<input type="checkbox"/>	1
<input type="checkbox"/>	2
<input type="checkbox"/>	3
<input type="checkbox"/>	4
<input type="checkbox"/>	5

Configuring Interface Settings for MSTP

Use the Spanning Tree > MSTP (Configure Interface - Configure) page to configure the STA interface settings for an MST instance.

Parameters

These parameters are displayed:

- ◆ **MST ID** – Instance identifier to configure. (Default: 0)
- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **STA Status** – Displays the current state of this interface within the Spanning Tree. (See “[Displaying Interface Settings for STA](#)” on page 180 for additional information.)
 - **Discarding** – Port receives STA configuration messages, but does not forward packets.
 - **Learning** – Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses.
 - **Forwarding** – Port forwards packets, and continues learning addresses.
- ◆ **Priority** – Defines the priority used for this port in the Spanning Tree Protocol. If the path cost for all ports on a switch are the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Protocol is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled. (Default: 128; Range: 0-240, in steps of 16)
- ◆ **Admin MST Path Cost** – This parameter is used by the MSTP to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. (Path cost takes precedence over port priority.) Note that when the Path Cost Method is set to short ([page 169](#)), the maximum path cost is 65,535.

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost “0” is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

The recommended range is listed in [Table 11 on page 176](#).

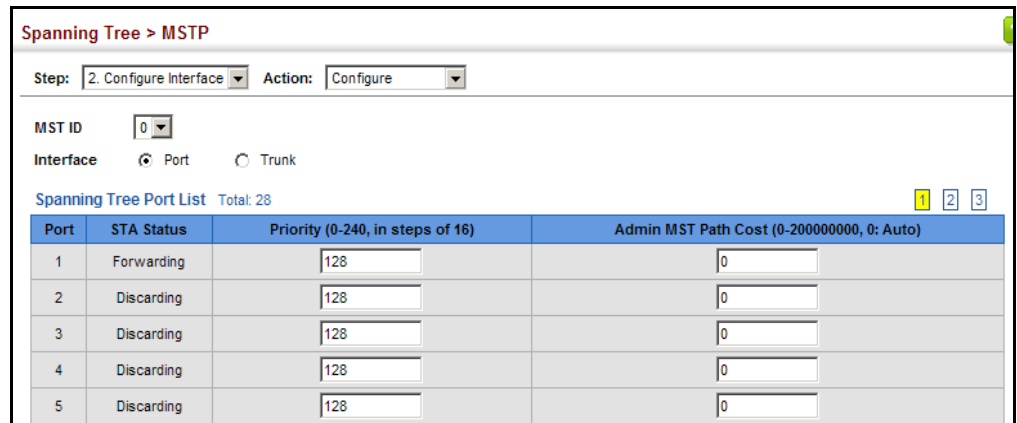
The default path costs are listed in [Table 12 on page 177](#).

Web Interface

To configure MSTP parameters for a port or trunk:

1. Click Spanning Tree, MSTP.
2. Select Configure Interface from the Step list.
3. Select Configure from the Action list.
4. Enter the priority and path cost for an interface
5. Click Apply.

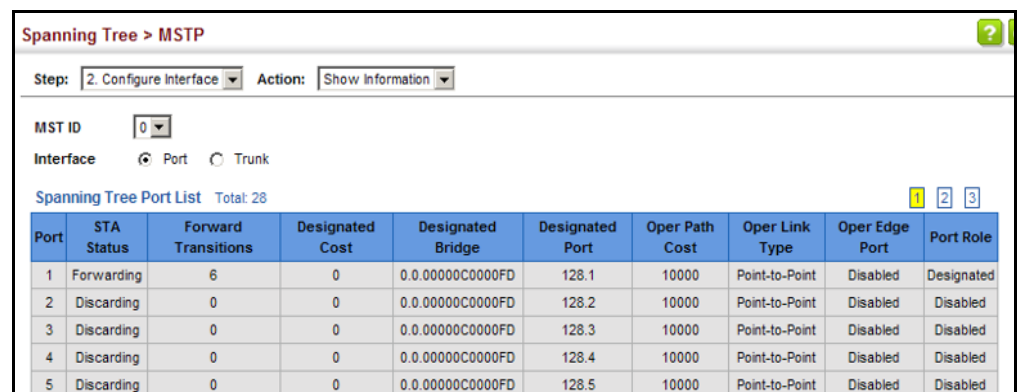
Figure 110: Configuring MSTP Interface Settings



To display MSTP parameters for a port or trunk:

1. Click Spanning Tree, MSTP.
2. Select Configure Interface from the Step list.
3. Select Show Information from the Action list.

Figure 111: Displaying MSTP Interface Settings



Congestion Control

The switch can set the maximum upload or download data transfer rate for any port. It can also control traffic storms by setting a maximum threshold for broadcast traffic or multicast traffic. It can also set bounding thresholds for broadcast and multicast storms which can be used to automatically trigger rate limits or to shut down a port.

Congestion Control includes following options:

- ◆ **Rate Limiting** – Sets the input and output rate limits for a port.
- ◆ **Storm Control** – Sets the traffic storm threshold for each interface.

Rate Limiting

Use the Traffic > Rate Limit page to apply rate limiting to ingress or egress ports. This function allows the network manager to control the maximum rate for traffic received or transmitted on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into or out of the network. Packets that exceed the acceptable amount of traffic are dropped.

Rate limiting can be applied to individual ports or trunks. When an interface is configured with this feature, the traffic rate will be monitored by the hardware to verify conformity. Non-conforming traffic is dropped, conforming traffic is forwarded without any changes.

Parameters

These parameters are displayed:

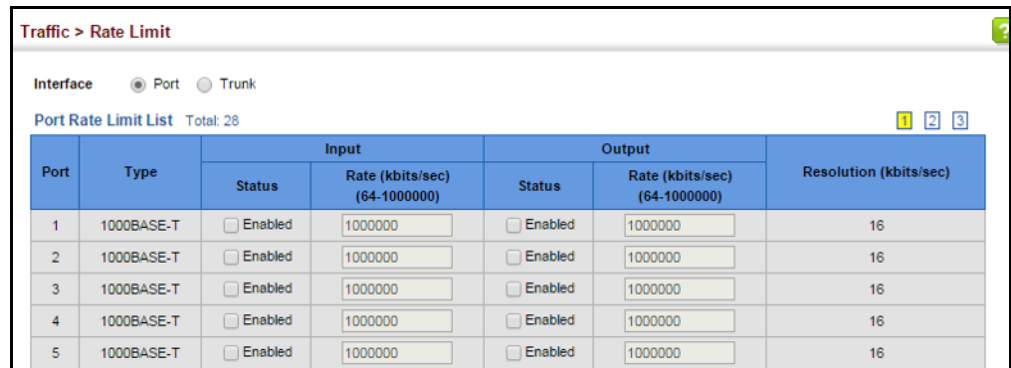
- ◆ **Interface** – Displays the switch's ports or trunks.
- ◆ **Type** – Indicates the port type (1000BASE-T, 1000BASE SFP, or 10GBASE SFP+).
- ◆ **Status** – Enables or disables the rate limit. (Default: Disabled)
- ◆ **Rate** – Sets the rate limit level.
(Range: 64 - 1,000,000 kbits per second for Gigabit Ethernet ports;
64 - 10,000,000 kbits per second for 10 Gigabit Ethernet ports)
- ◆ **Resolution** – Indicates the resolution at which the rate can be configured.

Web Interface

To configure rate limits:

1. Click Traffic, Rate Limit.
2. Set the interface type to Port or Trunk.
3. Enable the Rate Limit Status for the required interface.
4. Set the rate limit for required interfaces.
5. Click Apply.

Figure 112: Configuring Rate Limits



The screenshot shows the 'Traffic > Rate Limit' configuration page. At the top, there are radio buttons for 'Interface' type: 'Port' (selected) and 'Trunk'. Below this is a 'Port Rate Limit List' with a 'Total: 28' and three numbered tabs (1, 2, 3). The main table has columns for Port, Type, Input Status, Input Rate (kbits/sec), Output Status, Output Rate (kbits/sec), and Resolution (kbits/sec). All five rows show '1000BASE-T' ports with 'Enabled' status and a rate of '1000000' kbits/sec, and a resolution of '16' kbits/sec.

Port	Type	Input		Output		Resolution (kbits/sec)
		Status	Rate (kbits/sec) (64-1000000)	Status	Rate (kbits/sec) (64-1000000)	
1	1000BASE-T	<input type="checkbox"/> Enabled	1000000	<input type="checkbox"/> Enabled	1000000	16
2	1000BASE-T	<input type="checkbox"/> Enabled	1000000	<input type="checkbox"/> Enabled	1000000	16
3	1000BASE-T	<input type="checkbox"/> Enabled	1000000	<input type="checkbox"/> Enabled	1000000	16
4	1000BASE-T	<input type="checkbox"/> Enabled	1000000	<input type="checkbox"/> Enabled	1000000	16
5	1000BASE-T	<input type="checkbox"/> Enabled	1000000	<input type="checkbox"/> Enabled	1000000	16

Storm Control

Use the Traffic > Storm Control page to configure broadcast, multicast, and unknown unicast storm control thresholds. Traffic storms may occur when a device on your network is malfunctioning, or if application programs are not well designed or properly configured. If there is too much traffic on your network, performance can be severely degraded or everything can come to complete halt.

You can protect your network from traffic storms by setting a threshold for broadcast, multicast or unknown unicast traffic. Any packets exceeding the specified threshold will then be dropped.

Command Usage

- ◆ Broadcast Storm Control is enabled by default.
- ◆ When traffic exceeds the threshold specified for broadcast and multicast or unknown unicast traffic, packets exceeding the threshold are dropped until the rate falls back down beneath the threshold.
- ◆ Using both rate limiting and storm control on the same interface may lead to unexpected results. It is therefore not advisable to use both of these features on the same interface.

Parameters

These parameters are displayed:

- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **Type** – Indicates the port type (1000BASE-T, 1000BASE SFP, or 10GBASE SFP+).
- ◆ **Unknown Unicast** – Specifies storm control for unknown unicast traffic.
- ◆ **Multicast** – Specifies storm control for multicast traffic.
- ◆ **Broadcast** – Specifies storm control for broadcast traffic.
- ◆ **Status** – Enables or disables storm control. (Default: Disabled)
- ◆ **Rate** – Threshold level in packets per second. (Range: 500-262142 pps; Default: 500 pps)
- ◆ **Resolution** – Indicates the resolution at which the rate can be configured.

Web Interface

To configure broadcast storm control:

1. Click Traffic, Storm Control.
2. Set the interface type to Port or Trunk.
3. Set the Status field to enable or disable storm control.
4. Set the required threshold beyond which the switch will start dropping packets.
5. Click Apply.

Figure 113: Configuring Storm Control

Interface Port Trunk

Port Storm Control List Total: 28

Port	Type	Unknown Unicast		Multicast		Broadcast		Resolution (packets/sec)
		Status	Rate (packets/sec) (500-262142)	Status	Rate (packets/sec) (500-262142)	Status	Rate (packets/sec) (500-262142)	
1	1000BASE-T	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	1
2	1000BASE-T	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	1
3	1000BASE-T	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	1
4	1000BASE-T	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	1
5	1000BASE-T	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	<input type="checkbox"/> Enabled	500	1

Class of Service

Class of Service (CoS) allows you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with eight priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. You can set the default priority for each interface, and configure the mapping of frame priority tags to the switch's priority queues.

This chapter describes the following basic topics:

- ◆ [Layer 2 Queue Settings](#) – Configures each queue, including the default priority, queue mode, queue weight, and mapping of packets to queues based on CoS tags.
- ◆ [Layer 3/4 Priority Settings](#) – Selects the method by which inbound packets are processed (DSCP or CoS), and sets the per-hop behavior and drop precedence for internal processing.

Layer 2 Queue Settings

This section describes how to configure the default priority for untagged frames, set the queue mode, set the weights assigned to each queue, and map class of service tags to queues.

Setting the Default Priority for Interfaces

Use the [Traffic > Priority > Default Priority](#) page to specify the default port priority for each interface on the switch. All untagged packets entering the switch are tagged with the specified default port priority, and then sorted into the appropriate priority queue at the output port.

Command Usage

- ◆ This switch provides eight priority queues for each port. It uses Weighted Round Robin to prevent head-of-queue blockage, but can be configured to process each queue in strict order, or use a combination of strict and weighted queueing.
- ◆ The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.

- ◆ If the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.

Parameters

These parameters are displayed:

- ◆ **Interface** – Displays a list of ports or trunks.
- ◆ **CoS** – The priority that is assigned to untagged frames received on the specified interface. (Range: 0-7; Default: 0)

Web Interface

To configure the queue mode:

1. Click Traffic, Priority, Default Priority.
2. Select the interface type to display (Port or Trunk).
3. Modify the default priority for any interface.
4. Click Apply.

Figure 114: Setting the Default Port Priority

Port	CoS (0-7)
1	0
2	0
3	5
4	0
5	0

Selecting the Queue Mode

Use the Traffic > Priority > Queue page to set the queue mode for the egress queues on any interface. The switch can be set to service the queues based on a strict rule that requires all traffic in a higher priority queue to be processed before the lower priority queues are serviced, or Weighted Round-Robin (WRR) queuing which specifies a scheduling weight for each queue. It can also be configured to use a combination of strict and weighted queuing.

Command Usage

- ◆ Strict priority requires all traffic in a higher priority queue to be processed before lower priority queues are serviced.
- ◆ WRR queuing specifies a relative weight for each queue. WRR uses a predefined relative weight for each queue that determines the percentage of service time

the switch services each queue before moving on to the next queue. This prevents the head-of-line blocking that can occur with strict priority queuing.

- ◆ If Strict and WRR mode is selected, a combination of strict service is used for the high priority queues and weighted service for the remaining queues. The queues assigned to use strict priority should be specified using the Strict Mode field parameter.
- ◆ A weight can be assigned to each of the weighted queues (and thereby to the corresponding traffic priorities). This weight sets the frequency at which each queue is polled for service, and subsequently affects the response time for software applications assigned a specific priority value.

Service time is shared at the egress ports by defining scheduling weights for WRR, or one of the queuing modes that use a combination of strict and weighted queuing.

- ◆ The specified queue mode applies to all interfaces.

Parameters

These parameters are displayed:

- ◆ **Queue Mode**
 - **Strict** – Services the egress queues in sequential order, transmitting all traffic in the higher priority queues before servicing lower priority queues. This ensures that the highest priority packets are always serviced first, ahead of all other traffic.
 - **WRR** – Weighted Round-Robin shares bandwidth at the egress ports by using scheduling weights, and servicing each queue in a round-robin fashion. (This is the default setting.)
 - **Strict and WRR** – Uses strict priority on the high-priority queues and WRR on the remaining queues.
- ◆ **Queue ID** – The ID of the priority queue. (Range: 0-7)
- ◆ **Strict Mode** – If “Strict and WRR” mode is selected, then a combination of strict service is used for the high priority queues and weighted service for the remaining queues. Use this parameter to specify the queues assigned to use strict priority when using the strict-weighted queuing mode. (Default: Disabled)
- ◆ **Weight** – Sets a weight for each queue which is used by the WRR scheduler. (Range: 1-127; Default: Weights 1, 2, 4, 6, 8, 10, 12 and 14 are assigned to queues 0 - 7 respectively)

Web Interface

To configure the queue mode:

1. Click Traffic, Priority, Queue.
2. Set the queue mode.
3. If the weighted queue mode is selected, the queue weight can be modified if required.
4. If the queue mode that uses a combination of strict and weighted queuing is selected, the queues which are serviced first must be specified by enabling strict mode parameter in the table.
5. Click Apply.

Figure 115: Setting the Queue Mode (Strict)

The screenshot shows the 'Traffic > Priority > Queue' configuration page. The 'Queue Mode' dropdown menu is set to 'Strict'. There are 'Apply' and 'Revert' buttons at the bottom right.

Figure 116: Setting the Queue Mode (WRR)

The screenshot shows the 'Traffic > Priority > Queue' configuration page. The 'Port' dropdown is set to '1' and the 'Queue Mode' dropdown is set to 'WRR'. Below the dropdowns is a 'Queue Setting Table' with a 'Total: 8' label. The table has two columns: 'Queue ID' and 'Weight (1-127)'. The table contains 8 rows with Queue IDs from 0 to 7 and corresponding weights from 1 to 14. There are 'Apply' and 'Revert' buttons at the bottom right.

Queue ID	Weight (1-127)
0	1
1	2
2	4
3	6
4	8
5	10
6	12
7	14

Figure 117: Setting the Queue Mode (Strict and WRR)

Traffic > Priority > Queue

Port: 1

Queue Mode: Strict and WRR

Queue Setting Table Total: 8

Queue ID	Strict Mode	Weight (1-127)
0	Disabled	1
1	Disabled	2
2	Disabled	4
3	Disabled	6
4	Disabled	8
5	Disabled	10
6	Disabled	12
7	Disabled	14

Apply Revert

Layer 3/4 Priority Settings

Mapping Layer 3/4 Priorities to CoS Values

The switch supports several common methods of prioritizing layer 3/4 traffic to meet application requirements. Traffic priorities can be specified in the IP header of a frame, using the priority bits in the Type of Service (ToS) octet, or the number of the TCP/UDP port. If priority bits are used, the ToS octet may contain three bits for IP Precedence or six bits for Differentiated Services Code Point (DSCP) service. When these services are enabled, the priorities are mapped to a Class of Service value by the switch, and the traffic then sent to the corresponding output queue.

Because different priority information may be contained in the traffic, this switch maps priority values to the output queues in the following manner – The precedence for priority mapping is DSCP Priority and then Default Port Priority.



Note: The default settings used for mapping priority values from ingress traffic to internal DSCP values are used to determine the hardware queues used for egress traffic, not to replace the priority values. These defaults are designed to optimize priority services for the majority of network applications. It should not be necessary to modify any of the default settings, unless a queuing problem occurs with a particular application.

Setting Priority Processing to DSCP or CoS The switch allows a choice between using DSCP or CoS priority processing methods. Use the Priority > Trust Mode page to select the required processing method.

Command Usage

- ◆ If the QoS mapping mode is set to DSCP, and the ingress packet type is IPv4, then priority processing will be based on the DSCP value in the ingress packet.
- ◆ If the QoS mapping mode is set to DSCP, and a non-IP packet is received, the packet's CoS and CFI (Canonical Format Indicator) values are used for priority processing if the packet is tagged. For an untagged packet, the default port priority (see [page 193](#)) is used for priority processing.
- ◆ If the QoS mapping mode is set to CoS, and the ingress packet type is IPv4, then priority processing will be based on the CoS and CFI values in the ingress packet.

For an untagged packet, the default port priority (see [page 193](#)) is used for priority processing.

Parameters

These parameters are displayed:

- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Trust Mode**
 - **CoS** – Maps layer 3/4 priorities using Class of Service values. (This is the default setting.)
 - **DSCP** – Maps layer 3/4 priorities using Differentiated Services Code Point values.

Web Interface

To configure the trust mode:

1. Click Traffic, Priority, Trust Mode.
2. Set the trust mode for any port.
3. Click Apply.

Figure 118: Setting the Trust Mode

Port	Trust Mode
1	CoS ▼
2	CoS ▼
3	CoS ▼
4	CoS ▼
5	CoS ▼

Mapping Ingress DSCP Values to Internal DSCP Values

Use the Traffic > Priority > DSCP to DSCP page to map DSCP values in incoming packets to per-hop behavior and drop precedence values for internal priority processing.

The DSCP is six bits wide, allowing coding for up to 64 different forwarding behaviors. The DSCP replaces the ToS bits, but it retains backward compatibility with the three precedence bits so that non-DSCP compliant, ToS-enabled devices, will not conflict with the DSCP mapping. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding.

Command Usage

- ◆ Enter per-hop behavior and drop precedence for any of the DSCP values 0 - 63.
- ◆ This map is only used when the priority mapping mode is set to DSCP (see [page 198](#)), and the ingress packet type is IPv4. Any attempt to configure the DSCP mutation map will not be accepted by the switch, unless the trust mode has been set to DSCP.
- ◆ Two QoS domains can have different DSCP definitions, so the DSCP-to-PHB/ Drop Precedence mutation map can be used to modify one set of DSCP values to match the definition of another domain. The mutation map should be applied at the receiving port (ingress mutation) at the boundary of a QoS administrative domain.

Parameters

These parameters are displayed:

- ◆ **Port** – Specifies a port.
- ◆ **DSCP** – DSCP value in ingress packets. (Range: 0-63)
- ◆ **PHB** – Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

- ◆ **Drop Precedence** – Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

Table 13: Default Mapping of DSCP Values to Internal PHB/Drop Values

	ingress-dscp1	0	1	2	3	4	5	6	7	8	9
ingress-dscp10											
0		0,0	0,1	0,0	0,3	0,0	0,1	0,0	0,3	1,0	1,1
1		1,0	1,3	1,0	1,1	1,0	1,3	2,0	2,1	2,0	2,3
2		2,0	2,1	2,0	2,3	3,0	3,1	3,0	3,3	3,0	3,1
3		3,0	3,3	4,0	4,1	4,0	4,3	4,0	4,1	4,0	4,3
4		5,0	5,1	5,0	5,3	5,0	5,1	6,0	5,3	6,0	6,1
5		6,0	6,3	6,0	6,1	6,0	6,3	7,0	7,1	7,0	7,3
6		7,0	7,1	7,0	7,3						

The ingress DSCP is composed of ingress-dscp10 (most significant digit in the left column) and ingress-dscp1 (least significant digit in the top row (in other words, $\text{ingress-dscp} = \text{ingress-dscp10} * 10 + \text{ingress-dscp1}$); and the corresponding internal-dscp is shown at the intersecting cell in the table.

The ingress DSCP is bitwise ANDed with the binary value 11 to determine the drop precedence. If the resulting value is 10 binary, then the drop precedence is set to 0.

Web Interface

To map DSCP values to internal PHB/drop precedence:

1. Click Traffic, Priority, DSCP to DSCP.
2. Select Configure from the Action list.
3. Select the port to configure.
4. Set the PHB and drop precedence for any DSCP value.
5. Click Apply.

Figure 119: Configuring DSCP to DSCP Internal Mapping

Traffic > Priority > DSCP to DSCP

Action: Configure

Port: 1

DSCP (0-63):

PHB (0-7):

Drop Precedence: 0: Green

Apply Revert

To show the DSCP to internal PHB/drop precedence map:

1. Click Traffic, Priority, DSCP to DSCP.
2. Select Show from the Action list.

Figure 120: Showing DSCP to DSCP Internal Mapping

	DSCP	PHB	Drop Precedence
<input type="checkbox"/>	0	0	0: Green
<input type="checkbox"/>	1	1	1: Red
<input type="checkbox"/>	2	0	0: Green
<input type="checkbox"/>	3	0	3: Yellow
<input type="checkbox"/>	4	0	0: Green
<input type="checkbox"/>	5	0	1: Red
<input type="checkbox"/>	6	0	0: Green
<input type="checkbox"/>	7	0	3: Yellow
<input type="checkbox"/>	8	1	0: Green
<input type="checkbox"/>	9	1	1: Red

Mapping CoS Priorities to Internal DSCP Values

Use the Traffic > Priority > CoS to DSCP page to map CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for priority processing.

Command Usage

- ◆ The default mapping of CoS to PHB values is shown in [Table 14 on page 202](#).
- ◆ Enter up to eight CoS/CFI paired values, per-hop behavior and drop precedence.
- ◆ If a packet arrives with a 802.1Q header but it is not an IP packet, then the CoS/CFI-to-PHB/Drop Precedence mapping table is used to generate priority and drop precedence values for internal processing. Note that priority tags in the original packet are not modified by this command.
- ◆ The internal DSCP consists of three bits for per-hop behavior (PHB) which determines the queue to which a packet is sent; and two bits for drop precedence (namely color) which is used to control traffic congestion.

Parameters

These parameters are displayed:

- ◆ **Port** – Specifies a port. (Range: 1-10)
- ◆ **CoS** – CoS value in ingress packets. (Range: 0-7)

- ◆ **CFI** – Canonical Format Indicator. Set to this parameter to “0” to indicate that the MAC address information carried in the frame is in canonical format. (Range: 0-1)
- ◆ **PHB** – Per-hop behavior, or the priority used for this router hop. (Range: 0-7)
- ◆ **Drop Precedence** – Drop precedence used in controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

Table 14: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence

CoS	CFI	0	1
0		(0,0)	(0,0)
1		(1,0)	(1,0)
2		(2,0)	(2,0)
3		(3,0)	(3,0)
4		(4,0)	(4,0)
5		(5,0)	(5,0)
6		(6,0)	(6,0)
7		(7,0)	(7,0)

Web Interface

To map CoS/CFI values to internal PHB/drop precedence:

1. Click Traffic, Priority, CoS to DSCP.
2. Select Configure from the Action list.
3. Set the PHB and drop precedence for any of the CoS/CFI combinations.
4. Click Apply.

Figure 121: Configuring CoS to DSCP Internal Mapping

To show the CoS/CFI to internal PHB/drop precedence map:

1. Click Traffic, Priority, CoS to DSCP.
2. Select Show from the Action list.

Figure 122: Showing CoS to DSCP Internal Mapping

Traffic > Priority > CoS to DSCP ?

Action: Show ▾

CoS to DSCP Mapping List Total: 16 1 2

<input type="checkbox"/>	CoS	CFI	PHB	Drop Precedence
<input type="checkbox"/>	0	0	0	0: Green
<input type="checkbox"/>	0	1	0	0: Green
<input type="checkbox"/>	1	0	1	0: Green
<input type="checkbox"/>	1	1	1	0: Green
<input type="checkbox"/>	2	0	2	0: Green
<input type="checkbox"/>	2	1	2	0: Green
<input type="checkbox"/>	3	0	3	0: Green
<input type="checkbox"/>	3	1	3	0: Green
<input type="checkbox"/>	4	0	4	0: Green
<input type="checkbox"/>	4	1	4	0: Green

Default Revert

Quality of Service

This chapter describes the following tasks required to apply QoS policies:

- ◆ **Class Map** – Creates a map which identifies a specific class of traffic.
- ◆ **Policy Map** – Sets the boundary parameters used for monitoring inbound traffic, and the action to take for conforming and non-conforming traffic.
- ◆ **Binding to a Port** – Applies a policy map to an ingress port.

Overview

The commands described in this section are used to configure Quality of Service (QoS) classification criteria and service policies. Differentiated Services (DiffServ) provides policy-based management mechanisms used for prioritizing network resources to meet the requirements of specific traffic types on a per hop basis. Each packet is classified upon entry into the network based on access lists, IP Precedence, DSCP values, VLAN lists, CoS values, or source ports. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet. Based on configured network policies, different kinds of traffic can be marked for different kinds of forwarding.

All switches or routers that access the Internet rely on class information to provide the same forwarding treatment to packets in the same class. Class information can be assigned by end hosts, or switches or routers along the path. Priority can then be assigned based on a general policy, or a detailed examination of the packet. However, note that detailed examination of packets should take place close to the network edge so that core switches and routers are not overloaded.

Switches and routers along the path can use class information to prioritize the resources allocated to different traffic classes. The manner in which an individual device handles traffic in the DiffServ architecture is called per-hop behavior. All devices along a path should be configured in a consistent manner to construct a consistent end-to-end QoS solution.



Note: You can configure up to 16 rules per class map. You can also include multiple classes in a policy map.

Note: You should create a class map before creating a policy map. Otherwise, you will not be able to select a class map from the policy rule settings screen (see [page 210](#)).

Command Usage

To create a service policy for a specific category or ingress traffic, follow these steps:

1. Use the Configure Class (Add) page to designate a class name for a specific category of traffic.
2. Use the Configure Class (Add Rule) page to edit the rules for each class which specify a type of traffic based on an access list, a DSCP or IP Precedence value, a VLAN, or a CoS value.
3. Use the Configure Policy (Add) page to designate a policy name for a specific manner in which ingress traffic will be handled.
4. Use the Configure Policy (Add Rule) page to add one or more classes to the policy map. Assign policy rules to each class by “setting” the QoS value (CoS or PHB) to be assigned to the matching traffic class. The policy rule can also be configured to monitor the maximum throughput and burst rate. Then specify the action to take for conforming traffic, or the action to take for a policy violation.
5. Use the Configure Interface page to assign a policy map to a specific interface.



Note: Up to 16 classes can be included in a policy map.

Configuring a Class Map

A class map is used for matching packets to a specified class. Use the Traffic > DiffServ (Configure Class) page to configure a class map.

Command Usage

- ◆ The class map is used with a policy map ([page 210](#)) to create a service policy ([page 214](#)) for a specific interface that defines packet classification, service tagging, and bandwidth policing. Note that one or more class maps can be assigned to a policy map.
- ◆ Up to 32 class maps can be configured.

Parameters

These parameters are displayed:

Add

- ◆ **Class Name** – Name of the class map. (Range: 1-32 characters)
- ◆ **Type** – Only one match command is permitted per class map, so the match-any field refers to the criteria specified by the lone match command.

- ◆ **Description** – A brief description of a class map. (Range: 1-64 characters)

Add Rule

- ◆ **Class Name** – Name of the class map.
- ◆ **Type** – Only one match command is permitted per class map, so the match-any field refers to the criteria specified by the lone match command.
- ◆ **ACL** – Name of an access control list. Any type of ACL can be specified, including standard or extended IPv4/IPv6 ACLs and MAC ACLs.
- ◆ **IP DSCP** – A DSCP value. (Range: 0-63)
- ◆ **IP Precedence** – An IP Precedence value. (Range: 0-7)
- ◆ **IPv6 DSCP** – A DSCP value contained in an IPv6 packet. (Range: 0-63)
- ◆ **VLAN ID** – A VLAN. (Range:1-4094)
- ◆ **CoS** – A CoS value. (Range: 0-7)

Web Interface

To configure a class map:

1. Click Traffic, DiffServ.
2. Select Configure Class from the Step list.
3. Select Add from the Action list.
4. Enter a class name.
5. Enter a description.
6. Click Add.

Figure 123: Configuring a Class Map

Traffic > DiffServ

Step: 1. Configure Class Action: Add

Class Name: rd-class

Type: Match Any

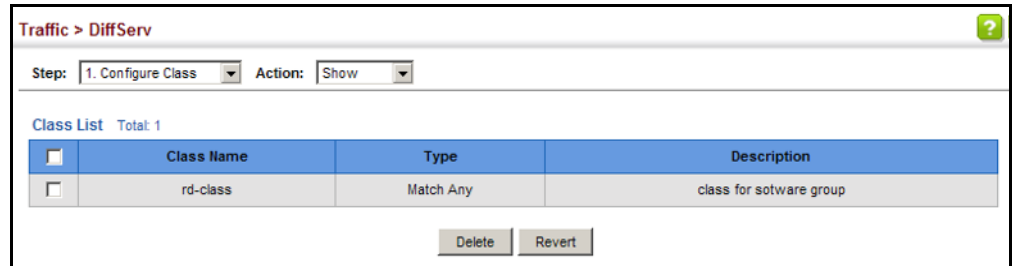
Description: class for software group

Apply Revert

To show the configured class maps:

1. Click Traffic, DiffServ.
2. Select Configure Class from the Step list.
3. Select Show from the Action list.

Figure 124: Showing Class Maps



To edit the rules for a class map:

1. Click Traffic, DiffServ.
2. Select Configure Class from the Step list.
3. Select Add Rule from the Action list.
4. Select the name of a class map.
5. Specify type of traffic for this class based on an access list, DSCP or IP Precedence value, VLAN, or CoS value. You can specify up to 16 items to match when assigning ingress traffic to a class map.
6. Click Apply.

Figure 125: Adding Rules to a Class Map

The screenshot shows the 'Traffic > DiffServ' configuration page. The 'Step' is '2. Configure Policy' and the 'Action' is 'Add Rule'. The 'Policy Name' is 'rd-policy'. Under the 'Rule' section, the 'Class Name' is 'rd-class'. The 'Action' is set to 'Set' with a 'CoS (0-7)' dropdown. The 'Meter Mode' is 'Flow'. Below this, there are input fields for 'Committed Information Rate (16-1000000)' in kbps, 'Committed Burst Size (128-8388608)' in bytes, 'Excess Burst Size (128-8388608)' in bytes, 'Peak Information Rate (16-1000000)' in kbps, and 'Peak Burst Size (128-8388608)' in bytes. The 'Conform' action is 'Transmit'. The 'Exceed' and 'Violate' actions are both set to 'Set IP DSCP (0-63)'.

To show the rules for a class map:

1. Click Traffic, DiffServ.
2. Select Configure Class from the Step list.
3. Select Show Rule from the Action list.

Figure 126: Showing the Rules for a Class Map

The screenshot shows the 'Traffic > DiffServ' configuration page. The 'Step' is '1. Configure Class' and the 'Action' is 'Show Rule'. The 'Class Name' is 'rd-class' and the 'Type' is 'Match Any'. Below this, there is a 'Rule List' table with 2 rules. The table has a header row with a checkbox and a 'Rule' column. The first rule is 'IP DSCP 3' and the second rule is 'IP Precedence 3'. At the bottom of the table, there are 'Delete' and 'Revert' buttons.

Rule
IP DSCP 3
IP Precedence 3

Creating QoS Policies

Use the Traffic > DiffServ (Configure Policy) page to create a policy map that can be attached to multiple interfaces. A policy map is used to group one or more class map statements (page 206). A policy map can then be bound by a service policy to one or more interfaces (page 214).

Configuring QoS policies requires several steps. A class map must first be configured which indicates how to match the inbound packets according to an access list, a DSCP or IP Precedence value, or a member of a specific VLAN. A policy map is then configured which indicates the boundary parameters used for monitoring inbound traffic. A policy map may contain one or more classes based on previously defined class maps.

The class of service or per-hop behavior (i.e., the priority used for internal queue processing) can be assigned to matching packets.

Meter Mode – Defines the committed information rate (maximum throughput).

- ◆ Policing is based on a token bucket, where bucket depth is the maximum burst before the bucket overflows, and the average rate tokens that are added to the bucket is by specified by the *committed-rate* option. Note that the token bucket functions similar to that described in RFC 2697 and RFC 2698.
- ◆ The behavior of the meter is specified in terms of its mode and two token buckets, C and E, which both share the common rate CIR. The maximum size of the token bucket C is BC and the maximum size of the token bucket E is BE.

The token buckets C and E are initially full, that is, the token count $T_c(0) = BC$ and the token count $T_e(0) = BE$. Thereafter, the token counts T_c and T_e are updated CIR times per second as follows:

- If T_c is less than BC, T_c is incremented by one, else
- if T_e is less than BE, T_e is incremented by one, else
- neither T_c nor T_e is incremented.

When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in Color-Blind mode:

- If $T_c(t) - B \geq 0$, the packet is green and T_c is decremented by B down to the minimum value of 0, else
- if $T_e(t) - B \geq 0$, the packets is yellow and T_e is decremented by B down to the minimum value of 0,
- else the packet is red and neither T_c nor T_e is decremented.

When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in Color-Aware mode:

- If the packet has been precolored as green and $T_c(t) - B \geq 0$, the packet is green and T_c is decremented by B down to the minimum value of 0, else

- If the packet has been precolored as yellow or green and if $Te(t)-B \geq 0$, the packets is yellow and Te is decremented by B down to the minimum value of 0, else
- the packet is red and neither Tc nor Te is decremented.

Parameters

These parameters are displayed:

Add

- ◆ **Policy Name** – Name of policy map. (Range: 1-32 characters)
- ◆ **Description** – A brief description of a policy map. (Range: 1-64 characters)

Add Rule

- ◆ **Policy Name** – Name of policy map.
- ◆ **Class Name** – Name of a class map that defines a traffic classification upon which a policy can act. A policy map can contain up to 32 class maps.
- ◆ **Action** – This attribute is used to set an internal QoS value in hardware for matching packets. The PHB label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion with the srTCM and trTCM metering functions.
 - **Set CoS** – Configures the service provided to ingress traffic by setting an internal CoS value for a matching packet (as specified in rule settings for a class map). (Range: 0-7)
See [Table 14, “Default Mapping of CoS/CFI to Internal PHB/Drop Precedence,” on page 202](#)).
 - **Set PHB** – Configures the service provided to ingress traffic by setting the internal per-hop behavior for a matching packet (as specified in rule settings for a class map). (Range: 0-7)
See [Table 13, “Default Mapping of DSCP Values to Internal PHB/Drop Values,” on page 200](#)).
 - **Set IP DSCP** – Configures the service provided to ingress traffic by setting an IP DSCP value for a matching packet (as specified in rule settings for a class map). (Range: 0-63)
- ◆ **Meter** – Check this to define the maximum throughput.
 - **Meter Mode (Rate)** – Defines the committed information rate. Policing is based on a token bucket, where the average rate tokens that are removed from the bucket is specified by the “Rate” option. The committed rate is in kilobits per second. (Range: 16-1000000 kbps at a granularity of 64 kbps or maximum port speed, whichever is lower)

Web Interface

To configure a policy map:

1. Click Traffic, DiffServ.
2. Select Configure Policy from the Step list.
3. Select Add from the Action list.
4. Enter a policy name.
5. Enter a description.
6. Click Apply.

Figure 127: Configuring a Policy Map

Traffic > DiffServ

Step: 2. Configure Policy Action: Add

Policy Name: rd-policy

Description: for the software group

Apply Revert

To show the configured policy maps:

1. Click Traffic, DiffServ.
2. Select Configure Policy from the Step list.
3. Select Show from the Action list.

Figure 128: Showing Policy Maps

Traffic > DiffServ

Step: 2. Configure Policy Action: Show

Policy List Total: 1

	Policy Name	Description
<input type="checkbox"/>	rd-policy	for the software group

Delete Revert

To edit the rules for a policy map:

1. Click Traffic, DiffServ.
2. Select Configure Policy from the Step list.
3. Select Add Rule from the Action list.
4. Select the name of a policy map.
5. Click on the Action field, and set the CoS or per-hop behavior for matching packets to specify the quality of service to be assigned to the matching traffic class.
6. Use the metering option to define the maximum throughput.
7. Click Apply.

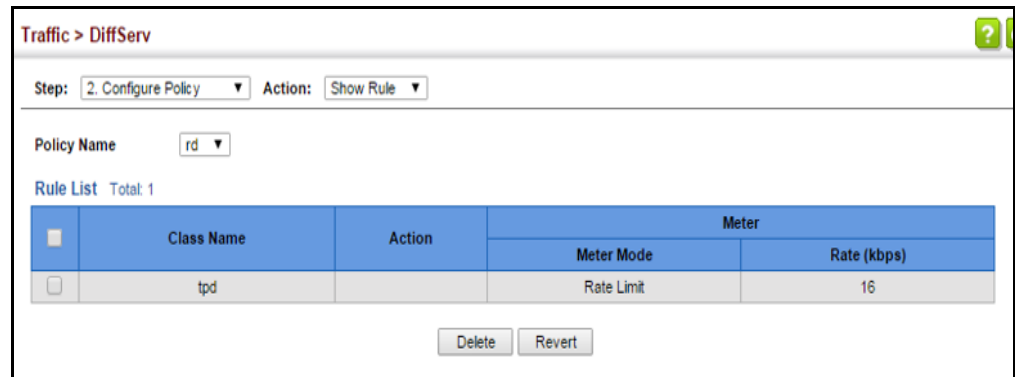
Figure 129: Adding Rules to a Policy Map

The screenshot shows the configuration interface for adding a rule to a policy map. The breadcrumb is "Traffic > DiffServ". The "Step" is "2. Configure Policy" and the "Action" is "Add Rule". The "Policy Name" is "rd". Under the "Rule:" section, the "Class Name" is "tpd". The "Action" checkbox is checked, and the "Meter" checkbox is unchecked. The "Rate Limit" is set to "kbps". The "Apply" and "Revert" buttons are visible at the bottom.

To show the rules for a policy map:

1. Click Traffic, DiffServ.
2. Select Configure Policy from the Step list.
3. Select Show Rule from the Action list.

Figure 130: Showing the Rules for a Policy Map



Attaching a Policy Map to a Port

Use the Traffic > DiffServ (Configure Interface) page to bind a policy map to a port.

Command Usage

First define a class map, define a policy map, and then bind the service policy to the required interface.

Parameters

These parameters are displayed:

- ◆ **Port** – Specifies a port. (Range: 1-10)
- ◆ **Ingress** – Applies the selected rule to ingress traffic.

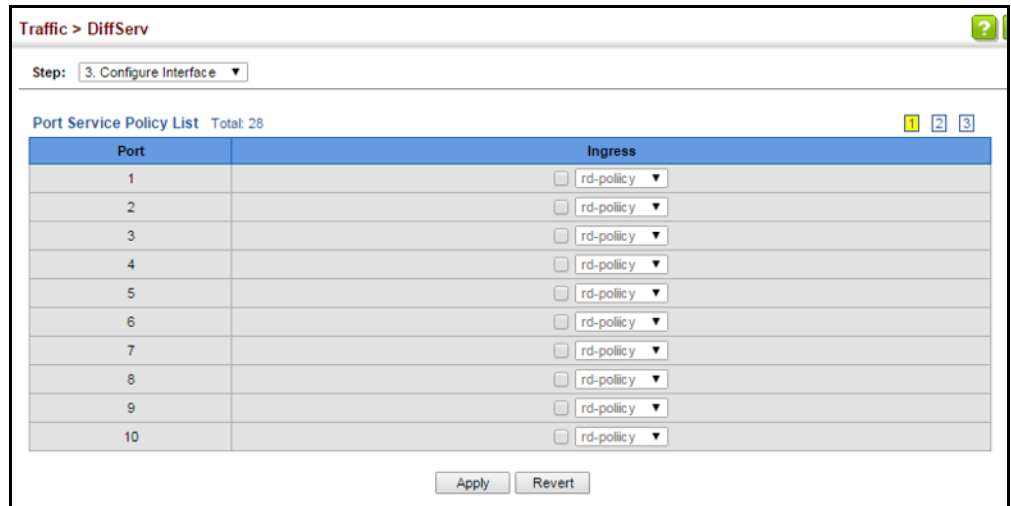
Web Interface

To bind a policy map to a port:

1. Click Traffic, DiffServ.
2. Select Configure Interface from the Step list.
3. Check the box under the Ingress field to enable a policy map for a port.
4. Select a policy map from the scroll-down box.

5. Click Apply.

Figure 131: Attaching a Policy Map to a Port



VoIP Traffic Configuration

This chapter covers the following topics:

- ◆ **Global Settings** – Enables VOIP globally, sets the Voice VLAN, and the aging time for attached ports.
- ◆ **Telephony OUI List** – Configures the list of phones to be treated as VOIP devices based on the specified Organization Unit Identifier (OUI).
- ◆ **Port Settings** – Configures the way in which a port is added to the Voice VLAN, the filtering of non-VoIP packets, the method of detecting VoIP traffic, and the priority assigned to voice traffic.

Overview

When IP telephony is deployed in an enterprise network, it is recommended to isolate the Voice over IP (VoIP) network traffic from other data traffic. Traffic isolation can provide higher voice quality by preventing excessive packet delays, packet loss, and jitter. This is best achieved by assigning all VoIP traffic to a single Voice VLAN.

The use of a Voice VLAN has several advantages. It provides security by isolating the VoIP traffic from other data traffic. End-to-end QoS policies and high priority can be applied to VoIP VLAN traffic across the network, guaranteeing the bandwidth it needs. VLAN isolation also protects against disruptive broadcast and multicast traffic that can seriously affect voice quality.

The switch allows you to specify a Voice VLAN for the network and set a CoS priority for the VoIP traffic. The VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member the Voice VLAN. Alternatively, switch ports can be manually configured.

Configuring VoIP Traffic

Use the Traffic > VoIP (Configure Global) page to configure the switch for VoIP traffic. First enable automatic detection of VoIP devices attached to the switch ports, then set the Voice VLAN ID for the network. The Voice VLAN aging time can also be set to remove a port from the Voice VLAN when VoIP traffic is no longer received on the port.

Command Usage

All ports are set to VLAN hybrid mode by default. Prior to enabling VoIP for a port (by setting the VoIP mode to Auto or Manual as described below), first ensure that VLAN membership is not set to access mode (see [“Adding Static Members to VLANs” on page 144](#)).

Parameters

These parameters are displayed:

- ◆ **Auto Detection Status** – Enables the automatic detection of VoIP traffic on switch ports. (Default: Disabled)
- ◆ **Voice VLAN** – Sets the Voice VLAN ID for the network. Only one Voice VLAN is supported and it must already be created on the switch. (Range: 1-4094)
- ◆ **Voice VLAN Aging Time** – The time after which a port is removed from the Voice VLAN when VoIP traffic is no longer received on the port. (Range: 5-43200 minutes; Default: 1440 minutes)



Note: The Voice VLAN ID cannot be modified when the global Auto Detection Status is enabled.

Web Interface

To configure global settings for a Voice VLAN:

1. Click Traffic, VoIP.
2. Select Configure Global from the Step list.
3. Enable Auto Detection.
4. Specify the Voice VLAN ID.
5. Adjust the Voice VLAN Aging Time if required.
6. Click Apply.

Figure 132: Configuring a Voice VLAN

Traffic > VoIP

Step: 1. Configure Global

Auto Detection Status Enabled

Voice VLAN 1234

Voice VLAN Aging Time (5-43200) 3000 sec

Apply Revert

Configuring Telephony OUI

VoIP devices attached to the switch can be identified by the vendor's Organizational Unique Identifier (OUI) in the source MAC address of received packets. OUI numbers are assigned to vendors and form the first three octets of device MAC addresses. The MAC OUI numbers for VoIP equipment can be configured on the switch so that traffic from these devices is recognized as VoIP. Use the Traffic > VoIP (Configure OUI) page to configure this feature.

Parameters

These parameters are displayed:

- ◆ **Telephony OUI** – Specifies a MAC address range to add to the list. (Format: xx-xx-xx-xx-xx-xx)
- ◆ **Mask** – Identifies a range of MAC addresses. Setting a mask of FF-FF-FF-00-00-00 identifies all devices with the same OUI (the first three octets). Other masks restrict the MAC address range. Setting a mask of FF-FF-FF-FF-FF-FF specifies a single MAC address. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx; Default: FF-FF-FF-00-00-00)
- ◆ **Description** – User-defined text that identifies the VoIP devices.

Web Interface

To configure MAC OUI numbers for VoIP equipment:

1. Click Traffic, VoIP.
2. Select Configure OUI from the Step list.
3. Select Add from the Action list.
4. Enter a MAC address that specifies the OUI for VoIP devices in the network.
5. Select a mask from the pull-down list to define a MAC address range.

6. Enter a description for the devices.
7. Click Apply.

Figure 133: Configuring an OUI Telephony List

Traffic > VoIP

Step: 2. Configure OUI Action: Add

Telephony OUI: 00-e0-bb-00-00-00

Mask: FF-FF-FF-00-00-00

Description: old phones

Apply Revert

To show the MAC OUI numbers used for VoIP equipment:

1. Click Traffic, VoIP.
2. Select Configure OUI from the Step list.
3. Select Show from the Action list.

Figure 134: Showing an OUI Telephony List

Traffic > VoIP

Step: 2. Configure OUI Action: Show

Telephony OUI List Total: 3

<input type="checkbox"/>	Telephony OUI	Mask	Description
<input type="checkbox"/>	00-E0-BB-00-00-00	FF-FF-FF-00-00-00	old phones
<input type="checkbox"/>	00-11-22-33-44-55	FF-FF-FF-00-00-00	new phones
<input type="checkbox"/>	00-98-76-54-32-10	FF-FF-FF-FF-FF-FF	Chris' phone

Delete Revert

Configuring VoIP Traffic Ports

Use the Traffic > VoIP (Configure Interface) page to configure ports for VoIP traffic, you need to set the mode (Auto or Manual), specify the discovery method to use, and set the traffic priority. You can also enable security filtering to ensure that only VoIP traffic is forwarded on the Voice VLAN.

Command Usage

All ports are set to VLAN hybrid mode by default. Prior to enabling VoIP for a port (by setting the VoIP mode to Auto or Manual as described below), first ensure that VLAN membership is not set to access mode (see [“Adding Static Members to VLANs”](#) on page 144).

Parameters

These parameters are displayed:

- ◆ **Mode** – Specifies if the port will be added to the Voice VLAN when VoIP traffic is detected. (Default: None)
 - **None** – The Voice VLAN feature is disabled on the port. The port will not detect VoIP traffic or be added to the Voice VLAN.
 - **Auto** – The port will be added as a tagged member to the Voice VLAN when VoIP traffic is detected on the port. You must select a method for detecting VoIP traffic, either OUI or 802.1AB (LLDP). When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list.
 - **Manual** – The Voice VLAN feature is enabled on the port, but the port must be manually added to the Voice VLAN.
- ◆ **Security** – Enables security filtering that discards any non-VoIP packets received on the port that are tagged with the voice VLAN ID. VoIP traffic is identified by source MAC addresses configured in the Telephony OUI list, or through LLDP that discovers VoIP devices attached to the switch. Packets received from non-VoIP sources are dropped. (Default: Disabled)
- ◆ **Discovery Protocol** – Selects a method to use for detecting VoIP traffic on the port. (Default: OUI)
 - **OUI** – Traffic from VoIP devices is detected by the Organizationally Unique Identifier (OUI) of the source MAC address. OUI numbers are assigned to vendors and form the first three octets of a device MAC address. MAC address OUI numbers must be configured in the Telephony OUI list so that the switch recognizes the traffic as being from a VoIP device.
 - **LLDP** – Uses LLDP (IEEE 802.1AB) to discover VoIP devices attached to the port. LLDP checks that the “telephone bit” in the system capability TLV is turned on. See [“Link Layer Discovery Protocol” on page 321](#) for more information on LLDP.
- ◆ **Priority** – Defines a CoS priority for port traffic on the Voice VLAN. The priority of any received VoIP packet is overwritten with the new priority when the Voice VLAN feature is active for the port. (Range: 0-6; Default: 6)
- ◆ **Remaining Age** – Number of minutes before this entry is aged out.

The Remaining Age starts to count down when the OUI’s MAC address expires from the MAC address table. Therefore, the MAC address aging time should be added to the overall aging time. For example, if you configure the MAC address table aging time to 30 seconds, and the voice VLAN aging time to 5 minutes, then after 5.5 minutes, a port will be removed from voice VLAN when VoIP traffic is no longer received on the port. Alternatively, if you clear the MAC address table manually, then the switch will also start counting down the Remaining Age.

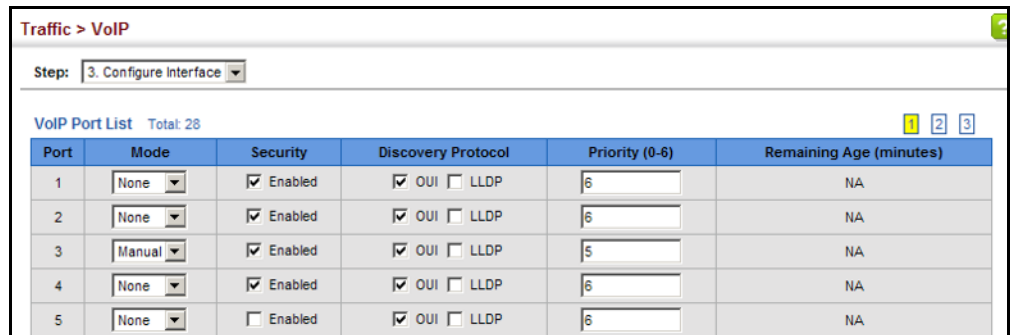
When VoIP Mode is set to Auto, the Remaining Age will be displayed. Otherwise, if the VoIP Mode is Disabled or set to Manual, the remaining age will display "NA."

Web Interface

To configure VoIP traffic settings for a port:

1. Click Traffic, VoIP.
2. Select Configure Interface from the Step list.
3. Configure any required changes to the VoIP settings each port.
4. Click Apply.

Figure 135: Configuring Port Settings for a Voice VLAN



Traffic > VoIP

Step: 3. Configure Interface

VoIP Port List Total: 28

Port	Mode	Security	Discovery Protocol	Priority (0-6)	Remaining Age (minutes)
1	None	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> OUI <input type="checkbox"/> LLDP	6	NA
2	None	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> OUI <input type="checkbox"/> LLDP	6	NA
3	Manual	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> OUI <input type="checkbox"/> LLDP	5	NA
4	None	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> OUI <input type="checkbox"/> LLDP	6	NA
5	None	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> OUI <input type="checkbox"/> LLDP	6	NA

Security Measures

You can configure this switch to authenticate users logging into the system for management access using local or remote authentication methods. Port-based authentication using IEEE 802.1X can also be configured to control either management access to the uplink ports or client access to the data ports. This switch provides secure network management access using the following options:

- ◆ [AAA](#) – Use local or remote authentication to configure access rights, specify authentication servers, configure remote authentication and accounting.
- ◆ [User Accounts](#) – Manually configure access rights on the switch for specified users.
- ◆ [Network Access](#) - Configure MAC authentication, intrusion response, dynamic VLAN assignment, and dynamic QoS assignment.
- ◆ [HTTPS](#) – Provide a secure web connection.
- ◆ [SSH](#) – Provide a secure shell (for secure Telnet access).
- ◆ [ACL](#) – Access Control Lists provide packet filtering for IP frames (based on address, protocol, Layer 4 protocol port number or TCP control code).
- ◆ [ARP Inspection](#) – Security feature that validates the MAC Address bindings for Address Resolution Protocol packets. Provides protection against ARP traffic with invalid MAC to IP Address bindings, which forms the basis for certain “man-in-the-middle” attacks.
- ◆ [IP Filter](#) – Filters management access to the web, SNMP or Telnet interface.
- ◆ [Port Security](#) – Configure secure addresses for individual ports.
- ◆ [Port Authentication](#) – Use IEEE 802.1X port authentication to control access to specific ports.
- ◆ [DHCP Snooping](#) – Filter IP traffic on insecure ports for which the source address cannot be identified via DHCP snooping.
- ◆ [DoS Protection](#) – Protects against Denial-of-Service attacks.
- ◆ [IPv4 Source Guard](#) – Filters IPv4 traffic on insecure ports for which the source address cannot be identified via DHCPv4 snooping nor static source bindings.



Note: The priority of execution for the filtering commands is Port Security, Port Authentication, Network Access, Web Authentication, Access Control Lists, IP Source Guard, and then DHCP Snooping.

AAA (Authentication, Authorization and Accounting)

The authentication, authorization, and accounting (AAA) feature provides the main framework for configuring access control on the switch. The three security functions can be summarized as follows:

- ◆ Authentication — Identifies users that request access to the network.
- ◆ Authorization — Determines if users can access specific services.
- ◆ Accounting — Provides reports, auditing, and billing for services that users have accessed on the network.

The AAA functions require the use of configured RADIUS or TACACS+ servers in the network. The security servers can be defined as sequential groups that are applied as a method for controlling user access to specified services. For example, when the switch attempts to authenticate a user, a request is sent to the first server in the defined group, if there is no response the second server will be tried, and so on. If at any point a pass or fail is returned, the process stops.

The switch supports the following AAA features:

- ◆ Accounting for IEEE 802.1X authenticated users that access the network through the switch.
- ◆ Accounting for users that access management interfaces on the switch through the console and Telnet.
- ◆ Accounting for commands that users enter at specific CLI privilege levels.
- ◆ Authorization of users that access management interfaces on the switch through the console and Telnet.

To configure AAA on the switch, you need to follow this general process:

1. Configure RADIUS and TACACS+ server access parameters. See [“Configuring Local/Remote Logon Authentication” on page 225](#).
2. Define RADIUS and TACACS+ server groups to support the accounting and authorization of services.

3. Define a method name for each service to which you want to apply accounting or authorization and specify the RADIUS or TACACS+ server groups to use.
4. Apply the method names to port or line interfaces.



Note: This guide assumes that RADIUS and TACACS+ servers have already been configured to support AAA. The configuration of RADIUS and TACACS+ server software is beyond the scope of this guide, refer to the documentation provided with the RADIUS or TACACS+ server software.

Configuring Local/ Remote Logon Authentication

Use the Security > AAA > System Authentication page to specify local or remote authentication. Local authentication restricts management access based on user names and passwords manually configured on the switch. Remote authentication uses a remote access authentication server based on RADIUS or TACACS+ protocols to verify management access.

Command Usage

- ◆ By default, management access is always checked against the authentication database stored on the local switch. If a remote authentication server is used, you must specify the authentication sequence. Then specify the corresponding parameters for the remote authentication protocol using the Security > AAA > Server page. Local and remote logon authentication control management access via the console port, web browser, or Telnet.
- ◆ You can specify up to three authentication methods for any user to indicate the authentication sequence. For example, if you select (1) RADIUS, (2) TACACS and (3) Local, the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted using the TACACS+ server, and finally the local user name and password is checked.

Parameters

These parameters are displayed:

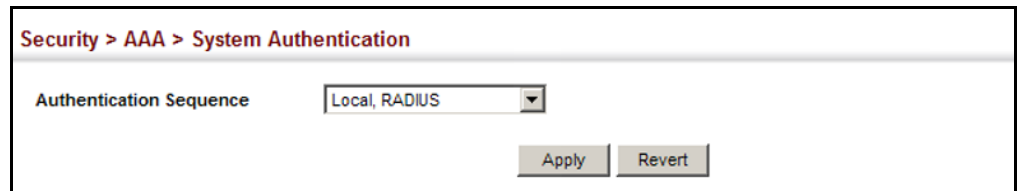
- ◆ **Authentication Sequence** – Select the authentication, or authentication sequence required:
 - **Local** – User authentication is performed only locally by the switch.
 - **RADIUS** – User authentication is performed using a RADIUS server only.
 - **TACACS** – User authentication is performed using a TACACS+ server only.
 - [authentication sequence] – User authentication is performed by up to three authentication methods in the indicated sequence.

Web Interface

To configure the method(s) of controlling management access:

1. Click Security, AAA, System Authentication.
2. Specify the authentication sequence (i.e., one to three methods).
3. Click Apply.

Figure 136: Configuring the Authentication Sequence

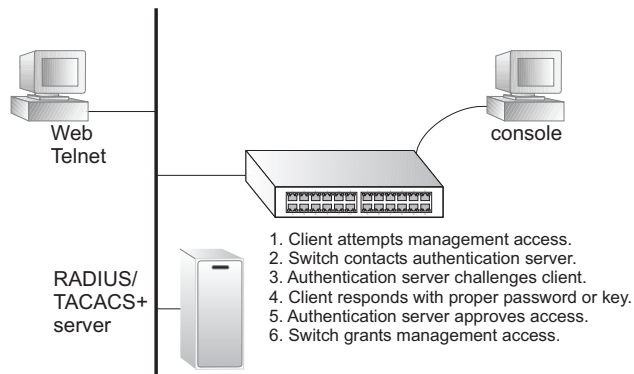


Configuring Remote Logon Authentication Servers

Use the Security > AAA > Server page to configure the message exchange parameters for RADIUS or TACACS+ remote access authentication servers.

Remote Authentication Dial-in User Service (RADIUS) and Terminal Access Controller Access Control System Plus (TACACS+) are logon authentication protocols that use software running on a central server to control access to RADIUS-aware or TACACS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user that requires management access to the switch.

Figure 137: Authentication Server Operation



RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a more reliable connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

Command Usage

- ◆ If a remote authentication server is used, you must specify the message exchange parameters for the remote authentication protocol. Both local and remote logon authentication control management access via the console port, web browser, or Telnet.
- ◆ RADIUS and TACACS+ logon authentication assign a specific privilege level for each user name/password pair. The user name, password, and privilege level must be configured on the authentication server. The encryption methods used for the authentication process must also be configured or negotiated between the authentication server and logon client. This switch can pass authentication messages between the server and client that have been encrypted using MD5 (Message-Digest 5), TLS (Transport Layer Security), or TTLS (Tunneled Transport Layer Security).

Parameters

These parameters are displayed:

Configure Server

- ◆ **RADIUS**
 - **Global** – Provides globally applicable RADIUS settings.
 - **Server Index** – Specifies one of five RADIUS servers that may be configured. The switch attempts authentication using the listed sequence of servers. The process ends when a server either approves or denies access to a user.
 - **Server IP Address** – Address of authentication server.
(A Server Index entry must be selected to display this item.)
 - **Accounting Server UDP Port** – Network (UDP) port on authentication server used for accounting messages. (Range: 1-65535; Default: 1813)
 - **Authentication Server UDP Port** – Network (UDP) port on authentication server used for authentication messages. (Range: 1-65535; Default: 1812)
 - **Authentication Timeout** – The number of seconds the switch waits for a reply from the RADIUS server before it resends the request.
(Range: 1-65535; Default: 5)
 - **Authentication Retries** – Number of times the switch tries to authenticate logon access via the authentication server. (Range: 1-30; Default: 2)
 - **Set Key** – Mark this box to set or modify the encryption key.
 - **Authentication Key** – Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes.
(Maximum length: 48 characters)

- **Confirm Authentication Key** – Re-type the string entered in the previous field to ensure no errors were made. The switch will not change the encryption key if these two fields do not match.

◆ **TACACS+**

- **Global** – Provides globally applicable TACACS+ settings.
- **Server Index** – Specifies the index number of the server to be configured. The switch currently supports only one TACACS+ server.
- **Server IP Address** – Address of the TACACS+ server. (A Server Index entry must be selected to display this item.)
- **Authentication Server TCP Port** – Network (TCP) port of TACACS+ server used for authentication messages. (Range: 1-65535; Default: 49)
- **Authentication Timeout** – The number of seconds the switch waits for a reply from the TACACS+ server before it resends the request. (Range: 1-65535; Default: 5)
- **Authentication Retries** – Number of times the switch tries to authenticate logon access via the authentication server. (Range: 1-30; Default: 2)
- **Set Key** – Mark this box to set or modify the encryption key.
- **Authentication Key** – Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes. (Maximum length: 48 characters)
- **Confirm Authentication Key** – Re-type the string entered in the previous field to ensure no errors were made. The switch will not change the encryption key if these two fields do not match.

Configure Group

- ◆ **Server Type** – Select RADIUS or TACACS+ server.
- ◆ **Group Name** - Defines a name for the RADIUS or TACACS+ server group. (Range: 1-64 characters)
- ◆ **Sequence at Priority** - Specifies the server and sequence to use for the group. (Range: 1-5 for RADIUS; 1 for TACACS)

When specifying the priority sequence for a sever, the server index must already be defined (see [“Configuring Local/Remote Logon Authentication” on page 225](#)).

Web Interface

To configure the parameters for RADIUS or TACACS+ authentication:

1. Click Security, AAA, Server.
2. Select Configure Server from the Step list.
3. Select RADIUS or TACACS+ server type.
4. Select Global to specify the parameters that apply globally to all specified servers, or select a specific Server Index to specify the parameters that apply to a specific server.
5. To set or modify the authentication key, mark the Set Key box, enter the key, and then confirm it
6. Click Apply.

Figure 138: Configuring Remote Authentication Server (RADIUS)

The screenshot shows the configuration page for a RADIUS server. The breadcrumb navigation is "Security > AAA > Server". The "Server Type" is set to "RADIUS" (selected with a radio button) and "TACACS+" is unselected. The "Global" option is unselected, and "Server Index" is set to "1" (selected with a radio button). The "Server IP Address" is "10.1.1.1". The "Accounting Server UDP Port (1-65535)" is "1813". The "Authentication Server UDP Port (1-65535)" is "1815". The "Authentication Timeout (1-65535)" is "10" seconds. The "Authentication Retries (1-30)" is "5". The "Set Key" checkbox is checked. The "Authentication Key" and "Confirm Authentication Key" fields are both masked with dots. At the bottom right, there are "Apply" and "Revert" buttons.

Figure 139: Configuring Remote Authentication Server (TACACS+)

The screenshot shows the configuration page for a TACACS+ server. The breadcrumb is 'Security > AAA > Server'. The 'Step' dropdown is set to '1. Configure Server'. Under 'Server Type', 'RADIUS' is unselected and 'TACACS+' is selected. The 'Global' radio button is unselected, and 'Server Index' is set to '1'. The 'Server IP Address' field contains '10.20.30.40'. The 'Authentication Server TCP Port (1-65535)' field contains '200'. The 'Authentication Timeout (1-540)' field contains '10' with 'sec' to its right. The 'Authentication Retries (1-30)' field contains '5'. The 'Set Key' checkbox is checked. The 'Authentication Key' and 'Confirm Authentication Key' fields both contain masked characters (dots). 'Apply' and 'Revert' buttons are at the bottom right.

To configure the RADIUS or TACACS+ server groups to use for accounting and authorization:

1. Click Security, AAA, Server.
2. Select Configure Group from the Step list.
3. Select Add from the Action list.
4. Select RADIUS or TACACS+ server type.
5. Enter the group name, followed by the index of the server to use for each priority level.
6. Click Apply.

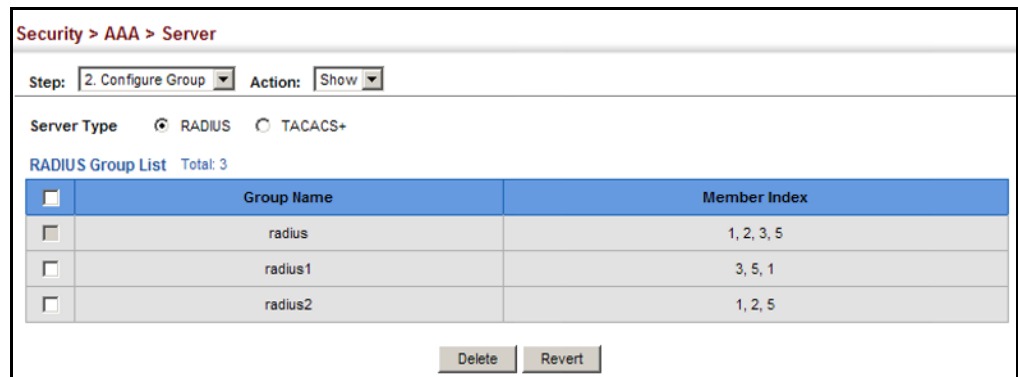
Figure 140: Configuring AAA Server Groups

The screenshot shows the configuration page for a RADIUS server group. The breadcrumb is 'Security > AAA > Server'. The 'Step' dropdown is set to '2. Configure Group' and the 'Action' dropdown is set to 'Add'. Under 'Server Type', 'RADIUS' is selected and 'TACACS+' is unselected. The 'RADIUS Group Name' field contains 'radius'. The 'Sequence At Priority 1' dropdown is set to '1'. The 'Sequence At Priority 2' dropdown is set to '3'. The 'Sequence At Priority 3' dropdown is set to '5'. The 'Sequence At Priority 4' dropdown is set to '2'. The 'Sequence At Priority 5' dropdown is set to 'None'. 'Apply' and 'Revert' buttons are at the bottom right.

To show the RADIUS or TACACS+ server groups used for accounting and authorization:

1. Click Security, AAA, Server.
2. Select Configure Group from the Step list.
3. Select Show from the Action list.

Figure 141: Showing AAA Server Groups



Configuring AAA Accounting

Use the Security > AAA > Accounting page to enable accounting of requested services for billing or security purposes, and also to display the configured accounting methods, the methods applied to specific interfaces, and basic accounting information recorded for user sessions.

Command Usage

AAA authentication through a RADIUS or TACACS+ server must be enabled before accounting is enabled.

Parameters

These parameters are displayed:

Configure Global

- ◆ **Periodic Update** - Specifies the interval at which the local accounting service updates information for all users on the system to the accounting server. (Range: 1-2147483647 minutes)

Configure Method

- ◆ **Accounting Type** – Specifies the service as:
 - **802.1X** – Accounting for end users.
 - **Command** – Administrative accounting to apply to commands entered at specific CLI privilege levels.

- **Exec** – Administrative accounting for local console, Telnet, or SSH connections.
- ◆ **Privilege Level** – The CLI privilege levels (0-15). This parameter only applies to Command accounting.
- ◆ **Method Name** – Specifies an accounting method for service requests. The “default” methods are used for a requested service if no other methods have been defined. (Range: 1-64 characters)

Note that the method name is only used to describe the accounting method configured on the specified RADIUS or TACACS+ servers. No information is sent to the servers about the method to use.
- ◆ **Accounting Notice** – Records user activity from log-in to log-off point.
- ◆ **Server Group Name** - Specifies the accounting server group. (Range: 1-64 characters)

The group names “radius” and “tacacs+” specifies all configured RADIUS and TACACS+ hosts (see [“Configuring Local/Remote Logon Authentication” on page 225](#)). Any other group name refers to a server group configured on the Security > AAA > Server (Configure Group) page.

Configure Service

- ◆ **Accounting Type** – Specifies the service as 802.1X, Command or Exec as described in the preceding section.
- ◆ **802.1X**
 - **Method Name** – Specifies a user defined accounting method to apply to an interface. This method must be defined in the Configure Method page. (Range: 1-64 characters)
- ◆ **Command**
 - **Privilege Level** – The CLI privilege levels (0-15).
 - **Console Method Name** – Specifies a user-defined method name to apply to commands entered at the specified CLI privilege level through the console interface.
 - **VTY Method Name** – Specifies a user-defined method name to apply to commands entered at the specified CLI privilege level through Telnet or SSH.
- ◆ **Exec**
 - **Console Method Name** – Specifies a user defined method name to apply to console connections.

- **VTY Method Name** – Specifies a user defined method name to apply to Telnet and SSH connections.

Show Information – Summary

- ◆ **Accounting Type** - Displays the accounting service.
- ◆ **Method Name** - Displays the user-defined or default accounting method.
- ◆ **Server Group Name** - Displays the accounting server group.
- ◆ **Interface** - Displays the port, console or Telnet interface to which these rules apply. (This field is null if the accounting method and associated server group has not been assigned to an interface.)

Show Information – Statistics

- ◆ **User Name** - Displays a registered user name.
- ◆ **Accounting Type** - Displays the accounting service.
- ◆ **Interface** - Displays the receive port number through which this user accessed the switch.
- ◆ **Time Elapsed** - Displays the length of time this entry has been active.

Web Interface

To configure global settings for AAA accounting:

1. Click Security, AAA, Accounting.
2. Select Configure Global from the Step list.
3. Enter the required update interval.
4. Click Apply.

Figure 142: Configuring Global Settings for AAA Accounting

The screenshot shows a web interface for configuring AAA accounting. The breadcrumb path is "Security > AAA > Accounting". Below this, there is a "Step:" dropdown menu currently set to "1. Configure Global". Underneath, there is a section for "Periodic Update (1-2147483647)" which includes a checked checkbox and a text input field containing the number "1", followed by the unit "min". At the bottom right of the configuration area, there are two buttons: "Apply" and "Revert".

To configure the accounting method applied to various service types and the assigned server group:

1. Click Security, AAA, Accounting.
2. Select Configure Method from the Step list.
3. Select Add from the Action list.
4. Select the accounting type (802.1X, Command, Exec).
5. Specify the name of the accounting method and server group name.
6. Click Apply.

Figure 143: Configuring AAA Accounting Methods

The screenshot shows the configuration page for AAA Accounting. The breadcrumb navigation is "Security > AAA > Accounting". The "Step" is set to "2. Configure Method" and the "Action" is "Add". The configuration fields are as follows:

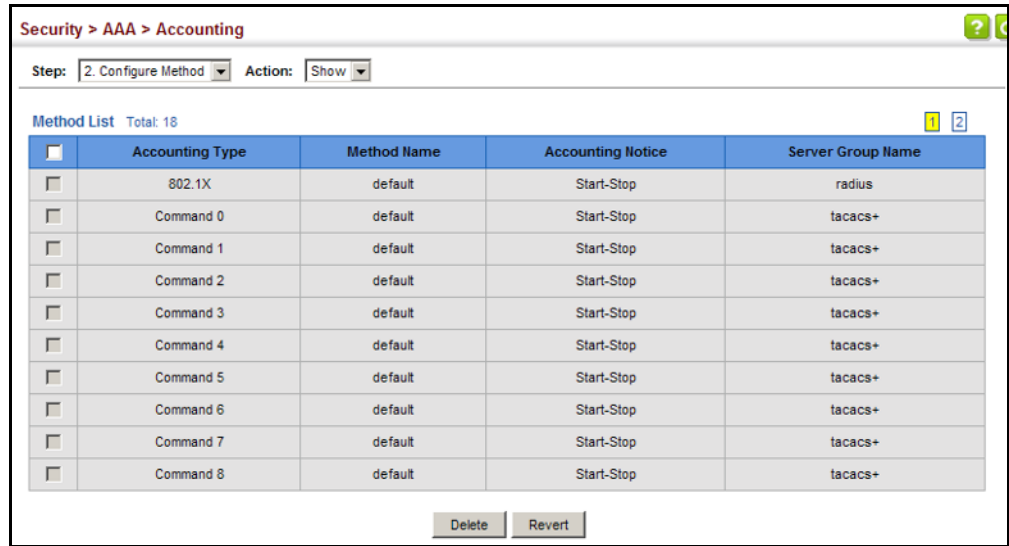
Accounting Type	802.1X
Method Name	default
Accounting Notice	Start-Stop
Server Group Name	<input checked="" type="radio"/> radius <input type="radio"/> <input type="text"/>

Buttons for "Apply" and "Revert" are located at the bottom right of the form.

To show the accounting method applied to various service types and the assigned server group:

1. Click Security, AAA, Accounting.
2. Select Configure Method from the Step list.
3. Select Show from the Action list.

Figure 144: Showing AAA Accounting Methods



To configure the accounting method applied to specific interfaces, console commands entered at specific privilege levels, and local console, Telnet, or SSH connections:

1. Click Security, AAA, Accounting.
2. Select Configure Service from the Step list.
3. Select the accounting type (802.1X, Command, Exec).
4. Enter the required accounting method.
5. Click Apply.

Figure 145: Configuring AAA Accounting Service for 802.1X Service

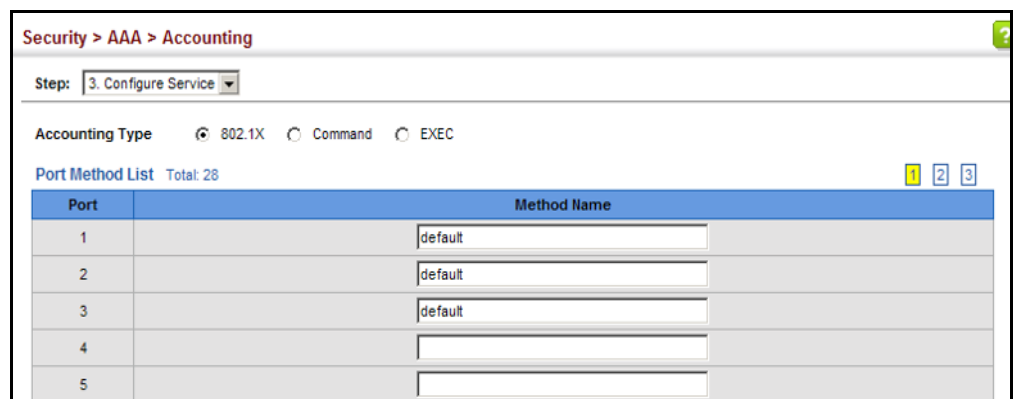


Figure 146: Configuring AAA Accounting Service for Command Service

Security > AAA > Accounting

Step: 3. Configure Service

Accounting Type 802.1X Command EXEC

Command Method List Total: 16

Privilege Level	Console Method Name	VTY Method Name
0	default	default
1	default	default
2	default	default
3	default	default
4	command4Method	default
5	default	command5Method

Figure 147: Configuring AAA Accounting Service for Exec Service

Security > AAA > Accounting

Step: 3. Configure Service

Accounting Type 802.1X Command EXEC

Console Method Name default

VTY Method Name default

Apply Revert

To display a summary of the configured accounting methods and assigned server groups for specified service types:

1. Click Security, AAA, Accounting.
2. Select Show Information from the Step list.
3. Click Summary.

Figure 148: Displaying a Summary of Applied AAA Accounting Methods

Security > AAA > Accounting

Step: 4. Show Information

Summary Statistics

Method List Total: 18

Accounting Type	Method Name	Server Group Name	Interface
802.1X	default	radius	
Command 0	default	tacacs+	
Command 1	default	tacacs+	
Command 2	default	tacacs+	
Command 3	default	tacacs+	
Command 4	default	tacacs+	
Command 5	default	tacacs+	
Command 6	default	tacacs+	
Command 7	default	tacacs+	
Command 8	default	tacacs+	

To display basic accounting information and statistics recorded for user sessions:

1. Click Security, AAA, Accounting.
2. Select Show Information from the Step list.
3. Click Statistics.

Figure 149: Displaying Statistics for AAA Accounting Sessions

Security > AAA > Accounting

Step: 4. Show Information

Summary Statistics

Accounting Statistics Total: 2

User Name	Accounting Type	Interface	Time Elapsed
Bob	802.1X	Eth1/1	3:44:55
Ted	802.1X	Eth1/5	1:24:51

Configuring AAA Authorization

Use the Security > AAA > Authorization page to enable authorization of requested services, and also to display the configured authorization methods, and the methods applied to specific interfaces.

Command Usage

- ◆ This feature performs authorization to determine if a user is allowed to run an Exec shell.
- ◆ AAA authentication through a RADIUS or TACACS+ server must be enabled before authorization is enabled.

Parameters

These parameters are displayed:

Configure Method

- ◆ **Authorization Type** – Specifies the service as:
 - **Command** – Administrative authorization to apply to commands entered at specific CLI privilege levels.
 - **Exec** – Administrative authorization for local console, Telnet, or SSH connections.
- ◆ **Method Name** – Specifies an authorization method for service requests. The “default” method is used for a requested service if no other methods have been defined. (Range: 1-64 characters)
- ◆ **Server Group Name** - Specifies the authorization server group. (Range: 1-64 characters)

The group name “tacacs+” specifies all configured TACACS+ hosts (see [“Configuring Local/Remote Logon Authentication” on page 225](#)). Any other group name refers to a server group configured on the TACACS+ Group Settings page. Authorization is only supported for TACACS+ servers.

Configure Service

- ◆ **Authorization Type** – Specifies the service as Exec, indicating administrative authorization for local console, Telnet, or SSH connections.
- ◆ **Console Method Name** – Specifies a user defined method name to apply to console connections.
- ◆ **VTY Method Name** – Specifies a user defined method name to apply to Telnet and SSH connections.

Show Information

- ◆ **Authorization Type** - Displays the authorization service.
- ◆ **Method Name** - Displays the user-defined or default accounting method.
- ◆ **Server Group Name** - Displays the authorization server group.
- ◆ **Interface** - Displays the console or Telnet interface to which these rules apply. (This field is null if the authorization method and associated server group has not been assigned to an interface.)

Web Interface

To configure the authorization method applied to the Exec service type and the assigned server group:

1. Click Security, AAA, Authorization.
2. Select Configure Method from the Step list.
3. Specify the name of the authorization method and server group name.
4. Click Apply.

Figure 150: Configuring AAA Authorization Methods

To show the authorization method applied to the EXEC service type and the assigned server group:

1. Click Security, AAA, Authorization.
2. Select Configure Method from the Step list.
3. Select Show from the Action list.

Figure 151: Showing AAA Authorization Methods

<input type="checkbox"/>	Authorization Type	Method Name	Server Group Name
<input type="checkbox"/>	EXEC	default	tacacs+
<input type="checkbox"/>	EXEC	aaa	tacacs1

To configure the authorization method applied to local console, Telnet, or SSH connections:

1. Click Security, AAA, Authorization.
2. Select Configure Service from the Step list.
3. Enter the required authorization method.
4. Click Apply.

Figure 152: Configuring AAA Authorization Methods for Exec Service

The screenshot shows the configuration page for AAA Authorization. The breadcrumb is "Security > AAA > Authorization". The "Step" dropdown is set to "2. Configure Service". The "Authorization Type" is set to "EXEC". The "Console Method Name" and "VTY Method Name" are both set to "tps-auth". There are "Apply" and "Revert" buttons at the bottom right.

To display the configured authorization method and assigned server groups for The Exec service type:

1. Click Security, AAA, Authorization.
2. Select Show Information from the Step list.

Figure 153: Displaying the Applied AAA Authorization Method

The screenshot shows the configuration page for AAA Authorization. The breadcrumb is "Security > AAA > Authorization". The "Step" dropdown is set to "3. Show Information". Below the configuration fields, there is a "Method List" section with a "Total: 3" indicator. The table below shows the applied authorization methods.

Authorization Type	Method Name	Server Group Name	Interface
EXEC	default	tacacs+	
EXEC	console	tacacs+	Console
EXEC	telnet	tacacs+	Telnet

Configuring User Accounts

Use the Security > User Accounts page to control management access to the switch based on manually configured user names and passwords.

Command Usage

- ◆ The default guest name is “guest” with the password “guest.” The default administrator name is “admin” with the password “admin.”
- ◆ The guest only has read access for most configuration parameters. However, the administrator has write access for all parameters governing the onboard agent. You should therefore assign a new administrator password as soon as possible, and store it in a safe place.

Parameters

These parameters are displayed:

- ◆ **User Name** – The name of the user.
(Maximum length: 32 characters; maximum number of users: 16)
- ◆ **Access Level** – Specifies command access privileges. (Range: 0-15)
Level 0, 8 and 15 are designed for users (guest), managers (network maintenance), and administrators (top-level access). The other levels can be used to configured specialized access profiles.
Level 0-7 provide the same default access to a limited number of commands which display the current status of the switch, as well as several database clear and reset functions. These commands are equivalent to those available under Normal Exec command mode in the CLI.
Level 8-14 provide the same default access privileges, including additional commands beyond those provided for Levels 0-7 (equivalent to CLI Normal Exec command mode), and a subset of the configuration commands provided for Level 15 (equivalent to CLI Privileged Exec command mode).
Level 15 provides full access to all commands.
The privilege level associated with any command can be changed using the “privilege” command described in the *CLI Reference Guide*.
Any privilege level can access all of the commands assigned to lower privilege levels. For example, privilege level 8 can access all commands assigned to privilege levels 7-0 according to default settings, and to any other commands assigned to levels 7-0 using the “privilege” command described in the *CLI Reference Guide*.
- ◆ **Password Type** – Specifies the following options:
 - **No Password** – No password is required for this user to log in.
 - **Plain Password** – Plain text unencrypted password.

- **Encrypted Password** – Encrypted password.

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP or FTP server. There is no need for you to manually configure encrypted passwords.

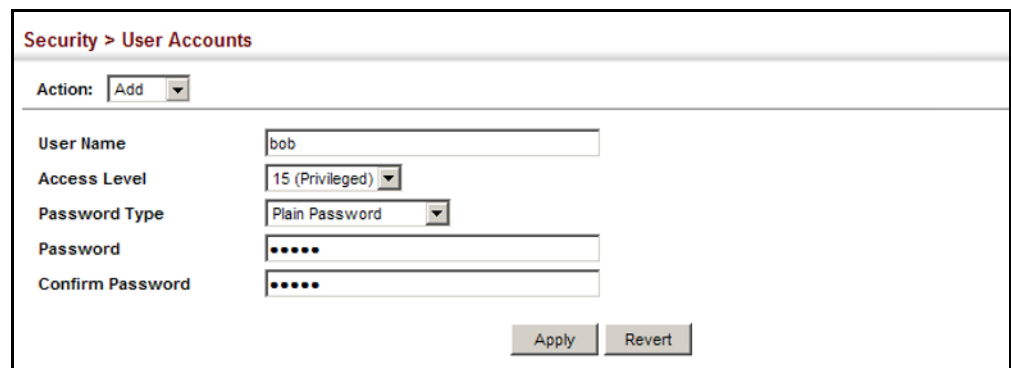
- ◆ **Password** – Specifies the user password. (Range: 0-32 characters, case sensitive)
- ◆ **Confirm Password** – Re-type the string entered in the previous field to ensure no errors were made. The switch will not change the password if these two fields do not match.

Web Interface

To configure user accounts:

1. Click Security, User Accounts.
2. Select Add from the Action list.
3. Specify a user name, select the user's access level, then enter a password if required and confirm it.
4. Click Apply.

Figure 154: Configuring User Accounts



The screenshot shows a web interface for configuring user accounts. The breadcrumb navigation is "Security > User Accounts". Below this, there is an "Action:" dropdown menu set to "Add". The form contains the following fields:

- User Name:** A text input field containing "bob".
- Access Level:** A dropdown menu set to "15 (Privileged)".
- Password Type:** A dropdown menu set to "Plain Password".
- Password:** A text input field with five dots representing a masked password.
- Confirm Password:** A text input field with five dots representing a masked password.

At the bottom right of the form, there are two buttons: "Apply" and "Revert".

To show user accounts:

1. Click Security, User Accounts.
2. Select Show from the Action list.

Figure 155: Showing User Accounts

Security > User Accounts

Action: Show

User Account List Total: 3

<input type="checkbox"/>	User Name	Access Level
<input type="checkbox"/>	admin	15
<input type="checkbox"/>	guest	0
<input type="checkbox"/>	bob	15

Delete Revert

Network Access (MAC Address Authentication)

Some devices connected to switch ports may not be able to support 802.1X authentication due to hardware or software limitations. This is often true for devices such as network printers, IP phones, and some wireless access points. The switch enables network access from these devices to be controlled by authenticating device MAC addresses with a central RADIUS server.



Note: RADIUS authentication must be activated and configured properly for the MAC Address authentication feature to work properly. (See [“Configuring Remote Logon Authentication Servers”](#) on page 226.)

Note: MAC authentication cannot be configured on trunk ports.

Command Usage

- ◆ MAC address authentication controls access to the network by authenticating the MAC address of each host that attempts to connect to a switch port. Traffic received from a specific MAC address is forwarded by the switch only if the source MAC address is successfully authenticated by a central RADIUS server. While authentication for a MAC address is in progress, all traffic is blocked until authentication is completed. On successful authentication, the RADIUS server may optionally assign VLAN and quality of service settings for the switch port.
- ◆ When enabled on a port, the authentication process sends a Password Authentication Protocol (PAP) request to a configured RADIUS server. The user name and password are both equal to the MAC address being authenticated. On the RADIUS server, PAP user name and passwords must be configured in the MAC address format XX-XX-XX-XX-XX-XX (all in upper case).
- ◆ Authenticated MAC addresses are stored as dynamic entries in the switch secure MAC address table and are removed when the aging time expires. The maximum number of secure MAC addresses supported for the switch system is 1024.

- ◆ Configured static MAC addresses are added to the secure address table when seen on a switch port. Static addresses are treated as authenticated without sending a request to a RADIUS server.
- ◆ When port status changes to down, all MAC addresses mapped to that port are cleared from the secure MAC address table. Static VLAN assignments are not restored.
- ◆ The RADIUS server may optionally return a VLAN identifier list to be applied to the switch port. The following attributes need to be configured on the RADIUS server.
 - **Tunnel-Type** = VLAN
 - **Tunnel-Medium-Type** = 802
 - **Tunnel-Private-Group-ID** = 1u,2t [VLAN ID list]

The VLAN identifier list is carried in the RADIUS “Tunnel-Private-Group-ID” attribute. The VLAN list can contain multiple VLAN identifiers in the format “1u,2t,3u” where “u” indicates an untagged VLAN and “t” a tagged VLAN.

- ◆ The RADIUS server may optionally return dynamic QoS assignments to be applied to a switch port for an authenticated user. The “Filter-ID” attribute (attribute 11) can be configured on the RADIUS server to pass the following QoS information:

Table 15: Dynamic QoS Profiles

Profile	Attribute Syntax	Example
DiffServ	service-policy-in = <i>policy-map-name</i>	service-policy-in=p1
Rate Limit	rate-limit-input = <i>rate</i>	rate-limit-input=100 (kbps)
	rate-limit-output = <i>rate</i>	rate-limit-output=200 (kbps)
802.1p	switchport-priority-default = <i>value</i>	switchport-priority-default=2
IP ACL	ip-access-group-in = <i>ip-acl-name</i>	ip-access-group-in=ipv4acl
IPv6 ACL	ipv6-access-group-in = <i>ipv6-acl-name</i>	ipv6-access-group-in=ipv6acl
MAC ACL	mac-access-group-in = <i>mac-acl-name</i>	mac-access-group-in=macAcl

- ◆ Multiple profiles can be specified in the Filter-ID attribute by using a semicolon to separate each profile.
For example, the attribute “service-policy-in=pp1;rate-limit-input=100” specifies that the diffserv profile name is “pp1,” and the ingress rate limit profile value is 100 kbps.
- ◆ If duplicate profiles are passed in the Filter-ID attribute, then only the first profile is used.
For example, if the attribute is “service-policy-in=p1;service-policy-in=p2”, then the switch applies only the DiffServ profile “p1.”

- ◆ Any unsupported profiles in the Filter-ID attribute are ignored.
For example, if the attribute is “map-ip-dscp=2:3;service-policy-in=p1,” then the switch ignores the “map-ip-dscp” profile.
- ◆ When authentication is successful, the dynamic QoS information may not be passed from the RADIUS server due to one of the following conditions (authentication result remains unchanged):
 - The Filter-ID attribute cannot be found to carry the user profile.
 - The Filter-ID attribute is empty.
 - The Filter-ID attribute format for dynamic QoS assignment is unrecognizable (can not recognize the whole Filter-ID attribute).
- ◆ Dynamic QoS assignment fails and the authentication result changes from success to failure when the following conditions occur:
 - Illegal characters found in a profile value (for example, a non-digital character in an 802.1p profile value).
 - Failure to configure the received profiles on the authenticated port.
- ◆ When the last user logs off on a port with a dynamic QoS assignment, the switch restores the original QoS configuration for the port.
- ◆ When a user attempts to log into the network with a returned dynamic QoS profile that is different from users already logged on to the same port, the user is denied access.
- ◆ While a port has an assigned dynamic QoS profile, any manual QoS configuration changes only take effect after all users have logged off the port.

Configuring Global Settings for Network Access

MAC address authentication is configured on a per-port basis, however there are two configurable parameters that apply globally to all ports on the switch. Use the Security > Network Access (Configure Global) page to configure MAC address authentication aging and reauthentication time.

Parameters

These parameters are displayed:

- ◆ **Aging Status** – Enables aging for authenticated MAC addresses stored in the secure MAC address table. (Default: Disabled)

This parameter applies to authenticated MAC addresses configured by the MAC Address Authentication process described in this section, as well as to any secure MAC addresses authenticated by 802.1X, regardless of the 802.1X Operation Mode (Single-Host, Multi-Host, or MAC-Based authentication as described on [page 294](#)).

Authenticated MAC addresses are stored as dynamic entries in the switch's secure MAC address table and are removed when the aging time expires.

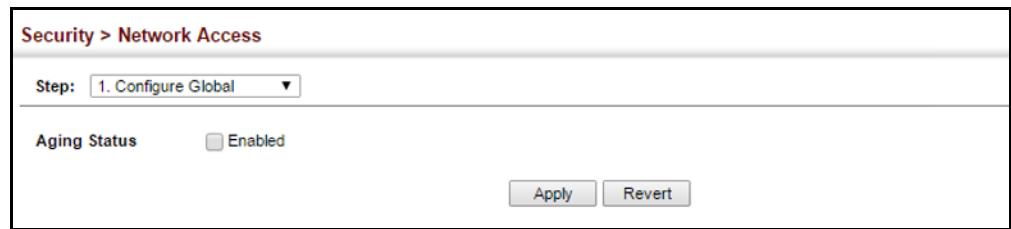
The maximum number of secure MAC addresses supported for the switch system is 1024.

Web Interface

To configure aging status and reauthentication time for MAC address authentication:

1. Click Security, Network Access.
2. Select Configure Global from the Step list.
3. Enable or disable aging for secure addresses, and modify the reauthentication time as required.
4. Click Apply.

Figure 156: Configuring Global Settings for Network Access



Configuring Network Access for Ports

Use the Security > Network Access (Configure Interface - General) page to configure MAC authentication on switch ports, including enabling address authentication, setting the maximum MAC count, and enabling dynamic VLAN or dynamic QoS assignments.

Parameters

These parameters are displayed:

- ◆ **Guest VLAN** – Specifies the VLAN to be assigned to the port when 802.1X Authentication or MAC authentication fails. (Range: 0-4094, where 0 means disabled; Default: Disabled)

The VLAN must already be created and active (see [“Configuring VLAN Groups” on page 142](#)). Also, when used with 802.1X authentication, intrusion action must be set for “Guest VLAN” (see [“Configuring Port Authenticator Settings for 802.1X” on page 294](#)).

A port can only be assigned to the guest VLAN in case of failed authentication, and switchport mode is set to Hybrid. (See [“Adding Static Members to VLANs” on page 144](#).)
- ◆ **Dynamic VLAN** – Enables dynamic VLAN assignment for an authenticated port. When enabled, any VLAN identifiers returned by the RADIUS server through the 802.1X authentication process are applied to the port, providing

the VLANs have already been created on the switch. (GVRP is not used to create the VLANs.) (Default: Enabled)

The VLAN settings specified by the first authenticated MAC address are implemented for a port. Other authenticated MAC addresses on the port must have the same VLAN configuration, or they are treated as authentication failures.

If dynamic VLAN assignment is enabled on a port and the RADIUS server returns no VLAN configuration (to the 802.1X authentication process), the authentication is still treated as a success, and the host is assigned to the default untagged VLAN.

When the dynamic VLAN assignment status is changed on a port, all authenticated addresses mapped to that port are cleared from the secure MAC address table.

- ◆ **MAC Filter ID** – Allows a MAC Filter to be assigned to the port. MAC addresses or MAC address ranges present in a selected MAC Filter are exempt from authentication on the specified port (as described under "[Configuring a MAC Address Filter](#)"). (Range: 1-64; Default: None)

Web Interface

To configure MAC authentication on switch ports:

1. Click Security, Network Access.
2. Select Configure Interface from the Step list.
3. Click the General button.
4. Set the guest VLAN to use when MAC Authentication or 802.1X Authentication fails, the dynamic VLAN, and the MAC filter.
5. Click Apply.

Figure 157: Configuring Interface Settings for Network Access

Port	Guest VLAN (0-4094, 0: Disabled)	Dynamic VLAN	MAC Filter (1-64)
1	0	<input checked="" type="checkbox"/> Enabled	<input type="checkbox"/> <input type="text"/>
2	0	<input checked="" type="checkbox"/> Enabled	<input type="checkbox"/> <input type="text"/>
3	0	<input checked="" type="checkbox"/> Enabled	<input type="checkbox"/> <input type="text"/>
4	0	<input checked="" type="checkbox"/> Enabled	<input type="checkbox"/> <input type="text"/>
5	0	<input checked="" type="checkbox"/> Enabled	<input type="checkbox"/> <input type="text"/>

Configuring a MAC Address Filter Use the Security > Network Access (Configure MAC Filter) page to designate specific MAC addresses or MAC address ranges as exempt from authentication. MAC addresses present in MAC Filter tables activated on a port are treated as pre-authenticated on that port.

Command Usage

- ◆ Specified MAC addresses are exempt from authentication.
- ◆ Up to 65 filter tables can be defined.
- ◆ There is no limitation on the number of entries used in a filter table.

Parameters

These parameters are displayed:

- ◆ **Filter ID** – Adds a filter rule for the specified filter. (Range: 1-64)
- ◆ **MAC Address** – The filter rule will check ingress packets against the entered MAC address or range of MAC addresses (as defined by the MAC Address Mask).
- ◆ **MAC Address Mask** – The filter rule will check for the range of MAC addresses defined by the MAC bit mask. If you omit the mask, the system will assign the default mask of an exact match. (Range: 000000000000 - FFFFFFFF; Default: FFFFFFFF)

Web Interface

To add a MAC address filter for MAC authentication:

1. Click Security, Network Access.
2. Select Configure MAC Filter from the Step list.
3. Select Add from the Action list.
4. Enter a filter ID, MAC address, and optional mask.
5. Click Apply.

Figure 158: Configuring a MAC Address Filter for Network Access

The screenshot shows the 'Security > Network Access' configuration page. At the top, there is a breadcrumb 'Security > Network Access'. Below it, there are two dropdown menus: 'Step: 3. Configure MAC Filter' and 'Action: Add'. The main configuration area contains three input fields: 'Filter ID (1-64)' with the value '22', 'MAC Address' with the value '11-22-33-44-55-66', and 'MAC Address Mask' with the value 'FFFFFFFF'. At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

To show the MAC address filter table for MAC authentication:

1. Click Security, Network Access.
2. Select Configure MAC Filter from the Step list.
3. Select Show from the Action list.

Figure 159: Showing the MAC Address Filter Table for Network Access

The screenshot shows the 'Security > Network Access' configuration page. At the top, there is a breadcrumb trail 'Security > Network Access'. Below it, there are two dropdown menus: 'Step: 3. Configure MAC Filter' and 'Action: Show'. The main content area is titled 'MAC Filter List' with a 'Total: 1' indicator. It contains a table with the following data:

<input type="checkbox"/>	Filter ID	MAC Address	MAC Address Mask
<input type="checkbox"/>	22	11-22-33-44-55-66	FF-FF-FF-FF-FF-FF

Below the table, there are two buttons: 'Delete' and 'Revert'.

Displaying Secure MAC Address Information

Use the Security > Network Access (Show Information) page to display the authenticated MAC addresses stored in the secure MAC address table. Information on the secure MAC entries can be displayed and selected entries can be removed from the table.

Parameters

These parameters are displayed:

- ◆ **Query By** – Specifies parameters to use in the MAC address query.
 - **Sort Key** – Sorts the information displayed based on MAC address, port interface, or attribute.
 - **MAC Address** – Specifies a specific MAC address.
 - **Interface** – Specifies a port interface.
 - **Attribute** – Displays static or dynamic addresses.
- ◆ **Authenticated MAC Address List**
 - **MAC Address** – The authenticated MAC address.
 - **Interface** – The port interface associated with a secure MAC address.
 - **RADIUS Server** – The IP address of the RADIUS server that authenticated the MAC address.
 - **Time** – The time when the MAC address was last authenticated.

- **Attribute** – Indicates a static or dynamic address.

Web Interface

To display the authenticated MAC addresses stored in the secure MAC address table:

1. Click Security, Network Access.
2. Select Show Information from the Step list.
3. Use the sort key to display addresses based MAC address, interface, or attribute.
4. Restrict the displayed addresses by entering a specific address in the MAC Address field, specifying a port in the Interface field, or setting the address type to static or dynamic in the Attribute field.
5. Click Query.

Figure 160: Showing Addresses Authenticated for Network Access

Security > Network Access

Step: 4. Show Information

Query by:

Sort Key: MAC Address

MAC Address

Interface: 1

Attribute: Static

Query

Authenticated MAC Address List Total: 8

<input type="checkbox"/>	MAC Address	Interface	RADIUS Server	Time	Attribute
<input type="checkbox"/>	00-00-86-45-F2-23	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 16m 12s	Dynamic
<input type="checkbox"/>	00-00-E8-5E-E1-DD	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 32m 24s	Dynamic
<input type="checkbox"/>	00-00-E8-81-93-30	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 40m 32s	Dynamic
<input type="checkbox"/>	00-01-80-31-B8-30	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 18m 51s	Dynamic
<input type="checkbox"/>	00-01-80-36-95-D8	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 32m 22s	Dynamic
<input type="checkbox"/>	00-01-80-3B-D3-7F	Unit 1 / Port 23	10.2.2.10	2008y 20m 12d 11h 22m 28s	Dynamic
<input type="checkbox"/>	00-01-80-3C-3C-19	Unit 2 / Port 23	10.2.2.10	2008y 20m 12d 11h 15m 19s	Dynamic
<input type="checkbox"/>	00-01-80-3C-3E-B3	Unit 2 / Port 23	10.2.2.10	2008y 20m 12d 11h 17m 40s	Dynamic

Delete Revert

Configuring HTTPS

You can configure the switch to enable the Secure Hypertext Transfer Protocol (HTTPS) over the Secure Socket Layer (SSL), providing secure access (i.e., an encrypted connection) to the switch's web interface.

Configuring Global Settings for HTTPS Use the Security > HTTPS (Configure Global) page to enable or disable HTTPS and specify the TCP port used for this service.

Command Usage

- ◆ Both the HTTP and HTTPS service can be enabled independently on the switch. However, you cannot configure both services to use the same TCP port. (HTTP can only be configured through the CLI using the "ip http server" command described in the *CLI Reference Guide*.)
- ◆ If you enable HTTPS, you must indicate this in the URL that you specify in your browser: `https://device[:port_number]`
- ◆ When you start HTTPS, the connection is established in this way:
 - The client authenticates the server using the server's digital certificate.
 - The client and server negotiate a set of security protocols to use for the connection.
 - The client and server generate session keys for encrypting and decrypting data.
- ◆ The client and server establish a secure encrypted connection.
A padlock icon should appear in the status bar for Internet Explorer 9, Mozilla Firefox 39, or Google Chrome 44, or more recent versions.
- ◆ The following web browsers and operating systems currently support HTTPS:

Table 16: HTTPS System Support

Web Browser	Operating System
Internet Explorer 9.x or later	Windows 7, 8, 10
Mozilla Firefox 39 or later	Windows 7, 8, 10, Linux
Google Chrome 44 or later	Windows 7, 8, 10

- ◆ To specify a secure-site certificate, see ["Replacing the Default Secure-site Certificate" on page 252](#).



Note: Connection to the web interface is not supported for HTTPS using an IPv6 link local address.

Parameters

These parameters are displayed:

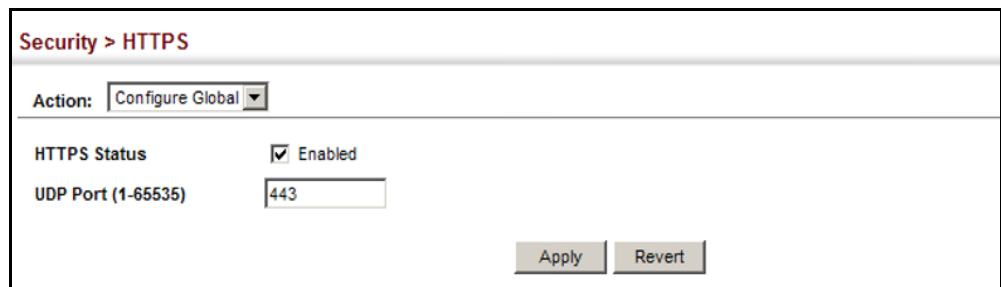
- ◆ **HTTPS Status** – Allows you to enable/disable the HTTPS server feature on the switch. (Default: Enabled)
- ◆ **HTTPS Port** – Specifies the TCP port number used for HTTPS connection to the switch’s web interface. (Default: Port 443)

Web Interface

To configure HTTPS:

1. Click Security, HTTPS.
2. Select Configure Global from the Step list.
3. Enable HTTPS and specify the port number if required.
4. Click Apply.

Figure 161: Configuring HTTPS



Security > HTTPS

Action:

HTTPS Status Enabled

UDP Port (1-65535)

Replacing the Default Secure-site Certificate

Use the Security > HTTPS (Copy Certificate) page to replace the default secure-site certificate.

When you log onto the web interface using HTTPS (for secure access), a Secure Sockets Layer (SSL) certificate appears for the switch. By default, the certificate that the web browser displays will be associated with a warning that the site is not recognized as a secure site. This is because the certificate has not been signed by an approved certification authority. If you want this warning to be replaced by a message confirming that the connection to the switch is secure, you must obtain a unique certificate and a private key and password from a recognized certification authority.



Caution: For maximum security, we recommend you obtain a unique Secure Sockets Layer certificate at the earliest opportunity. This is because the default certificate for the switch is not unique to the hardware you have purchased.

When you have obtained these, place them on your TFTP server and transfer them to the switch to replace the default (unrecognized) certificate with an authorized one.



Note: The switch must be reset for the new certificate to be activated. To reset the switch, see [“Resetting the System” on page 91](#) or type “reload” at the command prompt: `Console#reload`

Parameters

These parameters are displayed:

- ◆ **TFTP Server IP Address** – IP address of TFTP server which contains the certificate file.
- ◆ **Certificate Source File Name** – Name of certificate file stored on the TFTP server.
- ◆ **Private Key Source File Name** – Name of private key file stored on the TFTP server.
- ◆ **Private Password** – Password stored in the private key file. This password is used to verify authorization for certificate use, and is verified when downloading the certificate to the switch.
- ◆ **Confirm Password** – Re-type the string entered in the previous field to ensure no errors were made. The switch will not download the certificate if these two fields do not match.

Web Interface

To replace the default secure-site certificate:

1. Click Security, HTTPS.
2. Select Copy Certificate from the Step list.
3. Fill in the TFTP server, certificate and private key file name, and private password.
4. Click Apply.

Figure 162: Downloading the Secure-Site Certificate

The screenshot shows a configuration window titled "Security > HTTPS". At the top, there is a dropdown menu for "Action" set to "Copy Certificate". Below this are five input fields: "TFTP Server IP Address" with the value "192.168.1.9", "Certificate Source File Name" with "our-site-certificate", "Private Key Source File Name" with "our-private-key", "Private Password" with masked characters, and "Confirm Password" with masked characters. At the bottom right, there are "Apply" and "Revert" buttons.

Configuring the Secure Shell

The Berkeley-standard includes remote access tools originally designed for Unix systems. Some of these tools have also been implemented for Microsoft Windows and other environments. These tools, including commands such as *rlogin* (remote login), *rsh* (remote shell), and *rcp* (remote copy), are not secure from hostile attacks.

Secure Shell (SSH) includes server/client applications intended as a secure replacement for the older Berkeley remote access tools. SSH can also provide remote management access to this switch as a secure replacement for Telnet. When the client contacts the switch via the SSH protocol, the switch generates a public-key that the client uses along with a local user name and password for access authentication. SSH also encrypts all data transfers passing between the switch and SSH-enabled management station clients, and ensures that data traveling over the network arrives unaltered.



Note: You need to install an SSH client on the management station to access the switch for management via the SSH protocol.

Note: The switch supports both SSH Version 1.5 and 2.0 clients.

Command Usage

The SSH server on this switch supports both password and public key authentication. If password authentication is specified by the SSH client, then the password can be authenticated either locally or via a RADIUS or TACACS+ remote authentication server, as specified on the System Authentication page (page 225). If public key authentication is specified by the client, then you must configure authentication keys on both the client and the switch as described in the following section. Note that regardless of whether you use public key or password authentication, you still have to generate authentication keys on the switch (SSH Host Key Settings) and enable the SSH server (Authentication Settings).

To use the SSH server, complete these steps:

1. *Generate a Host Key Pair* – On the SSH Host Key Settings page, create a host public/private key pair.
2. *Provide Host Public Key to Clients* – Many SSH client programs automatically import the host public key during the initial connection setup with the switch. Otherwise, you need to manually create a known hosts file on the management station and place the host public key in it. An entry for a public key in the known hosts file would appear similar to the following example:

```
10.1.0.54 1024 35 15684995401867669259333946775054617325313674890836547254
15020245593199868544358361651999923329781766065830956 10825913212890233
76546801726272571413428762941301196195566782
595664104869574278881462065194174677298486546861571773939016477935594230357741
309802273708779454524083971752646358058176716709574804776117
```

3. *Import Client's Public Key to the Switch* – See [“Importing User Public Keys” on page 259](#) to copy a file containing the public key for all the SSH client's granted management access to the switch. (Note that these clients must be configured locally on the switch via the User Accounts page as described on [page 241](#).) The clients are subsequently authenticated using these keys. The current firmware only accepts public key files based on standard UNIX format as shown in the following example for an RSA Version 1 key:

```
1024 35
134108168560989392104094492015542534763164192187295892114317388005553616163105
177594083868631109291232226828519254374603100937187721199696317813662774141689
851320491172048303392543241016379975923714490119380060902539484084827178194372
288402533115952134861022902978982721353267131629432532818915045306393916643
steve@192.168.1.19
```

4. *Set the Optional Parameters* – On the SSH Settings page, configure the optional parameters, including the authentication timeout, the number of retries, and the server key size.
5. *Enable SSH Service* – On the SSH Settings page, enable the SSH server on the switch.
6. *Authentication* – One of the following authentication methods is employed:
 - Password Authentication (for SSH v1.5 or V2 Clients)*
 - a. The client sends its password to the server.
 - b. The switch compares the client's password to those stored in memory.
 - c. If a match is found, the connection is allowed.



Note: To use SSH with only password authentication, the host public key must still be given to the client, either during initial connection or manually entered into the known host file. However, you do not need to configure the client's keys.

Public Key Authentication – When an SSH client attempts to contact the switch, the SSH server uses the host key pair to negotiate a session key and encryption method. Only clients that have a private key corresponding to the public keys stored on the switch can access it. The following exchanges take place during this process:

Authenticating SSH v1.5 Clients

- a.** The client sends its RSA public key to the switch.
- b.** The switch compares the client's public key to those stored in memory.
- c.** If a match is found, the switch uses its secret key to generate a random 256-bit string as a challenge, encrypts this string with the user's public key, and sends it to the client.
- d.** The client uses its private key to decrypt the challenge string, computes the MD5 checksum, and sends the checksum back to the switch.
- e.** The switch compares the checksum sent from the client against that computed for the original string it sent. If the two checksums match, this means that the client's private key corresponds to an authorized public key, and the client is authenticated.

Authenticating SSH v2 Clients

- a.** The client first queries the switch to determine if DSA public key authentication using a preferred algorithm is acceptable.
- b.** If the specified algorithm is supported by the switch, it notifies the client to proceed with the authentication process. Otherwise, it rejects the request.
- c.** The client sends a signature generated using the private key to the switch.
- d.** When the server receives this message, it checks whether the supplied key is acceptable for authentication, and if so, it then checks whether the signature is correct. If both checks succeed, the client is authenticated.



Note: The SSH server supports up to eight client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

Note: The SSH server can be accessed using any configured IPv4 or IPv6 interface address on the switch.

Configuring the SSH Server

Use the Security > SSH (Configure Global) page to enable the SSH server and configure basic settings for authentication.



Note: You must generate DSA and RSA host keys before enabling the SSH server. See [“Generating the Host Key Pair” on page 258](#).

Parameters

These parameters are displayed:

- ◆ **SSH Server Status** – Allows you to enable/disable the SSH server on the switch. (Default: Disabled)
- ◆ **Version** – The Secure Shell version number. Version 2.0 is displayed, but the switch supports management access via either SSH Version 1.5 or 2.0 clients.
- ◆ **Authentication Timeout** – Specifies the time interval in seconds that the SSH server waits for a response from a client during an authentication attempt. (Range: 1-120 seconds; Default: 120 seconds)
- ◆ **Authentication Retries** – Specifies the number of authentication attempts that a client is allowed before authentication fails and the client has to restart the authentication process. (Range: 1-5 times; Default: 3)
- ◆ **Server-Key Size** – Specifies the SSH server key size. (Range: 512-896 bits; Default:768)
 - The server key is a private key that is never shared outside the switch.
 - The host key is shared with the SSH client, and is fixed at 1024 bits.

Web Interface

To configure the SSH server:

1. Click Security, SSH.
2. Select Configure Global from the Step list.
3. Enable the SSH server.
4. Adjust the authentication parameters as required.
5. Click Apply.

Figure 163: Configuring the SSH Server

The screenshot shows a web interface for configuring the SSH server. The breadcrumb is "Security > SSH". A dropdown menu shows "Step: 1. Configure Global". The configuration table is as follows:

SSH Server Status	<input checked="" type="checkbox"/> Enabled
Version	2.0
Authentication Timeout (1-120)	<input type="text" value="120"/> sec
Authentication Retries (1-5)	<input type="text" value="3"/>
Server-Key Size (512-896)	<input type="text" value="768"/>

At the bottom right, there are "Apply" and "Revert" buttons.

Generating the Host Key Pair Use the Security > SSH (Configure Host Key - Generate) page to generate a host public/private key pair used to provide secure communications between an SSH client and the switch. After generating this key pair, you must provide the host public key to SSH clients and import the client's public key to the switch as described in the section "Importing User Public Keys" on page 259.



Note: A host key pair must be configured on the switch before you can enable the SSH server. See "Configuring the SSH Server" on page 256.

Parameters

These parameters are displayed:

- ◆ **Host-Key Type** – The key type used to generate the host key pair (i.e., public and private keys). (Range: RSA (Version 1), DSA (Version 2), Both; Default: Both)
The SSH server uses RSA or DSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either DES (56-bit) or 3DES (168-bit) for data encryption.



Note: The switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 for SSHv2 clients.

- ◆ **Save** – Saves the host key from RAM (i.e., volatile memory) to flash memory. Otherwise, the host key pair is stored to RAM by default. Note that you must select this item from the Show page. (Default: Disabled)

Web Interface

To generate the SSH host key pair:

1. Click Security, SSH.
2. Select Configure Host Key from the Step list.
3. Select Generate from the Action list.
4. Select the host-key type from the drop-down box.
5. Click Apply.

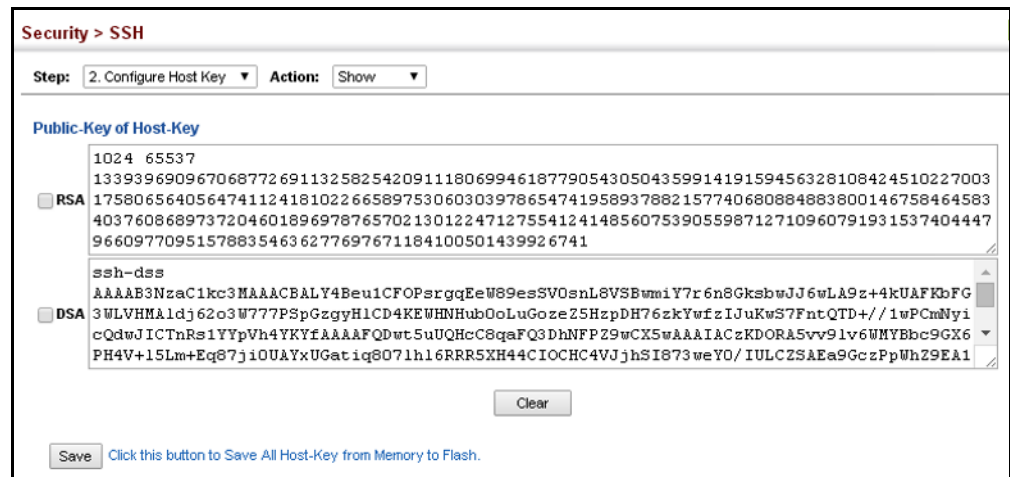
Figure 164: Generating the SSH Host Key Pair

The screenshot shows the 'Security > SSH' configuration page. At the top, the breadcrumb 'Security > SSH' is displayed. Below it, there are two dropdown menus: 'Step:' set to '2. Configure Host Key' and 'Action:' set to 'Generate'. Underneath, the 'Host-Key Type' is set to 'Both' in a dropdown menu. At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

To display or clear the SSH host key pair:

1. Click Security, SSH.
2. Select Configure Host Key from the Step list.
3. Select Show from the Action list.
4. Select the option to save the host key from memory to flash by clicking Save, or select the host-key type to clear and click Clear.

Figure 165: Showing the SSH Host Key Pair



Importing User Public Keys

Use the Security > SSH (Configure User Key - Copy) page to upload a user's public key to the switch. This public key must be stored on the switch for the user to be able to log in using the public key authentication mechanism. If the user's public key does not exist on the switch, SSH will revert to the interactive password authentication mechanism to complete authentication.

Parameters

These parameters are displayed:

- ◆ **User Name** – This drop-down box selects the user who's public key you wish to manage. Note that you must first create users on the User Accounts page (see ["Configuring User Accounts" on page 241](#)).
- ◆ **User Key Type** – The type of public key to upload.
 - RSA: The switch accepts a RSA version 1 encrypted public key.
 - DSA: The switch accepts a DSA version 2 encrypted public key.

The SSH server uses RSA or DSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either DES (56-bit) or 3DES (168-bit) for data encryption.

The switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 for SSHv2 clients.

- ◆ **TFTP Server IP Address** – The IP address of the TFTP server that contains the public key file you wish to import.
- ◆ **Source File Name** – The public key file to upload.

Web Interface

To copy the SSH user's public key:

1. Click Security, SSH.
2. Select Configure User Key from the Step list.
3. Select Copy from the Action list.
4. Select the user name and the public-key type from the respective drop-down boxes, input the TFTP server IP address and the public key source file name.
5. Click Apply.

Figure 166: Copying the SSH User's Public Key

The screenshot shows a web interface for configuring SSH settings. The breadcrumb is "Security > SSH". The "Step" dropdown is set to "3. Configure User Key" and the "Action" dropdown is set to "Copy". The form contains the following fields:

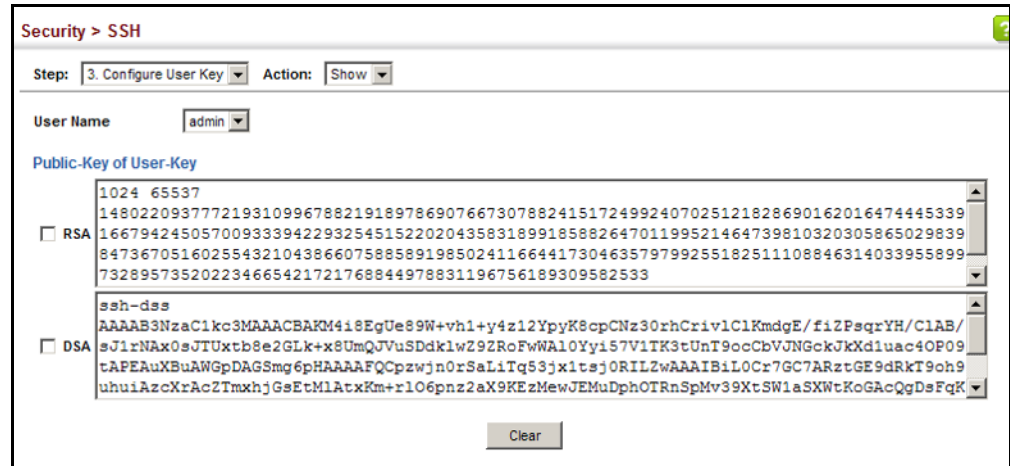
User Name	steve
User-Key Type	RSA
TFTP Server IP Address	192.168.0.61
Source File Name	rsa.pub

At the bottom right of the form are two buttons: "Apply" and "Revert".

To display or clear the SSH user's public key:

1. Click Security, SSH.
2. Select Configure User Key from the Step list.
3. Select Show from the Action list.
4. Select a user from the User Name list.
5. Select the host-key type to clear.
6. Click Clear.

Figure 167: Showing the SSH User's Public Key



Access Control Lists

Access Control Lists (ACL) provide packet filtering for IPv4/IPv6 frames (based on address, protocol, Layer 4 protocol port number or TCP control code), IPv6 frames (based on address, DSCP traffic class, or next header type), or any frames (based on MAC address or Ethernet type). To filter incoming packets, first create an access list, add the required rules, and then bind the list to a specific port.

Configuring Access Control Lists –

An ACL is a sequential list of permit or deny conditions that apply to IP addresses, MAC addresses, or other more specific criteria. This switch tests ingress or egress packets against the conditions in an ACL one by one. A packet will be accepted as soon as it matches a permit rule, or dropped as soon as it matches a deny rule. If no rules match, the packet is accepted.

Command Usage

The following restrictions apply to ACLs:

- ◆ The maximum number of ACLs is 512.
- ◆ The maximum number of rules per system is 2048 rules.
- ◆ An ACL can have up to 2048 rules. However, due to resource restrictions, the average number of rules bound to the ports should not exceed 20.
- ◆ The maximum number of rules that can be bound to the ports is 64 for each of the following list types: MAC ACLs, IP ACLs (including Standard and Extended ACLs), IPv6 Standard ACLs, and IPv6 Extended ACLs.

The maximum number of rules (Access Control Entries, or ACEs) stated above is the worst case scenario. In practice, the switch compresses the ACEs in TCAM (a hardware table used to store ACEs), but the actual maximum number of ACEs

possible depends on too many factors to be precisely determined. It depends on the amount of hardware resources reserved at runtime for this purpose.

Auto ACE Compression is a software feature used to compress all the ACEs of an ACL to utilize hardware resources more efficiency. Without compression, one ACE would occupy a fixed number of entries in TCAM. So if one ACL includes 25 ACEs, the ACL would need $(25 * n)$ entries in TCAM, where "n" is the fixed number of TCAM entries needed for one ACE. When compression is employed, before writing the ACE into TCAM, the software compresses the ACEs to reduce the number of required TCAM entries. For example, one ACL may include 128 ACEs which classify a continuous IP address range like 192.168.1.0~255. If compression is disabled, the ACL would occupy $(128*n)$ entries of TCAM, using up nearly all of the hardware resources. When using compression, the 128 ACEs are compressed into one ACE classifying the IP address as 192.168.1.0/24, which requires only "n" entries in TCAM. The above example is an ideal case for compression. The worst case would be if no any ACE can be compressed, in which case the used number of TCAM entries would be the same as without compression. It would also require more time to process the ACEs.

- ◆ If no matches are found down to the end of the list, the traffic is denied. For this reason, frequently hit entries should be placed at the top of the list. There is an implied deny for traffic that is not explicitly permitted. Also, note that a single-entry ACL with only one deny entry has the effect of denying all traffic. You should therefore use at least one permit statement in an ACL or all traffic will be blocked.

Because the switch stops testing after the first match, the order of the conditions is critical. If no conditions match, the packet will be denied.

The order in which active ACLs are checked is as follows:

1. User-defined rules in IP and MAC ACLs for ingress or egress ports are checked in parallel.
2. Rules within an ACL are checked in the configured order, from top to bottom.
3. If the result of checking an IP ACL is to permit a packet, but the result of a MAC ACL on the same packet is to deny it, the packet will be denied (because the decision to deny a packet has a higher priority for security reasons). A packet will also be denied if the IP ACL denies it and the MAC ACL accepts it.

Showing TCAM Utilization

Use the Security > ACL (Configure ACL - Show TCAM) page to show utilization parameters for TCAM (Ternary Content Addressable Memory), including the number policy control entries in use, the number of free entries, and the overall percentage of TCAM in use.

Command Usage

Policy control entries (PCEs) are used by various system functions which rely on rule-based searches, including Access Control Lists (ACLs), IP Source Guard filter

rules, Quality of Service (QoS) processes, QinQ, MAC-based VLANs, VLAN translation, or traps.

For example, when binding an ACL to a port, each rule in an ACL will use two PCEs; and when setting an IP Source Guard filter rule for a port, the system will also use two PCEs.

Parameters

These parameters are displayed:

- ◆ **Pool Capability Code** – Abbreviation for processes shown in the TCAM List.
- ◆ **Unit** – Stack unit identifier.
- ◆ **Device** – Memory chip used for indicated pools.
- ◆ **Pool** – Rule slice (or call group). Each slice has a fixed number of rules that are used for the specified features.
- ◆ **Total** – The maximum number of policy control entries allocated to the each pool.
- ◆ **Used** – The number of policy control entries used by the operating system.
- ◆ **Free** – The number of policy control entries available for use.
- ◆ **Capability** – The processes assigned to each pool.

Web Interface

To show information on TCAM utilization:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Show TCAM from the Action list.

Figure 168: Showing TCAM Utilization

Security > ACL

Step: 2. Configure ACL Action: Show TCAM

Pool Capability Code:

AM - MAC ACL, A4 - IPv4 ACL, A6S - IPv6 Standard ACL,
A6E - IPv6 extended ACL, DM - MAC diffServ, D4 - IPv4 diffServ,
D6S - IPv6 standard diffServ, D6E - IPv6 extended diffServ,
I - IP source guard, C - CPU interface, L - Link local,
Reserved - Reserved, ALL - All supported function,

TCAM List Total: 12

Unit	Device	Pool	Total	Used	Free	Capability
1	0	0	64	0	64	A6S
1	0	1	64	0	64	A6E
1	0	2	128	0	128	A4
1	0	3	128	0	128	AM
1	0	4	64	0	64	D6S D6E
1	0	5	128	0	128	D4
1	0	6	128	0	128	DM
1	0	7	128	128	0	Reserved
1	0	8	64	64	0	I
1	0	9	64	64	0	C
1	0	10	64	64	0	Reserved
1	0	11	64	64	0	L

Setting the ACL Name and Type

Use the Security > ACL (Configure ACL - Add) page to create an ACL.

Parameters

These parameters are displayed:

- ◆ **ACL Name** – Name of the ACL. (Maximum length: 32 characters)
- ◆ **Type** – The following filter modes are supported:
 - **IP Standard:** IPv4 ACL mode filters packets based on the source IPv4 address.
 - **IP Extended:** IPv4 ACL mode filters packets based on the source or destination IPv4 address, as well as the protocol type and protocol port number. If the “TCP” protocol is specified, then you can also filter packets based on the TCP control code.
 - **IPv6 Standard:** IPv6 ACL mode filters packets based on the source IPv6 address.
 - **IPv6 Extended:** IPv6 ACL mode filters packets based on the source or destination IP address, as well as DSCP, and the next header type.
 - **MAC** – MAC ACL mode filters packets based on the source or destination MAC address and the Ethernet frame type (RFC 1060).
 - **ARP** – ARP ACL specifies static IP-to-MAC address bindings used for ARP inspection (see “ARP Inspection” on page 279).

Web Interface

To configure the name and type of an ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add from the Action list.
4. Fill in the ACL Name field, and select the ACL type.
5. Click Apply.

Figure 169: Creating an ACL

To show a list of ACLs:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Show from the Action list.

Figure 170: Showing a List of ACLs

<input type="checkbox"/>	ACL Name	Type
<input type="checkbox"/>	aclStandard1	IP Standard
<input type="checkbox"/>	aclStandard2	IP Standard
<input type="checkbox"/>	acExtended1	IP Extended
<input type="checkbox"/>	acExtended2	IP Extended
<input type="checkbox"/>	aclMAC1	MAC
<input type="checkbox"/>	aclMAC2	MAC
<input type="checkbox"/>	aclMAC2	MAC
<input type="checkbox"/>	aclIPv6Standard	IPv6 Standard
<input type="checkbox"/>	aclIPv6Extended	IPv6 Extended
<input type="checkbox"/>	aclARP	ARP

Configuring a Standard IPv4 ACL Use the Security > ACL (Configure ACL - Add Rule - IP Standard) page to configure a Standard IPv4 ACL.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Address Type** – Specifies the source IP address. Use “Any” to include all possible addresses, “Host” to specify a specific host address in the Address field, or “IP” to specify a range of addresses with the Address and Subnet Mask fields. (Options: Any, Host, IP; Default: Any)
- ◆ **Source IP Address** – Source IP address.
- ◆ **Source Subnet Mask** – A subnet mask containing four integers from 0 to 255, each separated by a period. The mask uses 1 bits to indicate “match” and 0 bits to indicate “ignore.” The mask is bitwise ANDed with the specified source IP address, and compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.
- ◆ **Time Range** – Name of a time range.

Web Interface

To add rules to an IPv4 Standard ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select IP Standard from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).
7. Select the address type (Any, Host, or IP).
8. If you select “Host,” enter a specific address. If you select “IP,” enter a subnet address and the mask for an address range.
9. Click Apply.

Figure 171: Configuring a Standard IPv4 ACL

The screenshot shows the 'Security > ACL' configuration page. At the top, it says 'Step: 2. Configure ACL' and 'Action: Add Rule'. Below that, there are radio buttons for 'Type': IP Standard (selected), IP Extended, MAC, IPv6 Standard, IPv6 Extended, and ARP. The 'Name' field is 'R&D'. The 'Action' dropdown is set to 'Permit'. The 'Address Type' dropdown is set to 'Host'. The 'Source IP Address' field contains '10.1.1.21' and the 'Source Subnet Mask' field contains '255.255.255.255'. There is a checked checkbox for 'Time-Range' and a dropdown for 'Time-Range' set to 'R&D'. At the bottom right, there are 'Apply' and 'Revert' buttons.

Configuring an Extended IPv4 ACL Use the Security > ACL (Configure ACL - Add Rule - IP Extended) page to configure an Extended IPv4 ACL.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Source/Destination Address Type** – Specifies the source or destination IP address type. Use “Any” to include all possible addresses, “Host” to specify a specific host address in the Address field, or “IP” to specify a range of addresses with the Address and Subnet Mask fields. (Options: Any, Host, IP; Default: Any)
- ◆ **Source/Destination IP Address** – Source or destination IP address.
- ◆ **Source/Destination Subnet Mask** – Subnet mask for source or destination address. (See the description for Subnet Mask on [page 266](#).)
- ◆ **Source/Destination Port** – Source/destination port number for the specified protocol type. (Range: 0-65535)
- ◆ **Source/Destination Port Bit Mask** – Decimal number representing the port bits to match. (Range: 0-65535)
- ◆ **Protocol** – Specifies the protocol type to match as TCP, UDP or Others, where others indicates a specific protocol number (0-255). (Options: TCP, UDP, Others; Default: Others)

The following items are under TCP

- **Control Code** – Decimal number (representing a bit string) that specifies flag bits in byte 14 of the TCP header. (Range: 0-63)
- **Control Code Bit Mask** – Decimal number representing the code bits to match. (Range: 0-63)

The control bit mask is a decimal number (for an equivalent binary bit mask) that is applied to the control code. Enter a decimal number, where the equivalent binary bit “1” means to match a bit and “0” means to ignore a bit. The following bits may be specified:

- 1 (fin) – Finish
- 2 (syn) – Synchronize
- 4 (rst) – Reset
- 8 (psh) – Push
- 16 (ack) – Acknowledgement
- 32 (urg) – Urgent pointer

For example, use the code value and mask below to catch packets with the following flags set:

- SYN flag valid, use control-code 2, control bit mask 2
 - Both SYN and ACK valid, use control-code 18, control bit mask 18
 - SYN valid and ACK invalid, use control-code 2, control bit mask 18
- ◆ **Service Type** – Packet priority settings based on the following criteria:
- **Precedence** – IP precedence level. (Range: 0-7)
 - **DSCP** – DSCP priority level. (Range: 0-63)
- ◆ **Time Range** – Name of a time range.

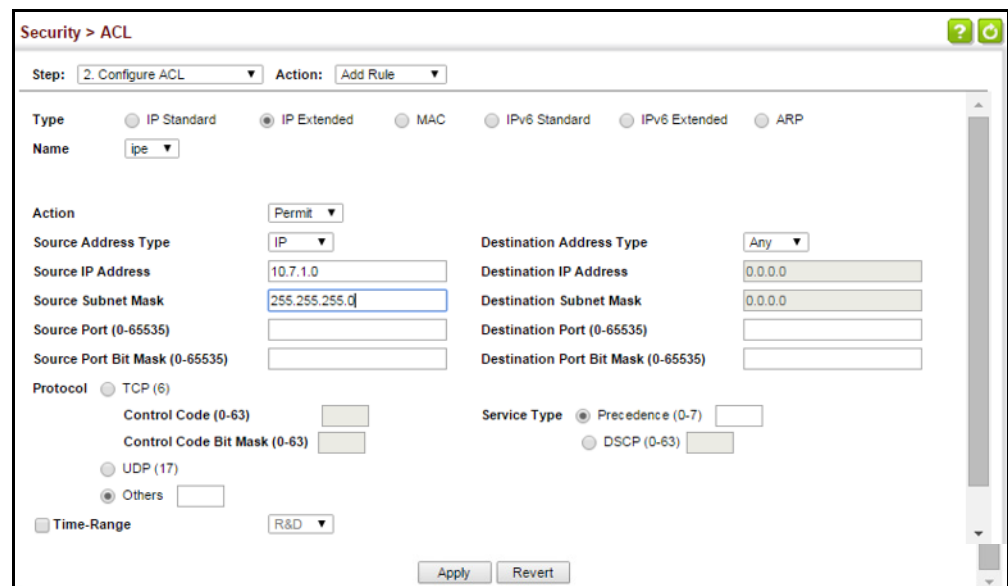
Web Interface

To add rules to an IPv4 Extended ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select IP Extended from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).

7. Select the address type (Any, Host, or IP).
8. If you select "Host," enter a specific address. If you select "IP," enter a subnet address and the mask for an address range.
9. Set any other required criteria, such as service type, protocol type, or control code.
10. Click Apply.

Figure 172: Configuring an Extended IPv4 ACL



Configuring a Standard IPv6 ACL Use the Security > ACL (Configure ACL - Add Rule - IPv6 Standard) page to configure a Standard IPv6 ACL.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Source Address Type** – Specifies the source IP address. Use "Any" to include all possible addresses, "Host" to specify a specific host address in the Address field, or "IPv6-Prefix" to specify a range of addresses. (Options: Any, Host, IPv6-Prefix; Default: Any)
- ◆ **Source IPv6 Address** – An IPv6 source address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using

8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

- ◆ **Source Prefix-Length** – A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address). (Range: 0-128 bits)
- ◆ **Time Range** – Name of a time range.

Web Interface

To add rules to a Standard IPv6 ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select IPv6 Standard from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).
7. Select the source address type (Any, Host, or IPv6-prefix).
8. If you select “Host,” enter a specific address. If you select “IPv6-prefix,” enter a subnet address and the prefix length.
9. Click Apply.

Figure 173: Configuring a Standard IPv6 ACL

The screenshot shows the configuration page for a Standard IPv6 ACL. The breadcrumb is "Security > ACL". The "Step" is "2. Configure ACL" and the "Action" is "Add Rule". Under "Type", "IPv6 Standard" is selected. The "Name" is "R&D#6S". The "Action" is "Permit". The "Source Address Type" is "Host". The "Source IPv6 Address" is "2009:DB9:2229::79". The "Source Prefix Length (0-128)" is "128". The "Time-Range" checkbox is unchecked, and the "Time-Range" dropdown is "R&D". "Apply" and "Revert" buttons are at the bottom right.

Configuring an Extended IPv6 ACL Use the Security > ACL (Configure ACL - Add Rule - IPv6 Extended) page to configure an Extended IPv6 ACL.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Source Address Type** – Specifies the source IP address type. Use “Any” to include all possible addresses, “Host” to specify a specific host address in the Address field, or “IPv6-Prefix” to specify a range of addresses. (Options: Any, Host, IPv6-Prefix; Default: Any)
- ◆ **Destination Address Type** – Specifies the destination IP address type. Use “Any” to include all possible addresses, or “IPv6-Prefix” to specify a range of addresses. (Options: Any, IPv6-Prefix; Default: Any)
- ◆ **Source/Destination IPv6 Address** – An IPv6 address or network class. The address must be formatted according to RFC 2373 “IPv6 Addressing Architecture,” using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.
- ◆ **Source/Destination Prefix-Length** – A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128 bits for the source prefix; 0-8 bits for the destination prefix)
- ◆ **DSCP** – DSCP traffic class. (Range: 0-63)
- ◆ **Source Port** – Protocol⁶ source port number. (Range: 0-65535)
- ◆ **Source Port Bit Mask** – Decimal number representing the port bits to match. (Range: 0-65535)
- ◆ **Destination Port** – Protocol⁶ destination port number. (Range: 0-65535)
- ◆ **Destination Port Bit Mask** – Decimal number representing the port bits to match. (Range: 0-65535)
- ◆ **Next Header** – Identifies the type of header immediately following the IPv6 header. (Range: 0-255)

Optional internet-layer information is encoded in separate headers that may be placed between the IPv6 header and the upper-layer header in a packet. There

6. Includes TCP, UDP or other protocol types.

are a small number of such extension headers, each identified by a distinct Next Header value. IPv6 supports the values defined for the IPv4 Protocol field in RFC 1700, and includes these commonly used headers:

- 0 : Hop-by-Hop Options (RFC 2460)
- 6 : TCP Upper-layer Header (RFC 1700)
- 17 : UDP Upper-layer Header (RFC 1700)
- 43 : Routing (RFC 2460)
- 44 : Fragment (RFC 2460)
- 50 : Encapsulating Security Payload (RFC 2406)
- 51 : Authentication (RFC 2402)
- 60 : Destination Options (RFC 2460)

◆ **Time Range** – Name of a time range.

Web Interface

To add rules to an Extended IPv6 ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select IPv6 Extended from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).
7. Select the address type (Any or IPv6-prefix).
8. If you select “Host,” enter a specific address. If you select “IPv6-prefix,” enter a subnet address and prefix length.
9. Set any other required criteria, such as DSCP or next header type.
10. Click Apply.

Figure 174: Configuring an Extended IPv6 ACL

The screenshot shows the configuration interface for an ACL. The breadcrumb is 'Security > ACL'. The current step is '2. Configure ACL' and the action is 'Add Rule'. The configuration parameters are as follows:

- Action: Permit
- Source Address Type: Any
- Source IPv6 Address: ::
- Source Prefix Length (0-128): 0
- Destination Address Type: Any
- Destination IPv6 Address: ::
- Destination Prefix Length (0-128): 0
- DSCP (0-63):
- Next-Header (0-255):
- Source Port (0-65535):
- Source Port Bit Mask (0-65535):
- Destination Port (0-65535):
- Destination Port Bit Mask (0-65535):
- Time-Range: R&D

Buttons for 'Apply' and 'Revert' are located at the bottom right of the form.

Configuring a MAC ACL Use the Security > ACL (Configure ACL - Add Rule - MAC) page to configure a MAC ACL based on hardware addresses, packet format, and Ethernet type.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Source/Destination Address Type** – Use “Any” to include all possible addresses, “Host” to indicate a specific MAC address, or “MAC” to specify an address range with the Address and Bit Mask fields. (Options: Any, Host, MAC; Default: Any)
- ◆ **Source/Destination MAC Address** – Source or destination MAC address.
- ◆ **Source/Destination Bit Mask** – Hexadecimal mask for source or destination MAC address.
- ◆ **Packet Format** – This attribute includes the following packet types:
 - **Any** – Any Ethernet packet type.
 - **Untagged-eth2** – Untagged Ethernet II packets.
 - **Untagged-802.3** – Untagged Ethernet 802.3 packets.
 - **Tagged-eth2** – Tagged Ethernet II packets.

- **Tagged-802.3** – Tagged Ethernet 802.3 packets.
- ◆ **VID** – VLAN ID. (Range: 1-4094)
- ◆ **VID Bit Mask** – VLAN bit mask. (Range: 0-4095)
- ◆ **Ethernet Type** – This option can only be used to filter Ethernet II formatted packets. (Range: 0-ffff hex.)

A detailed listing of Ethernet protocol types can be found in RFC 1060. A few of the more common types include 0800 (IP), 0806 (ARP), 8137 (IPX).
- ◆ **Ethernet Type Bit Mask** – Protocol bit mask. (Range: 0-ffff hex)
- ◆ **CoS** – CoS value. (Range: 0-7, where 7 is the highest priority)
- ◆ **CoS Bit Mask** – CoS bitmask. (Range: 0-7)
- ◆ **Time Range** – Name of a time range.

Web Interface

To add rules to a MAC ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select MAC from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).
7. Select the address type (Any, Host, or MAC).
8. If you select "Host," enter a specific address (e.g., 11-22-33-44-55-66). If you select "MAC," enter a base address and a hexadecimal bit mask for an address range.
9. Set any other required criteria, such as VID, Ethernet type, or packet format.
10. Click Apply.

Figure 175: Configuring a MAC ACL

The screenshot shows the 'Security > ACL' configuration page. At the top, it indicates 'Step: 2. Configure ACL' and 'Action: Add Rule'. The 'Type' section has radio buttons for 'IP Standard', 'IP Extended', 'MAC' (selected), 'IPv6 Standard', 'IPv6 Extended', and 'ARP'. The 'Name' field contains 'mac'. The 'Action' dropdown is set to 'Permit'. The 'Source Address Type' and 'Destination Address Type' are both set to 'Any'. The 'Source MAC Address', 'Destination MAC Address', 'Source Bit Mask', and 'Destination Bit Mask' fields all contain '00-00-00-00-00-00'. The 'Packet Format' dropdown is set to 'Any'. There are input fields for 'VID (1-4094)', 'VID Bit Mask (0-4095)', 'CoS (0-7)', and 'CoS Bit Mask (0-7)'. The 'Ethernet Type' and 'Ethernet Type Bit Mask' fields have a note '(0000-FFFF, hexadecimal value)'. The 'Time-Range' checkbox is unchecked, and the 'R&D' dropdown is set to 'R&D'. 'Apply' and 'Revert' buttons are at the bottom.

Configuring an ARP ACL

Use the Security > ACL (Configure ACL - Add Rule - ARP) page to configure ACLs based on ARP message addresses. ARP Inspection can then use these ACLs to filter suspicious traffic (see [“Configuring Global Settings for ARP Inspection” on page 280](#)).

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to show in the Name list.
- ◆ **Name** – Shows the names of ACLs matching the selected type.
- ◆ **Action** – An ACL can contain any combination of permit or deny rules.
- ◆ **Packet Type** – Indicates an ARP request, ARP response, or either type. (Range: IP, Request, Response; Default: IP)
- ◆ **Source/Destination IP Address Type** – Specifies the source or destination IPv4 address. Use “Any” to include all possible addresses, “Host” to specify a specific host address in the Address field, or “IP” to specify a range of addresses with the Address and Mask fields. (Options: Any, Host, IP; Default: Any)
- ◆ **Source/Destination IP Address** – Source or destination IP address.
- ◆ **Source/Destination IP Subnet Mask** – Subnet mask for source or destination address. (See the description for Subnet Mask on [page 266](#).)

- ◆ **Source/Destination MAC Address Type** – Use “Any” to include all possible addresses, “Host” to indicate a specific MAC address, or “MAC” to specify an address range with the Address and Mask fields. (Options: Any, Host, MAC; Default: Any)
- ◆ **Source/Destination MAC Address** – Source or destination MAC address.
- ◆ **Source/Destination MAC Bit Mask** – Hexadecimal mask for source or destination MAC address.
- ◆ **Log** – Logs a packet when it matches the access control entry.

Web Interface

To add rules to an ARP ACL:

1. Click Security, ACL.
2. Select Configure ACL from the Step list.
3. Select Add Rule from the Action list.
4. Select ARP from the Type list.
5. Select the name of an ACL from the Name list.
6. Specify the action (i.e., Permit or Deny).
7. Select the packet type (Request, Response, All).
8. Select the address type (Any, Host, or IP).
9. If you select “Host,” enter a specific address (e.g., 11-22-33-44-55-66). If you select “IP,” enter a base address and a hexadecimal bit mask for an address range.
10. Enable logging if required.
11. Click Apply.

Figure 176: Configuring a ARP ACL

Binding a Port to an Access Control List After configuring ACLs, use the Security > ACL (Configure Interface – Configure) page to bind the ports that need to filter traffic to the appropriate ACLs.

Parameters

These parameters are displayed:

- ◆ **Type** – Selects the type of ACLs to bind to a port.
- ◆ **Port** – Port identifier. {Range: 1-10}
- ◆ **ACL** – ACL used for ingress packets.
- ◆ **Time Range** – Name of a time range.
- ◆ **Counter** – Enables counter for ACL statistics.

Web Interface

To bind an ACL to a port:

1. Click Security, ACL.
2. Select Configure Interface from the Step list.
3. Select Configure from the Action list.
4. Select IP, MAC or IPv6 from the Type options.
5. Select a port.

6. Select the name of an ACL from the ACL list.
7. Click Apply.

Figure 177: Binding a Port to an ACL

The screenshot shows the 'Security > ACL' configuration page. At the top, there is a breadcrumb 'Security > ACL'. Below it, the 'Step' is set to '3. Configure Interface' and the 'Action' is 'Configure'. The 'Type' section has three radio buttons: 'IP' (selected), 'MAC', and 'IPv6'. The 'Port' is set to '1'. Under the 'Ingress' section, there are four checkboxes: 'ACL' (checked), 'Time-Range' (checked), and 'Counter' (unchecked). Each checked checkbox has a dropdown menu with 'R&D' selected. At the bottom right, there are 'Apply' and 'Revert' buttons.

Showing ACL Hardware Counters Use the Security > ACL > Configure Interface (Show Hardware Counters) page to show statistics for ACL hardware counters.

Parameters

These parameters are displayed:

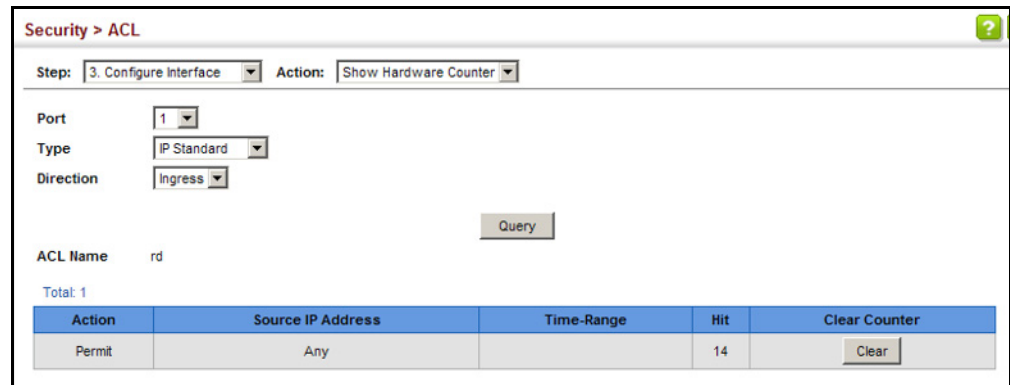
- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Type** – Selects the type of ACL.
- ◆ **Direction** – Displays statistics for ingress or egress traffic.
- ◆ **Query** – Displays statistics for selected criteria.
- ◆ **ACL Name** – The ACL bound this port.
- ◆ **Action** – Shows if action is to permit or deny specified packets.
- ◆ **Rules** – Shows the rules for the ACL bound to this port.
- ◆ **Time-Range** – Name of a time range.
- ◆ **Hit** – Shows the number of packets matching this ACL.
- ◆ **Clear Counter** – Clears the hit counter for the specified ACL.

Web Interface

To show statistics for ACL hardware counters:

1. Click Security, ACL.
2. Select Configure Interface from the Step list.
3. Select Show Hardware Counters from the Action list.
4. Select a port.
5. Select ingress or egress traffic.

Figure 178: Showing ACL Statistics



ARP Inspection

ARP Inspection is a security feature that validates the MAC Address bindings for Address Resolution Protocol packets. It provides protection against ARP traffic with invalid MAC-to-IP address bindings, which forms the basis for certain “man-in-the-middle” attacks. This is accomplished by intercepting all ARP requests and responses and verifying each of these packets before the local ARP cache is updated or the packet is forwarded to the appropriate destination. Invalid ARP packets are dropped.

ARP Inspection determines the validity of an ARP packet based on valid IP-to-MAC address bindings stored in a trusted database – the DHCP snooping binding database (see “[DHCP Snooping Global Configuration](#)” on page 302). This database is built by DHCP snooping if it is enabled on globally on the switch and on the required VLANs. ARP Inspection can also validate ARP packets against user-configured ARP access control lists (ACLs) for hosts with statically configured addresses (see “[Configuring an ARP ACL](#)” on page 275).

Command Usage

Enabling & Disabling ARP Inspection

- ◆ ARP Inspection is controlled on a global and VLAN basis.
- ◆ By default, ARP Inspection is disabled both globally and on all VLANs.
 - If ARP Inspection is globally enabled, then it becomes active only on the VLANs where it has been enabled.
 - When ARP Inspection is enabled globally, all ARP request and reply packets on inspection-enabled VLANs are redirected to the CPU and their switching behavior handled by the ARP Inspection engine.
 - If ARP Inspection is disabled globally, then it becomes inactive for all VLANs, including those where inspection is enabled.
 - When ARP Inspection is disabled, all ARP request and reply packets will bypass the ARP Inspection engine and their switching behavior will match that of all other packets.
 - Disabling and then re-enabling global ARP Inspection will not affect the ARP Inspection configuration of any VLANs.
 - When ARP Inspection is disabled globally, it is still possible to configure ARP Inspection for individual VLANs. These configuration changes will only become active after ARP Inspection is enabled globally again.
- ◆ The ARP Inspection engine in the current firmware version does not support ARP Inspection on trunk ports.

Configuring Global Settings for ARP Inspection

Use the Security > ARP Inspection (Configure General) page to enable ARP inspection globally for the switch, to validate address information in each packet, and configure logging.

Command Usage

ARP Inspection Validation

- ◆ By default, ARP Inspection Validation is disabled.
- ◆ Specifying at least one of the following validations enables ARP Inspection Validation globally. Any combination of the following checks can be active concurrently.
 - Destination MAC – Checks the destination MAC address in the Ethernet header against the target MAC address in the ARP body. This check is performed for ARP responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

- **IP** – Checks the ARP body for invalid and unexpected IP addresses. These addresses include 0.0.0.0, 255.255.255.255, and all IP multicast addresses. Sender IP addresses are checked in all ARP requests and responses, while target IP addresses are checked only in ARP responses.
- **Source MAC** – Checks the source MAC address in the Ethernet header against the sender MAC address in the ARP body. This check is performed on both ARP requests and responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

ARP Inspection Logging

- ◆ By default, logging is active for ARP Inspection, and cannot be disabled.
- ◆ The administrator can configure the log facility rate.
- ◆ When the switch drops a packet, it places an entry in the log buffer, then generates a system message on a rate-controlled basis. After the system message is generated, the entry is cleared from the log buffer.
- ◆ Each log entry contains flow information, such as the receiving VLAN, the port number, the source and destination IP addresses, and the source and destination MAC addresses.
- ◆ If multiple, identical invalid ARP packets are received consecutively on the same VLAN, then the logging facility will only generate one entry in the log buffer and one corresponding system message.
- ◆ If the log buffer is full, the oldest entry will be replaced with the newest entry.

Parameters

These parameters are displayed:

- ◆ **ARP Inspection Status** – Enables ARP Inspection globally. (Default: Disabled)
- ◆ **ARP Inspection Validation** – Enables extended ARP Inspection Validation if any of the following options are enabled. (Default: Disabled)
 - **Dst-MAC** – Validates the destination MAC address in the Ethernet header against the target MAC address in the body of ARP responses.
 - **IP** – Checks the ARP body for invalid and unexpected IP addresses. Sender IP addresses are checked in all ARP requests and responses, while target IP addresses are checked only in ARP responses.
 - **Allow Zeros** – Allows sender IP address to be 0.0.0.0.
 - **Src-MAC** – Validates the source MAC address in the Ethernet header against the sender MAC address in the ARP body. This check is performed on both ARP requests and responses.

- ◆ **Log Message Number** – The maximum number of entries saved in a log message. (Range: 0-256; Default: 5)
- ◆ **Log Interval** – The interval at which log messages are sent. (Range: 0-86400 seconds; Default: 1 second)

Web Interface

To configure global settings for ARP Inspection:

1. Click Security, ARP Inspection.
2. Select Configure General from the Step list.
3. Enable ARP inspection globally, enable any of the address validation options, and adjust any of the logging parameters if required.
4. Click Apply.

Figure 179: Configuring Global Settings for ARP Inspection

Security > ARP Inspection

Step: 1. Configure General

ARP Inspection Status Enabled

ARP Inspection Validation Dst-MAC IP Allow Zeros Src-MAC

Log Message Number (0-256)

Log Interval (0-86400) sec

Apply Revert

Configuring VLAN Settings for ARP Inspection

Use the Security > ARP Inspection (Configure VLAN) page to enable ARP inspection for any VLAN and to specify the ARP ACL to use.

Command Usage

ARP Inspection VLAN Filters (ACLs)

- ◆ By default, no ARP Inspection ACLs are configured and the feature is disabled.
- ◆ ARP Inspection ACLs are configured within the ARP ACL configuration page (see [page 275](#)).
- ◆ ARP Inspection ACLs can be applied to any configured VLAN.
- ◆ ARP Inspection uses the DHCP snooping bindings database for the list of valid IP-to-MAC address bindings. ARP ACLs take precedence over entries in the DHCP snooping bindings database. The switch first compares ARP packets to any specified ARP ACLs.

- ◆ If *Static* is specified, ARP packets are only validated against the selected ACL – packets are filtered according to any matching rules, packets not matching any rules are dropped, and the DHCP snooping bindings database check is bypassed.
- ◆ If *Static* is not specified, ARP packets are first validated against the selected ACL; if no ACL rules match the packets, then the DHCP snooping bindings database determines their validity.

Parameters

These parameters are displayed:

- ◆ **VLAN** – Identifier for configured VLANs.
- ◆ **DAI Status** – Enables Dynamic ARP Inspection for the selected VLAN. (Default: Disabled)
- ◆ **ACL Name** – Allows selection of any configured ARP ACLs. (Default: None)
- ◆ **Static** – When an ARP ACL is selected, and static mode also selected, the switch only performs ARP Inspection and bypasses validation against the DHCP Snooping Bindings database. When an ARP ACL is selected, but static mode is not selected, the switch first performs ARP Inspection and then validation against the DHCP Snooping Bindings database. (Default: Disabled)

Web Interface

To configure VLAN settings for ARP Inspection:

1. Click Security, ARP Inspection.
2. Select Configure VLAN from the Step list.
3. Enable ARP inspection for the required VLANs, select an ARP ACL filter to check for configured addresses, and select the Static option to bypass checking the DHCP snooping bindings database if required.
4. Click Apply.

Figure 180: Configuring VLAN Settings for ARP Inspection

Security > ARP Inspection

Step: 2. Configure VLAN

ARP Inspection VLAN List Total: 2

VLAN	DAI Status	ACL Name	ACL Status
1	<input type="checkbox"/> Enabled	<input type="checkbox"/> arp	<input type="checkbox"/> Static
2	<input type="checkbox"/> Enabled	<input type="checkbox"/> arp	<input type="checkbox"/> Static

Apply Revert

Configuring Interface Settings for ARP Inspection

Use the Security > ARP Inspection (Configure Interface) page to specify the ports that require ARP inspection, and to adjust the packet inspection rate.

Parameters

These parameters are displayed:

- ◆ **Interface** – Port or trunk identifier.
- ◆ **Trust Status** – Configures the port as trusted or untrusted. (Default: Untrusted)

By default, all untrusted ports are subject to ARP packet rate limiting, and all trusted ports are exempt from ARP packet rate limiting.

Packets arriving on trusted interfaces bypass all ARP Inspection and ARP Inspection Validation checks and will always be forwarded, while those arriving on untrusted interfaces are subject to all configured ARP inspection tests.

- ◆ **Packet Rate Limit** – Sets the maximum number of ARP packets that can be processed by CPU per second on trusted or untrusted ports. (Range: 0-2048; Default: 15)

Setting the rate limit to “0” means that there is no restriction on the number of ARP packets that can be processed by the CPU.

The switch will drop all ARP packets received on a port which exceeds the configured ARP-packets-per-second rate limit.

Web Interface

To configure interface settings for ARP Inspection:

1. Click Security, ARP Inspection.
2. Select Configure Interface from the Step list.
3. Specify any untrusted ports which require ARP inspection, and adjust the packet inspection rate.
4. Click Apply.

Figure 181: Configuring Interface Settings for ARP Inspection

Port	Trust Status	Packet Rate Limit (0-2048 pps)
1	<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> 15
2	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> 15
3	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> 15
4	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> 15
5	<input type="checkbox"/> Enabled	<input checked="" type="checkbox"/> 15

Displaying ARP Inspection Statistics Use the Security > ARP Inspection (Show Information - Show Statistics) page to display statistics about the number of ARP packets processed, or dropped for various reasons.

Parameters

These parameters are displayed:

Table 17: ARP Inspection Statistics

Parameter	Description
Received ARP packets before ARP inspection rate limit	Count of ARP packets received but not exceeding the ARP Inspection rate limit.
Dropped ARP packets in the process of ARP inspection rate limit	Count of ARP packets exceeding (and dropped by) ARP rate limiting.
ARP packets dropped by additional validation (IP)	Count of ARP packets that failed the IP address test.
ARP packets dropped by additional validation (Dst-MAC)	Count of packets that failed the destination MAC address test.
Total ARP packets processed by ARP inspection	Count of all ARP packets processed by the ARP Inspection engine.
ARP packets dropped by additional validation (Src-MAC)	Count of packets that failed the source MAC address test.
ARP packets dropped by ARP ACLs	Count of ARP packets that failed validation against ARP ACL rules.
ARP packets dropped by DHCP snooping	Count of packets that failed validation against the DHCP Snooping Binding database.

Web Interface

To display statistics for ARP Inspection:

1. Click Security, ARP Inspection.
2. Select Show Information from the Step list.
3. Select Show Statistics from the Action list.

Figure 182: Displaying Statistics for ARP Inspection

Security > ARP Inspection	
Step:	4. Show Information
Action:	Show Statistics
Received ARP packets before ARP inspection rate limit	1000
Dropped ARP packets in processing ARP inspection rate limit	5
Total ARP packets processed by ARP inspection	200
ARP packets dropped by additional validation (Src-MAC)	300
ARP packets dropped by additional validation (Dst-MAC)	2000
ARP packets dropped by additional validation (IP)	100
ARP packets dropped by ARP ACLs	5
ARP packets dropped by DHCP snooping	5

Displaying the ARP Inspection Log Use the Security > ARP Inspection (Show Information - Show Log) page to show information about entries stored in the log, including the associated VLAN, port, and address components.

Parameters

These parameters are displayed:

Table 18: ARP Inspection Log

Parameter	Description
VLAN ID	The VLAN where this packet was seen.
Port	The port where this packet was seen.
Src. IP Address	The source IP address in the packet.
Dst. IP Address	The destination IP address in the packet.
Src. MAC Address	The source MAC address in the packet.
Dst. MAC Address	The destination MAC address in the packet.

Web Interface

To display the ARP Inspection log:

1. Click Security, ARP Inspection.
2. Select Show Information from the Step list.
3. Select Show Log from the Action list.

Figure 183: Displaying the ARP Inspection Log

The screenshot shows the 'Security > ARP Inspection' configuration page. At the top, there are two dropdown menus: 'Step: 4. Show Information' and 'Action: Show Log'. Below this is a table titled 'ARP Inspection Log List' with a 'Total: 2' indicator. The table has six columns: VLAN ID, Port, Src. IP Address, Dst. IP Address, Src. MAC Address, and Dst. MAC Address. It contains two rows of data.

VLAN ID	Port	Src. IP Address	Dst. IP Address	Src. MAC Address	Dst. MAC Address
1	15	192.168.1.1	192.168.1.5	11-22-33-44-55-66	AA-BB-CC-DD-EE-FF
1	17	192.168.1.3	192.168.1.23	11-4E-33-75-55-BB	A0-3B-C9-DD-4E-1F

Filtering IP Addresses for Management Access

Use the Security > IP Filter page to create a list of up to 15 IP addresses or IP address groups that are allowed management access to the switch through the web interface, SNMP, or Telnet.

Command Usage

- ◆ The management interfaces are open to all IP addresses by default. Once you add an entry to a filter list, access to that interface is restricted to the specified addresses.
- ◆ If anyone tries to access a management interface on the switch from an invalid address, the switch will reject the connection, enter an event message in the system log, and send a trap message to the trap manager.
- ◆ IP address can be configured for SNMP, web and Telnet access respectively. Each of these groups can include up to five different sets of addresses, either individual addresses or address ranges.
- ◆ When entering addresses for the same group (i.e., SNMP, web or Telnet), the switch will not accept overlapping address ranges. When entering addresses for different groups, the switch will accept overlapping address ranges.
- ◆ You cannot delete an individual address from a specified range. You must delete the entire range, and reenter the addresses.
- ◆ You can delete an address range just by specifying the start address, or by specifying both the start address and end address.

Parameters

These parameters are displayed:

- ◆ **Mode**
 - **Web** – Configures IP address(es) for the web group.
 - **SNMP** – Configures IP address(es) for the SNMP group.

- **Telnet** – Configures IP address(es) for the Telnet group.
- **All** – Configures IP address(es) for all groups.
- ◆ **Start IP Address** – A single IP address, or the starting address of a range.
- ◆ **End IP Address** – The end address of a range.

Web Interface

To create a list of IP addresses authorized for management access:

1. Click Security, IP Filter.
2. Select Add from the Action list.
3. Select the management interface to filter (Web, SNMP, Telnet, All).
4. Enter the IP addresses or range of addresses that are allowed management access to an interface.
5. Click Apply

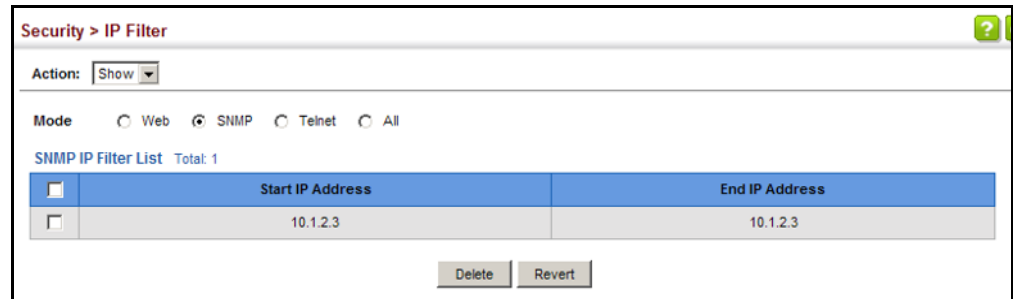
Figure 184: Creating an IP Address Filter for Management Access

The screenshot shows the 'Security > IP Filter' configuration page. At the top, there is a breadcrumb 'Security > IP Filter'. Below it, an 'Action:' dropdown menu is set to 'Add'. Underneath, the 'Mode' section has four radio buttons: 'Web' (selected), 'SNMP', 'Telnet', and 'All'. Below the mode selection, there are two text input fields: 'Start IP Address' containing '10.1.2.3' and an empty 'End IP Address' field. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show a list of IP addresses authorized for management access:

1. Click Security, IP Filter.
2. Select Show from the Action list.

Figure 185: Showing IP Addresses Authorized for Management Access



Configuring Port Security

Use the Security > Port Security page to configure the maximum number of device MAC addresses that can be learned by a switch port, stored in the address table, and authorized to access the network.

When port security is enabled on a port, the switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the address table will be authorized to access the network through that port. If a device with an unauthorized MAC address attempts to use the switch port, the intrusion will be detected and the switch can automatically take action by disabling the port and sending a trap message.

Command Usage

- ◆ The default maximum number of MAC addresses allowed on a secure port is zero (that is, disabled). To use port security, you must configure the maximum number of addresses allowed on a port.
- ◆ To configure the maximum number of address entries which can be learned on a port, and then specify the maximum number of dynamic addresses allowed. The switch will learn up to the maximum number of allowed address pairs <source MAC address, VLAN> for frames received on the port. When the port has reached the maximum number of MAC addresses, the port will stop learning new addresses. The MAC addresses already in the address table will be retained and will not be aged out.

Note that you can manually add additional secure addresses to a port using the Static Address Table ([page 157](#)).

- ◆ When the port security state is changed from enabled to disabled, all dynamically learned entries are cleared from the address table.
- ◆ If port security is enabled, and the maximum number of allowed addresses are set to a non-zero value, any device not in the address table that attempts to use the port will be prevented from accessing the switch.
- ◆ If a port is disabled (shut down) due to a security violation, it must be manually re-enabled from the Interface > Port > General page ([page 95](#)).
- ◆ A secure port has the following restrictions:
 - It cannot be used as a member of a static or dynamic trunk.
 - It should not be connected to a network interconnection device.
 - RSPAN and port security are mutually exclusive functions. If port security is enabled on a port, that port cannot be set as an RSPAN uplink port. Also, when a port is configured as an RSPAN uplink port, source port, or destination port, port security cannot be enabled on that port.

Parameters

These parameters are displayed:

- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Security Status** – Enables or disables port security on a port. (Default: Disabled)
- ◆ **Port Status** – The operational status:
 - Secure/Down – Port security is disabled.
 - Secure/Up – Port security is enabled.
 - Shutdown – Port is shut down due to a response to a port security violation.
- ◆ **Action** – Indicates the action to be taken when a port security violation is detected:
 - **None:** No action should be taken. (This is the default.)
 - **Trap:** Send an SNMP trap message.
 - **Shutdown:** Disable the port.
 - **Trap and Shutdown:** Send an SNMP trap message and disable the port.
- ◆ **Max MAC Count** – The maximum number of MAC addresses that can be learned on a port. (Range: 0 - 1024, where 0 means disabled)
The maximum address count is effective when port security is enabled or disabled.

- ◆ **Current MAC Count** – The number of MAC addresses currently associated with this interface.
- ◆ **MAC Filter** – Shows if MAC address filtering has been set under Security > Network Access (Configure MAC Filter) as described on [page 248](#).
- ◆ **MAC Filter ID** – The identifier for a MAC address filter.
- ◆ **Last Intrusion MAC** – The last unauthorized MAC address detected.
- ◆ **Last Time Detected Intrusion MAC** – The last time an unauthorized MAC address was detected.

Web Interface

To configure port security:

1. Click Security, Port Security.
2. Mark the check box in the Security Status column to enable security, set the action to take when an invalid address is detected on a port, and set the maximum number of MAC addresses allowed on the port.
3. Click Apply

Figure 186: Configuring Port Security

The screenshot shows the 'Security > Port Security' configuration page. It features a 'Port Security List' with a total of 26 ports. The table below displays the configuration for three specific ports.

Port	Security Status	Port Status	Action	Max MAC Count (0-1024)	Current MAC Count	MAC Filter	MAC Filter ID	Last Intrusion MAC	Last Time Detected Intrusion MAC
1	<input checked="" type="checkbox"/> Enabled	Secure/Down	Trap and Shutdown	0	1	Disabled	0	NA	NA
2	<input checked="" type="checkbox"/> Enabled	Secure/Down	Trap	0	0	Disabled	1	NA	NA
3	<input type="checkbox"/> Enabled	Secure/Down	None	0	0	Disabled	0	NA	NA

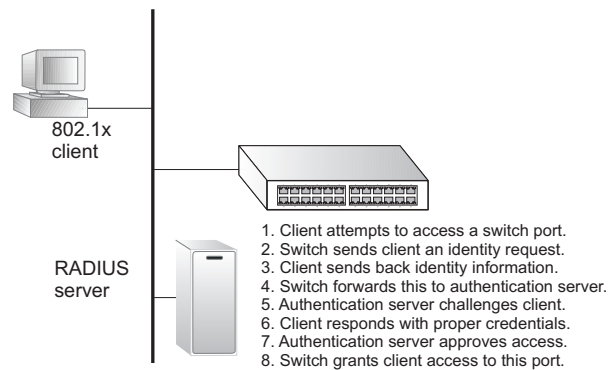
Configuring 802.1X Port Authentication

Network switches can provide open and easy access to network resources by simply attaching a client PC. Although this automatic configuration and access is a desirable feature, it also allows unauthorized personnel to easily intrude and possibly gain access to sensitive network data.

The IEEE 802.1X (dot1X) standard defines a port-based access control procedure that prevents unauthorized access to a network by requiring users to first submit credentials for authentication. Access to all switch ports in a network can be centrally controlled from a server, which means that authorized users can use the same credentials for authentication from any point within the network.

This switch uses the Extensible Authentication Protocol over LANs (EAPOL) to exchange authentication protocol messages with the client, and a remote RADIUS authentication server to verify user identity and access rights. When a client (i.e., Supplicant) connects to a switch port, the switch (i.e., Authenticator) responds with an EAPOL identity request. The client provides its identity (such as a user name) in an EAPOL response to the switch, which it forwards to the RADIUS server. The RADIUS server verifies the client identity and sends an access challenge back to the client. The EAP packet from the RADIUS server contains not only the challenge, but the authentication method to be used. The client can reject the authentication method and request another, depending on the configuration of the client software and the RADIUS server. The encryption method used to pass authentication messages can be MD5 (Message-Digest 5), TLS (Transport Layer Security), PEAP (Protected Extensible Authentication Protocol), or TTLS (Tunneled Transport Layer Security). The client responds to the appropriate method with its credentials, such as a password or certificate. The RADIUS server verifies the client credentials and responds with an accept or reject packet. If authentication is successful, the switch allows the client to access the network. Otherwise, non-EAP traffic on the port is blocked or assigned to a guest VLAN based on the “intrusion-action” setting. In “multi-host” mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.

Figure 187: Configuring Port Authentication



The operation of 802.1X on the switch requires the following:

- ◆ The switch must have an IP address assigned.
- ◆ RADIUS authentication must be enabled on the switch and the IP address of the RADIUS server specified.
- ◆ 802.1X must be enabled globally for the switch.
- ◆ Each switch port that will be used must be set to dot1X “Auto” mode.
- ◆ Each client that needs to be authenticated must have dot1X client software installed and properly configured.

- ◆ The RADIUS server and 802.1X client support EAP. (The switch only supports EAPOL in order to pass the EAP packets from the server to the client.)
- ◆ The RADIUS server and client also have to support the same EAP authentication type – MD5, PEAP, TLS, or TTLS. (Native support for these encryption methods is provided in Windows 8, 7, Vista and XP, and in Windows 2000 with Service Pack 4. To support these encryption methods in Windows 95 and 98, you can use the AEGIS dot1x client or other comparable client software)

Configuring 802.1X Global Settings

Use the Security > Port Authentication (Configure Global) page to configure IEEE 802.1X port authentication. The 802.1X protocol must be enabled globally for the switch system before port settings are active.

Parameters

These parameters are displayed:

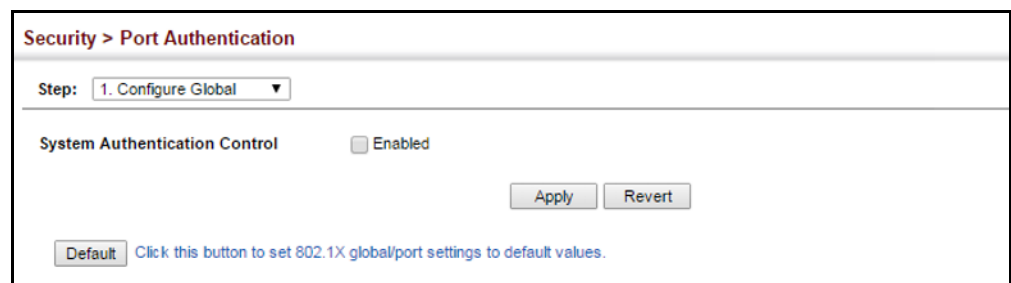
- ◆ **System Authentication Control** – Sets the global setting for 802.1X. (Default: Disabled)
- ◆ **Default** – Sets all configurable 802.1X global and port settings to their default values.

Web Interface

To configure global settings for 802.1X:

1. Click Security, Port Authentication.
2. Select Configure Global from the Step list.
3. Enable 802.1X globally for the switch.
4. Click Apply

Figure 188: Configuring Global Settings for 802.1X Port Authentication



Configuring Port Authenticator Settings for 802.1X

Use the Security > Port Authentication (Configure Interface – Authenticator) page to configure 802.1X port settings for the switch as the local authenticator. When 802.1X is enabled, you need to configure the parameters for the authentication process that runs between the client and the switch (i.e., authenticator), as well as the client identity lookup process that runs between the switch and authentication server.

Command Usage

- ◆ When the switch functions as a local authenticator between supplicant devices attached to the switch and the authentication server, configure the parameters for the exchange of EAP messages between the authenticator and clients on the Authenticator configuration page.
- ◆ This switch can be configured to serve as the authenticator on selected ports by setting the Control Mode to Auto on this configuration page, and as a supplicant on other ports by the setting the control mode to Force-Authorized on this page and enabling the PAE supplicant on the Supplicant configuration page.

Parameters

These parameters are displayed:

- ◆ **Port** – Port number.
- ◆ **Status** – Indicates if authentication is enabled or disabled on the port. The status is disabled if the control mode is set to Force-Authorized.
- ◆ **Authorized** – Displays the 802.1X authorization status of connected clients.
 - **Yes** – Connected client is authorized.
 - **N/A** – Connected client is not authorized, or port is not connected.
- ◆ **Control Mode** – Sets the authentication mode to one of the following options:
 - **Auto** – Requires a dot1x-aware client to be authorized by the authentication server. Clients that are not dot1x-aware will be denied access.
 - **Force-Authorized** – Forces the port to grant access to all clients, either dot1x-aware or otherwise. (This is the default setting.)
 - **Force-Unauthorized** – Forces the port to deny access to all clients, either dot1x-aware or otherwise.
- ◆ **Operation Mode** – Allows single or multiple hosts (clients) to connect to an 802.1X-authorized port. (Default: Single-Host)
 - **Single-Host** – Allows only a single host to connect to this port.

- **Multi-Host** – Allows multiple host to connect to this port.

In this mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.

- **MAC-Based** – Allows multiple hosts to connect to this port, with each host needing to be authenticated.

In this mode, each host connected to a port needs to pass authentication. The number of hosts allowed access to a port operating in this mode is limited only by the available space in the secure address table (i.e., up to 1024 addresses).

- ◆ **Max Count** – The maximum number of hosts that can connect to a port when the Multi-Host operation mode is selected. (Range: 1-1024; Default: 5)
- ◆ **Max Request** – Sets the maximum number of times the switch port will retransmit an EAP request packet to the client before it times out the authentication session. (Range: 1-10; Default 2)
- ◆ **Quiet Period** – Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client. (Range: 1-65535 seconds; Default: 60 seconds)
- ◆ **Tx Period** – Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet. (Range: 1-65535; Default: 30 seconds)
- ◆ **Supplicant Timeout** – Sets the time that a switch port waits for a response to an EAP request from a client before re-transmitting an EAP packet. (Range: 1-65535; Default: 30 seconds)

This command attribute sets the timeout for EAP-request frames other than EAP-request/identity frames. If dot1x authentication is enabled on a port, the switch will initiate authentication when the port link state comes up. It will send an EAP-request/identity frame to the client to request its identity, followed by one or more requests for authentication information. It may also send other EAP-request frames to the client during an active connection as required for reauthentication.

- ◆ **Server Timeout** – Sets the time that a switch port waits for a response to an EAP request from an authentication server before re-transmitting an EAP packet. (Default: 0 seconds)

A RADIUS server must be set before the correct operational value of 10 seconds will be displayed in this field. (See [“Configuring Remote Logon Authentication Servers”](#) on page 226.)

- ◆ **Re-authentication Status** – Sets the client to be re-authenticated after the interval specified by the Re-authentication Period. Re-authentication can be used to detect if a new device is plugged into a switch port. (Default: Disabled)
- ◆ **Re-authentication Period** – Sets the time period after which a connected client must be re-authenticated. (Range: 1-65535 seconds; Default: 3600 seconds)
- ◆ **Re-authentication Max Retries** – The maximum number of times the switch port will retransmit an EAP request/identity packet to the client before it times out the authentication session. (Range: 1-10; Default: 2)
- ◆ **Intrusion Action** – Sets the port's response to a failed authentication.
 - **Block Traffic** – Blocks all non-EAP traffic on the port. (This is the default setting.)
 - **Guest VLAN** – All traffic for the port is assigned to a guest VLAN. The guest VLAN must be separately configured (See [“Configuring VLAN Groups” on page 142](#)) and mapped on each port (See [“Configuring Network Access for Ports” on page 246](#)).

Supplicant List

- ◆ **Supplicant** – MAC address of authorized client.

Authenticator PAE State Machine

- ◆ **State** – Current state (including initialize, disconnected, connecting, authenticating, authenticated, aborting, held, force_authorized, force_unauthorized).
- ◆ **Reauth Count** – Number of times connecting state is re-entered.
- ◆ **Current Identifier** – Identifier sent in each EAP Success, Failure or Request packet by the Authentication Server.

Backend State Machine

- ◆ **State** – Current state (including request, response, success, fail, timeout, idle, initialize).
- ◆ **Request Count** – Number of EAP Request packets sent to the Supplicant without receiving a response.
- ◆ **Identifier (Server)** – Identifier carried in the most recent EAP Success, Failure or Request packet received from the Authentication Server.

Reauthentication State Machine

- ◆ **State** – Current state (including initialize, reauthenticate).

Web Interface

To configure port authenticator settings for 802.1X:

1. Click Security, Port Authentication.
2. Select Configure Interface from the Step list.
3. Modify the authentication settings for each port as required.
4. Click Apply

Figure 189: Configuring Interface Settings for 802.1X Port Authenticator

The screenshot shows the 'Security > Port Authentication' configuration page. The 'Step' dropdown is set to '2. Configure Interface'. The 'Type' is 'Authenticator'. The 'Port' is '1'. The 'Status' is 'Disabled'. The 'Authorized' checkbox is checked. The 'Control Mode' is 'Force-Authorized'. The 'Operation Mode' is 'Single-Host'. The 'Max Count (1-1024)' is 5. The 'Max Request (1-10)' is 2. The 'Quiet Period (1-65535)' is 60 sec. The 'Tx Period (1-65535)' is 30 sec. The 'Supplicant Timeout (1-65535)' is 30 sec. The 'Server Timeout' is 0 sec. The 'Re-authentication Status' checkbox is unchecked. The 'Re-authentication Period (1-65535)' is 3600 sec. The 'Re-authentication Max Retries (1-10)' is 2. The 'Intrusion Action' is 'Block Traffic'.

Below the configuration fields is a 'Supplicant List' table with 1 total entry:

Supplicant	Authenticator PAE State Machine			Backend State Machine		Reauthentication State Machine	
	State	Reauth Count	Current Identifier	State	Request Count	Identifier (Server)	State
00-00-00-00-00-00	Initialize	0	0	Initialize	0	0	Initialize

At the bottom of the page are 'Apply' and 'Revert' buttons.

Displaying 802.1X Statistics Use the Security > Port Authentication (Show Statistics) page to display statistics for dot1x protocol exchanges for any port.

Parameters

These parameters are displayed:

Table 19: 802.1X Statistics

Parameter	Description
<i>Authenticator</i>	
Rx EAPOL Start	The number of EAPOL Start frames that have been received by this Authenticator.
Rx EAPOL Logoff	The number of EAPOL Logoff frames that have been received by this Authenticator.
Rx EAPOL Invalid	The number of EAPOL frames that have been received by this Authenticator in which the frame type is not recognized.
Rx EAPOL Total	The number of valid EAPOL frames of any type that have been received by this Authenticator.
Rx Last EAPOLVer	The protocol version number carried in the most recent EAPOL frame received by this Authenticator.
Rx Last EAPOLSrc	The source MAC address carried in the most recent EAPOL frame received by this Authenticator.
Rx EAP Resp/Id	The number of EAP Resp/Id frames that have been received by this Authenticator.
Rx EAP Resp/Oth	The number of valid EAP Response frames (other than Resp/Id frames) that have been received by this Authenticator.
Rx EAP LenError	The number of EAPOL frames that have been received by this Authenticator in which the Packet Body Length field is invalid.
Tx EAP Req/Id	The number of EAP Req/Id frames that have been transmitted by this Authenticator.
Tx EAP Req/Oth	The number of EAP Request frames (other than Rq/Id frames) that have been transmitted by this Authenticator.
Tx EAPOL Total	The number of EAPOL frames of any type that have been transmitted by this Authenticator.
<i>Supplicant</i>	
Rx EAPOL Invalid	The number of EAPOL frames that have been received by this Supplicant in which the frame type is not recognized.
Rx EAPOL Total	The number of valid EAPOL frames of any type that have been received by this Supplicant.
Rx Last EAPOLVer	The protocol version number carried in the most recent EAPOL frame received by this Supplicant.
Rx Last EAPOLSrc	The source MAC address carried in the most recent EAPOL frame received by this Supplicant.
Rx EAP Resp/Id	The number of EAP Resp/Id frames that have been received by this Supplicant.
Rx EAP Resp/Oth	The number of valid EAP Response frames (other than Resp/Id frames) that have been received by this Supplicant.

Table 19: 802.1X Statistics (Continued)

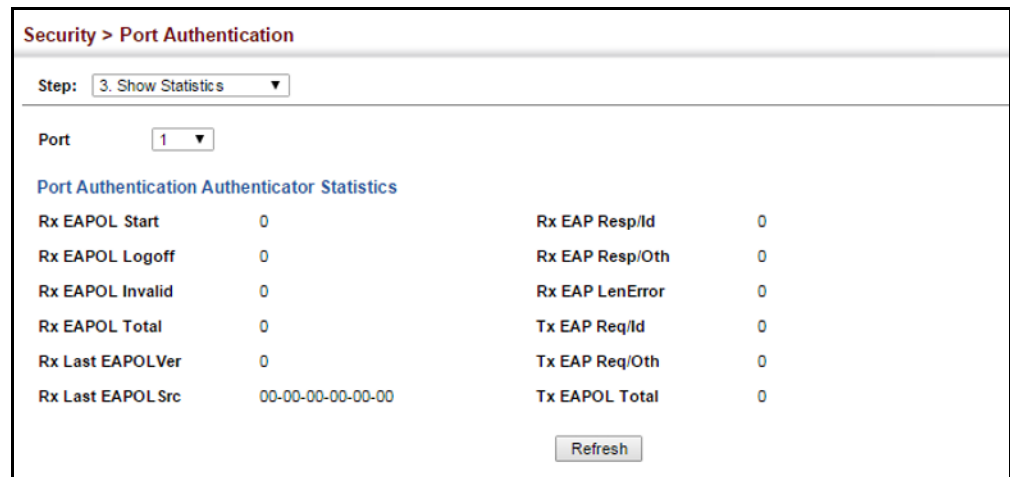
Parameter	Description
Rx EAP LenError	The number of EAPOL frames that have been received by this Supplicant in which the Packet Body Length field is invalid.
Tx EAPOL Total	The number of EAPOL frames of any type that have been transmitted by this Supplicant.
Tx EAPOL Start	The number of EAPOL Start frames that have been transmitted by this Supplicant.
Tx EAPOL Logoff	The number of EAPOL Logoff frames that have been transmitted by this Supplicant.
Tx EAP Req/Id	The number of EAP Req/Id frames that have been transmitted by this Supplicant.
Tx EAP Req/Oth	The number of EAP Request frames (other than Req/Id frames) that have been transmitted by this Supplicant.

Web Interface

To display port authenticator statistics for 802.1X:

1. Click Security, Port Authentication.
2. Select Show Statistics from the Step list.

Figure 190: Showing Statistics for 802.1X Port Authenticator



DHCP Snooping

The addresses assigned to DHCP clients on insecure ports can be carefully controlled using the dynamic bindings registered with DHCP Snooping (or using the static bindings configured with IP Source Guard). DHCP snooping allows a switch to protect a network from rogue DHCP servers or other devices which send port-related information to a DHCP server. This information can be useful in tracking an IP address back to a physical port.

Command Usage

DHCP Snooping Process

- ◆ Network traffic may be disrupted when malicious DHCP messages are received from an outside source. DHCP snooping is used to filter DHCP messages received on a non-secure interface from outside the network or fire wall. When DHCP snooping is enabled globally and enabled on a VLAN interface, DHCP messages received on an untrusted interface from a device not listed in the DHCP snooping table will be dropped.
- ◆ Table entries are only learned for trusted interfaces. An entry is added or removed dynamically to the DHCP snooping table when a client receives or releases an IP address from a DHCP server. Each entry includes a MAC address, IP address, lease time, VLAN identifier, and port identifier.
- ◆ The rate limit for the number of DHCP messages that can be processed by the switch is 100 packets per second. Any DHCP packets in excess of this limit are dropped.
- ◆ When DHCP snooping is enabled, DHCP messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCP snooping.
- ◆ Filtering rules are implemented as follows:
 - If the global DHCP snooping is disabled, all DHCP packets are forwarded.
 - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, all DHCP packets are forwarded for a *trusted* port. If the received packet is a DHCP ACK message, a dynamic DHCP snooping entry is also added to the binding table.
 - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is *not trusted*, it is processed as follows:
 - If the DHCP packet is a reply packet from a DHCP server (including OFFER, ACK or NAK messages), the packet is dropped.
 - If the DHCP packet is from a client, such as a DECLINE or RELEASE message, the switch forwards the packet only if the corresponding entry is found in the binding table.
 - If the DHCP packet is from a client, such as a DISCOVER, REQUEST, INFORM, DECLINE or RELEASE message, the packet is forwarded if MAC address verification is disabled. However, if MAC address verification is enabled, then the packet will only be forwarded if the client's hardware address stored in the DHCP packet is the same as the source MAC address in the Ethernet header.
 - If the DHCP packet is not a recognizable type, it is dropped.

- If a DHCP packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.
- If a DHCP packet is from server is received on a trusted port, it will be forwarded to both trusted and untrusted ports in the same VLAN.
- If the DHCP snooping is globally disabled, all dynamic bindings are removed from the binding table.
- *Additional considerations when the switch itself is a DHCP client* – The port(s) through which the switch submits a client request to the DHCP server must be configured as trusted. Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCP server. Also, when the switch sends out DHCP client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCP server, any packets received from untrusted ports are dropped.

DHCP Snooping Option 82

- ◆ DHCP provides a relay mechanism for sending information about its DHCP clients or the relay agent itself to the DHCP server. Also known as DHCP Option 82, it allows compatible DHCP servers to use the information when assigning IP addresses, or to set other services or policies for clients. It is also an effective tool in preventing malicious network attacks from attached clients on DHCP services, such as IP Spoofing, Client Identifier Spoofing, MAC Address Spoofing, and Address Exhaustion.
- ◆ DHCP Snooping must be enabled for Option 82 information to be inserted into request packets.
- ◆ When the DHCP Snooping Information Option 82 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server. This information may specify the MAC address or IP address of the requesting device (that is, the switch in this context).

By default, the switch also fills in the Option 82 circuit-id field with information indicating the local interface over which the switch received the DHCP client request, including the port and VLAN ID. This allows DHCP client-server exchange messages to be forwarded between the server and client without having to flood them to the entire VLAN.
- ◆ If DHCP Snooping Information Option 82 is enabled on the switch, information may be inserted into a DHCP request packet received over any VLAN (depending on DHCP snooping filtering rules). The information inserted into the relayed packets includes the circuit-id and remote-id, as well as the gateway Internet address.
- ◆ When the switch receives DHCP packets from clients that already include DHCP Option 82 information, the switch can be configured to set the action policy for

these packets. The switch can either drop the DHCP packets, keep the existing information, or replace it with the switch's relay information.

DHCP Snooping Global Configuration Use the Security > DHCP Snooping (Configure Global) page to enable DHCP Snooping globally on the switch, or to configure MAC Address Verification.

Parameters

These parameters are displayed:

General

- ◆ **DHCP Snooping Status** – Enables DHCP snooping globally. (Default: Disabled)
- ◆ **DHCP Snooping MAC-Address Verification** – Enables or disables MAC address verification. If the source MAC address in the Ethernet header of the packet is not same as the client's hardware address in the DHCP packet, the packet is dropped. (Default: Enabled)

Information

- ◆ **DHCP Snooping Information Option Status** – Enables or disables DHCP Option 82 information relay. (Default: Disabled)
- ◆ **DHCP Snooping Information Option Sub-option Format** – Enables or disables use of sub-type and sub-length fields in circuit-ID (CID) and remote-ID (RID) in Option 82 information. (Default: Enabled)
- ◆ **DHCP Snooping Information Option Remote ID** – Specifies the MAC address, IP address, or arbitrary identifier of the requesting device (i.e., the switch in this context).
 - **MAC Address** – Inserts a MAC address in the remote ID sub-option for the DHCP snooping agent (i.e., the MAC address of the switch's CPU). This attribute can be encoded in Hexadecimal or ASCII.
 - **IP Address** – Inserts an IP address in the remote ID sub-option for the DHCP snooping agent (i.e., the IP address of the management interface). This attribute can be encoded in Hexadecimal or ASCII.
 - *string* - An arbitrary string inserted into the remote identifier field. (Range: 1-32 characters)
- ◆ **DHCP Snooping Information Option Policy** – Specifies how to handle DHCP client request packets which already contain Option 82 information.
 - **Drop** – Drops the client's request packet instead of relaying it.
 - **Keep** – Retains the Option 82 information in the client request, and forwards the packets to trusted ports.
 - **Replace** – Replaces the Option 82 information circuit-id and remote-id fields in the client's request with information about the relay agent itself,

inserts the relay agent's address (when DHCP snooping is enabled), and forwards the packets to trusted ports. (This is the default policy.)

Web Interface

To configure global settings for DHCP Snooping:

1. Click Security, DHCP Snooping.
2. Select Configure Global from the Step list.
3. Select the required options for the general DHCP snooping process and for the DHCP snooping information option.
4. Click Apply

Figure 191: Configuring Global Settings for DHCP Snooping

The screenshot shows the configuration interface for DHCP Snooping. It is divided into two main sections: General and Information. In the General section, 'DHCP Snooping Status' is turned off, while 'DHCP Snooping MAC-Address Verification' is turned on. The Information section allows for further configuration of the DHCP Snooping Information Option, including its status (disabled), sub-option format (Extra Subtype Included), remote ID (MAC Address (Hex Encoded)), and policy (Replace). The interface includes 'Apply' and 'Revert' buttons at the bottom.

DHCP Snooping VLAN Configuration Use the Security > DHCP Snooping (Configure VLAN) page to enable or disable DHCP snooping on specific VLANs.

Command Usage

- ◆ When DHCP snooping is enabled globally on the switch, and enabled on the specified VLAN, DHCP packet filtering will be performed on any untrusted ports within the VLAN.
- ◆ When the DHCP snooping is globally disabled, DHCP snooping can still be configured for specific VLANs, but the changes will not take effect until DHCP snooping is globally re-enabled.
- ◆ When DHCP snooping is globally enabled, and DHCP snooping is then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of a configured VLAN. (Range: 1-4094)
- ◆ **DHCP Snooping Status** – Enables or disables DHCP snooping for the selected VLAN. When DHCP snooping is enabled globally on the switch, and enabled on the specified VLAN, DHCP packet filtering will be performed on any untrusted ports within the VLAN. (Default: Disabled)

Web Interface

To configure global settings for DHCP Snooping:

1. Click Security, DHCP Snooping.
2. Select Configure VLAN from the Step list.
3. Enable DHCP Snooping on any existing VLAN.
4. Click Apply

Figure 192: Configuring DHCP Snooping on a VLAN



Configuring Ports for DHCP Snooping Use the Security > DHCP Snooping (Configure Interface) page to configure switch ports as trusted or untrusted.

Command Usage

- ◆ A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or fire wall.
- ◆ When DHCP snooping is enabled both globally and on a VLAN, DHCP packet filtering will be performed on any untrusted ports within the VLAN.
- ◆ When an untrusted port is changed to a trusted port, all the dynamic DHCP snooping bindings associated with this port are removed.
- ◆ Set all ports connected to DHCP servers within the local network or fire wall to trusted state. Set all other ports outside the local network or fire wall to untrusted state.

Parameters

These parameters are displayed:

- ◆ **Trust Status** – Enables or disables a port as trusted. (Default: Disabled)
- ◆ **Max Number** – The maximum number of DHCP clients which can be supported per interface. (Range: 1-32; Default: 16)
- ◆ **Circuit ID** – Specifies DHCP Option 82 circuit ID suboption information.
 - **Mode** – Specifies the default string “VLAN-Unit-Port” or an arbitrary string. (Default: VLAN-Unit-Port)
 - **Value** – An arbitrary string inserted into the circuit identifier field. (Range: 1-32 characters)

Web Interface

To configure global settings for DHCP Snooping:

1. Click Security, DHCP Snooping.
2. Select Configure Interface from the Step list.
3. Display the list of ports or trunks.
4. Configure the trust status, maximum number of supported clients, and the circuit identifier.
5. Click Apply

Figure 193: Configuring the Port Mode for DHCP Snooping

The screenshot shows the 'Security > DHCP Snooping' configuration page. The 'Step' is set to '3. Configure Interface'. Under 'Interface', 'Port' is selected. Below this is a table titled 'DHCP Snooping Port List' with a total of 28 ports. The table has five columns: Port, Trust Status, Max Number (1 - 32), Mode, and Circuit ID Value. The first five rows are visible, each showing a port number, an 'Enabled' checkbox, a '16' in the Max Number field, and a 'VLAN-Unit-Port' dropdown in the Mode field. The Circuit ID Value field is empty for all rows.

Port	Trust Status	Max Number (1 - 32)	Circuit ID	
			Mode	Value
1	<input type="checkbox"/> Enabled	16	VLAN-Unit-Port	
2	<input type="checkbox"/> Enabled	16	VLAN-Unit-Port	
3	<input type="checkbox"/> Enabled	16	VLAN-Unit-Port	
4	<input type="checkbox"/> Enabled	16	VLAN-Unit-Port	
5	<input type="checkbox"/> Enabled	16	VLAN-Unit-Port	

Displaying DHCP Snooping Binding Information

Use the Security > DHCP Snooping (Show Information) page to display entries in the binding table.

Parameters

These parameters are displayed:

- ◆ **MAC Address** – Physical address associated with the entry.
- ◆ **IP Address** – IP address corresponding to the client.
- ◆ **Lease Time** – The time for which this IP address is leased to the client.
- ◆ **Type** – Entry types include:
 - **DHCP-Snooping** – Dynamically snooped.
 - **Static-DHCP-SNP** – Statically configured.
- ◆ **VLAN** – VLAN to which this entry is bound.
- ◆ **Interface** – Port or trunk to which this entry is bound.
- ◆ **Store** – Writes all dynamically learned snooping entries to flash memory. This function can be used to store the currently learned dynamic DHCP snooping entries to flash memory. These entries will be restored to the snooping table when the switch is reset. However, note that the lease time shown for a dynamic entry that has been restored from flash memory will no longer be valid.
- ◆ **Clear** – Removes all dynamically learned snooping entries from flash memory.

Web Interface

To display the binding table for DHCP Snooping:

1. Click Security, DHCP Snooping.
2. Select Show Information from the Step list.
3. Use the Store or Clear function if required.

Figure 194: Displaying the Binding Table for DHCP Snooping

The screenshot shows the 'Security > DHCP Snooping' configuration page. At the top, there is a 'Step:' dropdown menu set to '4. Show Information'. Below this is the 'DHCP Snooping Binding List' table, which has a 'Total: 6' label. The table has seven columns: a checkbox, MAC Address, IP Address, Lease Time (seconds), Type, VLAN, and Interface. There are six rows of data, each with a checkbox in the first column. Below the table are three buttons: 'Clear', 'Store To Flash', and 'Clear From Flash'.

<input type="checkbox"/>	MAC Address	IP Address	Lease Time (seconds)	Type	VLAN	Interface
<input type="checkbox"/>	00-10-B5-F4-00-01	10.2.44.96	5	DHCP-Snooping	1	Trunk 1
<input type="checkbox"/>	00-10-B5-F4-00-02	10.3.44.96	15	BOOTP-Snooping	1	Unit 1 / Port 2
<input type="checkbox"/>	00-10-B5-F4-00-03	10.4.44.96	25	DHCP-Snooping	1	Unit 1 / Port 3
<input type="checkbox"/>	00-10-B5-F4-00-04	10.5.44.96	10	BOOTP-Snooping	1	Trunk 4
<input type="checkbox"/>	00-10-B5-F4-00-05	10.6.44.96	10	DHCP-Snooping	1	Unit 1 / Port 5
<input type="checkbox"/>	00-10-B5-F4-00-06	10.7.44.96	5	BOOTP-Snooping	1	Unit 1 / Port 6

DoS Protection

Use the Security > DoS Protection page to protect against denial-of-service (DoS) attacks. A DoS attack is an attempt to block the services provided by a computer or network resource. This kind of attack tries to prevent an Internet site or service from functioning efficiently or at all. In general, DoS attacks are implemented by either forcing the target to reset, to consume most of its resources so that it can no longer provide its intended service, or to obstruct the communication media between the intended users and the target so that they can no longer communicate adequately. This section describes how to protect against DoS attacks.

Parameters

These parameters are displayed:

- ◆ **Smurf Attack** – Attacks in which a perpetrator generates a large amount of spoofed ICMP Echo Request traffic to the broadcast destination IP address (255.255.255.255), all of which uses a spoofed source address of the intended victim. The victim should crash due to the many interrupts required to send ICMP Echo response packets. (Default: Disabled)
- ◆ **TCP Null Scan** – A TCP NULL scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and no flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP NULL scan. (Default: Disabled)
- ◆ **TCP-SYN/FIN Scan** – A TCP SYN/FIN scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain SYN (synchronize) and FIN (finish) flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP SYN FIN scan. (Default: Disabled)

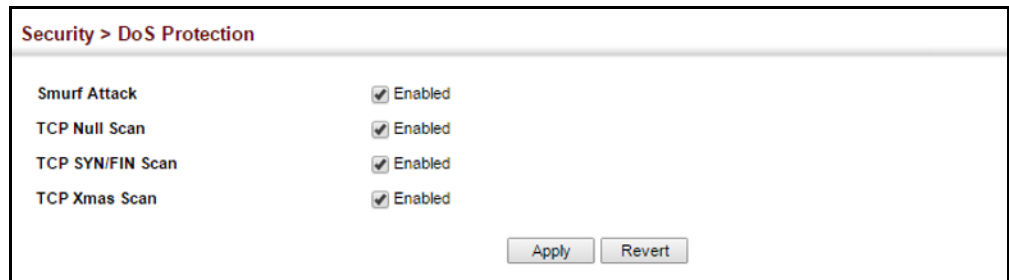
- ◆ **TCP Xmas Scan** – A so-called TCP XMAS scan message is used to identify listening TCP ports. This scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and the URG, PSH and FIN flags. If the target's TCP port is closed, the target replies with a TCP RST packet. If the target TCP port is open, it simply discards the TCP XMAS scan. (Default: Disabled)

Web Interface

To protect against DoS attacks:

1. Click Security, DoS Protection.
2. Enable protection for specific DoS attacks, and set the maximum allowed rate as required.
3. Click Apply

Figure 195: Protecting Against DoS Attacks



IPv4 Source Guard

IPv4 Source Guard is a security feature that filters IP traffic on network interfaces based on manually configured entries in the IP Source Guard table, or dynamic entries in the DHCP Snooping table when enabled (see ["DHCP Snooping" on page 299](#)). IP source guard can be used to prevent traffic attacks caused when a host tries to use the IPv4 address of a neighbor to access the network. This section describes how to configure IPv4 Source Guard.

Configuring Ports for IPv4 Source Guard

Use the Security > IP Source Guard > General page to set the filtering type based on source IP address, or source IP address and MAC address pairs. It also specifies lookup within the ACL binding table or the MAC address binding table, as well as the maximum number of allowed binding entries for the lookup tables.

IP Source Guard is used to filter traffic on an insecure port which receives messages from outside the network or fire wall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.

Command Usage

Filter Type

- ◆ Setting source guard mode to SIP (Source IP) or SIP-MAC (Source IP and MAC) enables this function on the selected port. Use the SIP option to check the VLAN ID, source IP address, and port number against all entries in the binding table. Use the SIP-MAC option to check these same parameters, plus the source MAC address. If no matching entry is found, the packet is dropped.



Note: Multicast addresses cannot be used by IP Source Guard.

- ◆ When enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping (see [“DHCP Snooping” on page 299](#)), or static addresses configured in the source guard binding table.
- ◆ If IP source guard is enabled, an inbound packet’s IP address (SIP option) or both its IP address and corresponding MAC address (SIP-MAC option) will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- ◆ An entry with same MAC address and a different VLAN ID cannot be added to the binding table.
- ◆ Filtering rules are implemented as follows:
 - If DHCP snooping is disabled (see [page 302](#)), IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the SIP-MAC option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, the packet will be forwarded.
 - If DHCP snooping is enabled, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the SIP-MAC option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, or dynamic DHCP snooping binding, the packet will be forwarded.
 - If IP source guard is enabled on an interface for which IP source bindings have not yet been configured (neither by static configuration in the IP source guard binding table nor dynamically learned from DHCP snooping), the switch will drop all IP traffic on that port, except for DHCP packets allowed by DHCP snooping.

Parameters

These parameters are displayed:

- ◆ **Filter Type** – Configures the switch to filter inbound traffic based source IP address, or source IP address and corresponding MAC address. (Default: None)
 - **Disabled** – Disables IP source guard filtering on the port.

- **SIP** – Enables traffic filtering based on IP addresses stored in the binding table.
- **SIP-MAC** – Enables traffic filtering based on IP addresses and corresponding MAC addresses stored in the binding table.
- ◆ **Filter Table** – Sets the source guard learning model to search for addresses in the ACL binding table or the MAC address binding table. (Default: ACL binding table)
- ◆ **Max Binding Entry** – The maximum number of entries that can be bound to an interface. (ACL Table: 1-5, Default: 5; MAC Table: 1-32, Default: 16)

This parameter sets the maximum number of address entries that can be mapped to an interface in the binding table, including both dynamic entries discovered by DHCP snooping (see “[DHCP Snooping](#)” on page 299) and static entries set by IP source guard (see “[Configuring Static Bindings for IPv4 Source Guard](#)” on page 311).

Web Interface

To set the IP Source Guard filter for ports:

1. Click Security, IP Source Guard, General.
2. Set the required filtering type, set the table type to use ACL or MAC address binding, and then set the maximum binding entries for each port.
3. Click Apply.

Figure 196: Setting the Filter Type for IPv4 Source Guard

Port	Filter Type	Filter Table	ACL Table Max Binding Entry (1-5)	MAC Table Max Binding Entry (1-32)
1	DISABLED ▼	ACL ▼	5	16
2	DISABLED ▼	ACL ▼	5	16
3	DISABLED ▼	ACL ▼	5	16
4	DISABLED ▼	ACL ▼	5	16
5	DISABLED ▼	ACL ▼	5	16
6	DISABLED ▼	ACL ▼	5	16

Configuring Static Bindings for IPv4 Source Guard

Use the Security > IP Source Guard > Static Binding (Configure ACL Table and Configure MAC Table) pages to bind a static address to a port. Table entries include a MAC address, IP address, lease time, entry type (Static, Dynamic), VLAN identifier, and port identifier. All static entries are configured with an infinite lease time, which is indicated with a value of zero in the table.

Command Usage

- ◆ Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding), VLAN identifier, and port identifier.
- ◆ Static addresses entered in the source guard binding table are automatically configured with an infinite lease time.
- ◆ When source guard is enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table.
- ◆ An entry with same MAC address and a different VLAN ID cannot be added to the binding table.
- ◆ Static bindings are processed as follows:
 - A valid static IP source guard entry will be added to the binding table in ACL mode if one of the following conditions is true:
 - If there is no entry with the same VLAN ID and MAC address, a new entry is added to the binding table using the type “static IP source guard binding.”
 - If there is an entry with the same VLAN ID and MAC address, and the type of entry is static IP source guard binding, then the new entry will replace the old one.
 - If there is an entry with the same VLAN ID and MAC address, and the type of the entry is dynamic DHCP snooping binding, then the new entry will replace the old one and the entry type will be changed to static IP source guard binding.
 - A valid static IP source guard entry will be added to the binding table in MAC mode if one of the following conditions are true:
 - If there is no binding entry with the same IP address and MAC address, a new entry will be added to the binding table using the type of static IP source guard binding entry.
 - If there is a binding entry with same IP address and MAC address, then the new entry shall replace the old one.
 - Only unicast addresses are accepted for static bindings.

Parameters

These parameters are displayed:

Add – Configure ACL Table

- ◆ **Port** – The port to which a static entry is bound.
- ◆ **VLAN** – ID of a configured VLAN (Range: 1-4094)
- ◆ **MAC Address** – A valid unicast MAC address.
- ◆ **IP Address** – A valid unicast IP address, including classful types A, B or C.

Add – Configure MAC Table

- ◆ **MAC Address** – A valid unicast MAC address.
- ◆ **VLAN** – ID of a configured VLAN or a range of VLANs. (Range: 1-4094)
- ◆ **IP Address** – A valid unicast IP address, including classful types A, B or C.
- ◆ **Port** – The port to which a static entry is bound. Specify a physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers. (Range: 1-10)

Show

- ◆ **MAC Address** – Physical address associated with the entry.
- ◆ **IP Address** – IP address corresponding to the client.
- ◆ **VLAN** – VLAN to which this entry is bound.
- ◆ **Interface** – The port to which this entry is bound.

Web Interface

To configure static bindings for IP Source Guard:

1. Click Security, IP Source Guard, Static Binding.
2. Select Configure ACL Table or Configure MAC Table from the Step list.
3. Select Add from the Action list.
4. Enter the required bindings for each port.
5. Click Apply

Figure 197: Configuring Static Bindings for IPv4 Source Guard

To display static bindings for IP Source Guard:

1. Click Security, IP Source Guard, Static Binding.
2. Select Configure ACL Table or Configure MAC Table from the Step list.
3. Select Show from the Action list.

Figure 198: Configuring Static Bindings for IPv4 Source Guard

Displaying Information for Dynamic IPv4 Source Guard Bindings

Use the Security > IP Source Guard > Dynamic Binding page to display the source-guard binding table for a selected interface.

Parameters

These parameters are displayed:

Query by

- ◆ **Port** – A port on this switch. (Range: 1-10)
- ◆ **VLAN** – ID of a configured VLAN (Range: 1-4094)
- ◆ **MAC Address** – A valid unicast MAC address.
- ◆ **IP Address** – A valid unicast IP address, including classful types A, B or C.

Dynamic Binding List

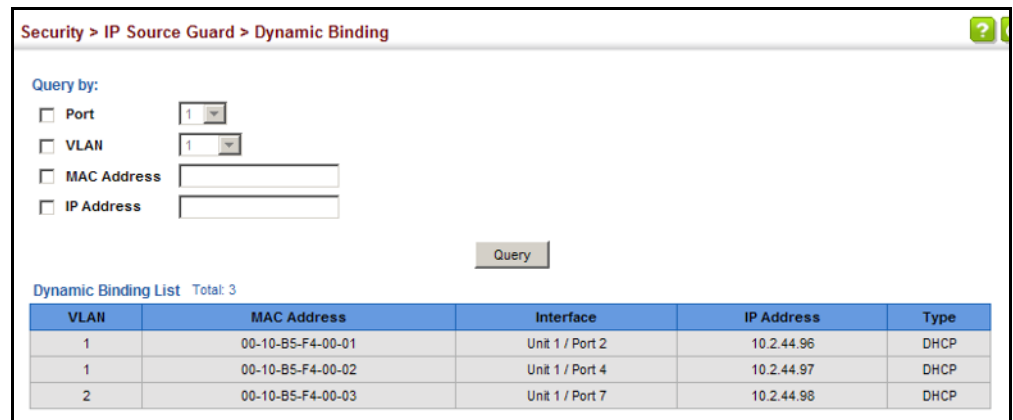
- ◆ **VLAN** – VLAN to which this entry is bound.
- ◆ **MAC Address** – Physical address associated with the entry.
- ◆ **Interface** – Port to which this entry is bound.
- ◆ **IP Address** – IP address corresponding to the client.
- ◆ **Type** – Entry types include DHCP-Snooping or BOOTP-Snooping.

Web Interface

To display the binding table for IP Source Guard:

1. Click Security, IP Source Guard, Dynamic Binding.
2. Mark the search criteria, and enter the required values.
3. Click Query

Figure 199: Showing the IPv4 Source Guard Binding Table



Security > IP Source Guard > Dynamic Binding

Query by:

Port

VLAN

MAC Address

IP Address

Query

Dynamic Binding List Total: 3

VLAN	MAC Address	Interface	IP Address	Type
1	00-10-B5-F4-00-01	Unit 1 / Port 2	10.2.44.96	DHCP
1	00-10-B5-F4-00-02	Unit 1 / Port 4	10.2.44.97	DHCP
2	00-10-B5-F4-00-03	Unit 1 / Port 7	10.2.44.98	DHCP

Basic Administration Protocols

This chapter describes basic administration tasks including:

- ◆ **Event Logging** – Sets conditions for logging event messages to system memory or flash memory, configures conditions for sending trap messages to remote log servers, and configures trap reporting to remote hosts using Simple Mail Transfer Protocol (SMTP).
- ◆ **Link Layer Discovery Protocol (LLDP)** – Configures advertisement of basic information about the local switch, or discovery of information about neighboring devices on the local broadcast domain.
- ◆ **Power over Ethernet⁷** – Sets the priority and power budget for each port.
- ◆ **Simple Network Management Protocol (SNMP)** – Configures switch management through SNMPv1, SNMPv2c or SNMPv3.
- ◆ **Remote Monitoring (RMON)** – Configures local collection of detailed statistics or events which can be subsequently retrieved through SNMP.
- ◆ **Time Range** – Sets a time range during which various functions are applied, including applied ACLs or PoE
- ◆ **Loopback Detection (LBD)** – Detects general loopback conditions caused by hardware problems or faulty protocol settings.

Configuring Event Logging

The switch allows you to control the logging of error messages, including the type of events that are recorded in switch memory, logging to a remote System Log (syslog) server, and displays a list of recent event messages.

System Log Configuration Use the Administration > Log > System (Configure Global) page to enable or disable event logging, and specify which levels are logged to RAM or flash memory.

Severe error messages that are logged to flash memory are permanently stored in the switch to assist in troubleshooting network problems. Up to 4096 log entries can be stored in the flash memory, with the oldest entries being overwritten first when the available log memory (256 kilobytes) has been exceeded.

The System Logs page allows you to configure and limit system messages that are logged to flash or RAM memory. The default is for event levels 0 to 3 to be logged to flash and levels 0 to 7 to be logged to RAM.

Parameters

These parameters are displayed:

- ◆ **System Log Status** – Enables/disables the logging of debug or error messages to the logging process. (Default: Enabled)
- ◆ **Flash Level** – Limits log messages saved to the switch’s permanent flash memory for all levels up to the specified level. For example, if level 3 is specified, all messages from level 0 to level 3 will be logged to flash. (Range: 0-7, Default: 3)

Table 20: Logging Levels

Level	Severity Name	Description
7	Debug	Debugging messages
6	Informational	Informational messages only
5	Notice	Normal but significant condition, such as cold start
4	Warning	Warning conditions (e.g., return false, unexpected return)
3	Error	Error conditions (e.g., invalid input, default used)
2	Critical	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
1	Alert	Immediate action needed
0	Emergency	System unusable

* There are only Level 2, 5 and 6 error messages for the current firmware release.

- ◆ **RAM Level** – Limits log messages saved to the switch’s temporary RAM memory for all levels up to the specified level. For example, if level 7 is specified, all messages from level 0 to level 7 will be logged to RAM. (Range: 0-7, Default: 7)



Note: The Flash Level must be equal to or less than the RAM Level.

Note: All log messages are retained in RAM and Flash after a warm restart (i.e., power is reset through the command interface).

Note: All log messages are retained in Flash and purged from RAM after a cold restart (i.e., power is turned off and then on through the power source).

- ◆ **Command Log Status** – Records the commands executed from the CLI, including the execution time and information about the CLI user including the user name, user interface (console port, telnet or SSH), and user IP address. The severity level for this record type is 6 (a number that indicates the facility used by the syslog server to dispatch log messages to an appropriate service).

Web Interface

To configure the logging of error messages to system memory:

1. Click Administration, Log, System.
2. Select Configure Global from the Step list.
3. Enable or disable system logging, set the level of event messages to be logged to flash memory and RAM.
4. Click Apply.

Figure 200: Configuring Settings for System Memory Logs

Administration > Log > System

Step: 1. Configure Global

System Log Status Enabled

Flash Level 3 - Error

RAM Level 7 - Debugging

Note: The Flash Level must be equal to or less than the RAM Level.

Apply Revert

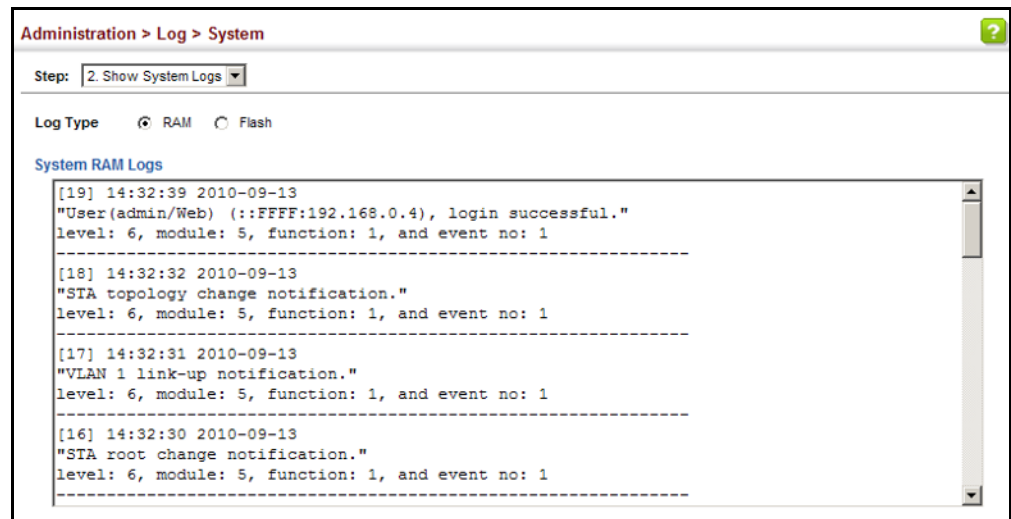
To show the error messages logged to system or flash memory:

1. Click Administration, Log, System.
2. Select Show System Logs from the Step list.

3. Click RAM to display log messages stored in system memory, or Flash to display messages stored in flash memory.

This page allows you to scroll through the logged system and event messages. The switch can store up to 2048 log entries in temporary random access memory (RAM; i.e., memory flushed on power reset) and up to 4096 entries in permanent flash memory.

Figure 201: Showing Error Messages Logged to System Memory



Remote Log Configuration

Use the Administration > Log > Remote page to send log messages to syslog servers or other management stations. You can also limit the event messages sent to only those messages below a specified level.

Parameters

These parameters are displayed:

- ◆ **Remote Log Status** – Enables/disables the logging of debug or error messages to the remote logging process. (Default: Disabled)
- ◆ **Logging Facility** – Sets the facility type for remote logging of syslog messages. There are eight facility types specified by values of 16 to 23. The facility type is used by the syslog server to dispatch log messages to an appropriate service.

The attribute specifies the facility type tag sent in syslog messages (see RFC 3164). This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to process messages, such as sorting or storing messages in the corresponding database. (Range: 16-23, Default: 23)
- ◆ **Logging Trap Level** – Limits log messages that are sent to the remote syslog server for all levels up to the specified level. For example, if level 3 is specified, all messages from level 0 to level 3 will be sent to the remote server. (Range: 0-7, Default: 7)

- ◆ **Server IP Address** – Specifies the IPv4 or IPv6 address of a remote server which will be sent syslog messages.
- ◆ **Port** - Specifies the UDP port number used by the remote server. (Range: 1-65535; Default: 514)

Web Interface

To configure the logging of error messages to remote servers:

1. Click Administration, Log, Remote.
2. Enable remote logging, specify the facility type to use for the syslog messages. and enter the IP address of the remote servers.
3. Click Apply.

Figure 202: Configuring Settings for Remote Logging of Error Messages

Administration > Log > Remote

Remote Log Status	<input type="checkbox"/> Enabled		
Logging Facility	23 - Local use 7		
Logging Trap Level	0 - System unusable		
Server IP Address 1	192.168.0.4	Port	514
Server IP Address 2		Port	
Server IP Address 3		Port	
Server IP Address 4		Port	
Server IP Address 5		Port	

Apply Revert

Sending Simple Mail Transfer Protocol Alerts

Use the Administration > Log > SMTP page to alert system administrators of problems by sending SMTP (Simple Mail Transfer Protocol) email messages when triggered by logging events of a specified level. The messages are sent to specified SMTP servers on the network and can be retrieved using POP or IMAP clients.

Parameters

These parameters are displayed:

- ◆ **SMTP Status** – Enables/disables the SMTP function. (Default: Enabled)
- ◆ **Severity** – Sets the syslog severity threshold level (see table on [page 316](#)) used to trigger alert messages. All events at this level or higher will be sent to the configured email recipients. For example, using Level 7 will report all events from level 7 to level 0. (Default: Level 7)

- ◆ **Email Source Address** – Sets the email address used for the “From” field in alert messages. You may use a symbolic email address that identifies the switch, or the address of an administrator responsible for the switch. (Range: 1-41 characters)
- ◆ **Email Destination Address** – Specifies the email recipients of alert messages. You can specify up to five recipients.
- ◆ **Server IP Address** – Specifies a list of up to three recipient SMTP servers. IPv4 or IPv6 addresses may be specified. The switch attempts to connect to the listed servers in sequential order if the first server fails to respond.

Web Interface

To configure SMTP alert messages:

1. Click Administration, Log, SMTP.
2. Enable SMTP, specify a source email address, and select the minimum severity level. Specify the source and destination email addresses, and one or more SMTP servers.
3. Click Apply.

Figure 203: Configuring SMTP Alert Messages

The screenshot shows the 'Administration > Log > SMTP' configuration page. It includes the following fields and controls:

- SMTP Status:** A checkbox labeled 'Enabled' which is checked.
- Severity:** A dropdown menu currently set to '3 - Error'.
- E-mail Source Address:** A text input field containing 'big-wheels@matel.com'.
- E-mail Destination Address 1:** A text input field containing 'chris@matel.com'.
- E-mail Destination Address 2:** An empty text input field.
- E-mail Destination Address 3:** An empty text input field.
- E-mail Destination Address 4:** An empty text input field.
- E-mail Destination Address 5:** An empty text input field.
- Server IP Address 1:** A text input field containing '192.168.1.4'.
- Server IP Address 2:** An empty text input field.
- Server IP Address 3:** An empty text input field.

At the bottom right of the form are two buttons: 'Apply' and 'Revert'.

Link Layer Discovery Protocol

Link Layer Discovery Protocol (LLDP) is used to discover basic information about neighboring devices on the local broadcast domain. LLDP is a Layer 2 protocol that uses periodic broadcasts to advertise information about the sending device. Advertised information is represented in Type Length Value (TLV) format according to the IEEE 802.1AB standard, and can include details such as device identification, capabilities and configuration settings. LLDP also defines how to store and maintain information gathered about the neighboring network nodes it discovers.

Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

Setting LLDP Timing Attributes

Use the Administration > LLDP (Configure Global) page to set attributes for general functions such as globally enabling LLDP on the switch, setting the message ageout time, and setting the frequency for broadcasting general advertisements or reports about changes in the LLDP MIB.

Parameters

These parameters are displayed:

- ◆ **LLDP** – Enables LLDP globally on the switch. (Default: Enabled)
- ◆ **Transmission Interval** – Configures the periodic transmit interval for LLDP advertisements. (Range: 5-32768 seconds; Default: 30 seconds)
- ◆ **Hold Time Multiplier** – Configures the time-to-live (TTL) value sent in LLDP advertisements as shown in the formula below. (Range: 2-10; Default: 4)

The time-to-live tells the receiving LLDP agent how long to retain all information pertaining to the sending LLDP agent if it does not transmit updates in a timely manner.

TTL in seconds is based on the following rule:
minimum value ((Transmission Interval * Holdtime Multiplier), or 65535)

Therefore, the default TTL is $4 * 30 = 120$ seconds.

- ◆ **Delay Interval** – Configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables. (Range: 1-8192 seconds; Default: 2 seconds)

The transmit delay is used to prevent a series of successive LLDP transmissions during a short period of rapid changes in local LLDP MIB objects, and to

increase the probability that multiple, rather than single changes, are reported in each transmission.

This attribute must comply with the rule:
 $(4 * \text{Delay Interval}) \leq \text{Transmission Interval}$

- ◆ **Reinitialization Delay** – Configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down. (Range: 1-10 seconds; Default: 2 seconds)

When LLDP is re-initialized on a port, all information in the remote systems LLDP MIB associated with this port is deleted.

- ◆ **Notification Interval** – Configures the allowed interval for sending SNMP notifications about LLDP MIB changes. (Range: 5-3600 seconds; Default: 5 seconds)

This parameter only applies to SNMP applications which use data stored in the LLDP MIB for network monitoring or management.

Information about changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a notification are included in the transmission. An SNMP agent should therefore periodically check the value of `IldpStatsRemTableLastChangeTime` to detect any `IldpRemTablesChange` notification-events missed due to throttling or transmission loss.

- ◆ **MED Fast Start Count** – Configures the amount of LLDP MED Fast Start LLDPDUs to transmit during the activation process of the LLDP-MED Fast Start mechanism. (Range: 1-10 packets; Default: 4 packets)

The MED Fast Start Count parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

Web Interface

To configure LLDP timing attributes:

1. Click Administration, LLDP.
2. Select Configure Global from the Step list.
3. Enable LLDP, and modify any of the timing parameters as required.
4. Click Apply.

Figure 204: Configuring LLDP Timing Attributes

Administration > LLDP

Step: 1. Configure Global

LLDP Enabled

Transmission Interval (5-32768) sec

Hold Time Multiplier (2-10)

Delay Interval (1-8192) sec

Reinitialization Delay (1-10) sec

Notification Interval (5-3600) sec

MED Fast Start Count (1-10)

Note: The Transmission Interval must be greater than or equal to 4 times the Delay Interval.

Apply Revert

Configuring LLDP Interface Attributes

Use the Administration > LLDP (Configure Interface - Configure General) page to specify the message attributes for individual interfaces, including whether messages are transmitted, received, or both transmitted and received, whether SNMP notifications are sent, and the type of information advertised.

Parameters

These parameters are displayed:

- ◆ **Admin Status** – Enables LLDP message transmit and receive modes for LLDP Protocol Data Units. (Options: Tx only, Rx only, TxRx, Disabled; Default: TxRx)
- ◆ **SNMP Notification** – Enables the transmission of SNMP trap notifications about LLDP and LLDP-MED changes. (Default: Enabled)

This option sends out SNMP trap notifications to designated target stations at the interval specified by the Notification Interval in the preceding section. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA-1057), or vendor-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.

For information on defining SNMP trap destinations, see [“Specifying Trap Managers”](#) on page 368.

Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of `IldpStatsRemTableLastChangeTime` to detect any `IldpRemTablesChange` notification-events missed due to throttling or transmission loss.

- ◆ **MED Notification** – Enables the transmission of SNMP trap notifications about LLDP-MED changes. (Default: Disabled)

◆ **Basic Optional TLVs** – Configures basic information included in the TLV field of advertised messages.

- **Management Address** – The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement. (Default: Enabled)

The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications in the performance of network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity MIB.

Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV.

Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV.

- **Port Description** – The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software. (Default: Enabled)
- **System Capabilities** – The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB. (Default: Enabled)
- **System Description** – The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software. (Default: Enabled)
- **System Name** – The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name. To configure the system name, see [“Displaying System Information” on page 62](#). (Default: Enabled)

◆ **802.1 Organizationally Specific TLVs** – Configures IEEE 802.1 information included in the TLV field of advertised messages.

- **Protocol Identity** – The protocols that are accessible through this interface (see [“Protocol VLANs” on page 148](#)). (Default: Enabled)

- **VLAN ID** – The port’s default VLAN identifier (PVID) indicates the VLAN with which untagged or priority-tagged frames are associated (see [“IEEE 802.1Q VLANs” on page 139](#)). (Default: Enabled)
 - **VLAN Name** – The name of all VLANs to which this interface has been assigned (see [“IEEE 802.1Q VLANs” on page 139](#)). (Default: Enabled)
 - **Port and Protocol VLAN ID** – The port-based protocol VLANs configured on this interface (see [“Protocol VLANs” on page 148](#)). (Default: Enabled)
- ◆ **802.3 Organizationally Specific TLVs** – Configures IEEE 802.3 information included in the TLV field of advertised messages.
- **Link Aggregation** – The link aggregation capabilities, aggregation status of the link, and the IEEE 802.3 aggregated port identifier if this interface is currently a link aggregation member. (Default: Enabled)
 - **Max Frame Size** – The maximum frame size. (See [“Configuring Support for Jumbo Frames” on page 64](#) for information on configuring the maximum frame size for this switch. (Default: Enabled)
 - **MAC/PHY Configuration/Status** – The MAC/PHY configuration and status which includes information about auto-negotiation support/capabilities, and operational Multistation Access Unit (MAU) type. (Default: Enabled)
 - **PoE⁸** – Power-over-Ethernet capabilities, including whether or not PoE is supported, currently enabled, if the port pins through which power is delivered can be controlled, the port pins selected to deliver power, and the power class. (Default: Enabled)
- ◆ **MED TLVs** – Configures general information included in the MED TLV field of advertised messages.
- **Capabilities** – This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch. (Default: Enabled)
 - **Extended Power⁸** – This option advertises extended Power-over-Ethernet capability details, such as power availability from the switch, and power state of the switch, including whether the switch is operating from primary or backup power (the Endpoint Device could use this information to decide to enter power conservation mode). (Default: Enabled)
 - **Inventory** – This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information. (Default: Enabled)
 - **Location** – This option advertises location identification details. (Default: Enabled)

- **Network Policy** – This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper network policy configurations frequently result in voice quality degradation or complete service disruption. (Default: Enabled)
- ◆ **MED-Location Civic Address** – Configures information for the location of the attached device included in the MED TLV field of advertised messages, including the country and the device type.
 - **Country** – The two-letter ISO 3166 country code in capital ASCII letters. (Example: DK, DE or US)
 - **Device entry refers to** – The type of device to which the location applies:
 - Location of DHCP server.
 - Location of network element closest to client.
 - Location of client. (This is the default.)

Web Interface

To configure LLDP interface attributes:

1. Click Administration, LLDP.
2. Select Configure Interface from the Step list.
3. Select Configure General from the Action list.
4. Select an interface from the Port or Trunk list.
5. Set the LLDP transmit/receive mode, specify whether or not to send SNMP trap messages, and select the information to advertise in LLDP messages.
6. Click Apply.

Figure 205: Configuring LLDP Interface Attributes

The screenshot shows the 'Administration > LLDP' configuration page. The 'Step' is '2. Configure Interface' and the 'Action' is 'Configure General'. The interface is set to 'Port 1'. Under 'Admin Status', 'Tx Rx' is selected. 'SNMP Notification' and 'MED Notification' are both disabled. Under 'Basic Optional TLVs', 'Management Address', 'Port Description', 'System Capabilities', 'System Description', and 'System Name' are all disabled. Under '802.1 Organizationally Specific TLVs', 'Protocol Identity', 'VLAN ID', 'VLAN Name', and 'Port and Protocol VLAN ID' are all enabled. Under '802.3 Organizationally Specific TLVs', 'Link Aggregation', 'Max Frame Size', 'MAC/PHY Configuration/Status', and 'PoE' are all disabled. Under 'MED TLVs', 'Capabilities', 'Extended Power', 'Inventory', 'Location', and 'Network Policy' are all disabled. The 'MED-Location Civic Address' section has 'Country' set to 'US' and 'Device entry refers to' set to 'Location of the client'. A note at the bottom states: 'Note: The country string shall be a two-letter ISO 3166 country code, e.g. US'. 'Apply' and 'Revert' buttons are at the bottom right.

Configuring LLDP Interface Civic-Address

Use the Administration > LLDP (Configure Interface – Add CA-Type) page to specify the physical location of the device attached to an interface.

Command Usage

- ◆ Use the Civic Address type (CA-Type) to advertise the physical location of the device attached to an interface, including items such as the city, street number, building and room information. The address location is specified as a type and value pair, with the civic address type defined in RFC 4776. The following table describes some of the CA type numbers and provides examples.

Table 21: LLDP MED Location CA Types

CA Type	Description	CA Value Example
1	National subdivisions (state, canton, province)	California
2	County, parish	Orange
3	City, township	Irvine
4	City division, borough, city district	West Irvine
5	Neighborhood, block	Riverside
6	Group of streets below the neighborhood level	Exchange
18	Street suffix or type	Avenue
19	House number	320
20	House number suffix	A

Table 21: LLDP MED Location CA Types (Continued)

CA Type	Description	CA Value Example
21	Landmark or vanity address	Tech Center
26	Unit (apartment, suite)	Apt 519
27	Floor	5
28	Room	509B

- ◆ Any number of CA type and value pairs can be specified for the civic address location, as long as the total does not exceed 250 characters.

Parameters

These parameters are displayed:

- ◆ **CA-Type** – Descriptor of the data civic address value. (Range: 0-255)
- ◆ **CA-Value** – Description of a location. (Range: 1-32 characters)

Web Interface

To specify the physical location of the attached device:

1. Click Administration, LLDP.
2. Select Configure Interface from the Step list.
3. Select Add CA-Type from the Action list.
4. Select an interface from the Port or Trunk list.
5. Specify a CA-Type and CA-Value pair.
6. Click Apply.

Figure 206: Configuring the Civic Address for an LLDP Interface

Administration > LLDP

Step: 2. Configure Interface Action: Add CA-Type

Interface Port 1 Trunk

CA-Type (0-255) 1

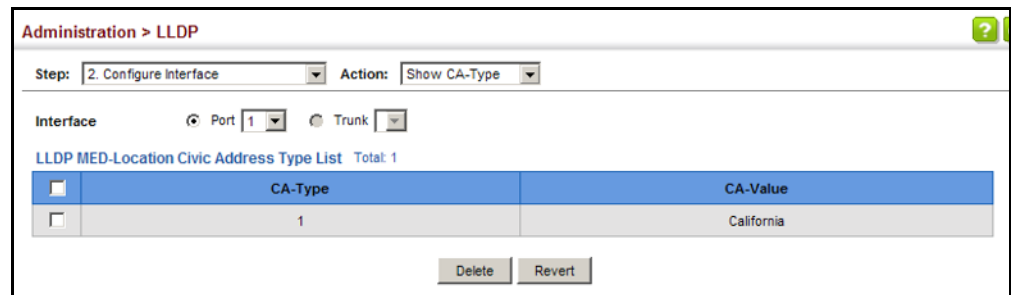
CA-Value California

Apply Revert

To show the physical location of the attached device:

1. Click Administration, LLDP.
2. Select Configure Interface from the Step list.
3. Select Show CA-Type from the Action list.
4. Select an interface from the Port or Trunk list.

Figure 207: Showing the Civic Address for an LLDP Interface



Displaying LLDP Local Device Information

Use the Administration > LLDP (Show Local Device Information) page to display information about the switch, such as its MAC address, chassis ID, management IP address, and port information.

Parameters

These parameters are displayed:

General Settings

- ◆ **Chassis Type** – Identifies the chassis containing the IEEE 802 LAN entity associated with the transmitting LLDP agent. There are several ways in which a chassis may be identified and a chassis ID subtype is used to indicate the type of component being referenced by the chassis ID field.

Table 22: Chassis ID Subtype

ID Basis	Reference
Chassis component	EntPhysicalAlias when entPhysClass has a value of 'chassis(3)' (IETF RFC 2737)
Interface alias	IfAlias (IETF RFC 2863)
Port component	EntPhysicalAlias when entPhysicalClass has a value 'port(10)' or 'backplane(4)' (IETF RFC 2737)
MAC address	MAC address (IEEE Std 802-2001)
Network address	networkAddress
Interface name	ifName (IETF RFC 2863)
Locally assigned	locally assigned

- ◆ **Chassis ID** – An octet string indicating the specific identifier for the particular chassis in this system.
- ◆ **System Name** – A string that indicates the system’s administratively assigned name (see “[Displaying System Information](#)” on page 62).
- ◆ **System Description** – A textual description of the network entity. This field is also displayed by the **show system** command.
- ◆ **System Capabilities Supported** – The capabilities that define the primary function(s) of the system.

Table 23: System Capabilities

ID Basis	Reference
Other	—
Repeater	IETF RFC 2108
Bridge	IETF RFC 2674
WLAN Access Point	IEEE 802.11 MIB
Router	IETF RFC 1812
Telephone	IETF RFC 2011
DOCSIS cable device	IETF RFC 2669 and IETF RFC 2670
End Station Only	IETF RFC 2011

- ◆ **System Capabilities Enabled** – The primary function(s) of the system which are currently enabled. Refer to the preceding table.
- ◆ **Management Address** – The management address associated with the local system. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.

Interface Settings

The attributes listed below apply to both port and trunk interface types. When a trunk is listed, the descriptions apply to the first port of the trunk.

- ◆ **Port/Trunk Description** – A string that indicates the port or trunk description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
- ◆ **Port/Trunk ID** – A string that contains the specific identifier for the port or trunk from which this LLDPDU was transmitted.

Interface Details

The attributes listed below apply to both port and trunk interface types. When a trunk is listed, the descriptions apply to the first port of the trunk.

- ◆ **Local Port/Trunk** – Local interface on this switch.

- ◆ **Port/Trunk ID Type** – There are several ways in which a port may be identified. A port ID subtype is used to indicate how the port is being referenced in the Port ID TLV.

Table 24: Port ID Subtype

ID Basis	Reference
Interface alias	IfAlias (IETF RFC 2863)
Chassis component	EntPhysicalAlias when entPhysClass has a value of 'chassis(3)' (IETF RFC 2737)
Port component	EntPhysicalAlias when entPhysicalClass has a value 'port(10)' or 'backplane(4)' (IETF RFC 2737)
MAC address	MAC address (IEEE Std 802-2001)
Network address	networkAddress
Interface name	ifName (IETF RFC 2863)
Agent circuit ID	agent circuit ID (IETF RFC 3046)
Locally assigned	locally assigned

- ◆ **Port/Trunk ID** – A string that contains the specific identifier for the local interface based on interface subtype used by this switch.
- ◆ **Port/Trunk Description** – A string that indicates the port or trunk description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
- ◆ **MED Capability** – The supported set of capabilities that define the primary function(s) of the interface:
 - LLDP-MED Capabilities
 - Network Policy
 - Location Identification
 - Extended Power via MDI – PSE
 - Extended Power via MDI – PD
 - Inventory

Web Interface

To display LLDP information for the local device:

1. Click Administration, LLDP.
2. Select Show Local Device Information from the Step list.
3. Select General, Port, Port Details, Trunk, or Trunk Details.

Figure 208: Displaying Local Device Information for LLDP (General)

Administration > LLDP

Step: 3. Show Local Device Information

General
 Port
 Port Details
 Trunk
 Trunk Details

LLDP Local Device Information

Chassis Type: MAC Address

Chassis ID: CC-37-AB-84-EA-BE

System Name:

System Description: GEP-1061

System Capabilities Supported: Bridge

System Capabilities Enabled: Bridge

Management Address: 192.168.1.1 (IPv4)

Figure 209: Displaying Local Device Information for LLDP (Port)

Administration > LLDP

Step: 3. Show Local Device Information

General
 Port
 Port Details
 Trunk
 Trunk Details

LLDP Local Device Port List Total: 28

Port	Port Description	Port ID
1	Ethernet Port on unit 1, port 1	00-00-E8-94-40-01
2	Ethernet Port on unit 1, port 2	00-00-E8-94-40-02
3	Ethernet Port on unit 1, port 3	00-00-E8-94-40-03
4	Ethernet Port on unit 1, port 4	00-00-E8-94-40-04
5	Ethernet Port on unit 1, port 5	00-00-E8-94-40-05

Figure 210: Displaying Local Device Information for LLDP (Port Details)

Administration > LLDP

Step: 3. Show Local Device Information

General
 Port
 Port Details
 Trunk
 Trunk Details

Port: 1

LLDP Local Port Information Details

Local Port: 1

Port ID Type: MAC Address

Port ID: 00-00-E8-94-40-01

Port Description: Ethernet Port on unit 1, port 1

MED Capability: LLDP-MED Capabilities, Network Policy, Location Identification, Inventory

Displaying LLDP Remote Device Information Use the Administration > LLDP (Show Remote Device Information) page to display information about devices connected directly to the switch's ports which are advertising information through LLDP, or to display detailed information about an LLDP-enabled device connected to a specific port on the local switch.

Parameters

These parameters are displayed:

Port

- ◆ **Local Port** – The local port to which a remote LLDP-capable device is attached.
- ◆ **Chassis ID** – An octet string indicating the specific identifier for the particular chassis in this system.
- ◆ **Port ID** – A string that contains the specific identifier for the port from which this LLDPDU was transmitted.
- ◆ **System Name** – A string that indicates the system's administratively assigned name.

Port Details

- ◆ **Port** – Port identifier on local switch. (Range: 1-10)
- ◆ **Remote Index** – Index of remote device attached to this port.
- ◆ **Local Port** – The local port to which a remote LLDP-capable device is attached.
- ◆ **Chassis Type** – Identifies the chassis containing the IEEE 802 LAN entity associated with the transmitting LLDP agent. There are several ways in which a chassis may be identified and a chassis ID subtype is used to indicate the type of component being referenced by the chassis ID field. (See [Table 22, "Chassis ID Subtype," on page 329.](#))
- ◆ **Chassis ID** – An octet string indicating the specific identifier for the particular chassis in this system.
- ◆ **System Name** – A string that indicates the system's assigned name.
- ◆ **System Description** – A textual description of the network entity.
- ◆ **Port Type** – Indicates the basis for the identifier that is listed in the Port ID field. See [Table 24, "Port ID Subtype," on page 331.](#)
- ◆ **Port Description** – A string that indicates the port's description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
- ◆ **Port ID** – A string that contains the specific identifier for the port from which this LLDPDU was transmitted.

- ◆ **System Capabilities Supported** – The capabilities that define the primary function(s) of the system. (See Table 23, "System Capabilities," on page 330.)
- ◆ **System Capabilities Enabled** – The primary function(s) of the system which are currently enabled. (See Table 23, "System Capabilities," on page 330.)
- ◆ **Management Address List** – The management addresses for this device. Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV.

If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.

Port Details – 802.1 Extension Information

- ◆ **Remote Port VID** – The port's default VLAN identifier (PVID) indicates the VLAN with which untagged or priority-tagged frames are associated.
- ◆ **Remote Port-Protocol VLAN List** – The port-based protocol VLANs configured on this interface, whether the given port (associated with the remote system) supports port-based protocol VLANs, and whether the port-based protocol VLANs are enabled on the given port associated with the remote system.
- ◆ **Remote VLAN Name List** – VLAN names associated with a port.
- ◆ **Remote Protocol Identity List** – Information about particular protocols that are accessible through a port. This object represents an arbitrary local integer value used by this agent to identify a particular protocol identity, and an octet string used to identify the protocols associated with a port of the remote system.

Port Details – 802.3 Extension Port Information

- ◆ **Remote Port Auto-Neg Supported** – Shows whether the given port (associated with remote system) supports auto-negotiation.
- ◆ **Remote Port Auto-Neg Adv-Capability** – The value (bitmap) of the ifMauAutoNegCapAdvertisedBits object (defined in IETF RFC 3636) which is associated with a port on the remote system.

Table 25: Remote Port Auto-Negotiation Advertised Capability

Bit	Capability
0	other or unknown
1	10BASE-T half duplex mode
2	10BASE-T full duplex mode
3	100BASE-T4
4	100BASE-TX half duplex mode

Table 25: Remote Port Auto-Negotiation Advertised Capability (Continued)

Bit	Capability
5	100BASE-TX full duplex mode
6	100BASE-T2 half duplex mode
7	100BASE-T2 full duplex mode
8	PAUSE for full-duplex links
9	Asymmetric PAUSE for full-duplex links
10	Symmetric PAUSE for full-duplex links
11	Asymmetric and Symmetric PAUSE for full-duplex links
12	1000BASE-X, -LX, -SX, -CX half duplex mode
13	1000BASE-X, -LX, -SX, -CX full duplex mode
14	1000BASE-T half duplex mode
15	1000BASE-T full duplex mode

- ◆ **Remote Port Auto-Neg Status** – Shows whether port auto-negotiation is enabled on a port associated with the remote system.
- ◆ **Remote Port MAU Type** – An integer value that indicates the operational MAU type of the sending device. This object contains the integer value derived from the list position of the corresponding dot3MauType as listed in IETF RFC 3636 and is equal to the last number in the respective dot3MauType OID.

Port Details – 802.3 Extension Power Information

- ◆ **Remote Power Class** – The port Class of the given port associated with the remote system (PSE – Power Sourcing Equipment or PD – Powered Device).
- ◆ **Remote Power MDI Status** – Shows whether MDI power is enabled on the given port associated with the remote system.
- ◆ **Remote Power Pairs** – “Signal” means that the signal pairs only are in use, and “Spare” means that the spare pairs only are in use.
- ◆ **Remote Power MDI Supported** – Shows whether MDI power is supported on the given port associated with the remote system.
- ◆ **Remote Power Pair Controllable** – Indicates whether the pair selection can be controlled for sourcing power on the given port associated with the remote system.
- ◆ **Remote Power Classification** – This classification is used to tag different terminals on the Power over LAN network according to their power consumption. Devices such as IP telephones, WLAN access points and others, will be classified according to their power requirements.

Port Details – 802.3 Extension Trunk Information

- ◆ **Remote Link Aggregation Capable** – Shows if the remote port is not in link aggregation state and/or it does not support link aggregation.
- ◆ **Remote Link Aggregation Status** – The current aggregation status of the link.
- ◆ **Remote Link Port ID** – This object contains the IEEE 802.3 aggregated port identifier, aAggPortID (IEEE 802.3-2002, 30.7.2.1.1), derived from the ifNumber of the ifIndex for the port component associated with the remote system. If the remote port is not in link aggregation state and/or it does not support link aggregation, this value should be zero.

Port Details – 802.3 Extension Frame Information

- ◆ **Remote Max Frame Size** – An integer value indicating the maximum supported frame size in octets on the port component associated with the remote system.

Port Details – LLDP-MED Capability⁹

- ◆ **Device Class** – Any of the following categories of endpoint devices:
 - Class 1 – The most basic class of endpoint devices.
 - Class 2 – Endpoint devices that supports media stream capabilities.
 - Class 3 – Endpoint devices that directly supports end users of the IP communication systems.
 - Network Connectivity Device – Devices that provide access to the IEEE 802 based LAN infrastructure for LLDP-MED endpoint devices. These may be any LAN access device including LAN switch/router, IEEE 802.1 bridge, IEEE 802.3 repeater, IEEE 802.11 wireless access point, or any device that supports the IEEE 802.1AB and MED extensions defined by this Standard and can relay IEEE 802 frames via any method.
- ◆ **Supported Capabilities** – The supported set of capabilities that define the primary function(s) of the port:
 - LLDP-MED Capabilities
 - Network Policy
 - Location Identification
 - Extended Power via MDI – PSE
 - Extended Power via MDI – PD
 - Inventory
- ◆ **Current Capabilities** – The set of capabilities that define the primary function(s) of the port which are currently enabled.

9. These fields are only displayed for end-node devices advertising LLDP-MED TLVs.

Port Details – Network Policy⁹

- ◆ **Application Type** – The primary application) defined for this network policy:
 - Voice
 - Voice Signaling
 - Guest Signaling
 - Guest Voice Signaling
 - Softphone Voice
 - Video Conferencing
 - Streaming Video
 - Video Signaling
- ◆ **Tagged Flag** – Indicates whether the specified application type is using a tagged or untagged VLAN.
- ◆ **Layer 2 Priority** – The Layer 2 priority to be used for the specified application type. This field may specify one of eight priority levels (0-7), where a value of 0 represents use of the default priority.
- ◆ **Unknown Policy Flag** – Indicates that an endpoint device wants to explicitly advertise that this policy is required by the device, but is currently unknown.
- ◆ **VLAN ID** – The VLAN identifier (VID) for the port as defined in IEEE 802.1Q. A value of zero indicates that the port is using priority tagged frames, meaning that only the IEEE 802.1D priority level is significant and the default PVID of the ingress port is used instead.
- ◆ **DSCP Value** – The DSCP value to be used to provide Diffserv node behavior for the specified application type. This field may contain one of 64 code point values (0-63). A value of 0 represents use of the default DSCP value as defined in RFC 2475.

Port Details – Location Identification⁹

- ◆ **Location Data Format** – Any of these location ID data formats:
 - Coordinate-based LCI¹⁰ – Defined in RFC 3825, includes latitude resolution, latitude, longitude resolution, longitude, altitude type, altitude resolution, altitude, and datum.
 - Civic Address LCI¹⁰ – Includes What, Country code, CA type, CA length and CA value. “What” is described as the field entry “Device entry refers to” under “[Configuring LLDP Interface Attributes](#).” The other items and described under “[Configuring LLDP Interface Civic-Address](#).”

10. Location Configuration Information

- ECS ELIN – Emergency Call Service Emergency Location Identification Number supports traditional PSAP-based Emergency Call Service in North America.
- ◆ **Country Code** – The two-letter ISO 3166 country code in capital ASCII letters. (Example: DK, DE or US)
- ◆ **What** – The type of device to which the location applies as described for the field entry “Device entry refers to” under “[Configuring LLDP Interface Attributes](#).”

Port Details – Extended Power-via-MDI

- ◆ **Power Type** – Power Sourcing Entity (PSE) or Power Device (PD).
- ◆ **Power Priority** – Shows power priority for a port. (Unknown, Low, High, Critical)
- ◆ **Power Source** – Shows information based on the type of device:
 - **PD** – Unknown, PSE, Local, PSE and Local
 - **PSE** – Unknown, Primary Power Source, Backup Power Source - Power conservation mode
- ◆ **Power Value** – The total power in watts required by a PD device from a PSE device, or the total power a PSE device is capable of sourcing over a maximum length cable based on its current configuration. This parameter supports a maximum power required or available value of 102.3 Watts to allow for future expansion. (Range: 0 - 102.3 Watts)

Port Details – Inventory⁹

- ◆ **Hardware Revision** – The hardware revision of the end-point device.
- ◆ **Software Revision** – The software revision of the end-point device.
- ◆ **Manufacture Name** – The manufacturer of the end-point device
- ◆ **Asset ID** – The asset identifier of the end-point device. End-point devices are typically assigned asset identifiers to facilitate inventory management and assets tracking.
- ◆ **Firmware Revision** – The firmware revision of the end-point device.
- ◆ **Serial Number** – The serial number of the end-point device.
- ◆ **Model Name** – The model name of the end-point device.

Web Interface

To display LLDP information for a remote port:

1. Click Administration, LLDP.
2. Select Show Remote Device Information from the Step list.
3. Select Port, Port Details, Trunk, or Trunk Details.
4. When the next page opens, select a port on this switch and the index for a remote device attached to this port.
5. Click Query.

Figure 211: Displaying Remote Device Information for LLDP (Port)

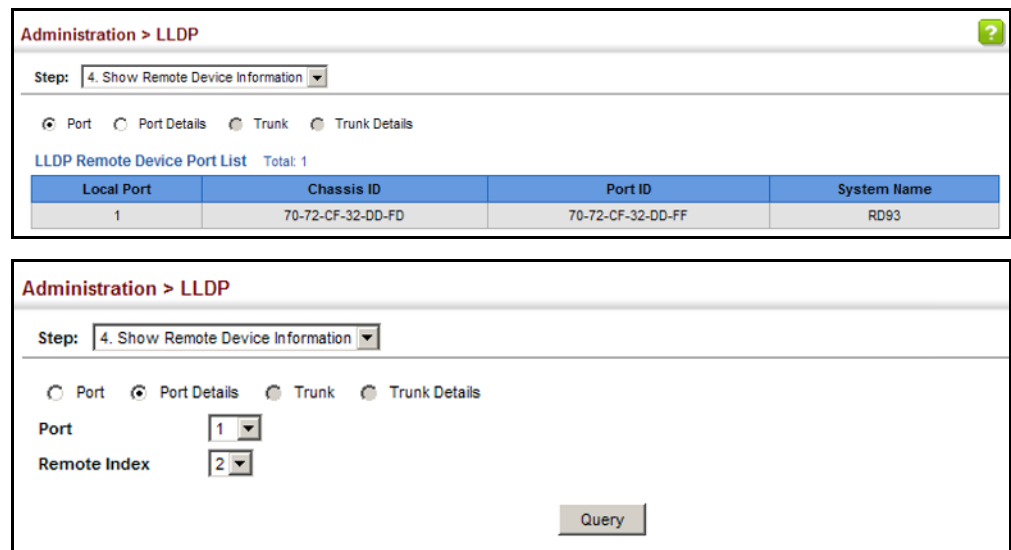


Figure 212: Displaying Remote Device Information for LLDP (Port Details)

Administration > LLDP ?

Step: 4. Show Remote Device Information

Port
 Port Details
 Trunk
 Trunk Details

Port: 23

Remote Index: 4

Query

LLDP Remote Device Port Information

Local Port	23	Port Type	MAC Address
Chassis Type	MAC Address	Port Description	Ethernet Port on unit 1, port 1
Chassis ID	00-E0-00-00-00-01	Port ID	00-E0-00-00-00-02
System Name		System Capabilities Supported	Bridge
System Description	ES3528MV2	System Capabilities Enabled	Bridge

Management Address List Total: 1

Address	Address Type
192.168.0.3	IPv4 Address

802.1 Extension Information

Remote Port VID: 1

Remote Port-Protocol VLAN List Total: 1

VLAN	Support	Status
1	Yes	Enabled

Remote VLAN Name List Total: 1

VLAN	Name
1	DefaultVlan

Remote Protocol Identity List Total: 1

Remote Protocol Identity (Hex)
88-CC

802.3 Extension Port Information

Remote Port Auto-Neg Supported	Yes	Remote Port Auto-Neg Status	Enabled
Remote Port Auto-Neg Adv-Capability	0000	Remote Port MAU Type	6

802.3 Extension Power Information

Remote Power Class	PSE	Remote Power MDI Supported	Yes
Remote Power MDI Status	Enabled	Remote Power Pair Controlable	No
Remote Power Pairs	Spare	Remote Power Classification	Class1

802.3 Extension Trunk Information

Remote Link Aggregation Capable	Yes	Remote Link Aggregation Status	Disabled
Remote Link Port ID	0		

802.3 Extension Frame Information

Remote Max Frame Size	1518
-----------------------	------

Additional information displayed by an end-point device which advertises LLDP-MED TLVs is shown in the following figure.

Figure 213: Displaying Remote Device Information for LLDP (End Node)

Administration > LLDP

Step: 4. Show Remote Device Information

LLDP-MED Capability

Device Class	Network Connectivity		
Supported Capabilities	LLDP-MED Capabilities, Network Policy, Location Identification, Inventory		
Current Capabilities	LLDP-MED Capabilities, Network Policy, Location Identification, Inventory		

Network Policy

Application Type	Guest Voice Signaling	Unknown Policy Flag	Disabled
Tagged Flag	Disabled	VLAN ID	7
Layer 2 Priority	2	DSCP Value	62

Location Identification

Location Data Format	Coordinate-based LCI		
Country Code	TW	What	2

Location Identification

Location Data Format	Civic Address LCI		
Country Code	US	What	2

Extended Power-via-MDI

Power Type	PSE	Power Source	Unknown
Power Priority	Unknown	Power Value	0 W Watts

Inventory

Hardware Revision	R01	Firmware Revision	1.2.2.1
Software Revision	1.2.2.1	Serial Number	LN10230092
Manufacture Name		Model Name	L
Asset ID			

Displaying Device Statistics

Use the Administration > LLDP (Show Device Statistics) page to display statistics for LLDP-capable devices attached to the switch, and for LLDP protocol messages transmitted or received on all local interfaces.

Parameters

These parameters are displayed:

General Statistics on Remote Devices

- ◆ **Neighbor Entries List Last Updated** – The time the LLDP neighbor entry list was last updated.
- ◆ **New Neighbor Entries Count** – The number of LLDP neighbors for which the remote TTL has not yet expired.
- ◆ **Neighbor Entries Deleted Count** – The number of LLDP neighbors which have been removed from the LLDP remote systems MIB for any reason.

- ◆ **Neighbor Entries Dropped Count** – The number of times which the remote database on this switch dropped an LLDPDU because of insufficient resources.
- ◆ **Neighbor Entries Age-out Count** – The number of times that a neighbor's information has been deleted from the LLDP remote systems MIB because the remote TTL timer has expired.

Port/Trunk

- ◆ **Frames Discarded** – Number of frames discarded because they did not conform to the general validation rules as well as any specific usage rules defined for the particular TLV.
- ◆ **Frames Invalid** – A count of all LLDPDUs received with one or more detectable errors.
- ◆ **Frames Received** – Number of LLDP PDUs received.
- ◆ **Frames Sent** – Number of LLDP PDUs transmitted.
- ◆ **TLVs Unrecognized** – A count of all TLVs not recognized by the receiving LLDP local agent.
- ◆ **TLVs Discarded** – A count of all LLDPDUs received and then discarded due to insufficient memory space, missing or out-of-sequence attributes, or any other reason.
- ◆ **Neighbor Ageouts** – A count of the times that a neighbor's information has been deleted from the LLDP remote systems MIB because the remote TTL timer has expired.

Web Interface

To display statistics for LLDP-capable devices attached to the switch:

1. Click Administration, LLDP.
2. Select Show Device Statistics from the Step list.
3. Select General, Port, or Trunk.

Figure 214: Displaying LLDP Device Statistics (General)

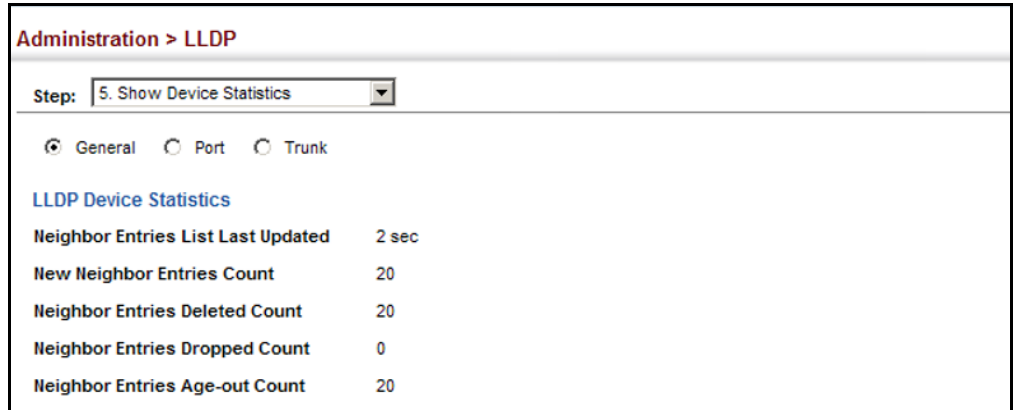
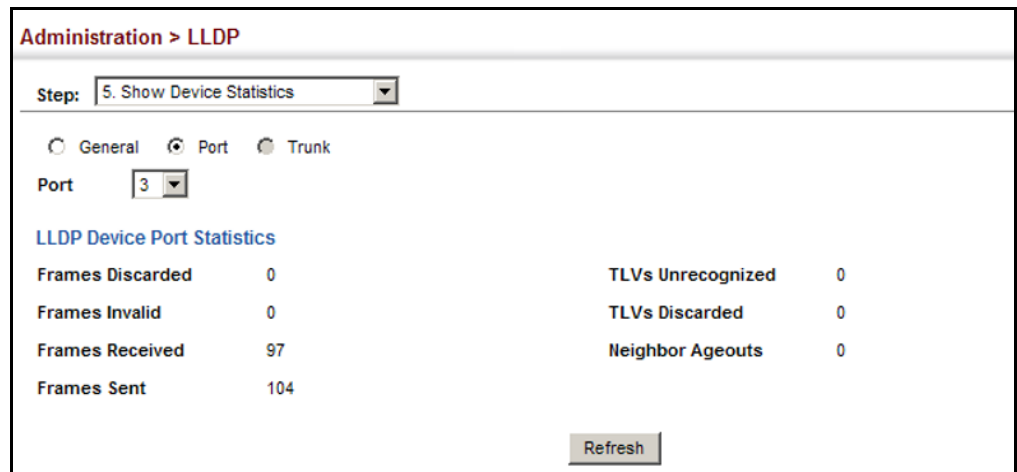


Figure 215: Displaying LLDP Device Statistics (Port)



Power over Ethernet

The GEP-1061 switch can provide DC power to a wide range of connected devices, eliminating the need for an additional power source and cutting down on the amount of cables attached to each device. Once configured to supply power, an automatic detection process is initialized by the switch that is authenticated by a PoE signature from the connected device. Detection and authentication prevent damage to non-compliant devices (prior to IEEE 802.3af).

The switch's power management enables individual port power to be controlled within the switch's power budget. Port power can be automatically turned on and off for connected devices, and a per-port power priority can be set so that the switch never exceeds its power budget. When a device is connected to a switch port, its power requirements are detected by the switch before power is supplied. If the power required by a device exceeds the power budget of the port or the whole switch, power is not supplied.

Ports can be set to one of three power priority levels, critical, high, or low. To control the power supply within the switch's budget, ports set at critical to high priority have power enabled in preference to those ports set at low priority. For example, when a device connected to a port is set to critical priority, the switch supplies the required power, if necessary by denying power to ports set for a lower priority during bootup.



Note: For more information on using the PoE provided by this switch refer to the *Installation Guide*.

Setting the Switch's Overall PoE Power Budget

Use the Administration > PoE > PSE (Configure Global) page to set the maximum PoE power budget for the switch (power available to all Gigabit Ethernet ports).

Parameters

These parameters are displayed:

- ◆ **PoE Maximum Available Power** – The power budget for the switch (i.e., power available to all switch ports). If devices connected to the switch require more power than the switch budget, the port power priority settings are used to control the supplied power.
- ◆ **PoE Maximum Allocation Power** – Sets a power budget for the switch. (Range: 50000-740000 milliwatts; Default: 125000 milliwatts)
- ◆ **Compatible Mode** – Allows the switch to detect and provide power to powered devices that were designed prior to the IEEE 802.3af PoE standard. (Default: Disabled)

The switch automatically detects attached PoE devices by periodically transmitting test voltages that over the Gigabit Ethernet copper-media ports. When an IEEE 802.3af or 802.3at compatible device is plugged into one of these ports, the powered device reflects the test voltage back to the switch, which may then turn on the power to this device. When the compatibility mode is enabled, this switch can detect IEEE 802.3af or 802.3at compliant devices and the more recent 802.3af non-compliant devices that also reflect the test voltages back to the switch. It cannot detect other legacy devices that do not reflect back the test voltages.

For legacy devices to be supported by this switch, they must be able to accept power over the data pairs connected to the RJ-45 ports.

Web Interface

To set the overall PoE power budget for switch:

1. Click Administration, PoE, PSE.
2. Select Configure Global from the Step list.

3. Set the maximum PoE power provided by the switch, and enable the compatible mode if required.
4. Click Apply.

Figure 216: Setting the Switch’s PoE Budget

Setting the Port PoE Power Budget Use the Administration > PoE > PSE page to set the maximum power provided to a port.

Command Usage

- ◆ This switch supports both the IEEE 802.3af PoE and IEEE 802.3at-2009 PoE Plus standards. To ensure that the correct power is supplied to powered devices (PD) compliant with these standards, the first detection pulse from the switch is based on 802.3af to which the 802.3af PDs will respond normally. It then sends a second PoE Plus pulse that causes an 802.3at PD to respond as a Class 4 device and draw Class 4 current. Afterwards, the switch exchanges information with the PD such as duty-cycle, peak and average power needs.
- ◆ All the RJ-45 ports support both the IEEE 802.3af and IEEE 802.3at standards. For the GEP-1061, the total PoE power delivered by all ports cannot exceed the maximum power budget of 125W.

The number of ports which can supply maximum power simultaneously to connected devices is listed in the following table. In this table, EPS refers to the optional external power supply.

Table 26: Maximum Number of Ports Providing Simultaneous Power

Switch	30W (802.3at)	15.4W (802.3af)	7.5W (802.3af)
GEP-1061	4	8	8

- ◆ If a device is connected to a switch port and the switch detects that it requires more than the power budget set for the port or to the overall switch, no power is supplied to the device (i.e., port power remains off).

- ◆ If the power demand from devices connected to all switch ports exceeds the power budget set for the switch, the port power priority settings are used to control the supplied power. For example:
 - If a device is connected to a low-priority port and causes the switch to exceed its budget, power to this port is not turned on.
 - If a device is connected to a critical or high-priority port and would cause the switch to exceed its power budget as determined during bootup, power is provided to the port only if the switch can drop power to one or more lower-priority ports and thereby remain within its overall budget.
 - If a device is connected to a port after the switch has finished booting up and would cause the switch to exceed its budget, power will not be provided to that port regardless of its priority setting.
 - If priority is not set for any ports, and there is not sufficient power to supply all of the ports, port priority defaults to Port 1, Port 2, Port 3 ... Port 24, with available power being supplied in that sequence.
 - If priority is not set for any ports, and PoE consumption exceeds the maximum power provided by the switch, power is shut down in the reverse sequence, starting from Port 24.

Parameters

These parameters are displayed:

- ◆ **Port** – The port number on the switch. (Range: 1-8)
- ◆ **Admin Status** – Enables PoE power on a port. Power is automatically supplied when a device is detected on a port, providing that the power demanded does not exceed the switch or port power budget. (Default: Enabled)
- ◆ **Mode** – Shows whether or not PoE power is being supplied to a port.
- ◆ **Time Range Name** – Name of a time range. If a time range is set, then PoE will be provided to an interface during the specified period.
- ◆ **Time Range Status** – Indicates if a time range has been applied to an interface, and whether it is currently active or inactive.
- ◆ **Priority** – Sets the power priority for a port. (Options: Low, High or Critical; Default: Low)
- ◆ **Power Allocation** – Sets the power budget for a port. (Range: 3000-30000 milliwatts; Default: 30000 milliwatts)
- ◆ **Power Consumption** – Current power consumption on a port.

Web Interface

To set the PoE power budget for a port:

1. Click Administration, PoE, PSE.
2. Enable PoE power on selected ports. Set the priority and the power budget. And specify a time range during which PoE will be provided to an interface.
3. Click Apply.

Figure 217: Setting a Port's PoE Budget

Administration > PoE > PSE

Step: 2. Configure Interface

PoE Port List Total: 24

Port	Admin Status	Mode	Time-Range Name	Time-Range Status	Priority	Power Allocation	Power Consumption (milliwatts)
1	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
2	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
3	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
4	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
5	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
6	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
7	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
8	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
9	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0
10	<input checked="" type="checkbox"/> Enabled	off	<input type="checkbox"/> R&D	NA	Low	34200	0

Apply Revert

Simple Network Management Protocol

Simple Network Management Protocol (SNMP) is a communication protocol designed specifically for managing devices on a network. Equipment commonly managed with SNMP includes switches, routers and host computers. SNMP is typically used to configure these devices for proper operation in a network environment, as well as to monitor them to evaluate performance or detect potential problems.

Managed devices supporting SNMP contain software, which runs locally on the device and is referred to as an agent. A defined set of variables, known as managed objects, is maintained by the SNMP agent and used to manage the device. These objects are defined in a Management Information Base (MIB) that provides a standard presentation of the information controlled by the agent. SNMP defines both the format of the MIB specifications and the protocol used to access this information over the network.

The switch includes an onboard agent that supports SNMP versions 1, 2c, and 3. This agent continuously monitors the status of the switch hardware, as well as the traffic passing through its ports. A network management station can access this

information using network management software. Access to the onboard agent from clients using SNMP v1 and v2c is controlled by community strings. To communicate with the switch, the management station must first submit a valid community string for authentication.

Access to the switch from clients using SNMPv3 provides additional security features that cover message integrity, authentication, and encryption; as well as controlling user access to specific areas of the MIB tree.

The SNMPv3 security structure consists of security models, with each model having its own security levels. There are three security models defined, SNMPv1, SNMPv2c, and SNMPv3. Users are assigned to “groups” that are defined by a security model and specified security levels. Each group also has a defined security access to set of MIB objects for reading and writing, which are known as “views.” The switch has a default view (all MIB objects) and default groups defined for security models v1 and v2c. The following table shows the security models and levels available and the system default settings.

Table 27: SNMPv3 Security Models and Levels

Model	Level	Group	Read View	Write View	Notify View	Security
v1	noAuthNoPriv	public (read only)	defaultview	none	none	Community string only
v1	noAuthNoPriv	private (read/write)	defaultview	defaultview	none	Community string only
v1	noAuthNoPriv	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	Community string only
v2c	noAuthNoPriv	public (read only)	defaultview	none	none	Community string only
v2c	noAuthNoPriv	private (read/write)	defaultview	defaultview	none	Community string only
v2c	noAuthNoPriv	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	Community string only
v3	noAuthNoPriv	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	A user name match only
v3	AuthNoPriv	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	Provides user authentication via MD5 or SHA algorithms
v3	AuthPriv	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	<i>user defined</i>	Provides user authentication via MD5 or SHA algorithms and data privacy using DES 56-bit encryption



Note: The predefined default groups and view can be deleted from the system. You can then define customized groups and views for the SNMP clients that require access.

Command Usage

Configuring SNMPv1/2c Management Access

To configure SNMPv1 or v2c management access to the switch, follow these steps:

1. Use the Administration > SNMP (Configure Global) page to enable SNMP on the switch, and to enable trap messages.
2. Use the Administration > SNMP (Configure User - Add Community) page to configure the community strings authorized for management access.
3. Use the Administration > SNMP (Configure Trap) page to specify trap managers so that key events are reported by this switch to your management station.

Configuring SNMPv3 Management Access

1. Use the Administration > SNMP (Configure Global) page to enable SNMP on the switch, and to enable trap messages.
2. Use the Administration > SNMP (Configure Trap) page to specify trap managers so that key events are reported by this switch to your management station.
3. Use the Administration > SNMP (Configure Engine) page to change the local engine ID. If you want to change the default engine ID, it must be changed before configuring other parameters.
4. Use the Administration > SNMP (Configure View) page to specify read and write access views for the switch MIB tree.
5. Use the Administration > SNMP (Configure User) page to configure SNMP user groups with the required security model (i.e., SNMP v1, v2c or v3) and security level (i.e., authentication and privacy).
6. Use the Administration > SNMP (Configure Group) page to assign SNMP users to groups, along with their specific authentication and privacy passwords.

Configuring Global Settings for SNMP

Use the Administration > SNMP (Configure Global) page to enable SNMPv3 service for all management clients (i.e., versions 1, 2c, 3), and to enable trap messages.

Parameters

These parameters are displayed:

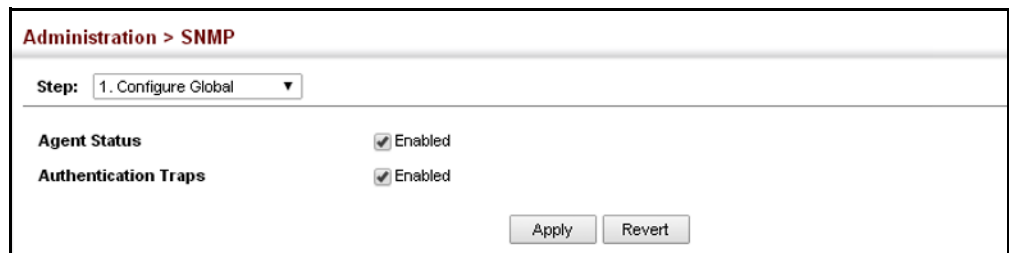
- ◆ **Agent Status** – Enables SNMP on the switch. (Default: Enabled)
- ◆ **Authentication Traps**¹¹ – Issues a notification message to specified IP trap managers whenever an invalid community string is submitted during the SNMP access authentication process. (Default: Enabled)

Web Interface

To configure global settings for SNMP:

1. Click Administration, SNMP.
2. Select Configure Global from the Step list.
3. Enable SNMP and the required trap types.
4. Click Apply

Figure 218: Configuring Global Settings for SNMP



Setting the Local Engine ID

Use the Administration > SNMP (Configure Engine - Set Engine ID) page to change the local engine ID. An SNMPv3 engine is an independent SNMP agent that resides on the switch. This engine protects against message replay, delay, and redirection. The engine ID is also used in combination with user passwords to generate the security keys for authenticating and encrypting SNMPv3 packets.

Command Usage

A local engine ID is automatically generated that is unique to the switch. This is referred to as the default engine ID. If the local engine ID is deleted or changed, all SNMP users will be cleared. You will need to reconfigure all existing users.

Parameters

These parameters are displayed:

- ◆ **Engine ID** – A new engine ID can be specified by entering 9 to 64 hexadecimal characters (5 to 32 octets in hexadecimal format). If an odd number of characters are specified, a trailing zero is added to the value to fill in the last octet. For example, the value “123456789” is equivalent to “1234567890”.
- ◆ **Engine Boots** – The number of times that the engine has (re-)initialized since the SNMP Engine ID was last configured.

11. These are legacy notifications and therefore when used for SNMPv3 hosts, they must be enabled in conjunction with the corresponding entries in the Notification View (page 353).

Web Interface

To configure the local SNMP engine ID:

1. Click Administration, SNMP.
2. Select Configure Engine from the Step list.
3. Select Set Engine ID from the Action list.
4. Enter an ID of a least 9 hexadecimal characters.
5. Click Apply

Figure 219: Configuring the Local Engine ID for SNMP

Administration > SNMP

Step: 2. Configure Engine Action: Set Engine ID

Engine ID 800001030300000c0000fd0000

Engine Boots 5

Default Save

Specifying a Remote Engine ID

Use the Administration > SNMP (Configure Engine - Add Remote Engine) page to configure a engine ID for a remote management station. To allow management access from an SNMPv3 user on a remote device, you must first specify the engine identifier for the SNMP agent on the remote device where the user resides. The remote engine ID is used to compute the security digest for authentication and encryption of packets passed between the switch and a user on the remote host.

Command Usage

SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it. (See ["Configuring Remote SNMPv3 Users" on page 365.](#))

Parameters

These parameters are displayed:

- ◆ **Remote Engine ID** – The engine ID can be specified by entering 9 to 64 hexadecimal characters (5 to 32 octets in hexadecimal format). If an odd number of characters are specified, a trailing zero is added to the value to fill in the last octet. For example, the value "123456789" is equivalent to "1234567890".
- ◆ **Remote IP Host** – The IPv4 address of a remote management station which is using the specified engine ID.

Web Interface

To configure a remote SNMP engine ID:

1. Click Administration, SNMP.
2. Select Configure Engine from the Step list.
3. Select Add Remote Engine from the Action list.
4. Enter an ID of a least 9 hexadecimal characters, and the IP address of the remote host.
5. Click Apply

Figure 220: Configuring a Remote Engine ID for SNMP

The screenshot shows the 'Administration > SNMP' configuration page. The 'Step' dropdown is set to '2. Configure Engine' and the 'Action' dropdown is set to 'Add Remote Engine'. There are two input fields: 'Remote Engine ID' with the value '5432100000' and 'Remote IP Host' with the value '192.168.1.19'. At the bottom right, there are 'Apply' and 'Revert' buttons.

To show the remote SNMP engine IDs:

1. Click Administration, SNMP.
2. Select Configure Engine from the Step list.
3. Select Show Remote Engine from the Action list.

Figure 221: Showing Remote Engine IDs for SNMP

The screenshot shows the 'Administration > SNMP' configuration page with the 'Action' dropdown set to 'Show Remote Engine'. Below the configuration fields, there is a table titled 'SNMPv3 Remote Engine List' with a 'Total: 1' indicator. The table has three columns: a checkbox, 'Remote Engine ID', and 'Remote IP Host'. The first row contains a checked checkbox, the ID '5432100000', and the IP '192.168.1.19'. At the bottom right, there are 'Delete' and 'Revert' buttons.

	Remote Engine ID	Remote IP Host
<input checked="" type="checkbox"/>	5432100000	192.168.1.19

Setting SNMPv3 Views Use the Administration > SNMP (Configure View) page to configure SNMPv3 views which are used to restrict user access to specified portions of the MIB tree. The predefined view “defaultview” includes access to the entire MIB tree.

Parameters

These parameters are displayed:

Add View

- ◆ **View Name** – The name of the SNMP view. (Range: 1-32 characters)
- ◆ **OID Subtree** – Specifies the initial object identifier of a branch within the MIB tree. Wild cards can be used to mask a specific portion of the OID string. Use the Add OID Subtree page to configure additional object identifiers. (Range: 1-64 characters)
- ◆ **Type** – Indicates if the object identifier of a branch within the MIB tree is included or excluded from the SNMP view.

Add OID Subtree

- ◆ **View Name** – Lists the SNMP views configured in the Add View page. (Range: 1-32 characters)
- ◆ **OID Subtree** – Adds an additional object identifier of a branch within the MIB tree to the selected View. Wild cards can be used to mask a specific portion of the OID string. (Range: 1-64 characters)
- ◆ **Type** – Indicates if the object identifier of a branch within the MIB tree is included or excluded from the SNMP view.

Web Interface

To configure an SNMP view of the switch’s MIB database:

1. Click Administration, SNMP.
2. Select Configure View from the Step list.
3. Select Add View from the Action list.
4. Enter a view name and specify the initial OID subtree in the switch’s MIB database to be included or excluded in the view. Use the Add OID Subtree page to add additional object identifier branches to the view.
5. Click Apply

Figure 222: Creating an SNMP View

The screenshot shows the 'Administration > SNMP' configuration page. At the top, the breadcrumb 'Administration > SNMP' is visible. Below it, the 'Step' dropdown is set to '3. Configure View' and the 'Action' dropdown is set to 'Add View'. The main configuration area contains three fields: 'View Name' with the value 'ifEntry.a', 'OID Subtree' with the value '1.3.6.1.2.1.2.2.1.1.*', and 'Type' with the value 'Included'. At the bottom right, there are 'Apply' and 'Revert' buttons.

To show the SNMP views of the switch's MIB database:

1. Click Administration, SNMP.
2. Select Configure View from the Step list.
3. Select Show View from the Action list.

Figure 223: Showing SNMP Views

The screenshot shows the 'Administration > SNMP' configuration page. At the top, the breadcrumb 'Administration > SNMP' is visible. Below it, the 'Step' dropdown is set to '3. Configure View' and the 'Action' dropdown is set to 'Show View'. The main area displays a table titled 'SNMPv3 View List' with a 'Total: 2' count. The table has a header row with a checkbox and 'View Name'. Below the header, there are two rows: one for 'ifEntry.a' and one for 'defaultview', each with a checkbox. At the bottom right, there are 'Delete' and 'Revert' buttons.

<input type="checkbox"/>	View Name
<input type="checkbox"/>	ifEntry.a
<input type="checkbox"/>	defaultview

To add an object identifier to an existing SNMP view of the switch's MIB database:

1. Click Administration, SNMP.
2. Select Configure View from the Step list.
3. Select Add OID Subtree from the Action list.
4. Select a view name from the list of existing views, and specify an additional OID subtree in the switch's MIB database to be included or excluded in the view.
5. Click Apply

Figure 224: Adding an OID Subtree to an SNMP View

Administration > SNMP

Step: 3. Configure View Action: Add OID Subtree

View Name: ifEntry.a

OID Subtree: 1.3.6.1.2.1.2.2.1.2.*

Type: Included

Apply Revert

To show the OID branches configured for the SNMP views of the switch's MIB database:

1. Click Administration, SNMP.
2. Select Configure View from the Step list.
3. Select Show OID Subtree from the Action list.
4. Select a view name from the list of existing views.

Figure 225: Showing the OID Subtree Configured for SNMP Views

Administration > SNMP

Step: 3. Configure View Action: Show OID Subtree

View Name: ifEntry.a

SNMPv3 View OID Subtree List Total: 2

<input type="checkbox"/>	OID Subtree	Type
<input type="checkbox"/>	1.3.6.1.2.1.2.2.1.1.*	Included
<input type="checkbox"/>	1.3.6.1.2.1.2.2.1.2.*	Included

Delete Revert

Configuring SNMPv3 Groups

Use the Administration > SNMP (Configure Group) page to add an SNMPv3 group which can be used to set the access policy for its assigned users, restricting them to specific read, write, and notify views. You can use the pre-defined default groups or create new groups to map a set of SNMP users to SNMP views.

Parameters

These parameters are displayed:

- ◆ **Group Name** – The name of the SNMP group to which the user is assigned. (Range: 1-32 characters)
- ◆ **Security Model** – The user security model; SNMP v1, v2c or v3.

- ◆ **Security Level** – The following security levels are only used for the groups assigned to the SNMP security model:
 - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications. (This is the default security level.)
 - **AuthNoPriv** – SNMP communications use authentication, but the data is not encrypted.
 - **AuthPriv** – SNMP communications use both authentication and encryption.
- ◆ **Read View** – The configured view for read access. (Range: 1-32 characters)
- ◆ **Write View** – The configured view for write access. (Range: 1-32 characters)
- ◆ **Notify View** – The configured view for notifications. (Range: 1-32 characters)

Table 28: Supported Notification Messages

Model	Level	Group
<i>RFC 1493 Traps</i>		
newRoot	1.3.6.1.2.1.17.0.1	The newRoot trap indicates that the sending agent has become the new root of the Spanning Tree; the trap is sent by a bridge soon after its election as the new root, e.g., upon expiration of the Topology Change Timer immediately subsequent to its election.
topologyChange	1.3.6.1.2.1.17.0.2	A topologyChange trap is sent by a bridge when any of its configured ports transitions from the Learning state to the Forwarding state, or from the Forwarding state to the Discarding state. The trap is not sent if a newRoot trap is sent for the same transition.
<i>SNMPv2 Traps</i>		
coldStart	1.3.6.1.6.3.1.1.5.1	A coldStart trap signifies that the SNMPv2 entity, acting in an agent role, is reinitializing itself and that its configuration may have been altered.
warmStart	1.3.6.1.6.3.1.1.5.2	A warmStart trap signifies that the SNMPv2 entity, acting in an agent role, is reinitializing itself such that its configuration is unaltered.
linkDown*	1.3.6.1.6.3.1.1.5.3	A linkDown trap signifies that the SNMP entity, acting in an agent role, has detected that the ifOperStatus object for one of its communication links is about to enter the down state from some other state (but not from the notPresent state). This other state is indicated by the included value of ifOperStatus.
linkUp*	1.3.6.1.6.3.1.1.5.4	A linkUp trap signifies that the SNMP entity, acting in an agent role, has detected that the ifOperStatus object for one of its communication links left the down state and transitioned into some other state (but not into the notPresent state). This other state is indicated by the included value of ifOperStatus.
authenticationFailure*	1.3.6.1.6.3.1.1.5.5	An authenticationFailure trap signifies that the SNMPv2 entity, acting in an agent role, has received a protocol message that is not properly authenticated. While all implementations of the SNMPv2 must be capable of generating this trap, the snmpEnableAuthenTraps object indicates whether this trap will be generated.
<i>RMON Events (V2)</i>		
risingAlarm	1.3.6.1.2.1.16.0.1	The SNMP trap that is generated when an alarm entry crosses its rising threshold and generates an event that is configured for sending SNMP traps.
fallingAlarm	1.3.6.1.2.1.16.0.2	The SNMP trap that is generated when an alarm entry crosses its falling threshold and generates an event that is configured for sending SNMP traps.

Table 28: Supported Notification Messages (Continued)

Model	Level	Group
<i>Private Traps</i>		
swPowerStatusChangeTrap	1.3.6.1.4.1.22426.43.103.2.1.0.1	This trap is sent when the power state changes.
swPortSecurityTrap	1.3.6.1.4.1.22426.43.103.2.1.0.36	This trap is sent when the port is being intruded. This trap will only be sent when the portSecActionTrap is enabled.
swIpFilterRejectTrap	1.3.6.1.4.1.22426.43.103.2.1.0.40	This trap is sent when an incorrect IP address is rejected by the IP Filter.
pethPsePortOnOffNotification	1.3.6.1.4.1.22426.43.103.2.1.0.43	This notification indicates if a PSE port is delivering power to the PD. This notification should be sent on every status change except in searching mode.
pethPsePortPowerMaintenanceStatusNotification	1.3.6.1.4.1.22426.43.103.2.1.0.44	This notification indicates a Port Change Status and should be sent on every status change.
pethMainPowerUsageOnNotification	1.3.6.1.4.1.22426.43.103.2.1.0.45	This notification indicates PSE threshold usage indication is on; and the power usage is above the threshold.
pethMainPowerUsageOffNotification	1.3.6.1.4.1.22426.43.103.2.1.0.46	This notification indicates that the PSE threshold usage indication is off; and the usage power is below the threshold.
swAtcBcastStormAlarmFireTrap	1.3.6.1.4.1.22426.43.103.2.1.0.70	When broadcast traffic is detected as a storm, this trap is fired.
swAtcBcastStormAlarmClearTrap	1.3.6.1.4.1.22426.43.103.2.1.0.71	When a broadcast storm is detected as normal traffic, this trap is fired.
swAtcBcastStormTcApplyTrap	1.3.6.1.4.1.22426.43.103.2.1.0.72	When ATC is activated, this trap is fired.
swAtcBcastStormTcReleaseTrap	1.3.6.1.4.1.22426.43.103.2.1.0.73	When ATC is released, this trap is fired.
swAtcMcastStormAlarmFireTrap	1.3.6.1.4.1.22426.43.103.2.1.0.74	When multicast traffic is detected as the storm, this trap is fired.
swAtcMcastStormAlarmClearTrap	1.3.6.1.4.1.22426.43.103.2.1.0.75	When multicast storm is detected as normal traffic, this trap is fired.
swAtcMcastStormTcApplyTrap	1.3.6.1.4.1.22426.43.103.2.1.0.76	When ATC is activated, this trap is fired.
swAtcMcastStormTcReleaseTrap	1.3.6.1.4.1.22426.43.103.2.1.0.77	When ATC is released, this trap is fired.
stpBpduGuardPortShutdownTrap	1.3.6.1.4.1.22426.43.103.2.1.0.91	This trap will be sent when an interface is shut down because of BPDU guard.
swLoopbackDetectionTrap	1.3.6.1.4.1.22426.43.103.2.1.0.95	This trap is sent when loopback BPDUs have been detected.
networkAccessPortLinkDetectionTrap	1.3.6.1.4.1.22426.43.103.2.1.0.96	This trap is sent when a networkAccessPortLinkDetection event is triggered.
dot1agCfmMepUpTrap	1.3.6.1.4.1.22426.43.103.2.1.0.97	This trap is sent when a new remote MEP is discovered.
dot1agCfmMepDownTrap	1.3.6.1.4.1.22426.43.103.2.1.0.98	This trap is sent when port status or interface status TLV received from remote MEP indicates it is not up.
dot1agCfmConfigFailTrap	1.3.6.1.4.1.22426.43.103.2.1.0.99	This trap is sent when a MEP receives a CCM with MPID which already exists on the same MA in this switch.

Table 28: Supported Notification Messages (Continued)

Model	Level	Group
dot1agCfmLoopFindTrap	1.3.6.1.4.1.22426.43.103.2.1.0.100	This trap is sent when a MEP receives its own CCMs.
dot1agCfmMepUnknownTrap	1.3.6.1.4.1.22426.43.103.2.1.0.101	This trap is sent when a CCM is received from an unexpected MEP.
dot1agCfmMepMissingTrap	1.3.6.1.4.1.22426.43.103.2.1.0.102	This trap is sent when the cross-check enable timer expires and no CCMs were received from an expected (configured) MEP.
dot1agCfmMaUpTrap	1.3.6.1.4.1.22426.43.103.2.1.0.103	This trap is sent when all expected remote MEPs are up.
autoUpgradeTrap	1.3.6.1.4.1.22426.43.103.2.1.0.104	This trap is sent when auto upgrade is executed.
swCpuUtiRisingNotification	1.3.6.1.4.1.22426.43.103.2.1.0.107	This notification indicates that the CPU utilization has risen from <code>cpuUtiFallingThreshold</code> to <code>cpuUtiRisingThreshold</code> .
swCpuUtiFallingNotification	1.3.6.1.4.1.22426.43.103.2.1.0.108	This notification indicates that the CPU utilization has fallen from <code>cpuUtiRisingThreshold</code> to <code>cpuUtiFallingThreshold</code> .
swMemoryUtiRisingThreshold Notification	1.3.6.1.4.1.22426.43.103.2.1.0.109	This notification indicates that the memory utilization has risen from <code>memoryUtiFallingThreshold</code> to <code>memoryUtiRisingThreshold</code> .
swMemoryUtiFallingThreshold Notification	1.3.6.1.4.1.22426.43.103.2.1.0.110	This notification indicates that the memory utilization has fallen from <code>memoryUtiRisingThreshold</code> to <code>memoryUtiFallingThreshold</code> .
dhcpRougeServerAttackTrap	1.3.6.1.4.1.22426.43.103.2.1.0.114	This trap is sent when receiving a DHCP packet from a rouge server.
macNotificationTrap	1.3.6.1.4.1.22426.43.103.2.1.0.138	This trap is sent when there are changes of the dynamic MAC addresses on the switch.
lbdDetectionTrap	1.3.6.1.4.1.22426.43.103.2.1.0.141	This trap is sent when a loopback condition is detected by LBD.
lbdRecoveryTrap	1.3.6.1.4.1.22426.43.103.2.1.0.142	This trap is sent when a recovery is done by LBD.
sfpThresholdAlarmWarnTrap	1.3.6.1.4.1.22426.43.103.2.1.0.189	This trap is sent when the SFP's A/D quantity is not within alarm/warning thresholds.
udldPortShutdownTrap	1.3.6.1.4.1.22426.43.103.2.1.0.192	This trap is sent when the port is shut down by UDLD.
userAuthenticationFailureTrap	1.3.6.1.4.1.22426.43.103.2.1.0.199	This trap will be triggered if authentication fails.
userAuthenticationSuccessTrap	1.3.6.1.4.1.22426.43.103.2.1.0.200	This trap will be triggered if authentication is successful.
loginTrap	1.3.6.1.4.1.22426.43.103.2.1.0.201	This trap is sent when user logs in.
logoutTrap	1.3.6.1.4.1.22426.43.103.2.1.0.202	This trap is sent when user logs out.
fileCopyTrap	1.3.6.1.4.1.22426.43.103.2.1.0.208	This trap is sent when file copy is executed. If the copy action is triggered by the system, the login user information (<code>trapVarLoginUserName/ trapVarSessionType/ trapVarLoginInetAddressTypes/ trapVarLoginInetAddress</code>) will be a null value.
userauthCreateUserTrap	1.3.6.1.4.1.22426.43.103.2.1.0.209	This trap is sent when a user account is created.

Table 28: Supported Notification Messages (Continued)

Model	Level	Group
userauthDeleteUserTrap	1.3.6.1.4.1.22426.43.103.2.1.0.210	This trap is sent when a user account is deleted.
userauthModifyUserPrivilegeTrap	1.3.6.1.4.1.22426.43.103.2.1.0.211	This trap is sent when user privilege is modified.
cpuGuardControlTrap	1.3.6.1.4.1.22426.43.103.2.1.0.213	This trap is sent when CPU utilization rises above the high-watermark the first time or when CPU utilization rises from below the low-watermark to above the high-watermark.
cpuGuardReleaseTrap	1.3.6.1.4.1.22426.43.103.2.1.0.214	This trap is sent when CPU utilization falls from above the high-watermark to below the low-watermark.

* These are legacy notifications and therefore must be enabled in conjunction with the corresponding traps on the SNMP Configuration menu.

Web Interface

To configure an SNMP group:

1. Click Administration, SNMP.
2. Select Configure Group from the Step list.
3. Select Add from the Action list.
4. Enter a group name, assign a security model and level, and then select read, write, and notify views.
5. Click Apply

Figure 226: Creating an SNMP Group

To show SNMP groups:

1. Click Administration, SNMP.
2. Select Configure Group from the Step list.
3. Select Show from the Action list.

Figure 227: Showing SNMP Groups

	Group Name	Model	Level	Read View	Write View	Notify View
<input type="checkbox"/>	public	v1	noAuthNoPriv	defaultview	No writeview specified	No notifyview specified
<input type="checkbox"/>	public	v2c	noAuthNoPriv	defaultview	No writeview specified	No notifyview specified
<input type="checkbox"/>	private	v1	noAuthNoPriv	defaultview	defaultview	No notifyview specified
<input type="checkbox"/>	private	v2c	noAuthNoPriv	defaultview	defaultview	No notifyview specified

Setting Community Access Strings Use the Administration > SNMP (Configure Community – Add) page to configure up to five community strings authorized for management access by clients using SNMP v1 and v2c. For security reasons, you should consider removing the default strings.

Parameters

These parameters are displayed:

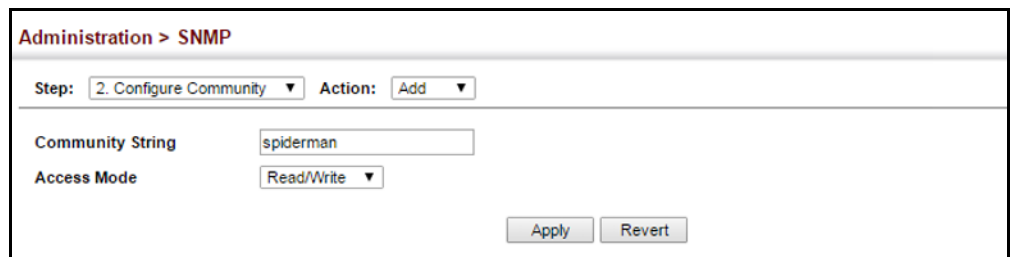
- ◆ **Community String** – A community string that acts like a password and permits access to the SNMP protocol.
Range: 1-32 characters, case sensitive
Default strings: “public” (Read-Only), “private” (Read/Write)
- ◆ **Access Mode** – Specifies the access rights for the community string:
 - **Read-Only** – Authorized management stations are only able to retrieve MIB objects.
 - **Read/Write** – Authorized management stations are able to both retrieve and modify MIB objects.

Web Interface

To set a community access string:

1. Click Administration, SNMP.
2. Select Configure Community from the Step list.
3. Select Add from the Action list.
4. Add new community strings as required, and select the corresponding access rights from the Access Mode list.
5. Click Apply

Figure 228: Setting Community Access Strings



To show the community access strings:

1. Click Administration, SNMP.
2. Select Configure Community from the Step list.
3. Select Show from the Action list.

Figure 229: Showing Community Access Strings

The screenshot shows a web interface for 'Administration > SNMP'. At the top, there are two dropdown menus: 'Step: 2. Configure Community' and 'Action: Show'. Below this is a table titled 'SNMP Community String List' with a 'Total: 3' indicator. The table has three columns: a checkbox, 'Community String', and 'Access Mode'. There are three rows of data. Below the table are 'Delete' and 'Revert' buttons.

<input type="checkbox"/>	Community String	Access Mode
<input type="checkbox"/>	public	Read-Only
<input type="checkbox"/>	private	Read/Write
<input type="checkbox"/>	spiderman	Read/Write

Configuring Local SNMPv3 Users

Use the Administration > SNMP (Configure User - Add SNMPv3 Local User) page to authorize management access for SNMPv3 clients, or to identify the source of SNMPv3 trap messages sent from the local switch. Each SNMPv3 user is defined by a unique name. Users must be configured with a specific security level and assigned to a group. The SNMPv3 group restricts users to a specific read, write, and notify view.

Parameters

These parameters are displayed:

- ◆ **User Name** – The name of user connecting to the SNMP agent.
(Range: 1-32 characters)
- ◆ **Group Name** – The name of the SNMP group to which the user is assigned.
(Range: 1-32 characters)
- ◆ **Security Model** – The user security model; SNMP v1, v2c or v3.
- ◆ **Security Level** – The following security levels are only used for the groups assigned to the SNMP security model:
 - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications. (This is the default security level.)
 - **AuthNoPriv** – SNMP communications use authentication, but the data is not encrypted.
 - **AuthPriv** – SNMP communications use both authentication and encryption.

- ◆ **Authentication Protocol** – The method used for user authentication. (Options: MD5, SHA; Default: MD5)
- ◆ **Authentication Password** – A minimum of eight plain text characters is required. (Range: 8-32 characters)
- ◆ **Privacy Protocol** – The encryption algorithm use for data privacy; only 56-bit DES is currently available.
- ◆ **Privacy Password** – A minimum of eight plain text characters is required.

Web Interface

To configure a local SNMPv3 user:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.
3. Select Add SNMPv3 Local User from the Action list.
4. Enter a name and assign it to a group. If the security model is set to SNMPv3 and the security level is authNoPriv or authPriv, then an authentication protocol and password must be specified. If the security level is authPriv, a privacy password must also be specified.
5. Click Apply

Figure 230: Configuring Local SNMPv3 Users

Administration > SNMP

Step: 5. Configure User Action: Add SNMPv3 Local User

SNMPv3 User

User Name: chris

Group Name: public r&d

Security Model: v3

Security Level: authPriv

User Authentication

Authentication Protocol: MD5

Authentication Password: greenpeace

Data Privacy

Privacy Protocol: DES56

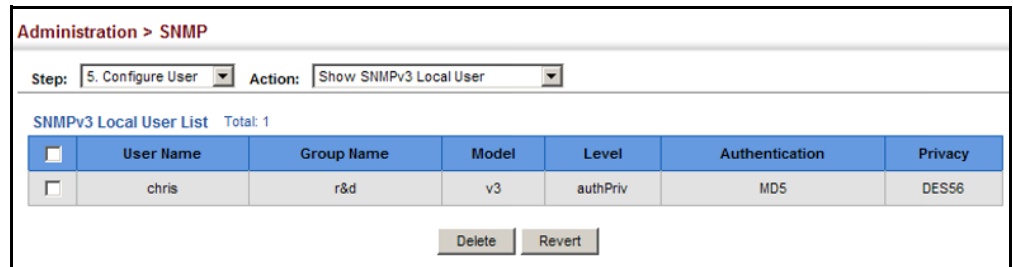
Privacy Password: einstien

Apply Revert

To show local SNMPv3 users:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.
3. Select Show SNMPv3 Local User from the Action list.

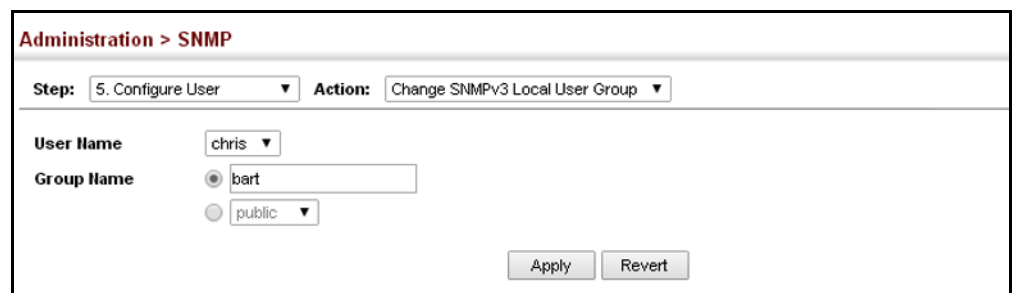
Figure 231: Showing Local SNMPv3 Users



To change a local SNMPv3 local user group:

1. Click Administration, SNMP.
2. Select Change SNMPv3 Local User Group from the Action list.
3. Select the User Name.
4. Enter a new group name.
5. Click Apply

Figure 232: Changing a Local SNMPv3 User Group



Configuring Remote SNMPv3 Users

Use the Administration > SNMP (Configure User - Add SNMPv3 Remote User) page to identify the source of SNMPv3 inform messages sent from the local switch. Each SNMPv3 user is defined by a unique name. Users must be configured with a specific security level and assigned to a group. The SNMPv3 group restricts users to a specific read, write, and notify view.

Command Usage

- ◆ To grant management access to an SNMPv3 user on a remote device, you must first specify the engine identifier for the SNMP agent on the remote device where the user resides. The remote engine ID is used to compute the security digest for authentication and encryption of packets passed between the switch and the remote user. (See “[Specifying Trap Managers](#)” on page 368 and “[Specifying a Remote Engine ID](#)” on page 351.)

Parameters

These parameters are displayed:

- ◆ **User Name** – The name of user connecting to the SNMP agent.
(Range: 1-32 characters)
- ◆ **Group Name** – The name of the SNMP group to which the user is assigned.
(Range: 1-32 characters)
- ◆ **Remote IP** – IPv4 address of the remote device where the user resides.
- ◆ **Security Model** – The user security model; SNMP v1, v2c or v3. (Default: v3)
- ◆ **Security Level** – The following security levels are only used for the groups assigned to the SNMP security model:
 - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications. (This is the default security level.)
 - **AuthNoPriv** – SNMP communications use authentication, but the data is not encrypted.
 - **AuthPriv** – SNMP communications use both authentication and encryption.
- ◆ **Authentication Protocol** – The method used for user authentication.
(Options: MD5, SHA; Default: MD5)
- ◆ **Authentication Password** – A minimum of eight plain text characters is required.
- ◆ **Privacy Protocol** – The encryption algorithm use for data privacy; only 56-bit DES is currently available.
- ◆ **Privacy Password** – A minimum of eight plain text characters is required.

Web Interface

To configure a remote SNMPv3 user:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.

3. Select Add SNMPv3 Remote User from the Action list.
4. Enter a name and assign it to a group. Enter the IP address to identify the source of SNMPv3 inform messages sent from the local switch. If the security model is set to SNMPv3 and the security level is authNoPriv or authPriv, then an authentication protocol and password must be specified. If the security level is authPriv, a privacy password must also be specified.
5. Click Apply

Figure 233: Configuring Remote SNMPv3 Users

The screenshot shows the 'Administration > SNMP' configuration page. At the top, there are two dropdown menus: 'Step: 5. Configure User' and 'Action: Add SNMPv3 Remote User'. Below this, the 'SNMPv3 User' section contains the following fields:

- User Name:** mark
- Group Name:** public (selected with radio button), r&d (selected with radio button)
- Remote IP:** 192.168.1.19
- Security Model:** v3
- Security Level:** authPriv

The 'User Authentication' section contains:

- Authentication Protocol:** MD5
- Authentication Password:** greenpeace

The 'Data Privacy' section contains:

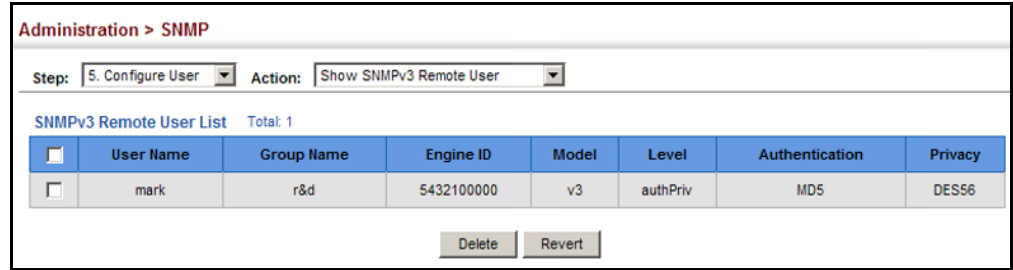
- Privacy Protocol:** DES56
- Privacy Password:** einstien

At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show remote SNMPv3 users:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.
3. Select Show SNMPv3 Remote User from the Action list.

Figure 234: Showing Remote SNMPv3 Users



The screenshot shows the 'Administration > SNMP' configuration page. At the top, there are two dropdown menus: 'Step: 5. Configure User' and 'Action: Show SNMPv3 Remote User'. Below this is a table titled 'SNMPv3 Remote User List' with a 'Total: 1' indicator. The table has the following columns: 'User Name', 'Group Name', 'Engine ID', 'Model', 'Level', 'Authentication', and 'Privacy'. A single row is displayed with the following values: 'mark', 'r&d', '5432100000', 'v3', 'authPriv', 'MD5', and 'DES56'. Below the table are two buttons: 'Delete' and 'Revert'.

<input type="checkbox"/>	User Name	Group Name	Engine ID	Model	Level	Authentication	Privacy
<input type="checkbox"/>	mark	r&d	5432100000	v3	authPriv	MD5	DES56

Specifying Trap Managers

Use the Administration > SNMP (Configure Trap) page to specify the host devices to be sent traps and the types of traps to send. Traps indicating status changes are issued by the switch to the specified trap managers. You must specify trap managers so that key events are reported by this switch to your management station (using network management software). You can specify up to five management stations that will receive authentication failure messages and other trap messages from the switch.

Command Usage

- ◆ Notifications are issued by the switch as trap messages by default. The recipient of a trap message does not send a response to the switch. Traps are therefore not as reliable as inform messages, which include a request for acknowledgement of receipt. Informs can be used to ensure that critical information is received by the host. However, note that informs consume more system resources because they must be kept in memory until a response is received. Informs also add to network traffic. You should consider these effects when deciding whether to issue notifications as traps or informs.

To send an inform to a SNMPv2c host, complete these steps:

1. Enable the SNMP agent ([page 349](#)).
2. Create a view with the required notification messages ([page 353](#)).
3. Configure the group (matching the community string specified on the Configure Trap - Add page) to include the required notify view ([page 355](#)).
4. Enable trap informs as described in the following pages.

To send an inform to a SNMPv3 host, complete these steps:

1. Enable the SNMP agent ([page 349](#)).
2. Create a remote SNMPv3 user to use in the message exchange process ([page 363](#)). If the user specified in the trap configuration page does not exist, an SNMPv3 group will be automatically created using the name of the specified remote user, and default settings for the read, write, and notify view.
3. Create a view with the required notification messages ([page 353](#)).
4. Create a group that includes the required notify view ([page 355](#)).
5. Enable trap informs as described in the following pages.

Parameters

These parameters are displayed:

SNMP Version 1

- ◆ **IP Address** – IPv4 or IPv6 address of a new management station to receive notification message (i.e., the targeted recipient).
- ◆ **Version** – Specifies whether to send notifications as SNMP v1, v2c, or v3 traps. (Default: v1)
- ◆ **Community String** – Specifies a valid community string for the new trap manager entry. (Range: 1-32 characters, case sensitive)
Although you can set this string in the Configure Trap – Add page, we recommend defining it in the Configure User – Add Community page.
- ◆ **UDP Port** – Specifies the UDP port number used by the trap manager. (Default: 162)

SNMP Version 2c

- ◆ **IP Address** – IPv4 or IPv6 address of a new management station to receive notification message (i.e., the targeted recipient).
- ◆ **Version** – Specifies whether to send notifications as SNMP v1, v2c, or v3 traps.
- ◆ **Notification Type**
 - **Traps** – Notifications are sent as trap messages.
 - **Inform** – Notifications are sent as inform messages. Note that this option is only available for version 2c and 3 hosts. (Default: traps are used)
 - **Timeout** – The number of seconds to wait for an acknowledgment before resending an inform message. (Range: 0-2147483647 centiseconds; Default: 1500 centiseconds)
 - **Retry times** – The maximum number of times to resend an inform message if the recipient does not acknowledge receipt. (Range: 0-255; Default: 3)
- ◆ **Community String** – Specifies a valid community string for the new trap manager entry. (Range: 1-32 characters, case sensitive)
Although you can set this string in the Configure Trap – Add page, we recommend defining it in the Configure User – Add Community page.
- ◆ **UDP Port** – Specifies the UDP port number used by the trap manager. (Default: 162)

SNMP Version 3

- ◆ **IP Address** – IPv4 or IPv6 address of a new management station to receive notification message (i.e., the targeted recipient).
- ◆ **Version** – Specifies whether to send notifications as SNMP v1, v2c, or v3 traps.
- ◆ **Notification Type**
 - **Traps** – Notifications are sent as trap messages.
 - **Inform** – Notifications are sent as inform messages. Note that this option is only available for version 2c and 3 hosts. (Default: traps are used)
 - **Timeout** – The number of seconds to wait for an acknowledgment before resending an inform message. (Range: 0-2147483647 centiseconds; Default: 1500 centiseconds)
 - **Retry times** – The maximum number of times to resend an inform message if the recipient does not acknowledge receipt. (Range: 0-255; Default: 3)
- ◆ **Local User Name** – The name of a local user which is used to identify the source of SNMPv3 trap messages sent from the local switch. (Range: 1-32 characters)

If an account for the specified user has not been created ([page 363](#)), one will be automatically generated.
- ◆ **Remote User Name** – The name of a remote user which is used to identify the source of SNMPv3 inform messages sent from the local switch. (Range: 1-32 characters)

If an account for the specified user has not been created ([page 365](#)), one will be automatically generated.
- ◆ **UDP Port** – Specifies the UDP port number used by the trap manager. (Default: 162)
- ◆ **Security Level** – When trap version 3 is selected, you must specify one of the following security levels. (Default: noAuthNoPriv)
 - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications.
 - **AuthNoPriv** – SNMP communications use authentication, but the data is not encrypted.
 - **AuthPriv** – SNMP communications use both authentication and encryption.

Web Interface

To configure trap managers:

1. Click Administration, SNMP.
2. Select Configure Trap from the Step list.
3. Select Add from the Action list.
4. Fill in the required parameters based on the selected SNMP version.
5. Click Apply

Figure 235: Configuring Trap Managers (SNMPv1)

The screenshot shows a web interface titled "Administration > SNMP". At the top, there are two dropdown menus: "Step:" with "6. Configure Trap" selected and "Action:" with "Add" selected. Below this, there are four input fields: "IP Address" with the value "192.168.0.3", "Version" with a dropdown menu showing "v1", "Community String" with the value "private", and "UDP Port (1-65535)" with the value "162". At the bottom right, there are two buttons: "Apply" and "Revert".

Figure 236: Configuring Trap Managers (SNMPv2c)

The screenshot shows a web interface titled "Administration > SNMP". At the top, there are two dropdown menus: "Step:" with "6. Configure Trap" selected and "Action:" with "Add" selected. Below this, there are seven input fields: "IP Address" with the value "192.168.2.9", "Version" with a dropdown menu showing "v2c", "Notification Type" with a dropdown menu showing "Inform", "Timeout (0-2147483647)" with an empty input field and the unit "centiseconds" to its right, "Retry Times (0-255)" with an empty input field, "Community String" with the value "venus", and "UDP Port (1-65535)" with an empty input field. At the bottom right, there are two buttons: "Apply" and "Revert".

Figure 237: Configuring Trap Managers (SNMPv3)

The screenshot shows the 'Administration > SNMP' configuration page. At the top, the 'Step' is set to '6. Configure Trap' and the 'Action' is 'Add'. The configuration fields are as follows:

- IP Address: 192.168.2.9
- Version: v3
- Notification Type: Inform
- Timeout (0-2147483647): [empty] centiseconds
- Retry Times (0-255): [empty]
- Remote User Name: [empty]
- UDP Port (1-65535): [empty]
- Security Level: authPriv

Buttons for 'Apply' and 'Revert' are located at the bottom right.

To show configured trap managers:

1. Click Administration, SNMP.
2. Select Configure Trap from the Step list.
3. Select Show from the Action list.

Figure 238: Showing Trap Managers

The screenshot shows the 'Administration > SNMP' configuration page with the 'Action' set to 'Show'. It displays a table titled 'SNMP Trap Manager List' with a total of 5 entries. The table has the following columns: IP Address, Version, Community String/User Name, UDP Port, Security Level, Timeout, and Retry Times.

<input type="checkbox"/>	IP Address	Version	Community String/User Name	UDP Port	Security Level	Timeout	Retry Times
<input type="checkbox"/>	192.168.0.4	v3	steve	162	noAuthNoPriv		
<input type="checkbox"/>	192.168.0.5	v3	bobby	162	noAuthNoPriv		
<input type="checkbox"/>	192.168.0.6	v3	betty	162	authNoPriv		
<input type="checkbox"/>	192.168.2.9	v2c	venus	162		1600	5
<input type="checkbox"/>	192.168.5.8	v3	margaret	162	authPriv	1600	5

Buttons for 'Delete' and 'Revert' are located at the bottom right.

Creating SNMP Notification Logs Use the Administration > SNMP (Configure Notify Filter - Add) page to create an SNMP notification log.

Command Usage

- ◆ Systems that support SNMP often need a mechanism for recording Notification information as a hedge against lost notifications, whether there are Traps or Informs that may be exceeding retransmission limits. The Notification Log MIB (NLM, RFC 3014) provides an infrastructure in which information from other MIBs may be logged.
- ◆ Given the service provided by the NLM, individual MIBs can now bear less responsibility to record transient information associated with an event against

the possibility that the Notification message is lost, and applications can poll the log to verify that they have not missed any important Notifications.

- ◆ If notification logging is not configured, when the switch reboots, some SNMP traps (such as warm start) cannot be logged.
- ◆ To avoid this problem, notification logging should be configured as described in this section, and these commands stored in the startup configuration file using the System > File (Copy – Running-Config) page as described on [page 69](#). Then when the switch reboots, SNMP traps (such as warm start) can now be logged.
- ◆ Based on the default settings used in RFC 3014, a notification log can contain up to 256 entries, and the entry aging time is 1440 minutes. Information recorded in a notification log, and the entry aging time can only be configured using SNMP from a network management station.
- ◆ When a trap host is created using the Administration > SNMP (Configure Trap – Add) page described on [page 368](#), a default notify filter will be created.

Parameters

These parameters are displayed:

- ◆ **IP Address** – The IPv4 or IPv6 address of a remote device. The specified target host must already have been configured using the Administration > SNMP (Configure Trap – Add) page.

The notification log is stored locally. It is not sent to a remote device. This remote host parameter is only required to complete mandatory fields in the SNMP Notification MIB.

- ◆ **Filter Profile Name** – Notification log profile name. (Range: 1-32 characters)

Web Interface

To create an SNMP notification log:

1. Click Administration, SNMP.
2. Select Configure Notify Filter from the Step list.
3. Select Add from the Action list.
4. Fill in the IP address of a configured trap manager and the filter profile name.
5. Click Apply

Figure 239: Creating SNMP Notification Logs

Administration > SNMP

Step: 7. Configure Notify Filter Action: Add

IP Address: 192.168.0.99

Filter Profile Name: R&D

Apply Revert

To show configured SNMP notification logs:

1. Click Administration, SNMP.
2. Select Configure Notify Filter from the Step list.
3. Select Show from the Action list.

Figure 240: Showing SNMP Notification Logs

Administration > SNMP

Step: 7. Configure Notify Filter Action: Show

SNMP Notify Filter List Total: 1

<input type="checkbox"/>	Filter profile name	IP Address
<input type="checkbox"/>	R&D	192.168.0.99

Delete Revert

Showing SNMP Statistics Use the Administration > SNMP (Show Statistics) page to show counters for SNMP input and output protocol data units.

Parameters

The following counters are displayed:

- ◆ **SNMP packets input** – The total number of messages delivered to the SNMP entity from the transport service.
- ◆ **Bad SNMP version errors** – The total number of SNMP messages which were delivered to the SNMP entity and were for an unsupported SNMP version.
- ◆ **Unknown community name** – The total number of SNMP messages delivered to the SNMP entity which used a SNMP community name not known to said entity.
- ◆ **Illegal operation for community name supplied** – The total number of SNMP messages delivered to the SNMP entity which represented an SNMP operation which was not allowed by the SNMP community named in the message.

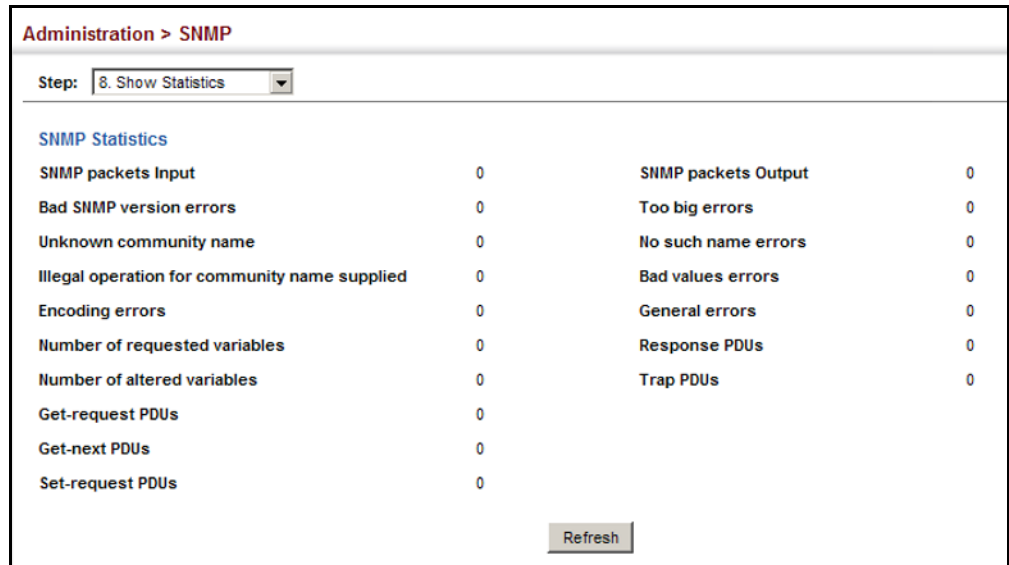
- ◆ **Encoding errors** – The total number of ASN.1 or BER errors encountered by the SNMP entity when decoding received SNMP messages.
- ◆ **Number of requested variables** – The total number of MIB objects which have been retrieved successfully by the SNMP protocol entity as the result of receiving valid SNMP Get-Request and Get-Next PDUs.
- ◆ **Number of altered variables** – The total number of MIB objects which have been altered successfully by the SNMP protocol entity as the result of receiving valid SNMP Set-Request PDUs.
- ◆ **Get-request PDUs** – The total number of SNMP Get-Request PDUs which have been accepted and processed, or generated, by the SNMP protocol entity.
- ◆ **Get-next PDUs** – The total number of SNMP Get-Next PDUs which have been accepted and processed, or generated, by the SNMP protocol entity.
- ◆ **Set-request PDUs** – The total number of SNMP Set-Request PDUs which have been accepted and processed, or generated, by the SNMP protocol entity.
- ◆ **SNMP packets output** – The total number of SNMP Messages which were passed from the SNMP protocol entity to the transport service.
- ◆ **Too big errors** – The total number of SNMP PDUs which were generated by the SNMP protocol entity and for which the value of the error-status field is “tooBig.”
- ◆ **No such name errors** – The total number of SNMP PDUs which were delivered to, or generated by, the SNMP protocol entity and for which the value of the error-status field is “noSuchName.”
- ◆ **Bad values errors** – The total number of SNMP PDUs which were delivered to, or generated by, the SNMP protocol entity and for which the value of the error-status field is “badValue.”
- ◆ **General errors** – The total number of SNMP PDUs which were delivered to, or generated by, the SNMP protocol entity and for which the value of the error-status field is “genErr.”
- ◆ **Response PDUs** – The total number of SNMP Get-Response PDUs which have been accepted and processed by, or generated by, the SNMP protocol entity.
- ◆ **Trap PDUs** – The total number of SNMP Trap PDUs which have been accepted and processed by, or generated by, the SNMP protocol entity.

Web Interface

To show SNMP statistics:

1. Click Administration, SNMP.
2. Select Show Statistics from the Step list.

Figure 241: Showing SNMP Statistics



Remote Monitoring

Remote Monitoring allows a remote device to collect information or respond to specified events on an independent basis. This switch is an RMON-capable device which can independently perform a wide range of tasks, significantly reducing network management traffic. It can continuously run diagnostics and log information on network performance. If an event is triggered, it can automatically notify the network administrator of a failure and provide historical information about the event. If it cannot connect to the management agent, it will continue to perform any specified tasks and pass data back to the management station the next time it is contacted.

The switch supports mini-RMON, which consists of the Statistics, History, Event and Alarm groups. When RMON is enabled, the system gradually builds up information about its physical interfaces, storing this information in the relevant RMON database group. A management agent then periodically communicates with the switch using the SNMP protocol. However, if the switch encounters a critical event, it can automatically send a trap message to the management agent which can then respond to the event if so configured.

Configuring RMON Alarms

Use the Administration > RMON (Configure Global - Add - Alarm) page to define specific criteria that will generate response events. Alarms can be set to test data over any specified time interval, and can monitor absolute or changing values (such as a statistical counter reaching a specific value, or a statistic changing by a certain amount over the set interval). Alarms can be set to respond to rising or falling thresholds. (However, note that after an alarm is triggered it will not be triggered again until the statistical value crosses the opposite bounding threshold and then back across the trigger threshold.

Command Usage

- ◆ If an alarm is already defined for an index, the entry must be deleted before any changes can be made.

Parameters

These parameters are displayed:

- ◆ **Index** – Index to this entry. (Range: 1-65535)
- ◆ **Variable** – The object identifier of the MIB variable to be sampled. Only variables of the type etherStatsEntry.n.n may be sampled.

Note that etherStatsEntry.n uniquely defines the MIB variable, and etherStatsEntry.n.n defines the MIB variable, plus the etherStatsIndex. For example, 1.3.6.1.2.1.16.1.1.1.6.1 denotes etherStatsBroadcastPkts, plus the etherStatsIndex of 1.
- ◆ **Interval** – The polling interval. (Range: 1-31622400 seconds)
- ◆ **Sample Type** – Tests for absolute or relative changes in the specified variable.
 - **Absolute** – The variable is compared directly to the thresholds at the end of the sampling period.
 - **Delta** – The last sample is subtracted from the current value and the difference is then compared to the thresholds.
- ◆ **Rising Threshold** – If the current value is greater than or equal to the rising threshold, and the last sample value was less than this threshold, then an alarm will be generated. After a rising event has been generated, another such event will not be generated until the sampled value has fallen below the rising threshold, reaches the falling threshold, and again moves back up to the rising threshold. (Range: 0-2147483647)
- ◆ **Rising Event Index** – The index of the event to use if an alarm is triggered by monitored variables reaching or crossing above the rising threshold. If there is no corresponding entry in the event control table, then no event will be generated. (Range: 0-65535)
- ◆ **Falling Threshold** – If the current value is less than or equal to the falling threshold, and the last sample value was greater than this threshold, then an

alarm will be generated. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the falling threshold, reaches the rising threshold, and again moves back down to the failing threshold. (Range: 0-2147483647)

- ◆ **Falling Event Index** – The index of the event to use if an alarm is triggered by monitored variables reaching or crossing below the falling threshold. If there is no corresponding entry in the event control table, then no event will be generated. (Range: 0-65535)
- ◆ **Owner** – Name of the person who created this entry. (Range: 1-32 characters)

Web Interface

To configure an RMON alarm:

1. Click Administration, RMON.
2. Select Configure Global from the Step list.
3. Select Add from the Action list.
4. Click Alarm.
5. Enter an index number, the MIB object to be polled (etherStatsEntry.n.n), the polling interval, the sample type, the thresholds, and the event to trigger.
6. Click Apply

Figure 242: Configuring an RMON Alarm

The screenshot shows the 'Administration > RMON' configuration page. At the top, there are dropdown menus for 'Step: 1. Configure Global' and 'Action: Add'. Below this, there are radio buttons for 'Alarm' (selected) and 'Event'. The main configuration area contains the following fields:

Index (1-65535)	1
Variable	6.1
Interval (1-31622400)	15 sec
Sample Type	Delta
Rising Threshold (0-2147483647)	100
Rising Event Index (0-65535)	30
Falling Threshold (0-2147483647)	1
Falling Event Index (0-65535)	2
Owner	bill

At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

To show configured RMON alarms:

1. Click Administration, RMON.
2. Select Configure Global from the Step list.
3. Select Show from the Action list.
4. Click Alarm.

Figure 243: Showing Configured RMON Alarms

Administration > RMON

Step: 1. Configure Global Action: Show

Alarm Event

RMON Alarm List Total: 28

<input type="checkbox"/>	Index	Status	Variable	Interval	Type	Last Value	Rising Threshold	Rising Event Index	Falling Threshold	Falling Event Index	Owner
<input type="checkbox"/>	1	Valid	1.3.6.1.2.1.16.1.1.1.6.1	30	Delta	0	892800	0	446400	0	
<input type="checkbox"/>	2	Valid	1.3.6.1.2.1.16.1.1.1.6.2	30	Delta	0	892800	0	446400	0	
<input type="checkbox"/>	3	Valid	1.3.6.1.2.1.16.1.1.1.6.3	30	Delta	0	892800	0	446400	0	
<input type="checkbox"/>	4	Valid	1.3.6.1.2.1.16.1.1.1.6.4	30	Delta	0	892800	0	446400	0	
<input type="checkbox"/>	5	Valid	1.3.6.1.2.1.16.1.1.1.6.5	30	Delta	0	892800	0	446400	0	

Configuring RMON Events

Use the Administration > RMON (Configure Global - Add - Event) page to set the action to take when an alarm is triggered. The response can include logging the alarm or sending a message to a trap manager. Alarms and corresponding events provide a way of immediately responding to critical network problems.

Command Usage

- ◆ If an alarm is already defined for an index, the entry must be deleted before any changes can be made.
- ◆ One default event is configured as follows:
 - event Index = 1
 - Description: RMON_TRAP_LOG
 - Event type: log & trap
 - Event community name is public
 - Owner is RMON_SNMP

Parameters

These parameters are displayed:

- ◆ **Index** – Index to this entry. (Range: 1-65535)

- ◆ **Type** – Specifies the type of event to initiate:
 - **None** – No event is generated.
 - **Log** – Generates an RMON log entry when the event is triggered. Log messages are processed based on the current configuration settings for event logging (see [“System Log Configuration” on page 316](#)).
 - **Trap** – Sends a trap message to all configured trap managers (see [“Specifying Trap Managers” on page 368](#)).
 - **Log and Trap** – Logs the event and sends a trap message.
- ◆ **Community** – A password-like community string sent with the trap operation to SNMP v1 and v2c hosts.

Although the community string can be set on this configuration page, it is recommended that it be defined on the SNMP trap configuration page (see [“Setting Community Access Strings” on page 362](#)) prior to configuring it here. (Range: 1-32 characters)
- ◆ **Description** – A comment that describes this event. (Range: 1-127 characters)
- ◆ **Owner** – Name of the person who created this entry. (Range: 1-32 characters)

Web Interface

To configure an RMON event:

1. Click Administration, RMON.
2. Select Configure Global from the Step list.
3. Select Add from the Action list.
4. Click Event.
5. Enter an index number, the type of event to initiate, the community string to send with trap messages, the name of the person who created this event, and a brief description of the event.
6. Click Apply

Figure 244: Configuring an RMON Event

To show configured RMON events:

1. Click Administration, RMON.
2. Select Configure Global from the Step list.
3. Select Show from the Action list.
4. Click Event.

Figure 245: Showing Configured RMON Events

Index	Status	Type	Community	Description	Owner	Last Fired
1	Valid	None		None	None	00:00:00
2	Valid	Log		Log	Log	00:00:00
3	Valid	Trap	Trap	Trap	Trap	00:00:00
4	Valid	Log and Trap	Log and Trap	Log and Trap	Log and Trap	00:00:00

Configuring RMON History Samples

Use the Administration > RMON (Configure Interface - Add - History) page to collect statistics on a physical interface to monitor network utilization, packet types, and errors. A historical record of activity can be used to track down intermittent problems. The record can be used to establish normal baseline activity, which may reveal problems associated with high traffic levels, broadcast storms, or other unusual events. It can also be used to predict network growth and plan for expansion before your network becomes too overloaded.

Command Usage

- ◆ Each index number equates to a port on the switch.
- ◆ If history collection is already enabled on an interface, the entry must be deleted before any changes can be made.
- ◆ The information collected for each sample includes:
input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, fragments, jabbers, CRC alignment errors, collisions, drop events, and network utilization.

For a description of the statistics displayed on the Show Details page, refer to ["Showing Port or Trunk Statistics" on page 100](#).
- ◆ The switch reserves two index entries for each port. If a default index entry is re-assigned to another port using the Add page, this index will not appear in the Show nor Show Details page for the port to which is normally assigned. For example, if control entry 15 is assigned to port 5, this index entry will be removed from the Show and Show Details page for port 8.

Parameters

These parameters are displayed:

- ◆ **Port** – The port number on the switch. (Range: 1-10)
- ◆ **Index** - Index to this entry. (Range: 1-65535)
- ◆ **Interval** - The polling interval. (Range: 1-3600 seconds; Default: 1800 seconds)
- ◆ **Buckets** - The number of buckets requested for this entry. (Range: 1-65536; Default: 8)

The number of buckets granted are displayed on the Show page.
- ◆ **Owner** - Name of the person who created this entry. (Range: 1-32 characters)

Web Interface

To periodically sample statistics on a port:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Add from the Action list.
4. Click History.
5. Select a port from the list as the data source.

6. Enter an index number, the sampling interval, the number of buckets to use, and the name of the owner for this entry.
7. Click Apply

Figure 246: Configuring an RMON History Sample

The screenshot shows the 'Administration > RMON' configuration page. At the top, 'Step' is set to '2. Configure Interface' and 'Action' is set to 'Add'. Below this, there are radio buttons for 'History' (selected) and 'Statistics'. A 'Port' dropdown menu is set to '2'. The 'Index (1-65535)' field contains '100', 'Interval (1-3600)' contains '60' with 'sec' to its right, 'Buckets (1-65535)' contains '10', and the 'Owner' field contains 'david'. At the bottom right, there are 'Apply' and 'Revert' buttons.

To show configured RMON history samples:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Show from the Action list.
4. Select a port from the list.
5. Click History.

Figure 247: Showing Configured RMON History Samples

The screenshot shows the 'Administration > RMON' configuration page with 'Action' set to 'Show'. The 'Port' dropdown menu is set to '1'. Below the configuration fields, there is a table titled 'RMON History Port List' with a 'Total: 2' indicator. The table has columns for Index, Status, Interval, Requested Buckets, Granted Buckets, and Owner. At the bottom, there are 'Delete' and 'Revert' buttons.

<input type="checkbox"/>	Index	Status	Interval	Requested Buckets	Granted Buckets	Owner
<input type="checkbox"/>	1	Valid	1800	8	8	
<input type="checkbox"/>	2	Valid	30	8	8	

To show collected RMON history samples:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Show Details from the Action list.
4. Select a port from the list.
5. Click History.

Figure 248: Showing Collected RMON History Samples

History Index	Sample Index	Interval Start	Octets	Packets	Broadcast Packets	Multicast Packets	Undersize Packets	Oversize Packets	Fragments	Jabbers	CRC Align Errors	Collisions	Drop Events	Network Utilization
1	1	00:00:01	756105	3218	91	894	0	0	0	0	0	0	0	0
2	71	00:35:01	21490	76	0	15	0	0	0	0	0	0	0	0
2	72	00:35:31	46521	120	0	15	0	0	0	0	0	0	0	0
2	73	00:36:01	21682	79	0	15	0	0	0	0	0	0	0	0
2	74	00:36:31	21554	77	0	15	0	0	0	0	0	0	0	0

Configuring RMON Statistical Samples

Use the Administration > RMON (Configure Interface - Add - Statistics) page to collect statistics on a port, which can subsequently be used to monitor the network for common errors and overall traffic rates.

Command Usage

- ◆ If statistics collection is already enabled on an interface, the entry must be deleted before any changes can be made.
- ◆ The information collected for each entry includes:
input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, CRC alignment errors, jabbers, fragments, collisions, drop events, and frames of various sizes.

Parameters

These parameters are displayed:

- ◆ **Port** – The port number on the switch. (Range: 1-10)
- ◆ **Index** - Index to this entry. (Range: 1-65535)
- ◆ **Owner** - Name of the person who created this entry. (Range: 1-32 characters)

Web Interface

To enable regular sampling of statistics on a port:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Add from the Action list.
4. Click Statistics.
5. Select a port from the list as the data source.
6. Enter an index number, and the name of the owner for this entry
7. Click Apply

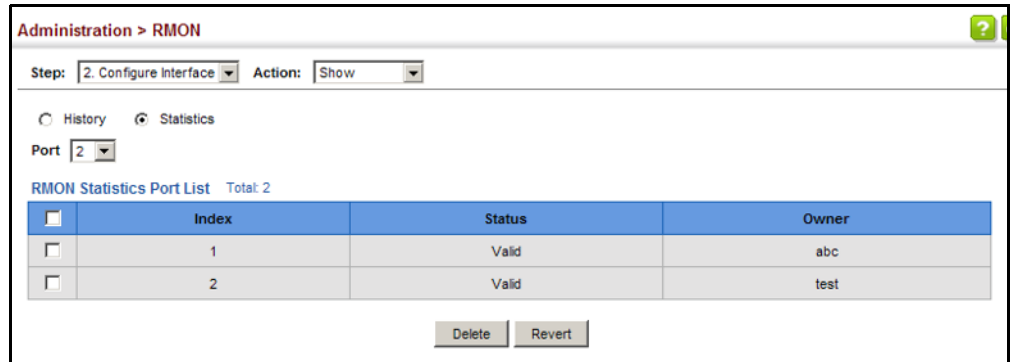
Figure 249: Configuring an RMON Statistical Sample

The screenshot shows the 'Administration > RMON' web interface. At the top, there is a breadcrumb trail 'Administration > RMON'. Below this, there are two dropdown menus: 'Step: 2. Configure Interface' and 'Action: Add'. Underneath, there are two radio buttons: 'History' (unselected) and 'Statistics' (selected). Below the radio buttons, there is a 'Port' dropdown menu set to '2'. There are two text input fields: 'Index (1-65535)' with the value '100' and 'Owner' with the value 'mary'. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show configured RMON statistical samples:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Show from the Action list.
4. Select a port from the list.
5. Click Statistics.

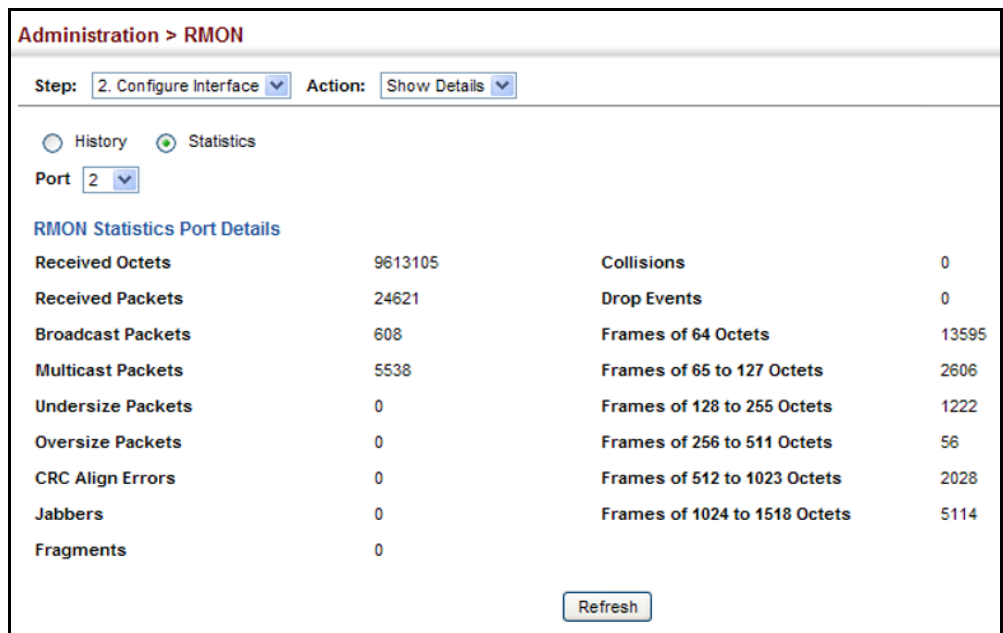
Figure 250: Showing Configured RMON Statistical Samples



To show collected RMON statistical samples:

1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Show Details from the Action list.
4. Select a port from the list.
5. Click Statistics.

Figure 251: Showing Collected RMON Statistical Samples



Setting a Time Range

Use the Administration > Time Range page to set a time range during which various functions are applied, including applied ACLs or PoE.

Command Usage

- ◆ If both an absolute rule and one or more periodic rules are configured for the same time range (i.e., named entry), that entry will only take effect if the current time is within the absolute time range and one of the periodic time ranges.
- ◆ A maximum of eight rules can be configured for a time range.

Parameters

These parameters are displayed:

Add

- ◆ **Time-Range Name** – Name of a time range. (Range: 1-32 characters)

Add Rule

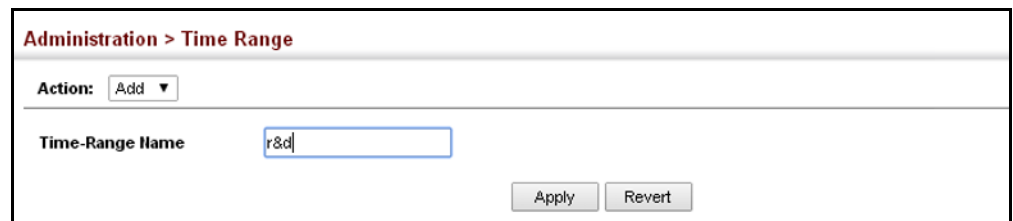
- ◆ **Time-Range** – Name of a time range.
- ◆ **Mode**
 - **Absolute** – Specifies a specific time or time range.
 - **Start/End** – Specifies the hours, minutes, month, day, and year at which to start or end.
 - **Periodic** – Specifies a periodic interval.
 - **Start/To** – Specifies the days of the week, hours, and minutes at which to start or end.

Web Interface

To configure a time range:

1. Click Administration, Time Range.
2. Select Add from the Action list.
3. Enter the name of a time range.
4. Click Apply.

Figure 252: Setting the Name of a Time Range

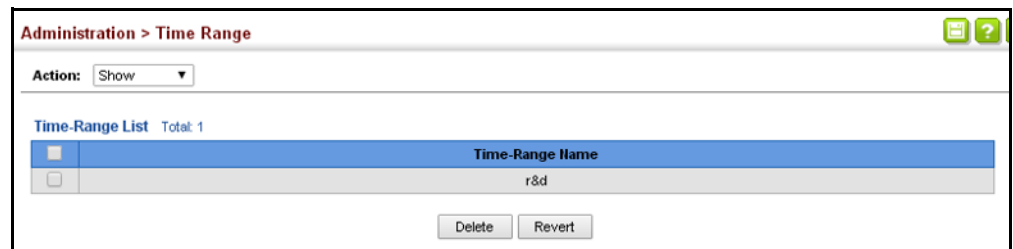


The screenshot shows the 'Administration > Time Range' page. At the top, there is a breadcrumb 'Administration > Time Range'. Below it, an 'Action:' dropdown menu is set to 'Add'. A text input field labeled 'Time-Range Name' contains the text 'r&d'. At the bottom right, there are two buttons: 'Apply' and 'Revert'.

To show a list of time ranges:

1. Click Administration, Time Range.
2. Select Show from the Action list.

Figure 253: Showing a List of Time Ranges



The screenshot shows the 'Administration > Time Range' page. At the top, there is a breadcrumb 'Administration > Time Range'. Below it, an 'Action:' dropdown menu is set to 'Show'. A table titled 'Time-Range List' with 'Total: 1' is displayed. The table has two columns: a checkbox column and a 'Time-Range Name' column. The first row has a checked checkbox and the name 'r&d'. At the bottom right, there are two buttons: 'Delete' and 'Revert'.

To configure a rule for a time range:

1. Click Administration, Time Range.
2. Select Add Rule from the Action list.
3. Select the name of time range from the drop-down list.
4. Select a mode option of Absolute or Periodic.
5. Fill in the required parameters for the selected mode.
6. Click Apply.

Figure 254: Add a Rule to a Time Range

To show the rules configured for a time range:

1. Click Administration, Time Range.
2. Select Show Rule from the Action list.

Figure 255: Showing the Rules Configured for a Time Range

	Mode	Start	End
<input type="checkbox"/>	Periodic	Weekend 05:00	Weekend 06:00

LBD Configuration

The switch can be configured to detect general loopback conditions caused by hardware problems or faulty protocol settings. When enabled, a control frame is transmitted on the participating ports, and the switch monitors inbound traffic to see if the frame is looped back.

Usage Guidelines

- ◆ The default settings for the control frame transmit interval and recover time may be adjusted to improve performance for your specific environment. The shutdown mode may also need to be changed once you determine what kind of packets are being looped back.
- ◆ General loopback detection provided by the commands described in this section and loopback detection provided by the spanning tree protocol cannot both be enabled at the same time. If loopback detection is enabled for the

spanning tree protocol, general loopback detection cannot be enabled on the same interface.

- ◆ When a loopback event is detected on an interface or when an interface is released from a shutdown state caused by a loopback event, a trap message is sent and the event recorded in the system log.
- ◆ Loopback detection must be enabled both globally and on an interface for loopback detection to take effect.

Configuring Global Settings for LBD

Use the Administration > LBD (Configure Global) page to enable loopback detection globally, specify the interval at which to transmit control frames, the interval to wait before releasing an interface from shutdown state, the response to a detected loopback, and the traps to send.

Parameters

These parameters are displayed:

- ◆ **Global Status** – Enables loopback detection globally on the switch. (Default: Enabled)
- ◆ **Transmit Interval** – Specifies the interval at which to transmit loopback detection control frames. (Range: 1-32767 seconds; Default: 10 seconds)
- ◆ **Recover Time** – Specifies the interval to wait before the switch automatically releases an interface from shutdown state. (Range: 60-1,000,000 seconds; Default: 60 seconds)

When the loopback detection mode is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.

If the recover time is not enabled (checkbox unmarked), all ports placed in shutdown state can be restored to operation using the Release button. To restore a specific port, re-enable Admin status on the Configure Interface page.

- ◆ **Action** – Specifies the protective action the switch takes when a loopback condition is detected. (Options: None, Shutdown; Default: Shutdown)
 - **None** - No action is taken.
 - **Shutdown** – When the response to a detected loopback condition is set to shut down a port, and a port receives a control frame sent by itself, this means that the port is in looped state, and the VLAN in the frame payload is also in looped state with the wrong VLAN tag. The looped port is therefore shut down.

When the loopback detection response is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.

- ◆ **Trap** – Sends a trap when a loopback condition is detected, or when the switch recovers from a loopback condition. (Options: Both, Detect, None, Recover; Default: None)
 - **Both** – Sends an SNMP trap message when a loopback condition is detected, or when the switch recovers from a loopback condition.
 - **Detect** – Sends an SNMP trap message when a loopback condition is detected.
 - **None** – Does not send an SNMP trap for loopback detection or recovery.
 - **Recover** – Sends an SNMP trap message when the switch recovers from a loopback condition.
- ◆ **Release** – Releases all interfaces currently shut down by the loopback detection feature.

Web Interface

To configure global settings for LBD:

1. Click Administration, LBD, Configure Global.
2. Make the required configuration changes.
3. Click Apply.

Figure 256: Configuring Global Settings for LBD

The screenshot shows the 'Administration > LBD' configuration page. At the top, there is a breadcrumb 'Administration > LBD' and a 'Step: 1. Configure Global' dropdown menu. The main configuration area includes:

- Global Status:** A checkbox labeled 'Enabled' which is currently unchecked.
- Transmit Interval (1-32767):** A text input field containing '10' followed by 'sec'.
- Recover Time (60-1000000):** A checked checkbox followed by a text input field containing '60' followed by 'sec'.
- Action:** A dropdown menu with 'Shutdown' selected.
- Trap:** A dropdown menu with 'None' selected.

At the bottom right of the configuration area are two buttons: 'Apply' and 'Revert'. Below the configuration area, there is a 'Release' button followed by the text 'Click this button to release all looped ports manually'.

Configuring Interface Settings for LBD Use the Administration > LBD (Configure Interface) page to enable loopback detection on an interface, to display the loopback operational state, and the VLANs which are looped back.

Parameters

These parameters are displayed:

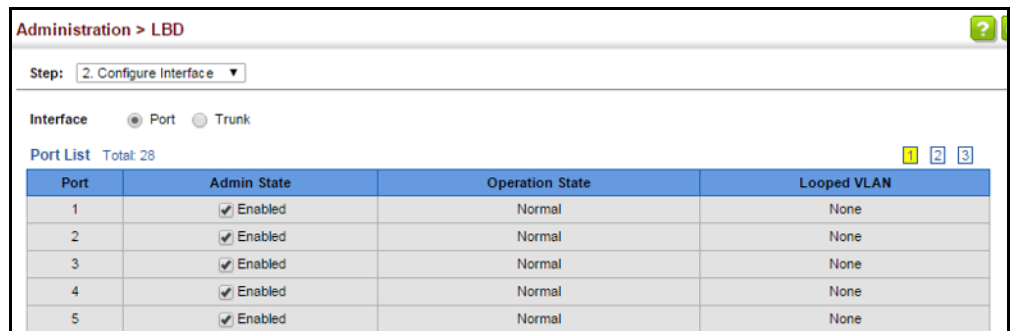
- ◆ **Interface** – Displays a list of ports or trunks.
 - **Port** – Port Identifier. (Range: 1-10)
 - **Trunk** – Trunk Identifier. (Range: 1-8)
- ◆ **Admin State** – Manually enables or disables an interface. (Default: Enabled)
- ◆ **Operation State** – Valid states include Normal or Looped.
- ◆ **Looped VLAN** – Shows the VLANs which are in looped state.

Web Interface

To configure interface settings for LBD:

1. Click Administration, LBD, Configure Interface.
2. Make the required configuration changes.
3. Click Apply.

Figure 257: Configuring Interface Settings for LBD



The screenshot shows the 'Administration > LBD' configuration page. At the top, there is a breadcrumb 'Administration > LBD' and a 'Step: 2. Configure Interface' dropdown. Below this, there are radio buttons for 'Interface' type: 'Port' (selected) and 'Trunk'. A 'Port List' section shows 'Total: 28' ports. A table displays the first five ports with columns for Port, Admin State, Operation State, and Looped VLAN. All ports are currently 'Enabled' and in 'Normal' state, with 'None' for the Looped VLAN.

Port	Admin State	Operation State	Looped VLAN
1	<input checked="" type="checkbox"/> Enabled	Normal	None
2	<input checked="" type="checkbox"/> Enabled	Normal	None
3	<input checked="" type="checkbox"/> Enabled	Normal	None
4	<input checked="" type="checkbox"/> Enabled	Normal	None
5	<input checked="" type="checkbox"/> Enabled	Normal	None

Multicast Filtering

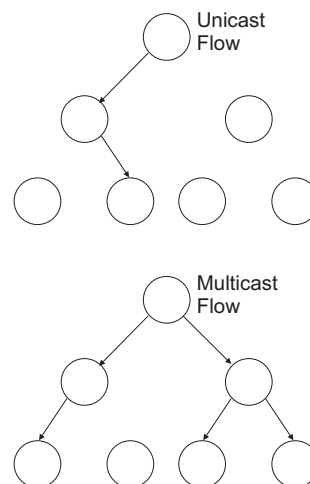
This chapter describes how to configure the following multicast services:

- ◆ **IGMP Snooping** – Configures snooping and query parameters.
- ◆ **Filtering and Throttling** – Filters specified multicast service, or throttles the maximum of multicast groups allowed on an interface.
- ◆ **MLD Snooping** – Configures snooping and query parameters for IPv6.

Overview

Multicasting is used to support real-time applications such as video conferencing or streaming audio. A multicast server does not have to establish a separate connection with each client. It merely broadcasts its service to the network, and any hosts that want to receive the multicast register with their local multicast switch/router. Although this approach reduces the network overhead required by a multicast server, the broadcast traffic must be carefully pruned at every multicast switch/router it passes through to ensure that traffic is only passed on to the hosts which subscribed to this service.

Figure 258: Multicast Filtering Concept



This switch can use Internet Group Management Protocol (IGMP) to filter multicast traffic. IGMP Snooping can be used to passively monitor or “snoop” on exchanges between attached hosts and an IGMP-enabled device, most commonly a multicast router. In this way, the switch can discover the ports that want to join a multicast group, and set its filters accordingly.

If there is no multicast router attached to the local subnet, multicast traffic and query messages may not be received by the switch. In this case (Layer 2) IGMP Query can be used to actively ask the attached hosts if they want to receive a specific multicast service. IGMP Query thereby identifies the ports containing hosts requesting to join the service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service.

The purpose of IP multicast filtering is to optimize a switched network's performance, so multicast packets will only be forwarded to those ports containing multicast group hosts or multicast routers/switches, instead of flooding traffic to all ports in the subnet (VLAN).

You can also configure a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation.

Layer 2 IGMP (Snooping and Query for IPv4)

IGMP Snooping and Query – If multicast routing is not supported on other switches in your network, you can use IGMP Snooping and IGMP Query ([page 396](#)) to monitor IGMP service requests passing between multicast clients and servers, and dynamically configure the switch ports which need to forward multicast traffic. IGMP Snooping conserves bandwidth on network segments where no node has expressed interest in receiving a specific multicast service. For switches that do not support multicast routing, or where multicast routing is already enabled on other switches in the local network segment, IGMP Snooping is the only service required to support multicast filtering.

When using IGMPv3 snooping, service requests from IGMP Version 1, 2 or 3 hosts are all forwarded to the upstream router as IGMPv3 reports. The primary enhancement provided by IGMPv3 snooping is in keeping track of information about the specific multicast sources which downstream IGMPv3 hosts have requested or refused. The switch maintains information about both multicast groups and channels, where a group indicates a multicast flow for which the hosts have *not* requested a specific source (the only option for IGMPv1 and v2 hosts unless statically configured on the switch), and a channel indicates a flow for which the hosts have requested service from a specific source. For IGMPv1/v2 hosts, the source address of a channel is always null (indicating that any source is acceptable), but for IGMPv3 hosts, it may include a specific address when requested.

Only IGMPv3 hosts can request service from a specific multicast source. When downstream hosts request service from a specific source for a multicast service, these sources are all placed in the Include list, and traffic is forwarded to the hosts from each of these sources. IGMPv3 hosts may also request that service be forwarded from any source except for those specified. In this case, traffic is filtered from sources in the Exclude list, and forwarded from all other available sources.



Note: When the switch is configured to use IGMPv3 snooping, the snooping version may be downgraded to version 2 or version 1, depending on the version of the IGMP query packets detected on each VLAN.

Note: IGMP snooping will not function unless a multicast router port is enabled on the switch. This can be accomplished in one of two ways. A static router port can be manually configured (see [“Specifying Static Interfaces for a Multicast Router” on page 400](#)). Using this method, the router port is never timed out, and will continue to function until explicitly removed. The other method relies on the switch to dynamically create multicast routing ports whenever multicast routing protocol packets or IGMP query packets are detected on a port.

Note: A maximum of up to 1023 multicast entries can be maintained for IGMP snooping. Once the table is full, no new entries are learned. Any subsequent multicast traffic not found in the table is dropped if unregistered-flooding is disabled (default behavior) and no router port is configured in the attached VLAN, or flooded throughout the VLAN if unregistered-flooding is enabled (see [“Configuring IGMP Snooping and Query Parameters” on page 396](#)).

Static IGMP Router Interface – If IGMP snooping cannot locate the IGMP querier, you can manually designate a known IGMP querier (i.e., a multicast router/switch) connected over the network to an interface on your switch ([page 400](#)). This interface will then join all the current multicast groups supported by the attached router/switch to ensure that multicast traffic is passed to all appropriate interfaces within the switch.

Static IGMP Host Interface – For multicast applications that you need to control more carefully, you can manually assign a multicast service to specific interfaces on the switch ([page 402](#)).

IGMP Snooping with Proxy Reporting – The switch supports last leave, and query suppression (as defined in DSL Forum TR-101, April 2006):

- ◆ When proxy reporting is disabled, all IGMP reports received by the switch are forwarded natively to the upstream multicast routers.
- ◆ Last Leave: Intercepts, absorbs and summarizes IGMP leaves coming from IGMP hosts. IGMP leaves are relayed upstream only when necessary, that is, when the last user leaves a multicast group.
- ◆ Query Suppression: Intercepts and processes IGMP queries in such a way that IGMP specific queries are never sent to client ports.

The only deviation from TR-101 is that the marking of IGMP traffic initiated by the switch with priority bits as defined in R-250 is not supported.

Configuring IGMP Snooping and Query Parameters

Use the Multicast > IGMP Snooping > General page to configure the switch to forward multicast traffic intelligently. Based on the IGMP query and report messages, the switch forwards multicast traffic only to the ports that request it. This prevents the switch from broadcasting the traffic to all ports and possibly disrupting network performance.

Command Usage

- ◆ **IGMP Snooping** – This switch can passively snoop on IGMP Query and Report packets transferred between IP multicast routers/switches and IP multicast host groups to identify the IP multicast group members. It simply monitors the IGMP packets passing through it, picks out the group registration information, and configures the multicast filters accordingly.



Note: If unknown multicast traffic enters a VLAN which has been configured with a router port, the traffic is forwarded to that port. However, if no router port exists on the VLAN, the traffic is dropped if unregistered data flooding is disabled (default behavior), or flooded throughout the VLAN if unregistered data flooding is enabled (see “Unregistered Data Flooding” in the Command Attributes section).

- ◆ **IGMP Querier** – A router, or multicast-enabled switch, can periodically ask their hosts if they want to receive multicast traffic. If there is more than one router/switch on the LAN performing IP multicasting, one of these devices is elected “querier” and assumes the role of querying the LAN for group members. It then propagates the service requests on to any upstream multicast switch/router to ensure that it will continue to receive the multicast service.



Note: Multicast routers use this information from IGMP snooping and query reports, along with a multicast routing protocol such as DVMRP or PIM, to support IP multicasting across the Internet.

Parameters

These parameters are displayed:

- ◆ **IGMP Snooping Status** – When enabled, the switch will monitor network traffic to determine which hosts want to receive multicast traffic. This is referred to as IGMP Snooping. (Default: Disabled)

When IGMP snooping is enabled globally, the per VLAN interface settings for IGMP snooping take precedence (see “[Setting IGMP Snooping Status per Interface](#)” on page 404).

When IGMP snooping is disabled globally, snooping can still be configured per VLAN interface, but the interface settings will not take effect until snooping is re-enabled globally.

- ◆ **Proxy Reporting Status** – Enables IGMP Snooping with Proxy Reporting. (Default: Disabled)

When proxy reporting is enabled with this command, the switch performs “IGMP Snooping with Proxy Reporting” (as defined in DSL Forum TR-101, April 2006), including last leave, and query suppression.

Last leave sends out a proxy query when the last member leaves a multicast group, and query suppression means that specific queries are not forwarded from an upstream multicast router to hosts downstream from this device.

When proxy reporting is disabled, all IGMP reports received by the switch are forwarded natively to the upstream multicast routers.

- ◆ **TCN Flood** – Enables flooding of multicast traffic if a spanning tree topology change notification (TCN) occurs. (Default: Disabled)

When a spanning tree topology change occurs, the multicast membership information learned by switch may be out of date. For example, a host linked to one port before the topology change (TC) may be moved to another port after the change. To ensure that multicast data is delivered to all receivers, by default, a switch in a VLAN (with IGMP snooping enabled) that receives a Bridge Protocol Data Unit (BPDU) with TC bit set (by the root bridge) will enter into “multicast flooding mode” for a period of time until the topology has stabilized and the new locations of all multicast receivers are learned.

If a topology change notification (TCN) is received, and all the uplink ports are subsequently deleted, a time out mechanism is used to delete all of the currently learned multicast channels.

When a new uplink port starts up, the switch sends unsolicited reports for all currently learned channels out the new uplink port.

By default, the switch immediately enters into “multicast flooding mode” when a spanning tree topology change occurs. In this mode, multicast traffic will be flooded to all VLAN ports. If many ports have subscribed to different multicast groups, flooding may cause excessive packet loss on the link between the switch and the end host. Flooding may be disabled to avoid this, causing multicast traffic to be delivered only to those ports on which multicast group members have been learned. Otherwise, the time spent in flooding mode can be manually configured to reduce excessive loading.

When the spanning tree topology changes, the root bridge sends a proxy query to quickly re-learn the host membership/port relations for multicast channels. The root bridge also sends an unsolicited Multicast Router Discover (MRD) request to quickly locate the multicast routers in this VLAN.

The proxy query and unsolicited MRD request are flooded to all VLAN ports except for the receiving port when the switch receives such packets.

- ◆ **TCN Query Solicit** – Sends out an IGMP general query solicitation when a spanning tree topology change notification (TCN) occurs. (Default: Disabled)

When the root bridge in a spanning tree receives a TCN for a VLAN where IGMP snooping is enabled, it issues a global IGMP leave message (or query solicitation). When a switch receives this solicitation, it floods it to all ports in the VLAN where the spanning tree change occurred. When an upstream

multicast router receives this solicitation, it immediately issues an IGMP general query.

A query solicitation can be sent whenever the switch notices a topology change, even if it is not the root bridge in spanning tree.

- ◆ **Router Alert Option** – Discards any IGMPv2/v3 packets that do not include the Router Alert option. (Default: Disabled)

As described in Section 9.1 of RFC 3376 for IGMP Version 3, the Router Alert Option can be used to protect against DOS attacks. One common method of attack is launched by an intruder who takes over the role of querier, and starts overloading multicast hosts by sending a large number of group-and-source-specific queries, each with a large source list and the Maximum Response Time set to a large value.

To protect against this kind of attack, (1) routers should not forward queries. This is easier to accomplish if the query carries the Router Alert option. (2) Also, when the switch is acting in the role of a multicast host (such as when using proxy routing), it should ignore version 2 or 3 queries that do not contain the Router Alert option.

- ◆ **Unregistered Data Flooding** – Floods unregistered multicast traffic into the attached VLAN. (Default: Disabled)

Once the table used to store multicast entries for IGMP snooping and multicast routing is filled, no new entries are learned. If no router port is configured in the attached VLAN, and unregistered-flooding is disabled, any subsequent multicast traffic not found in the table is dropped, otherwise it is flooded throughout the VLAN.

- ◆ **Forwarding Priority** – Assigns a CoS priority to all multicast traffic. (Range: 0-7, where 7 is the highest priority; Default: Disabled)

This parameter can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

- ◆ **Version Exclusive** – Discards any received IGMP messages which use a version different to that currently configured by the IGMP Version attribute. (Default: Disabled)

- ◆ **IGMP Unsolicited Report Interval** – Specifies how often the upstream interface should transmit unsolicited IGMP reports when proxy reporting is enabled. (Range: 1-65535 seconds, Default: 400 seconds)

When a new upstream interface (that is, uplink port) starts up, the switch sends unsolicited reports for all currently learned multicast channels via the new upstream interface.

This command only applies when proxy reporting is enabled.

- ◆ **Router Port Expire Time** – The time the switch waits after the previous querier stops before it considers it to have expired. (Range: 1-65535, Recommended Range: 300-500 seconds, Default: 300)
- ◆ **IGMP Snooping Version** – Sets the protocol version for compatibility with other devices on the network. This is the IGMP Version the switch uses to send snooping reports. (Range: 1-3; Default: 2)

This attribute configures the IGMP report/query version used by IGMP snooping. Versions 1 - 3 are all supported, and versions 2 and 3 are backward compatible, so the switch can operate with other devices, regardless of the snooping version employed.
- ◆ **Querier Status** – When enabled, the switch can serve as the Querier, which is responsible for asking hosts if they want to receive multicast traffic. This feature is not supported for IGMPv3 snooping. (Default: Disabled)

Web Interface

To configure general settings for IGMP Snooping and Query:

1. Click Multicast, IGMP Snooping, General.
2. Adjust the IGMP settings as required.
3. Click Apply.

Figure 259: Configuring General Settings for IGMP Snooping

The screenshot shows the configuration page for IGMP Snooping General settings. The breadcrumb path is "Multicast > IGMP Snooping > General". The settings are as follows:

Setting	Value
IGMP Snooping Status	<input checked="" type="checkbox"/> Enabled
Proxy Reporting Status	<input type="checkbox"/> Enabled
TCN Flood	<input type="checkbox"/> Enabled
TCN Query Solicit	<input type="checkbox"/> Enabled
Router Alert Option	<input type="checkbox"/> Enabled
Unregistered Data Flooding	<input type="checkbox"/> Enabled
Forwarding Priority (0-7)	<input type="checkbox"/> <input type="text" value=""/>
Version Exclusive	<input type="checkbox"/> Enabled
IGMP Unsolicited Report Interval (1-65535)	<input type="text" value="400"/> seconds
Router Port Expire Time (1-65535)	<input type="text" value="300"/> seconds
IGMP Snooping Version (1-3)	<input type="text" value="2"/>
Querier Status	<input type="checkbox"/> Enabled

Buttons: Apply, Revert

Specifying Static Interfaces for a Multicast Router Use the Multicast > IGMP Snooping > Multicast Router (Add Static Multicast Router) page to statically attach an interface to a multicast router/switch.

Depending on network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/switch connected over the network to an interface (port or trunk) on the switch, the interface (and a specified VLAN) can be manually configured to join all the current multicast groups supported by the attached router. This can ensure that multicast traffic is passed to all the appropriate interfaces within the switch.

Command Usage

IGMP Snooping must be enabled globally on the switch (see [“Configuring IGMP Snooping and Query Parameters” on page 396](#)) before a multicast router port can take effect.

Parameters

These parameters are displayed:

Add Static Multicast Router

- ◆ **VLAN** – Selects the VLAN which is to propagate all multicast traffic coming from the attached multicast router. (Range: 1-4094)
- ◆ **Interface** – Activates the Port or Trunk scroll down list.
- ◆ **Port or Trunk** – Specifies the interface attached to a multicast router.

Show Static Multicast Router

- ◆ **VLAN** – Selects the VLAN for which to display any configured static multicast routers.
- ◆ **Interface** – Shows the interface to which the specified static multicast routers are attached.

Show Current Multicast Router

- ◆ **VLAN** – Selects the VLAN for which to display any currently active multicast routers.
- ◆ **Interface** – Shows the interface to which an active multicast router is attached.
- ◆ **Type** – Shows if this entry is static or dynamic.
- ◆ **Expire** – Time until this dynamic entry expires.

Web Interface

To specify a static interface attached to a multicast router:

1. Click Multicast, IGMP Snooping, Multicast Router.
2. Select Add Static Multicast Router from the Action list.
3. Select the VLAN which will forward all the corresponding multicast traffic, and select the port or trunk attached to the multicast router.
4. Click Apply.

Figure 260: Configuring a Static Interface for a Multicast Router

The screenshot shows the 'Multicast > IGMP Snooping > Multicast Router' configuration page. The 'Action' dropdown is set to 'Add Static Multicast Router'. The 'VLAN' dropdown is set to '1'. The 'Interface' section has radio buttons for 'Port' (selected) and 'Trunk'. The 'Port' dropdown is set to '1'. There are 'Apply' and 'Revert' buttons at the bottom right.

To show the static interfaces attached to a multicast router:

1. Click Multicast, IGMP Snooping, Multicast Router.
2. Select Show Static Multicast Router from the Action list.
3. Select the VLAN for which to display this information.

Figure 261: Showing Static Interfaces Attached a Multicast Router

The screenshot shows the 'Multicast > IGMP Snooping > Multicast Router' configuration page. The 'Action' dropdown is set to 'Show Static Multicast Router'. The 'VLAN' dropdown is set to '1'. Below the dropdowns, there is a table titled 'Static Multicast Router Interface List' with a 'Total: 6' indicator. The table has a checkbox column and an 'Interface' column. The interfaces listed are: Unit 1 / Port 1, Unit 1 / Port 2, Unit 1 / Port 3, Trunk 2, Trunk 5, and Unit 1 / Port 4. There are 'Delete' and 'Revert' buttons at the bottom right.

<input type="checkbox"/>	Interface
<input type="checkbox"/>	Unit 1 / Port 1
<input type="checkbox"/>	Unit 1 / Port 2
<input type="checkbox"/>	Unit 1 / Port 3
<input type="checkbox"/>	Trunk 2
<input type="checkbox"/>	Trunk 5
<input type="checkbox"/>	Unit 1 / Port 4

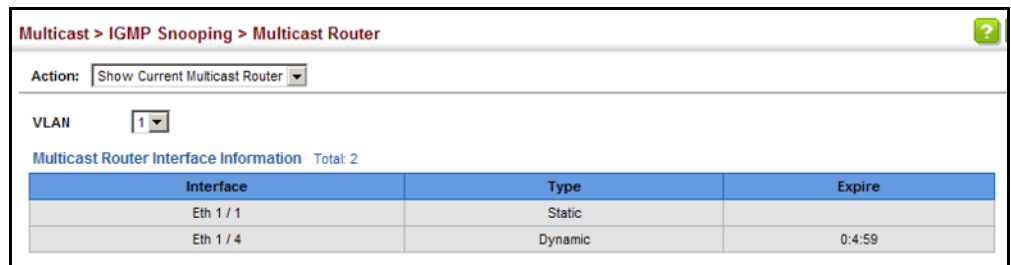
Multicast routers that are attached to ports on the switch use information obtained from IGMP, along with a multicast routing protocol (such as PIM) to support IP

multicasting across the Internet. These routers may be dynamically discovered by the switch or statically assigned to an interface on the switch.

To show the all interfaces attached to a multicast router:

1. Click Multicast, IGMP Snooping, Multicast Router.
2. Select Current Multicast Router from the Action list.
3. Select the VLAN for which to display this information. Ports in the selected VLAN which are attached to a neighboring multicast router/switch are displayed.

Figure 262: Showing Current Interfaces Attached a Multicast Router



The screenshot shows a web interface for configuring Multicast Router. The breadcrumb is "Multicast > IGMP Snooping > Multicast Router". The "Action" dropdown is set to "Show Current Multicast Router". The "VLAN" dropdown is set to "1". Below this, there is a table titled "Multicast Router Interface Information" with a "Total: 2" count. The table has three columns: "Interface", "Type", and "Expire".

Interface	Type	Expire
Eth 1 / 1	Static	
Eth 1 / 4	Dynamic	0:4:59

Assigning Interfaces to Multicast Services Use the Multicast > IGMP Snooping > IGMP Member (Add Static Member) page to statically assign a multicast service to an interface.

Multicast filtering can be dynamically configured using IGMP Snooping and IGMP Query messages (see [“Configuring IGMP Snooping and Query Parameters” on page 396](#)). However, for certain applications that require tighter control, it may be necessary to statically configure a multicast service on the switch. First add all the ports attached to participating hosts to a common VLAN, and then assign the multicast service to that VLAN group.

Command Usage

- ◆ Static multicast addresses are never aged out.
- ◆ When a multicast address is assigned to an interface in a specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

Parameters

These parameters are displayed:

- ◆ **VLAN** – Specifies the VLAN which is to propagate the multicast service. (Range: 1-4094)
- ◆ **Interface** – Activates the Port or Trunk scroll down list.
- ◆ **Port or Trunk** – Specifies the interface assigned to a multicast group.

- ◆ **Multicast IP** – The IP address for a specific multicast service.

Web Interface

To statically assign an interface to a multicast service:

1. Click Multicast, IGMP Snooping, IGMP Member.
2. Select Add Static Member from the Action list.
3. Select the VLAN that will propagate the multicast service, specify the interface attached to a multicast service (through an IGMP-enabled switch or multicast router), and enter the multicast IP address.
4. Click Apply.

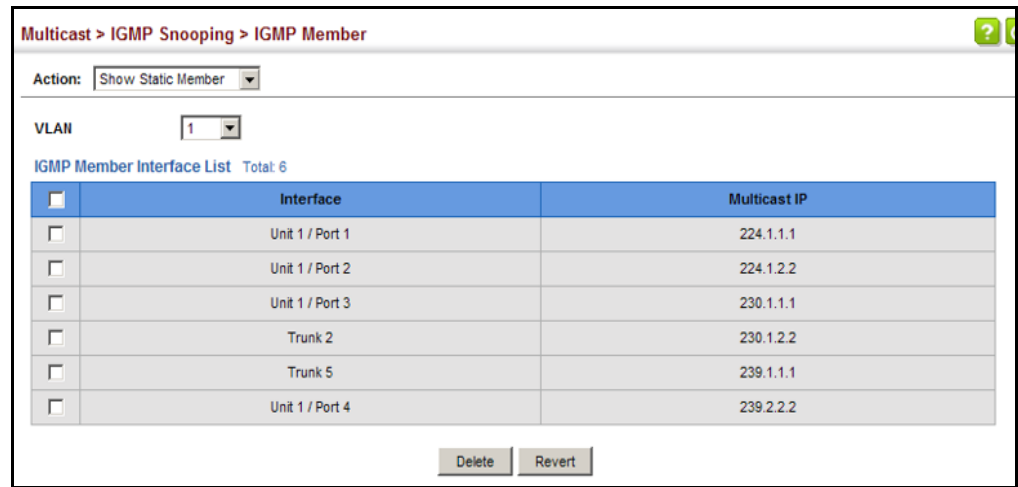
Figure 263: Assigning an Interface to a Multicast Service

The screenshot shows a web interface for configuring IGMP Member settings. The breadcrumb path is "Multicast > IGMP Snooping > IGMP Member". The "Action" dropdown is set to "Add Static Member". The "VLAN" dropdown is set to "1". The "Interface" section has two options: "Port 1" (selected with a radio button) and "Trunk 1" (unselected). The "Multicast IP" text input field contains "224.1.1.1". At the bottom right, there are "Apply" and "Revert" buttons.

To show the static interfaces assigned to a multicast service:

1. Click Multicast, IGMP Snooping, IGMP Member.
2. Select Show Static Member from the Action list.
3. Select the VLAN for which to display this information.

Figure 264: Showing Static Interfaces Assigned to a Multicast Service



Setting IGMP Snooping Status per Interface

Use the Multicast > IGMP Snooping > Interface (Configure VLAN) page to configure IGMP snooping attributes for a VLAN. To configure snooping globally, refer to “Configuring IGMP Snooping and Query Parameters” on page 396.

Command Usage

Multicast Router Discovery

There have been many mechanisms used in the past to identify multicast routers. This has led to interoperability issues between multicast routers and snooping switches from different vendors. In response to this problem, the Multicast Router Discovery (MRD) protocol has been developed for use by IGMP snooping and multicast routing devices. MRD is used to discover which interfaces are attached to multicast routers, allowing IGMP-enabled devices to determine where to send multicast source and group membership messages. (MRD is specified in draft-ietf-magma-mrdisc-07.)

Multicast source data and group membership reports must be received by all multicast routers on a segment. Using the group membership protocol query messages to discover multicast routers is insufficient due to query suppression. MRD therefore provides a standardized way to identify multicast routers without relying on any particular multicast routing protocol.



Note: The default values recommended in the MRD draft are implemented in the switch.

Multicast Router Discovery uses the following three message types to discover multicast routers:

- ◆ Multicast Router Advertisement – Advertisements are sent by routers to advertise that IP multicast forwarding is enabled. These messages are sent

unsolicited periodically on all router interfaces on which multicast forwarding is enabled. They are sent upon the occurrence of these events:

- Upon the expiration of a periodic (randomized) timer.
 - As a part of a router's start up procedure.
 - During the restart of a multicast forwarding interface.
 - On receipt of a Solicitation message.
- ◆ **Multicast Router Solicitation** – Devices send Solicitation messages in order to solicit Advertisement messages from multicast routers. These messages are used to discover multicast routers on a directly attached link. Solicitation messages are also sent whenever a multicast forwarding interface is initialized or re-initialized. Upon receiving a solicitation on an interface with IP multicast forwarding and MRD enabled, a router will respond with an Advertisement.
- ◆ **Multicast Router Termination** – These messages are sent when a router stops IP multicast routing functions on an interface. Termination messages are sent by multicast routers when:
- Multicast forwarding is disabled on an interface.
 - An interface is administratively disabled.
 - The router is gracefully shut down.

Advertisement and Termination messages are sent to the All-Snoopers multicast address. Solicitation messages are sent to the All-Routers multicast address.



Note: MRD messages are flooded to all ports in a VLAN where IGMP snooping or routing has been enabled. To ensure that older switches which do not support MRD can also learn the multicast router port, the switch floods IGMP general query packets, which do not have a null source address (0.0.0.0), to all ports in the attached VLAN. IGMP packets with a null source address are only flooded to all ports in the VLAN if the system is operating in multicast flooding mode, such as when a new VLAN or new router port is being established, or an spanning tree topology change has occurred. Otherwise, this kind of packet is only forwarded to known multicast routing ports.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of configured VLANs. (Range: 1-4094)
- ◆ **IGMP Snooping Status** – When enabled, the switch will monitor network traffic on the indicated VLAN interface to determine which hosts want to receive multicast traffic. This is referred to as IGMP Snooping. (Default: Disabled)

When IGMP snooping is enabled globally (see [page 396](#)), the per VLAN interface settings for IGMP snooping take precedence.

When IGMP snooping is disabled globally, snooping can still be configured per VLAN interface, but the interface settings will not take effect until snooping is re-enabled globally.

- ◆ **Version Exclusive** – Discards any received IGMP messages (except for multicast protocol packets) which use a version different to that currently configured by the IGMP Version attribute. (Options: Enabled, Using Global Status; Default: Using Global Status)

If version exclusive is disabled on a VLAN, then this setting is based on the global setting configured on the Multicast > IGMP Snooping > General page. If it is enabled on a VLAN, then this setting takes precedence over the global setting.

- ◆ **Immediate Leave Status** – Immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate leave is enabled for the parent VLAN. (Default: Disabled)

If immediate leave is not used, a multicast router (or querier) will send a group-specific query message when an IGMPv2 group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified time out period. Note that this time out is set to Last Member Query Interval * Robustness Variable (fixed at 2) as defined in RFC 2236.

If immediate leave is enabled, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, either a service host or a neighbor running IGMP snooping.

This attribute is only effective if IGMP snooping is enabled, and IGMPv2 or IGMPv3 snooping is used.

If immediate leave is enabled, the following options are provided:

- **By Group** – The switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, either a service host or a neighbor running IGMP snooping.
 - **By Host IP** – The switch will not send out a group-specific query when an IGMPv2/v3 leave message is received. But will check if there are other hosts joining the multicast group. Only when all hosts on that port leave the group will the member port be deleted.
- ◆ **Multicast Router Discovery** – MRD is used to discover which interfaces are attached to multicast routers. (Default: Disabled)
 - ◆ **General Query Suppression** – Suppresses general queries except for ports attached to downstream multicast hosts. (Default: Disabled)

By default, general query messages are flooded to all ports, except for the multicast router through which they are received.

If general query suppression is enabled, then these messages are forwarded only to downstream ports which have joined a multicast service.

- ◆ **Proxy Reporting** – Enables IGMP Snooping with Proxy Reporting. (Options: Enabled, Disabled, Using Global Status; Default: Using Global Status)

When proxy reporting is enabled with this command, the switch performs “IGMP Snooping with Proxy Reporting” (as defined in DSL Forum TR-101, April 2006), including last leave, and query suppression.

Last leave sends out a proxy query when the last member leaves a multicast group, and query suppression means that specific queries are not forwarded from an upstream multicast router to hosts downstream from this device.

Rules Used for Proxy Reporting

When IGMP Proxy Reporting is disabled, the switch will use a null IP address for the source of IGMP query and report messages unless a proxy query address has been set.

When IGMP Proxy Reporting is enabled, the source address is based on the following criteria:

- If a proxy query address is configured, the switch will use that address as the source IP address in general and group-specific query messages sent to downstream hosts, and in report and leave messages sent upstream from the multicast router port.
- If a proxy query address is not configured, the switch will use the VLAN's IP address as the IP source address in general and group-specific query messages sent downstream, and use the source address of the last IGMP message received from a downstream host in report and leave messages sent upstream from the multicast router port.

- ◆ **Interface Version** – Sets the protocol version for compatibility with other devices on the network. This is the IGMP Version the switch uses to send snooping reports. (Options: 1-3, Using Global Version; Default: Using Global Version)

This attribute configures the IGMP report/query version used by IGMP snooping. Versions 1 - 3 are all supported, and versions 2 and 3 are backward compatible, so the switch can operate with other devices, regardless of the snooping version employed.

- ◆ **Query Interval** – The interval between sending IGMP general queries. (Range: 2-31744 seconds; Default: 125 seconds)

An IGMP general query message is sent by the switch at the interval specified by this attribute. When this message is received by downstream hosts, all receivers build an IGMP report for the multicast groups they have joined.

This attribute applies when the switch is serving as the querier ([page 396](#)), or as a proxy host when IGMP snooping proxy reporting is enabled ([page 396](#)).

- ◆ **Query Response Interval** – The maximum time the system waits for a response to general queries. (Range: 10-31740 tenths of a second in multiples of 10; Default: 10 seconds)

This attribute applies when the switch is serving as the querier (page 396), or as a proxy host when IGMP snooping proxy reporting is enabled (page 396).

- ◆ **Last Member Query Interval** – The interval to wait for a response to a group-specific or group-and-source-specific query message. (Range: 1-31744 tenths of a second in multiples of 10; Default: 1 second)

When a multicast host leaves a group, it sends an IGMP leave message. When the leave message is received by the switch, it checks to see if this host is the last to leave the group by sending out an IGMP group-specific or group-and-source-specific query message, and starts a timer. If no reports are received before the timer expires, the group record is deleted, and a report is sent to the upstream multicast router.

A reduced value will result in reduced time to detect the loss of the last member of a group or source, but may generate more burst traffic.

This attribute will take effect only if IGMP snooping proxy reporting is enabled (page 396) or IGMP querier is enabled (page 396).

- ◆ **Last Member Query Count** – The number of IGMP proxy group-specific or group-and-source-specific query messages that are sent out before the system assumes there are no more local members. (Range: 1-255; Default: 2)

This attribute will take effect only if IGMP snooping proxy reporting or IGMP querier is enabled.

- ◆ **Proxy Query Address** – A static source address for locally generated query and report messages used by IGMP Proxy Reporting. (Range: Any valid IP unicast address; Default: 0.0.0.0)

IGMP Snooping uses a null IP address of 0.0.0.0 for the source of IGMP query messages which are proxied to downstream hosts to indicate that it is not the elected querier, but is only proxying these messages as defined in RFC 4541. The switch also uses a null address in IGMP reports sent to upstream ports.

Many hosts do not implement RFC 4541, and therefore do not understand query messages with the source address of 0.0.0.0. These hosts will therefore not reply to the queries, causing the multicast router to stop sending traffic to them.

To resolve this problem, the source address in proxied IGMP query messages can be replaced with any valid unicast address (other than the router's own address).

Web Interface

To configure IGMP snooping on a VLAN:

1. Click Multicast, IGMP Snooping, Interface.
2. Select Configure VLAN from the Action list.

3. Select the VLAN to configure and update the required parameters.
4. Click Apply.

Figure 265: Configuring IGMP Snooping on a VLAN

To show the interface settings for IGMP snooping:

1. Click Multicast, IGMP Snooping, Interface.
2. Select Show VLAN Information from the Action list.

Figure 266: Showing Interface Settings for IGMP Snooping

VLAN	IGMP Snooping Status	Immediate Leave Status	Query Interval	Query Response Interval	Last Member Query Interval	Last Member Query Count	Proxy (Query) Address	Proxy Reporting	Multicast Router Discovery	General Query Suppression	Version Exclusive	Interface Version
1	Enabled	Disabled	10	100	10	2	10.1.1.1	Enabled	Enabled	Disabled	Enabled	1
2	Disabled	Disabled	10	100	10	2	20.2.2.2	Disabled	Disabled	Enabled	Disabled	3
3	Disabled	Disabled	10	100	10	2	30.3.3.3	Disabled	Enabled	Disabled	Disabled	2
10	Disabled	Disabled	10	100	10	2	100.10.10.10	Disabled	Disabled	Enabled	Disabled	1

Filtering IGMP Query Packets and Multicast Data

Use the Multicast > IGMP Snooping > Interface (Configure Interface) page to configure an interface to drop IGMP query packets or multicast data packets.

Parameters

These parameters are displayed:

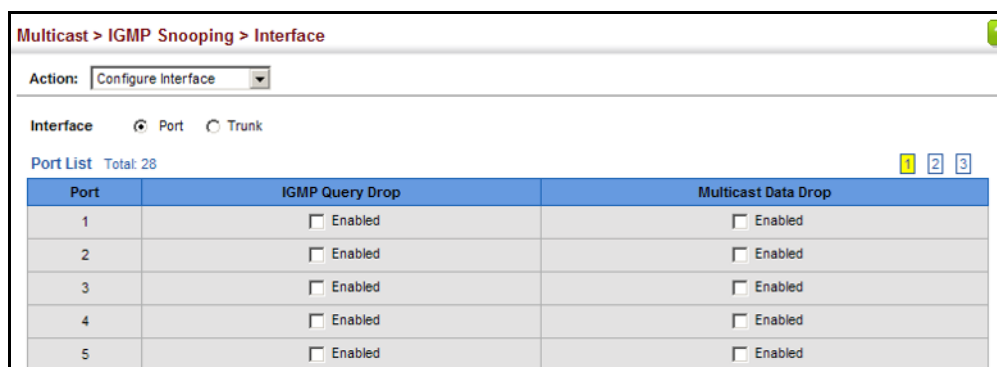
- ◆ **Interface** – Port or Trunk identifier.
- ◆ **IGMP Query Drop** – Configures an interface to drop any IGMP query packets received on the specified interface. If this switch is acting as a Querier, this prevents it from being affected by messages received from another Querier.
- ◆ **Multicast Data Drop** – Configures an interface to stop multicast services from being forwarded to users attached to the downstream port (i.e., the interfaces specified by this command).

Web Interface

To drop IGMP query packets or multicast data packets:

1. Click Multicast, IGMP Snooping, Interface.
2. Select Configure Interface from the Action list.
3. Select Port or Trunk interface.
4. Enable the required drop functions for any interface.
5. Click Apply.

Figure 267: Dropping IGMP Query or Multicast Data Packets



Displaying Multicast Groups Discovered by IGMP Snooping

Use the Multicast > IGMP Snooping > Forwarding Entry page to display the forwarding entries learned through IGMP Snooping.

Command Usage

To display information about multicast groups, IGMP Snooping must first be enabled on the switch (see [page 396](#)).

Parameters

These parameters are displayed:

- ◆ **VLAN** – An interface on the switch that is forwarding traffic to downstream ports for the specified multicast group address.
- ◆ **Group Address** – IP multicast group address with subscribers directly attached or downstream from the switch, or a static multicast group assigned to this interface.
- ◆ **Interface** – A downstream port or trunk that is receiving traffic for the specified multicast group. This field may include both dynamically and statically configured multicast router ports.
- ◆ **Up Time** – Time that this multicast group has been known.
- ◆ **Expire** – Time until this entry expires.
- ◆ **Count** – The number of times this address has been learned by IGMP snooping.

Web Interface

To show multicast groups learned through IGMP snooping:

1. Click Multicast, IGMP Snooping, Forwarding Entry.

Figure 268: Showing Multicast Groups Learned by IGMP Snooping

Multicast > IGMP Snooping > Forwarding Entry

IGMP Snooping Forwarding Entry List Total: 10

VLAN	Group Address	Source Address	Interface	Up Time	Expire	Count
1	224.1.1.1	*	Eth 1 / 9 (Router Port)	00:00:06:46		2 (Port)
			Eth 1 / 11 (Member Port)	00:00:06:46	03:46	1 (Host)
1	224.1.1.2	192.168.1.2	Eth 1 / 9 (Router Port)		02:24	1 (Port)
2	224.1.1.3	*	Eth 1 / 9 (Router Port)	00:00:16:14		1 (Port)
2	239.255.255.250	*	Eth 1 / 9 (Router Port)	00:00:08:47		2 (Port)
			Eth 1 / 11 (Member Port)	00:00:08:47	03:46	1 (Host)

Clear Click this button to clear all IGMP Snooping dynamic groups.

Displaying IGMP Snooping Statistics Use the Multicast > IGMP Snooping > Statistics pages to display IGMP snooping protocol-related statistics for the specified interface.

Parameters

These parameters are displayed:

- ◆ **VLAN** – VLAN identifier. (Range: 1-4094)
- ◆ **Port** – Port identifier. (Range: 1-10)
- ◆ **Trunk** – Trunk identifier. (Range: 1-8)

Query Statistics

- ◆ **Other Querier** – IP address of remote querier on this interface.
- ◆ **Other Querier Expire** – Time after which remote querier is assumed to have expired.
- ◆ **Other Querier Uptime** – Time remote querier has been up.
- ◆ **Self Querier** – IP address of local querier on this interface.
- ◆ **Self Querier Expire** – Time after which local querier is assumed to have expired.
- ◆ **Self Querier Uptime** – Time local querier has been up.
- ◆ **General Query Received** – The number of general queries received on this interface.
- ◆ **General Query Sent** – The number of general queries sent from this interface.
- ◆ **Specific Query Received** – The number of specific queries received on this interface.
- ◆ **Specific Query Sent** – The number of specific queries sent from this interface.
- ◆ **Warn Rate Limit** – The rate at which received query messages of the wrong version type cause the Vx warning count to increment. Note that “0 sec” means that the Vx warning count is incremented for each wrong message version received.
- ◆ **V1 Warning Count** – The number of times the query version received (Version 1) does not match the version configured for this interface.
- ◆ **V2 Warning Count** – The number of times the query version received (Version 2) does not match the version configured for this interface.

- ◆ **V3 Warning Count** – The number of times the query version received (Version 3) does not match the version configured for this interface.

VLAN, Port, and Trunk Statistics

Input Statistics

- ◆ **Report** – The number of IGMP membership reports received on this interface.
- ◆ **Leave** – The number of leave messages received on this interface.
- ◆ **G Query** – The number of general query messages received on this interface.
- ◆ **G(-S)-S Query** – The number of group specific or group-and-source specific query messages received on this interface.
- ◆ **Drop** – The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, packet content not allowed, or IGMP group report received.
- ◆ **Join Success** – The number of times a multicast group was successfully joined.
- ◆ **Group** – The number of IGMP groups active on this interface.

Output Statistics

- ◆ **Report** – The number of IGMP membership reports sent from this interface.
- ◆ **Leave** – The number of leave messages sent from this interface.
- ◆ **G Query** – The number of general query messages sent from this interface.
- ◆ **G(-S)-S Query** – The number of group specific or group-and-source specific query messages sent from this interface.

Web Interface

To display statistics for IGMP snooping query-related messages:

1. Click Multicast, IGMP Snooping, Statistics.
2. Select Show Query Statistics from the Action list.
3. Select a VLAN.

Figure 269: Displaying IGMP Snooping Statistics – Query

Action: Show Query Statistics

VLAN: 1

Query Statistics

Other Querier	None
Other Querier Expire	00(m):00(s)
Other Querier Uptime	00(h):00(m):00(s)
Self Querier	192.168.1.1
Self Querier Expire	00(m):00(s)
Self Querier Uptime	00(h):00(m):00(s)
General Query Received	0
General Query Sent	0
Specific Query Received	0
Specific Query Sent	0
Warn Rate Limit	0 sec.
V1 Warning Count	0
V2 Warning Count	0
V3 Warning Count	0

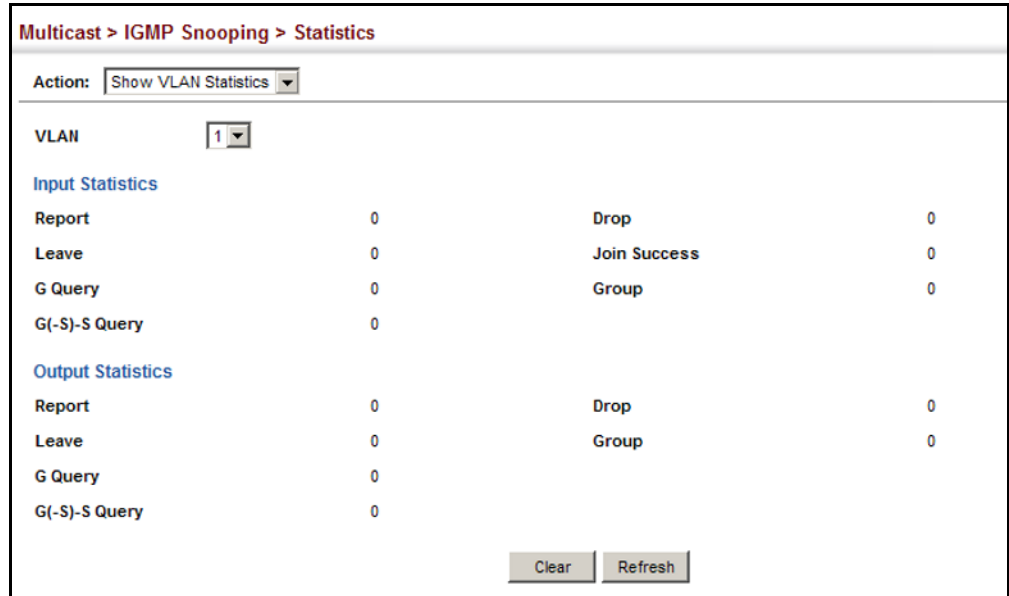
Clear All [Click this button to clear all IGMP Snooping statistics.](#)

Refresh

To display IGMP snooping protocol-related statistics for a VLAN:

1. Click Multicast, IGMP Snooping, Statistics.
2. Select Show VLAN Statistics from the Action list.
3. Select a VLAN.

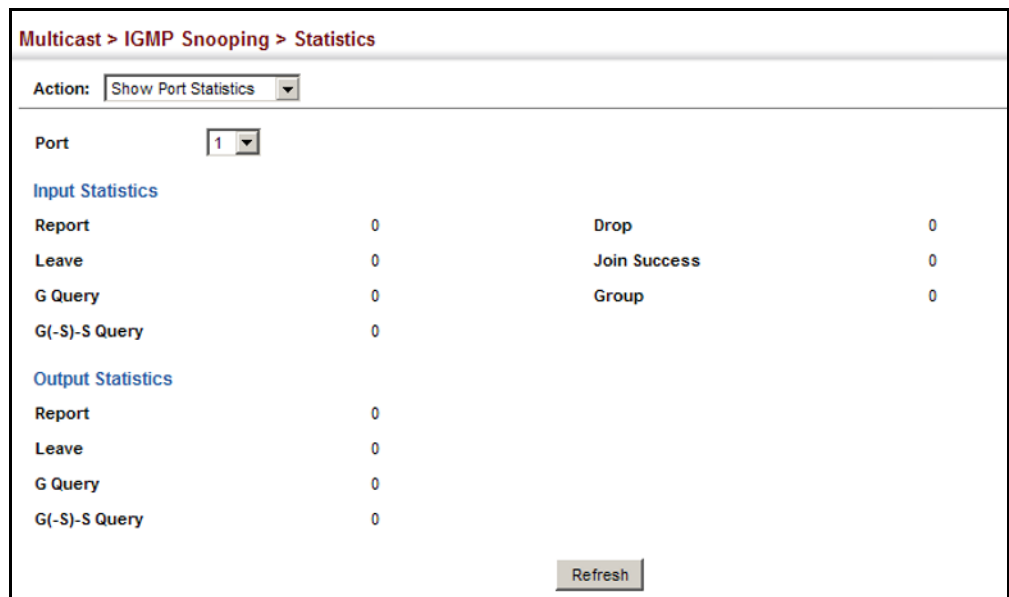
Figure 270: Displaying IGMP Snooping Statistics – VLAN



To display IGMP snooping protocol-related statistics for a port:

1. Click Multicast, IGMP Snooping, Statistics.
2. Select Show Port Statistics from the Action list.
3. Select a Port.

Figure 271: Displaying IGMP Snooping Statistics – Port



Filtering and Throttling IGMP Groups

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The IGMP filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and IGMP throttling limits the number of simultaneous multicast groups a port can join.

IGMP filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An IGMP filter profile can contain one or more addresses, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, IGMP join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the IGMP join report is forwarded as normal. If a requested multicast group is denied, the IGMP join report is dropped.

IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

Enabling IGMP Filtering and Throttling

Use the Multicast > IGMP Snooping > Filter (Configure General) page to enable IGMP filtering and throttling globally on the switch.

Parameters

These parameters are displayed:

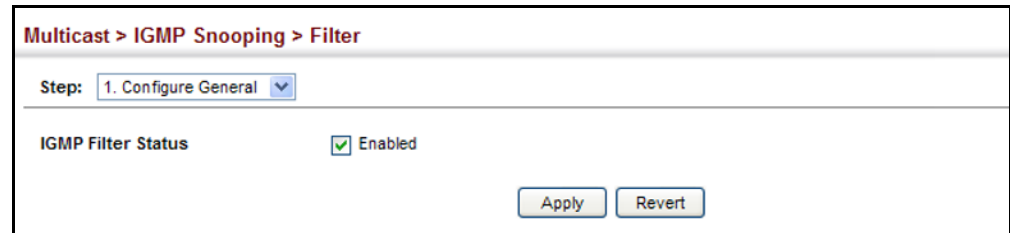
- ◆ **IGMP Filter Status** – Enables IGMP filtering and throttling globally for the switch. (Default: Disabled)

Web Interface

To enable IGMP filtering and throttling on the switch:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure General from the Step list.
3. Enable IGMP Filter Status.
4. Click Apply.

Figure 272: Enabling IGMP Filtering and Throttling



Configuring IGMP Filter Profiles

Use the Multicast > IGMP Snooping > Filter (Configure Profile – Add) page to create an IGMP profile and set its access mode. Then use the (Add Multicast Group Range) page to configure the multicast groups to filter.

Command Usage

Specify a range of multicast groups by entering a start and end IP address; or specify a single multicast group by entering the same IP address for the start and end of the range.

Parameters

These parameters are displayed:

Add

- ◆ **Profile ID** – Creates an IGMP profile. (Range: 1-4294967295)
- ◆ **Access Mode** – Sets the access mode of the profile; either permit or deny. (Default: Deny)

When the access mode is set to permit, IGMP join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, IGMP join reports are only processed when the multicast group is not in the controlled range.

Add Multicast Group Range

- ◆ **Profile ID** – Selects an IGMP profile to configure.
- ◆ **Start Multicast IP Address** – Specifies the starting address of a range of multicast groups.
- ◆ **End Multicast IP Address** – Specifies the ending address of a range of multicast groups.

Web Interface

To create an IGMP filter profile and set its access mode:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure Profile from the Step list.
3. Select Add from the Action list.
4. Enter the number for a profile, and set its access mode.
5. Click Apply.

Figure 273: Creating an IGMP Filtering Profile

The screenshot shows the 'Multicast > IGMP Snooping > Filter' configuration page. The 'Step' dropdown is set to '2. Configure Profile' and the 'Action' dropdown is set to 'Add'. The 'Profile ID (1-4294967295)' field contains the value '19'. The 'Access Mode' dropdown is set to 'Permit'. At the bottom right, there are 'Apply' and 'Revert' buttons.

To show the IGMP filter profiles:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure Profile from the Step list.
3. Select Show from the Action list.

Figure 274: Showing the IGMP Filtering Profiles Created

The screenshot shows the 'Multicast > IGMP Snooping > Filter' configuration page with the 'Action' dropdown set to 'Show'. Below the configuration fields, there is a table titled 'IGMP Snooping Filter Profile List' with a 'Total: 1' indicator. The table has three columns: a checkbox, 'Profile ID', and 'Action Mode'. One row is visible with a checked checkbox, Profile ID '19', and Action Mode 'Permit'. At the bottom right, there are 'Delete' and 'Revert' buttons.

	Profile ID	Action Mode
<input checked="" type="checkbox"/>	19	Permit

To add a range of multicast groups to an IGMP filter profile:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure Profile from the Step list.
3. Select Add Multicast Group Range from the Action list.

4. Select the profile to configure, and add a multicast group address or range of addresses.
5. Click Apply.

Figure 275: Adding Multicast Groups to an IGMP Filtering Profile

Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Add Multicast Group Range

Profile ID: 19

Start Multicast IP Address: 239.2.3.1

End Multicast IP Address: 239.2.3.200

Apply Revert

To show the multicast groups configured for an IGMP filter profile:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure Profile from the Step list.
3. Select Show Multicast Group Range from the Action list.
4. Select the profile for which to display this information.

Figure 276: Showing the Groups Assigned to an IGMP Filtering Profile

Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Show Multicast Group Range

Profile ID: 19

Multicast IP Address Range List Total: 1

	Start Multicast IP Address	End Multicast IP Address
<input type="checkbox"/>	239.2.3.1	239.2.3.200

Delete Revert

Configuring IGMP Filtering and Throttling for Interfaces

Use the Multicast > IGMP Snooping > Filter (Configure Interface) page to assign and IGMP filter profile to interfaces on the switch, or to throttle multicast traffic by limiting the maximum number of multicast groups an interface can join at the same time.

Command Usage

- ◆ IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new IGMP join reports will be dropped. If the action is

set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

Parameters

These parameters are displayed:

- ◆ **Interface** – Port or trunk identifier.
An IGMP profile or throttling setting can be applied to a port or trunk. When ports are configured as trunk members, the trunk uses the settings applied to the first port member in the trunk.
- ◆ **Profile ID** – Selects an existing profile to assign to an interface.
- ◆ **Max Multicast Groups** – Sets the maximum number of multicast groups an interface can join at the same time. (Range: 1-511; Default: 511)
- ◆ **Current Multicast Groups** – Displays the current multicast groups the interface has joined.
- ◆ **Throttling Action Mode** – Sets the action to take when the maximum number of multicast groups for the interface has been exceeded. (Default: Deny)
 - **Deny** - The new multicast group join report is dropped.
 - **Replace** - The new multicast group replaces an existing group.
- ◆ **Throttling Status** – Indicates if the throttling action has been implemented on the interface. (Options: True or False)

Web Interface

To configure IGMP filtering or throttling for a port or trunk:

1. Click Multicast, IGMP Snooping, Filter.
2. Select Configure Interface from the Step list.
3. Select a profile to assign to an interface, then set the maximum number of allowed multicast groups and the throttling response.
4. Click Apply.

Figure 277: Configuring IGMP Filtering and Throttling Interface Settings

Port	Profile ID	Max Multicast Groups (1-511)	Current Multicast Groups	Throttling Action Mode	Throttling Status
1	19	511	0	Deny	False
2	(none)	511	0	Deny	False
3	(none)	511	0	Deny	False
4	(none)	511	0	Deny	False
5	(none)	511	0	Deny	False

MLD Snooping (Snooping and Query for IPv4)

Multicast Listener Discovery (MLD) snooping operates on IPv6 traffic and performs a similar function to IGMP snooping for IPv4. That is, MLD snooping dynamically configures switch ports to limit IPv6 multicast traffic so that it is forwarded only to ports with users that want to receive it. This reduces the flooding of IPv6 multicast packets in the specified VLANs.

There are two versions of the MLD protocol, version 1 and version 2. MLDv1 control packets include Listener Query, Listener Report, and Listener Done messages (equivalent to IGMPv2 query, report, and leave messages). MLDv2 control packets include MLDv2 query and report messages, as well as MLDv1 report and done messages.

Remember that IGMP Snooping and MLD Snooping are independent functions, and can therefore both function at the same time.

Configuring MLD Snooping and Query Parameters

Use the Multicast > MLD Snooping > General page to configure the switch to forward multicast traffic intelligently. Based on the MLD query and report messages, the switch forwards multicast traffic only to the ports that request it. This prevents the switch from broadcasting the traffic to all ports and possibly disrupting network performance.

Parameters

These parameters are displayed:

- ◆ **MLD Snooping Status** – When enabled, the switch will monitor network traffic to determine which hosts want to receive multicast traffic. (Default: Disabled)
- ◆ **Querier Status** – When enabled, the switch can serve as the querier for MLDv2 snooping if elected. The querier is responsible for asking hosts if they want to receive multicast traffic. (Default: Disabled)

An IPv6 address must be configured on the VLAN interface from which the querier will act if elected. When serving as the querier, the switch uses this IPv6 address as the query source address.

The querier will not start or will disable itself after having started if it detects an IPv6 multicast router on the network.

- ◆ **Robustness** – MLD Snooping robustness variable. A port will be removed from the receiver list for a multicast service when no MLD reports are detected in response to a number of MLD queries. The robustness variable sets the number of queries on ports for which there is no report. (Range: 2-10 Default: 2)

- ◆ **Query Interval** – The interval between sending MLD general queries. (Range: 60-125 seconds; Default: 125 seconds)

This attribute applies when the switch is serving as the querier.

An MLD general query message is sent by the switch at the interval specified by this attribute. When this message is received by downstream hosts, all receivers build an MLD report for the multicast groups they have joined.

- ◆ **Query Max Response Time** – The maximum response time advertised in MLD general queries. (Range: 5-25 seconds; Default: 10 seconds)

This attribute controls how long the host has to respond to an MLD Query message before the switch deletes the group if it is the last member.

- ◆ **Router Port Expiry Time** – The time the switch waits after the previous querier stops before it considers the router port (i.e., the interface that had been receiving query packets) to have expired. (Range: 300-500 seconds; Default: 300 seconds)

- ◆ **MLD Snooping Version** – The protocol version used for compatibility with other devices on the network. This is the MLD version the switch uses to send snooping reports. (Range: 1-2; Default: 2)

- ◆ **Unknown Multicast Mode** – The action for dealing with unknown multicast packets. Options include:

- **Flood** – Floods any received IPv6 multicast packets that have not been requested by a host to all ports in the VLAN.
- **To Router Port** – Forwards any received IPv6 multicast packets that have not been requested by a host to ports that are connected to a detected multicast router. (This is the default action.)

Web Interface

To configure general settings for MLD Snooping:

1. Click Multicast, MLD Snooping, General.
2. Adjust the settings as required.

3. Click Apply.

Figure 278: Configuring General Settings for MLD Snooping

Multicast > MLD Snooping > General

MLD Snooping Status	<input type="checkbox"/> Enabled
Querier Status	<input type="checkbox"/> Enabled
Robustness (2-10)	<input type="text" value="2"/>
Query Interval (60-125)	<input type="text" value="125"/> seconds
Query Max Response Time (5-25)	<input type="text" value="10"/> seconds
Router Port Expiry Time (300-500)	<input type="text" value="300"/> seconds
MLD Snooping Version (1-2)	<input type="text" value="2"/>
Unknown Multicast Mode	<input type="text" value="To Router Port"/>

Apply Revert

Setting Immediate Leave Status for MLD Snooping per Interface

Use the Multicast > MLD Snooping > Interface page to configure Immediate Leave status for a VLAN.

Parameters

These parameters are displayed:

- ◆ **VLAN** – A VLAN identification number. (Range: 1-4094)
- ◆ **Immediate Leave Status** – Immediately deletes a member port of an IPv6 multicast service when a leave packet is received at that port and immediate leave is enabled for the parent VLAN. (Default: Disabled)

If MLD immediate-leave is *not* used, a multicast router (or querier) will send a group-specific query message when an MLD group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified timeout period.

If MLD immediate-leave is enabled, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one MLD-enabled device, either a service host or a neighbor running MLD snooping.

Web Interface

To configure immediate leave for MLD Snooping:

1. Click Multicast, MLD Snooping, Interface.
2. Select a VLAN, and set the status for immediate leave.
3. Click Apply.

Figure 279: Configuring Immediate Leave for MLD Snooping

Specifying Static Interfaces for an IPv6 Multicast Router

Use the Multicast > MLD Snooping > Multicast Router (Add Static Multicast Router) page to statically attach an interface to an IPv6 multicast router/switch.

Depending on your network connections, MLD snooping may not always be able to locate the MLD querier. Therefore, if the MLD querier is a known multicast router/switch connected over the network to an interface (port or trunk) on the switch, you can manually configure that interface to join all the current multicast groups.

Command Usage

MLD Snooping must be enabled globally on the switch (see [“Configuring MLD Snooping and Query Parameters” on page 421](#)) before a multicast router port can take effect.

Parameters

These parameters are displayed:

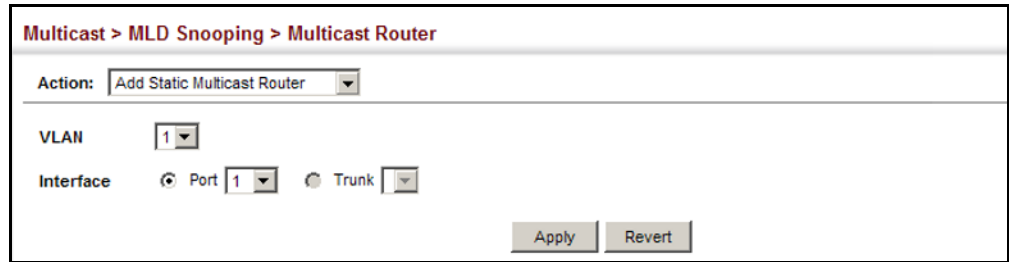
- ◆ **VLAN** – Selects the VLAN which is to propagate all IPv6 multicast traffic coming from the attached multicast router. (Range: 1-4094)
- ◆ **Interface** – Activates the Port or Trunk scroll down list.
- ◆ **Port or Trunk** – Specifies the interface attached to a multicast router.

Web Interface

To specify a static interface attached to a multicast router:

1. Click Multicast, MLD Snooping, Multicast Router.
2. Select Add Static Multicast Router from the Action list.
3. Select the VLAN which will forward all the corresponding IPv6 multicast traffic, and select the port or trunk attached to the multicast router.
4. Click Apply.

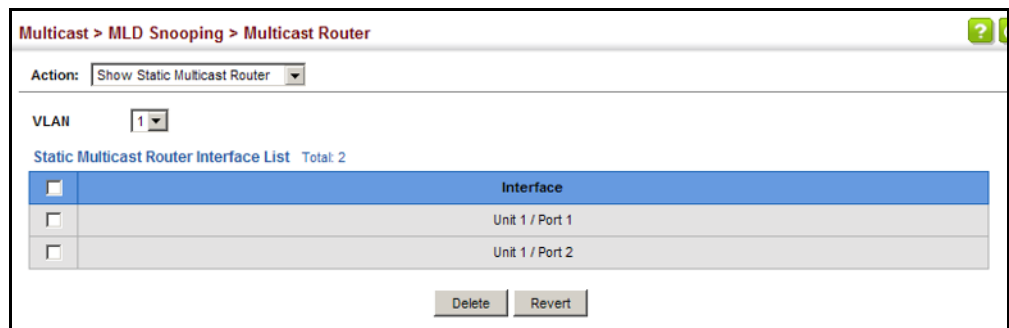
Figure 280: Configuring a Static Interface for an IPv6 Multicast Router



To show the static interfaces attached to a multicast router:

1. Click Multicast, MLD Snooping, Multicast Router.
2. Select Show Static Multicast Router from the Action list.
3. Select the VLAN for which to display this information.

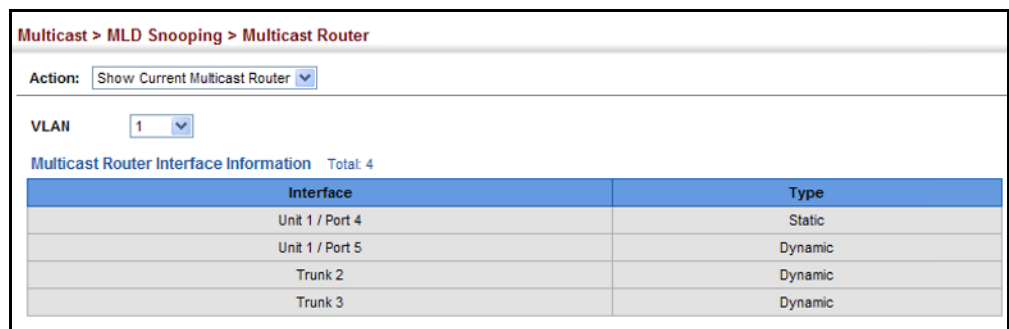
Figure 281: Showing Static Interfaces Attached an IPv6 Multicast Router



To show all the interfaces attached to a multicast router:

1. Click Multicast, MLD Snooping, Multicast Router.
2. Select Current Multicast Router from the Action list.
3. Select the VLAN for which to display this information. Ports in the selected VLAN which are attached to a neighboring multicast router/switch are displayed.

Figure 282: Showing Current Interfaces Attached an IPv6 Multicast Router



Assigning Interfaces to IPv6 Multicast Services Use the Multicast > MLD Snooping > MLD Member (Add Static Member) page to statically assign an IPv6 multicast service to an interface.

Multicast filtering can be dynamically configured using MLD snooping and query messages (see “[Configuring MLD Snooping and Query Parameters](#)” on page 421). However, for certain applications that require tighter control, it may be necessary to statically configure a multicast service on the switch. First add all the ports attached to participating hosts to a common VLAN, and then assign the multicast service to that VLAN group.

Command Usage

- ◆ Static multicast addresses are never aged out.
- ◆ When a multicast address is assigned to an interface in a specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

Parameters

These parameters are displayed:

- ◆ **VLAN** – Specifies the VLAN which is to propagate the multicast service. (Range: 1-4094)
- ◆ **Multicast IPv6 Address** – The IP address for a specific multicast service.
- ◆ **Interface** – Activates the Port or Trunk scroll down list.
- ◆ **Port or Trunk** – Specifies the interface assigned to a multicast group.
- ◆ **Type** (Show Current Member) – Shows if this multicast stream was statically configured by the user, discovered by MLD Snooping, or is a data stream to which no other ports are subscribing (i.e., the stream is flooded onto VLAN instead of being trapped to the CPU for processing, or is being processed by MVR6).

Web Interface

To statically assign an interface to an IPv6 multicast service:

1. Click Multicast, MLD Snooping, MLD Member.
2. Select Add Static Member from the Action list.
3. Select the VLAN that will propagate the multicast service, specify the interface attached to a multicast service (through an MLD-enabled switch or multicast router), and enter the multicast IP address.
4. Click Apply.

Figure 283: Assigning an Interface to an IPv6 Multicast Service

Multicast > MLD Snooping > MLD Member

Action: Add Static Member

VLAN: 1

Multicast IPv6 Address: FF00:0:0:0:0:10C

Interface: Port 1

Apply Revert

To show the static interfaces assigned to an IPv6 multicast service:

1. Click Multicast, MLD Snooping, MLD Member.
2. Select Show Static Member from the Action list.
3. Select the VLAN for which to display this information.

Figure 284: Showing Static Interfaces Assigned to an IPv6 Multicast Service

Multicast > MLD Snooping > MLD Member

Action: Show Static Member

VLAN: 1

MLD Member Interface List Total: 8

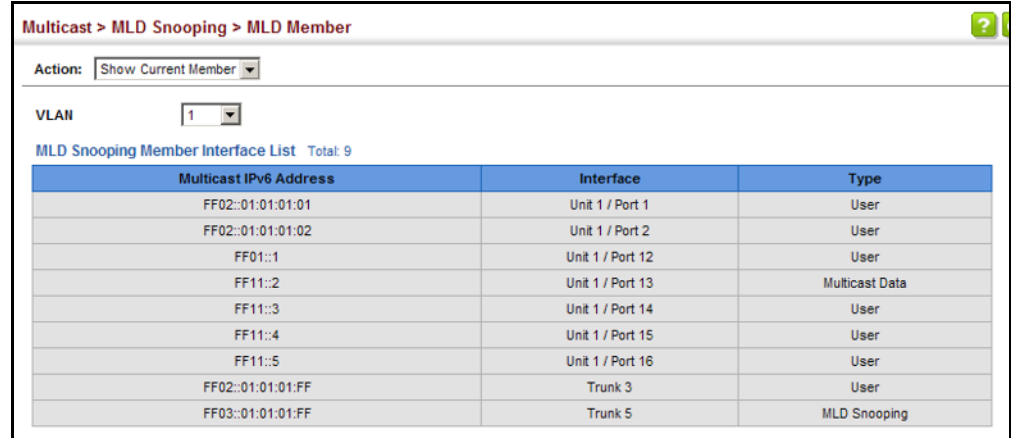
	Multicast IPv6 Address	Interface
<input type="checkbox"/>	FF02::01:01:01:01	Unit 1 / Port 1
<input type="checkbox"/>	FF02::01:01:01:02	Unit 1 / Port 2
<input type="checkbox"/>	FF01::1	Unit 1 / Port 12
<input type="checkbox"/>	FF01::2	Unit 1 / Port 13
<input type="checkbox"/>	FF01::3	Unit 1 / Port 14
<input type="checkbox"/>	FF01::4	Unit 1 / Port 15
<input type="checkbox"/>	FF01::5	Unit 1 / Port 16
<input type="checkbox"/>	FF02::01:01:01:FF	Trunk 3

Delete Revert

To display information about all IPv6 multicast groups, MLD Snooping or multicast routing must first be enabled on the switch. To show all of the interfaces statically or dynamically assigned to an IPv6 multicast service:

1. Click Multicast, MLD Snooping, MLD Member.
2. Select Show Current Member from the Action list.
3. Select the VLAN for which to display this information.

Figure 285: Showing Current Interfaces Assigned to an IPv6 Multicast Service



Multicast IPv6 Address	Interface	Type
FF02::01:01:01:01	Unit 1 / Port 1	User
FF02::01:01:01:02	Unit 1 / Port 2	User
FF01::1	Unit 1 / Port 12	User
FF11::2	Unit 1 / Port 13	Multicast Data
FF11::3	Unit 1 / Port 14	User
FF11::4	Unit 1 / Port 15	User
FF11::5	Unit 1 / Port 16	User
FF02::01:01:01:FF	Trunk 3	User
FF03::01:01:01:FF	Trunk 5	MLD Snooping

Showing MLD Snooping Groups and Source List

Use the Multicast > MLD Snooping > Group Information page to display known multicast groups, member ports, the means by which each group was learned, and the corresponding source list.

Parameters

These parameters are displayed:

- ◆ **VLAN** – VLAN identifier. (Range: 1-4094)
- ◆ **Interface** – Port or trunk identifier.
- ◆ **Group Address** – The IP address for a specific multicast service.
- ◆ **Type** – The means by which each group was learned – MLD Snooping or Multicast Data.
- ◆ **Filter Mode** – The filter mode is used to summarize the total listening state of a multicast address to a minimum set such that all nodes' listening states are respected. In Include mode, the router only uses the request list, indicating that the reception of packets sent to the specified multicast address is requested only from those IP source addresses listed in the hosts' source-list. In Exclude mode, the router uses both the request list and exclude list, indicating that the reception of packets sent to the given multicast address is requested from all IP source addresses, except for those listed in the exclude source-list and for any other sources where the source timer status has expired.
- ◆ **Filter Timer Elapse** – The Filter timer is only used when a specific multicast address is in Exclude mode. It represents the time for the multicast address filter mode to expire and change to Include mode.
- ◆ **Request List** – Sources included on the router's request list.
- ◆ **Exclude List** – Sources included on the router's exclude list.

Web Interface

To display known MLD multicast groups:

1. Click Multicast, MLD Snooping, Group Information.
2. Select the port or trunk, and then select a multicast service assigned to that interface.

Figure 286: Showing IPv6 Multicast Services and Corresponding Sources

Multicast > MLD Snooping > Group Information

VLAN: 1

Interface: Port 1 Trunk 1

Group Address: FF02::01:01:01:01

Type: MLD Snooping

Filter Mode: Exclude

Filter Timer: 10 seconds

Elapse:

Request List Total: 3

IPv6 Address
::01:02:03:01
::01:02:03:02
::01:02:03:03

Exclude List Total: 3

IPv6 Address
::02:02:03:01
::02:02:03:02
::02:02:03:03

This chapter provides information on network functions including:

- ◆ **Ping** – Sends ping message to another node on the network.
- ◆ **Trace Route** – Sends ICMP echo request packets to another node on the network.
- ◆ **Address Resolution Protocol** – Describes how to configure ARP aging time, proxy ARP, or static addresses. Also shows how to display dynamic entries in the ARP cache.

Using the Ping Function

Use the Tools > Ping page to send ICMP echo request packets to another node on the network.

Parameters

These parameters are displayed:

- ◆ **Host Name/IP Address** – Alias or IPv4/IPv6 address of the host.
- ◆ **Probe Count** – Number of packets to send. (Range: 1-16)
- ◆ **Packet Size** – Number of bytes in a packet. (Range: 32-512 bytes for IPv4, 0-1500 bytes for IPv6)

The actual packet size will be eight bytes larger than the size specified because the switch adds header information.

Command Usage

- ◆ Use the ping command to see if another site on the network can be reached.
- ◆ The following are some results of the **ping** command:
 - *Normal response* - The normal response occurs in one to ten seconds, depending on network traffic.
 - *Destination does not respond* - If the host does not respond, a “timeout” appears in ten seconds.
 - *Destination unreachable* - The gateway for this destination indicates that the destination is unreachable.

- *Network or host unreachable* - The gateway found no corresponding entry in the route table.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface.

Web Interface

To ping another device on the network:

1. Click Tools, Ping.
2. Specify the target device and ping parameters.
3. Click Apply.

Figure 287: Pinging a Network Device

The screenshot shows a web interface titled "Tool > Ping". It has three input fields: "Host Name/IP Address" (empty), "Probe Count (1-16)" (set to 5), and "Data Size (IPv4 : 32-512, IPv6 : 0-1500)" (empty) followed by "bytes". Below these fields is a note: "Note: For IPv4 Data Size, 0 - 31 changed to 32 bytes, 32 - 512 is valid input, 513 - 1500 changed to 512 bytes, < 0 or > 1500 not valid input". There are "Apply" and "Revert" buttons. The "Result" section shows a successful ping to 192.168.2.99 with 5 packets received (100%) and 0 packets lost (0%).

```
Tool > Ping
Host Name/IP Address: 
Probe Count (1-16): 
Data Size (IPv4 : 32-512, IPv6 : 0-1500):  bytes

Note: For IPv4 Data Size,
0 - 31 changed to 32 bytes
32 - 512 is valid input
513 - 1500 changed to 512 bytes
< 0 or > 1500 not valid input

[Apply] [Revert]

Result
PING to 192.168.2.99, by 5 of 32-byte payload ICMP packets, timeout is 3 seconds

response time: 0 ms
response time: 0 ms
response time: 0 ms
response time: 0 ms
response time: 0 ms

Ping statistics for 192.168.2.99:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
  Minimum = 0 ms, Maximum = 0 ms, Average = 0 ms
```

Using the Trace Route Function

Use the Tools > Trace Route page to show the route packets take to the specified destination.

Parameters

These parameters are displayed:

- ◆ **Destination IP Address** – Alias or IPv4/IPv6 address of the host.

- ◆ **IPv4 Max Failures** – The maximum number of failures before which the trace route is terminated. (Fixed: 5)
- ◆ **IPv6 Max Failures** – The maximum number of failures before which the trace route is terminated. (Range: 1-255; Default: 5)

Command Usage

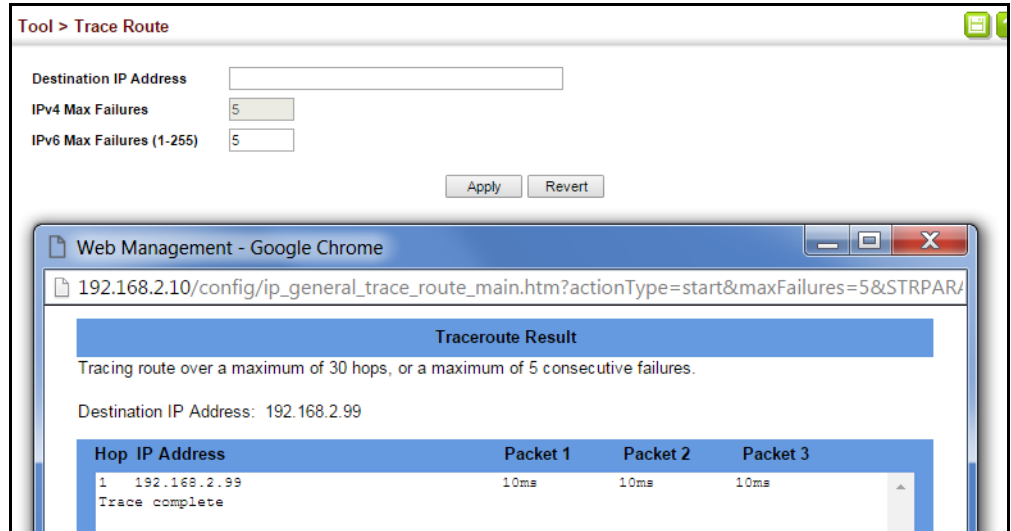
- ◆ Use the trace route function to determine the path taken to reach a specified destination.
- ◆ A trace terminates when the destination responds, when the maximum timeout (TTL) is exceeded, or the maximum number of hops is exceeded.
- ◆ The trace route function first sends probe datagrams with the TTL value set at one. This causes the first router to discard the datagram and return an error message. The trace function then sends several probe messages at each subsequent TTL level and displays the round-trip time for each message. Not all devices respond correctly to probes by returning an “ICMP port unreachable” message. If the timer goes off before a response is returned, the trace function prints a series of asterisks and the “Request Timed Out” message. A long sequence of these messages, terminating only when the maximum timeout has been reached, may indicate this problem with the target device.
- ◆ The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the trace route is sent.

Web Interface

To trace the route to another device on the network:

1. Click Tools, Trace Route.
2. Specify the target device.
3. Click Apply.

Figure 288: Tracing the Route to a Network Device



Address Resolution Protocol

If IP routing is enabled (page 673), the router uses its routing tables to make routing decisions, and uses Address Resolution Protocol (ARP) to forward traffic from one hop to the next. ARP is used to map an IP address to a physical layer (i.e., MAC) address. When an IP frame is received by this router (or any standards-based router), it first looks up the MAC address corresponding to the destination IP address in the ARP cache. If the address is found, the router writes the MAC address into the appropriate field in the frame header, and forwards the frame on to the next hop. IP traffic passes along the path to its final destination in this way, with each routing device mapping the destination IP address to the MAC address of the next hop toward the recipient, until the packet is delivered to the final destination.

If there is no entry for an IP address in the ARP cache, the router will broadcast an ARP request packet to all devices on the network. The ARP request contains the following fields similar to that shown in this example:

Table 29: Address Resolution Protocol

destination IP address	10.1.0.19
destination MAC address	?
source IP address	10.1.0.253
source MAC address	00-00-ab-cd-00-00

When devices receive this request, they discard it if their address does not match the destination IP address in the message. However, if it does match, they write their own hardware address into the destination MAC address field and send the message back to the source hardware address. When the source device receives a reply, it writes the destination IP address and corresponding MAC address into its

cache, and forwards the IP traffic on to the next hop. As long as this entry has not timed out, the router will be able forward traffic directly to the next hop for this destination without having to broadcast another ARP request.

Also, if the switch receives a request for its own IP address, it will send back a response, and also cache the MAC of the source device's IP address.

Displaying Dynamic or Local ARP Entries

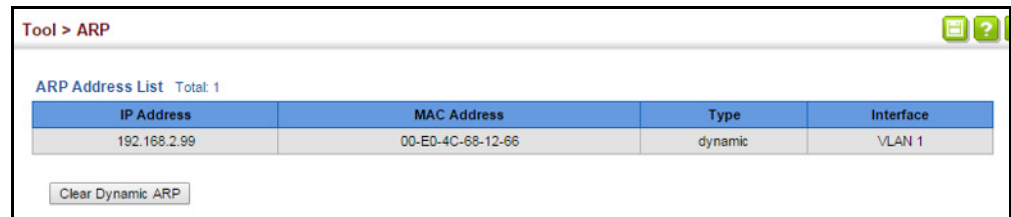
Use the Tools > ARP page to display dynamic or local entries in the ARP cache. The ARP cache contains static entries, and entries for local interfaces, including subnet, host, and broadcast addresses. However, most entries will be dynamically learned through replies to broadcast messages.

Web Interface

To display all dynamic and local entries in the ARP cache:

1. Click IP, ARP.
2. Select Show Information from the Step List.
3. Click ARP Addresses.

Figure 289: Displaying ARP Entries



IP Address	MAC Address	Type	Interface
192.168.2.99	00-E0-4C-68-12-66	dynamic	VLAN 1

Clear Dynamic ARP

This chapter describes the following IP services:

- ◆ **DNS** – Configures default domain names, identifies servers to use for dynamic lookup, and shows how to configure static entries.
- ◆ **DHCP Client** – Specifies the DHCP client identifier for an interface.
- ◆ **DHCP Relay** – Enables DHCP relay service for attached host devices, including DHCP option 82 information, and defines the servers to which client requests are forwarded.
- ◆ **DHCP Dynamic Provision** – Enables dynamic provision via DHCP.



Note: For information on DHCP snooping which is included in this folder, see [“DHCP Snooping” on page 299](#).

Domain Name Service

DNS service on this switch allows host names to be mapped to IP addresses using static table entries or by redirection to other name servers on the network. When a client device designates this switch as a DNS server, the client will attempt to resolve host names into IP addresses by forwarding DNS queries to the switch, and waiting for a response.

You can manually configure entries in the DNS table used for mapping domain names to IP addresses, configure default domain names, or specify one or more name servers to use for domain name to address translation.

Configuring General DNS Service Parameters

Use the IP Service > DNS - General (Configure Global) page to enable domain lookup and set the default domain name.

Command Usage

- ◆ To enable DNS service on this switch, enable domain lookup status, and configure one or more name servers (see [“Configuring a List of Name Servers” on page 440](#)).
- ◆ If one or more name servers are configured, but DNS is not yet enabled and the switch receives a DHCP packet containing a DNS field with a list of DNS servers,

then the switch will automatically enable DNS host name-to-address translation.

Parameters

These parameters are displayed:

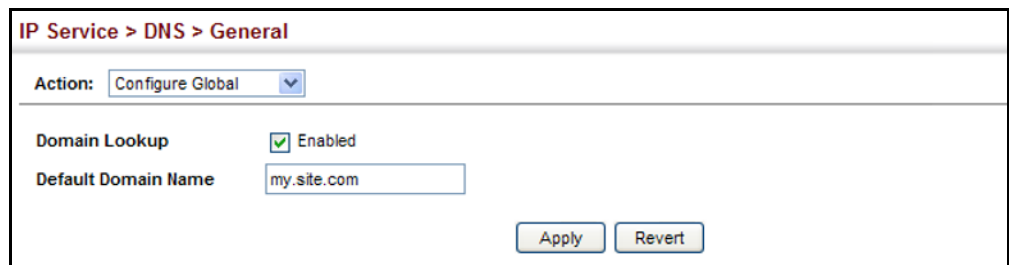
- ◆ **Domain Lookup** – Enables DNS host name-to-address translation. (Default: Disabled)
- ◆ **Default Domain Name** – Defines the default domain name appended to incomplete host names. Do not include the initial dot that separates the host name from the domain name. (Range: 1-127 alphanumeric characters)

Web Interface

To configure general settings for DNS:

1. Click IP Service, DNS.
2. Select Configure Global from the Action list.
3. Enable domain lookup, and set the default domain name.
4. Click Apply.

Figure 290: Configuring General Settings for DNS



The screenshot shows a web interface for configuring DNS settings. At the top, the breadcrumb is "IP Service > DNS > General". Below this, there is an "Action:" dropdown menu currently set to "Configure Global". Underneath, the "Domain Lookup" option is checked, with a status of "Enabled". The "Default Domain Name" field contains the text "my.site.com". At the bottom right of the configuration area, there are two buttons: "Apply" and "Revert".

Configuring a List of Domain Names Use the IP Service > DNS - General (Add Domain Name) page to configure a list of domain names to be tried in sequential order.

Command Usage

- ◆ Use this page to define a list of domain names that can be appended to incomplete host names (i.e., host names passed from a client that are not formatted with dotted notation).
- ◆ If there is no domain list, the default domain name is used (see [“Configuring General DNS Service Parameters” on page 437](#)). If there is a domain list, the system will search it for a corresponding entry. If none is found, it will use the default domain name.

- ◆ When an incomplete host name is received by the DNS service on this switch and a domain name list has been specified, the switch will work through the domain list, appending each domain name in the list to the host name, and checking with the specified name servers for a match (see “Configuring a List of Name Servers” on page 440).
- ◆ If all name servers are deleted, DNS will automatically be disabled.

Parameters

These parameters are displayed:

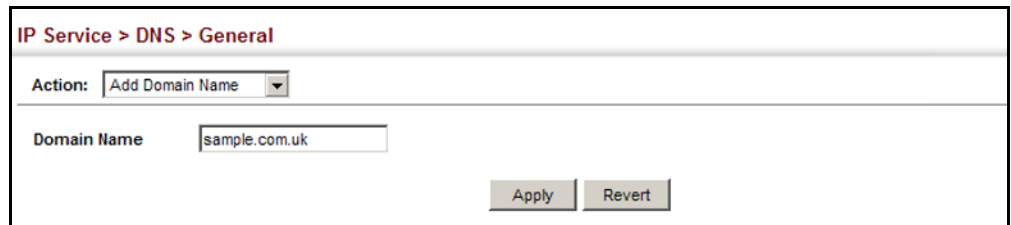
Domain Name – Name of the host. Do not include the initial dot that separates the host name from the domain name. (Range: 1-68 characters)

Web Interface

To create a list domain names:

1. Click IP Service, DNS.
2. Select Add Domain Name from the Action list.
3. Enter one domain name at a time.
4. Click Apply.

Figure 291: Configuring a List of Domain Names for DNS

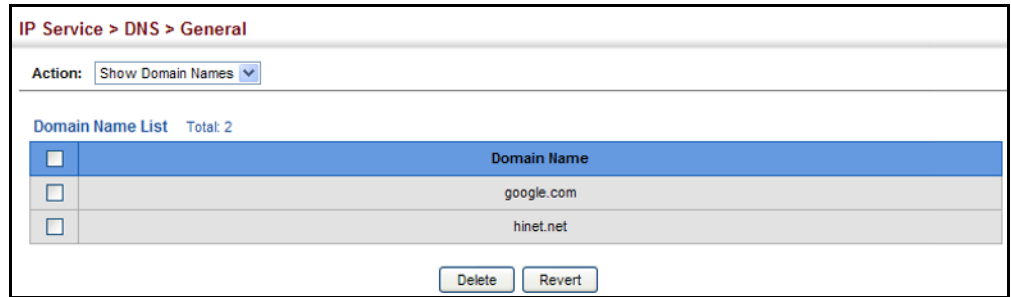


The screenshot shows a web interface for configuring DNS. The breadcrumb path is "IP Service > DNS > General". Below the breadcrumb, there is an "Action:" label followed by a dropdown menu currently set to "Add Domain Name". Underneath, there is a "Domain Name" label followed by a text input field containing the text "sample.com.uk". At the bottom right of the form, there are two buttons: "Apply" and "Revert".

To show the list domain names:

1. Click IP Service, DNS.
2. Select Show Domain Names from the Action list.

Figure 292: Showing the List of Domain Names for DNS



Configuring a List of Name Servers Use the IP Service > DNS - General (Add Name Server) page to configure a list of name servers to be tried in sequential order.

Command Usage

- ◆ To enable DNS service on this switch, configure one or more name servers, and enable domain lookup status (see [“Configuring General DNS Service Parameters” on page 437](#)).
- ◆ When more than one name server is specified, the servers are queried in the specified sequence until a response is received, or the end of the list is reached with no response.
- ◆ If all name servers are deleted, DNS will automatically be disabled. This is done by disabling the domain lookup status.

Parameters

These parameters are displayed:

Name Server IP Address – Specifies the IPv4 or IPv6 address of a domain name server to use for name-to-address resolution. Up to six IP addresses can be added to the name server list.

Web Interface

To create a list name servers:

1. Click IP Service, DNS.
2. Select Add Name Server from the Action list.
3. Enter one name server at a time.
4. Click Apply.

Figure 293: Configuring a List of Name Servers for DNS

IP Service > DNS > General

Action: Add Name Server

Name Server IP Address: 192.168.1.10

Apply Revert

To show the list name servers:

1. Click IP Service, DNS.
2. Select Show Name Servers from the Action list.

Figure 294: Showing the List of Name Servers for DNS

IP Service > DNS > General

Action: Show Name Servers

Name Server IP Address List Total: 3

<input type="checkbox"/>	Name Server IP Address
<input type="checkbox"/>	192.168.1.10
<input type="checkbox"/>	140.113.5.7
<input type="checkbox"/>	10.7.231.5

Delete Revert

Configuring Static DNS Host to Address Entries

Use the IP Service > DNS - Static Host Table (Add) page to manually configure static entries in the DNS table that are used to map domain names to IP addresses.

Command Usage

- ◆ Static entries may be used for local devices connected directly to the attached network, or for commonly used resources located elsewhere on the network.

Parameters

These parameters are displayed:

- ◆ **Host Name** – Name of a host device that is mapped to one or more IP addresses. (Range: 1-127 characters)
- ◆ **IP Address** – IPv4 or IPv6 address(es) associated with a host name.

Web Interface

To configure static entries in the DNS table:

1. Click IP Service, DNS, Static Host Table.
2. Select Add from the Action list.
3. Enter a host name and the corresponding address.
4. Click Apply.

Figure 295: Configuring Static Entries in the DNS Table

IP Service > DNS > Static Host Table

Action: Add

Host Name: yahoo.com

IP Address: 10.2.78.3

Apply Revert

To show static entries in the DNS table:

1. Click IP Service, DNS, Static Host Table.
2. Select Show from the Action list.

Figure 296: Showing Static Entries in the DNS Table

IP Service > DNS > Static Host Table

Action: Show

IP Address List Total: 3

	Host	IP Address
<input type="checkbox"/>	yahoo.com	10.2.78.3
<input type="checkbox"/>	hinet.net	124.29.31.155
<input type="checkbox"/>	google.com	133.45.211.18

Delete Revert

Displaying the DNS Cache Use the IP Service > DNS - Cache page to display entries in the DNS cache that have been learned via the designated name servers.

Command Usage

Servers or other network devices may support one or more connections via multiple IP addresses. If more than one IP address is associated with a host name via information returned from a name server, a DNS client can try each address in succession, until it establishes a connection with the target device.

Parameters

These parameters are displayed:

- ◆ **No.** – The entry number for each resource record.
- ◆ **Flag** – The flag is always “4” indicating a cache entry and therefore unreliable.
- ◆ **Type** – This field includes CNAME which specifies the host address for the owner, and ALIAS which specifies an alias.
- ◆ **IP** – The IP address associated with this record.
- ◆ **TTL** – The time to live reported by the name server.
- ◆ **Host** – The host name associated with this record.

Web Interface

To display entries in the DNS cache:

1. Click IP Service, DNS, Cache.

Figure 297: Showing Entries in the DNS Cache

The screenshot shows a web interface with a breadcrumb trail 'IP Service > DNS > Cache' and a help icon. Below the breadcrumb is a section titled 'Cache Information' with a 'Total: 3' indicator. A table displays the following data:

No.	Flag	Type	IP	TTL	Host
1	4	CNAME	192.168.110.2	360	www.sina.com.cn
2	4	CNAME	10.2.44.3	892	www.yahoo.akadns.new
3	4	ALIAS	pointer to: 2	298	www.yahoo.com

Below the table is a 'Clear' button.

Dynamic Host Configuration Protocol

Dynamic Host Configuration Protocol (DHCP) can dynamically allocate an IP address and other configuration information to network clients when they boot up. If a subnet does not already include a BOOTP or DHCP server, you can relay DHCP client requests to a DHCP server on another subnet, or configure the DHCP server on this switch to support that subnet.

When configuring the DHCP server on this switch, you can configure an address pool for each unique IP interface, or manually assign a static IP address to clients based on their hardware address or client identifier. The DHCP server can provide the host’s IP address, domain name, gateway router and DNS server, information about the host’s boot image including the TFTP server to access for download and the name of the boot file, or boot information for NetBIOS Windows Internet Naming Service (WINS).

Specifying a DHCP Client Identifier Use the IP Service > DHCP > Client page to specify the DHCP client identifier for a VLAN interface.

Command Usage

- ◆ The class identifier is used identify the vendor class and configuration of the switch to the DHCP server, which then uses this information to decide on how to service the client or the type of information to return.
- ◆ The general framework for this DHCP option is set out in RFC 2132 (Option 60). This information is used to convey configuration settings or other identification information about a client, but the specific string to use should be supplied by your service provider or network administrator. Options 60, 66 and 67 statements can be added to the server daemon's configuration file.

Table 30: Options 60, 66 and 67 Statements

Option	Statement	
	Keyword	Parameter
60	vendor-class-identifier	a string indicating the vendor class identifier
66	tftp-server-name	a string indicating the tftp server name
67	bootfile-name	a string indicating the bootfile name

- ◆ By default, DHCP option 66/67 parameters are not carried in a DHCP server reply. To ask for a DHCP reply with option 66/67 information, the DHCP client request sent by this switch includes a "parameter request list" asking for this information. Besides, the client request also includes a "vendor class identifier" that allows the DHCP server to identify the device, and select the appropriate configuration file for download. This information is included in Option 55 and 124.

Table 31: Options 55 and 124 Statements

Option	Statement	
	Keyword	Parameter
55	dhcp-parameter-request-list	a list of parameters, separated by "
124	vendor-class-identifier	a string indicating the vendor class identifier

- ◆ The server should reply with the TFTP server name and boot file name.
- ◆ Note that the vendor class identifier can be formatted in either text or hexadecimal, but the format used by both the client and server must be the same.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of configured VLAN.

- ◆ **Vendor Class ID** – The following options are supported when the check box is marked to enable this feature:
 - **Default** – The default string is the model number.
 - **Text** – A text string. (Range: 1-32 characters)
 - **Hex** – A hexadecimal value. (Range: 1-64 characters)

Web Interface

To configure a DHCP client identifier:

1. Click IP Service, DHCP, Client.
2. Mark the check box to enable this feature. Select the default setting, or the format for a vendor class identifier. If a non-default value is used, enter a text string or hexadecimal value.
3. Click Apply.

Figure 298: Specifying a DHCP Client Identifier

The screenshot shows a web interface for configuring DHCP client settings. The breadcrumb path is 'IP Service > DHCP > Client'. There are two main configuration rows: 'VLAN' with a dropdown menu showing '1', and 'Vendor Class ID' which includes a checked checkbox, a dropdown menu set to 'Default', and a text input field containing the value 'ECS2000-28P'. At the bottom right of the configuration area, there are two buttons: 'Apply' and 'Revert'.

Configuring DHCP Relay Service

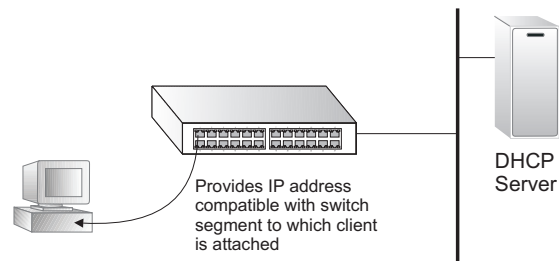
Use the IP Service > DHCP > Relay page to configure DHCP relay service for attached host devices, including DHCP option 82 information. DHCP provides an option for sending information about its DHCP clients to the DHCP server (specifically, the interface on the relay server through which the DHCP client request was received). Also known as DHCP Relay Option 82, it allows compatible DHCP servers to use this information when assigning IP addresses, or to set other services or policies for clients.

If DHCP relay is enabled, and this switch sees a DHCP request broadcast, it inserts its own IP address into the request so that the DHCP server will know the subnet where the client is located. Then, the switch forwards the packet to the DHCP server. When the server receives the DHCP request, it allocates a free IP address for the DHCP client from its defined scope for the DHCP client's subnet, and sends a DHCP response back to the DHCP relay agent (i.e., this switch). This switch then passes the DHCP response received from the server to the client.

Option 82 information contains information which can identify both the relay agent and the interface through which the DHCP request was received:

- ◆ The DHCP Relay Information Option Remote ID (RID) is the access node identifier – a string used to identify the switch to the DHCP server.
- ◆ The DHCP Relay Information Option Fields are the Option 82 circuit identification fields (CID – including VLAN ID, stack unit, and port). These fields identify the requesting device by indicating the interface through which the relay agent received the request.

Figure 299: Layer 3 DHCP Relay Service



Command Usage

- ◆ You must specify the IP address for at least one active DHCP server. Otherwise, the switch's DHCP relay agent will not be able to forward client requests to a DHCP server. Up to five DHCP servers can be specified in order of preference.

If any of the specified DHCP server addresses are not located in the same network segment with this switch, specify the default router through which this switch can reach other IP subnetworks (see ["Configuring the IPv4 Default Gateway"](#) or ["Configuring the IPv6 Default Gateway"](#)).

- ◆ DHCP relay configuration will be disabled if an active DHCP server is detected on the same network segment.
- ◆ DHCP Snooping Information Option 82 (see [page 299](#)) and DHCP Relay Information Option 82 cannot both be enabled at the same time.
- ◆ DHCP request packets received by the switch are handled as follows:
 - If a DHCP relay server has been set on the switch, when the switch receives a DHCP request packet *without* option 82 information from the management VLAN or a non-management VLAN, it will add option 82 relay information and the relay agent's address to the DHCP request packet, and then unicast it to the DHCP server.
 - If a DHCP relay server has been set on the switch, when the switch receives a DHCP request packet *with* option 82 information from the management

VLAN or a non-management VLAN, it will process it according to the configured relay information option policy:

- If the policy is “replace,” the DHCP request packet’s option 82 content (the RID and CID sub-option) is replaced with information provided by the switch. The relay agent address is inserted into the DHCP request packet, and the switch then unicasts this packet to the DHCP server.
- If the policy is “keep,” the DHCP request packet's option 82 content will be retained. The relay agent address is inserted into the DHCP request packet, and the switch then unicasts this packet to the DHCP server.
- If the policy is “drop,” the original DHCP request packet is flooded onto the VLAN which received the packet but is not relayed.

◆ DHCP reply packets received by the relay agent are handled as follows:

When the relay agent receives a DHCP reply packet with Option 82 information over the management VLAN, it first ensures that the packet is destined for it.

- If the RID in the DHCP reply packet is not identical with that configured on the switch, the option 82 information is retained, and the packet is flooded onto the VLAN through which it was received.
 - If the RID in the DHCP reply packet matches that configured on the switch, it then removes the Option 82 information from the packet, and sends it on as follows:
 - If the DHCP packet’s broadcast flag is on, the switch uses the circuit-id information contained in the option 82 information fields to identify the VLAN connected to the requesting client and then broadcasts the DHCP reply packet to this VLAN.
 - If the DHCP packet’s broadcast flag is off, the switch uses the circuit-id information in option 82 fields to identify the interface connected to the requesting client and unicasts the reply packet to the client.
- ◆ DHCP packets are flooded onto the VLAN which received them if DHCP relay service is enabled on the switch and any of the following situations apply:
- There is no DHCP relay server set on the switch, when the switch receives a DHCP packet.
 - A DHCP relay server has been set on the switch, when the switch receives a DHCP request packet with a non-zero relay agent address field (that is not the address of this switch).
 - A DHCP relay server has been set on the switch, when the switch receives DHCP reply packet without option 82 information from the management VLAN.
 - The reply packet contains a valid relay agent address field (that is not the address of this switch), or receives a reply packet with a zero relay agent address through the management VLAN.

- A DHCP relay server has been set on the switch, and the switch receives a reply packet on a non-management VLAN.

Parameters

These parameters are displayed:

- ◆ **Insertion of Relay Information** – Enable DHCP Option 82 information relay. (Default: Disabled)
- ◆ **DHCP Option Policy** – Specifies how to handle client requests which already contain DHCP Option 82 information:
 - **Drop** - Floods the original request packet onto the VLAN that received it instead of relaying it. (This is the default.)
 - **Keep** - Retains the Option 82 information in the client request, inserts the relay agent's address, and unicasts the packet to the DHCP server.
 - **Replace** - Replaces the Option 82 information circuit-id and remote-id fields in the client's request with information provided by the relay agent itself, inserts the relay agent's address, and unicasts the packet to the DHCP server.
- ◆ **DHCP Sub-option Format** – Specifies whether or not to use the sub-type and sub-length fields in the circuit-ID (CID) and remote-ID (RID) in Option 82 information. (Default: Included)
- ◆ **Server IP Address** – Addresses of DHCP servers or relay servers to be used by the switch's DHCP relay agent in order of preference.
- ◆ **Restart DHCP Relay** – Use this button to re-initialize DHCP relay service.

Web Interface

To configure DHCP relay service:

1. Click IP Service, DHCP, Relay.
2. Enable or disable Option 82 relay information.
3. Set the Option 82 policy to specify how to handle Option 82 information already contained in DHCP client request packets.
4. Select whether or not to include the use of sub-type and sub-length fields for the circuit-ID (CID) and remote-ID (RID) in Option 82 information generated by the switch.
5. Enter up to five IP addresses for DHCP servers or relay servers in order of preference for any VLAN.
6. Click Apply.

Figure 300: Configuring DHCP Relay Service

Enabling DHCP Dynamic Provision

Use the IP Service > DHCP > Dynamic Provision to enable dynamic provisioning via DHCP.

Command Usage

DHCPD is the daemon used by Linux to dynamically configure TCP/IP information for client systems. To support DHCP option 66/67, you have to add corresponding statements to the configuration file of DHCPD. Information on how to complete this process are described in [“Downloading a Configuration File and Other Parameters Provided by a DHCP Server”](#) as described in the *CLI Reference Guide*.

Some alternative commands which can be added to the DHCPD to complete the dynamic provisioning process are also described under the **ip dhcp dynamic-provision** command in the *CLI Reference Guide*.

By default, the parameters for DHCP option 66/67 are not carried by the reply sent from the DHCP server. To ask for a DHCP reply with option 66/67, the client can inform the server that it is interested in option 66/67 by sending a DHCP request that includes a 'parameter request list' option. Besides this, the client can also send a DHCP request that includes a 'vendor class identifier' option to the server so that the DHCP server can identify the device, and determine what information should be given to requesting device.

Parameters

These parameters are displayed:

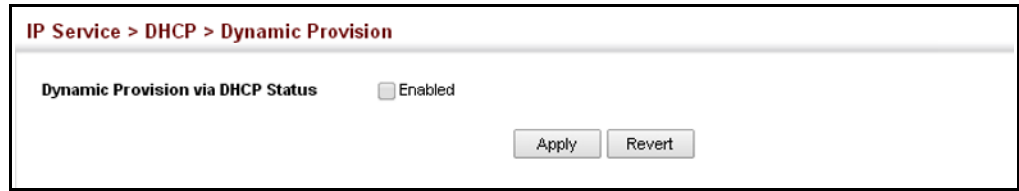
- ◆ **Dynamic Provision via DHCP Status** – Enables dynamic provisioning via DHCP. (Default: Disabled)

Web Interface

To enable dynamic provisioning via DHCP:

1. Click IP Service, DHCP, Dynamic Provision.
2. Mark the Enable box if dynamic provisioning is configured on the DHCP daemon, and required for bootup.
3. Click Apply.

Figure 301: Enabling Dynamic Provisioning via DHCP



IP Configuration

This chapter describes how to configure an IP interface for management access to the switch over the network. This switch supports both IP Version 4 and Version 6, and can be managed simultaneously through either of these address types. You can manually configure a specific IPv4 or IPv6 address, or direct the switch to obtain an IPv4 address from a BOOTP or DHCP server. An IPv6 address can either be manually configured or dynamically generated.

This chapter provides information on network functions including:

- ◆ [IPv4 Configuration](#) – Sets an IPv4 address for management access.
- ◆ [IPv6 Configuration](#) – Sets an IPv6 address for management access.

Setting the Switch's IP Address (IP Version 4)

This section describes how to configure an IPv4 interface for management access over the network. This switch supports both IPv4 and IPv6, and can be managed through either of these address types. For information on configuring the switch with an IPv6 address, see [“Setting the Switch's IP Address \(IP Version 6\)” on page 455](#).

Configuring the IPv4 Default Gateway Use the System > IP (Configure Global) page to configure an IPv4 default gateway for the switch.

Parameters

These parameters are displayed:

- ◆ **Gateway IP Address** – IP address of the gateway router between the switch and management stations that exist on other network segments.
(Default: None)

An IP default gateway must be defined if the management station is located in a different IP segment.

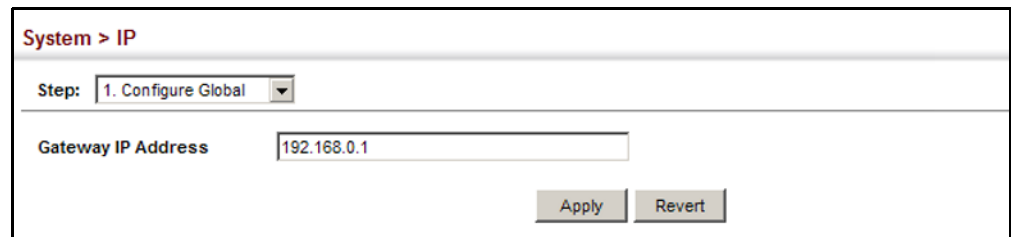
An IP default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the switch.

Web Interface

To configure an IPv4 default gateway for the switch:

1. Click System, IP.
2. Select Configure Global from the Action list.
3. Enter the IPv4 default gateway.
4. Click Apply.

Figure 302: Configuring the IPv4 Default Gateway



The screenshot shows a web interface for configuring the switch's IP. The breadcrumb navigation is "System > IP". Below this, there is a "Step:" dropdown menu currently set to "1. Configure Global". The main configuration area has a label "Gateway IP Address" followed by a text input field containing the value "192.168.0.1". At the bottom right of the form, there are two buttons: "Apply" and "Revert".

Configuring IPv4 Interface Settings

Use the System > IP (Configure Interface – Add Address) page to configure an IPv4 address for the switch. The default IPv4 address for VLAN 1 is set to 192.168.1.1 using the subnet mask 255.255.255.0. To change the switch's default settings to values that are compatible with your network, you may need to establish a default gateway between the switch and management stations that exist on another network segment.

You can direct the device to obtain an address from a BOOTP or DHCP server, or manually configure a static IP address. Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods. Anything other than this format will not be accepted.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of the VLAN to be used for management access. By default, all ports on the switch are members of VLAN 1. However, the management station can be attached to a port belonging to any VLAN, as long as that VLAN has been assigned an IP address. (Range: 1-4094; Default: VLAN 1)
- ◆ **IP Address Mode** – Specifies whether IP functionality is enabled via manual configuration (User Specified), Dynamic Host Configuration Protocol (DHCP), or Boot Protocol (BOOTP). If DHCP/BOOTP is enabled, IP will not function until a reply has been received from the server. Requests will be broadcast periodically by the switch for an IP address. DHCP/BOOTP responses can include the IP address, subnet mask, and default gateway. (Default: User Specified)

- ◆ **IP Address Type** – Specifies a primary or secondary IP address. An interface can have only one primary IP address, but can have many secondary IP addresses. In other words, secondary addresses need to be specified if more than one IP subnet can be accessed through this interface. For initial configuration, set this parameter to Primary. (Options: Primary, Secondary; Default: Primary)

Note that a secondary address cannot be configured prior to setting the primary IP address, and the primary address cannot be removed if a secondary address is still present. Also, if any router or switch in a network segment uses a secondary address, all other routers/switches in that segment must also use a secondary address from the same network or subnet address space.

- ◆ **IP Address** – IP Address of the VLAN. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. (Default: 192.168.1.1)
- ◆ **Subnet Mask** – This mask identifies the host address bits used for routing to specific subnets. (Default: 255.255.255.0)
- ◆ **Restart DHCP** – Requests a new IP address from the DHCP server.

Web Interface

To set a static IPv4 address for the switch:

1. Click System, IP.
2. Select Configure Interface from the Step list.
3. Select Add Address from the Action list.
4. Select any configured VLAN, set IP Address Mode to "User Specified," set IP Address Type to "Primary" if no address has yet been configured for this interface, and then enter the IP address and subnet mask.
5. Select Primary or Secondary Address Type.
6. Click Apply.

Figure 303: Configuring a Static IPv4 Address

The screenshot shows the 'System > IP' configuration page. At the top, the 'Step' is set to '1. Configure Interface' and the 'Action' is 'Add Address'. The configuration fields are as follows:

VLAN	1
IP Address Mode	User Specified
IP Address Type	Primary
IP Address	192.168.0.2
Subnet Mask	255.255.255.0

Below the fields, there is a 'Restart DHCP' button with the text 'Click this button to resend DHCP client request.' At the bottom right, there are 'Apply' and 'Revert' buttons.

To obtain an dynamic IPv4 address through DHCP/BOOTP for the switch:

1. Click System, IP.
2. Select Configure Interface from the Step list.
3. Select Add Address from the Action list.
4. Select any configured VLAN, and set IP Address Mode to "BOOTP" or "DHCP"
5. Click Apply to save your changes.
6. Then click Restart DHCP to immediately request a new address.

IP will be enabled but will not function until a BOOTP or DHCP reply is received. Requests are broadcast every few minutes using exponential backoff until IP configuration information is obtained from a BOOTP or DHCP server.

Figure 304: Configuring a Dynamic IPv4 Address

The screenshot shows the 'System > IP' configuration page. At the top, the 'Step' is set to '2. Configure Interface' and the 'Action' is 'Add Address'. The configuration fields are as follows:

VLAN	1
IP Address Mode	DHCP
IP Address Type	Primary
IP Address	
Subnet Mask	

Below the fields, there is a 'Restart DHCP' button with the text 'Click this button to resend DHCP client request.' At the bottom right, there are 'Apply' and 'Revert' buttons.



Note: The switch will also broadcast a request for IP configuration settings on each power reset.

Note: If you lose the management connection, make a console connection to the switch and enter “show ip interface” to determine the new switch address.

Renewing DHCP – DHCP may lease addresses to clients indefinitely or for a specific period of time. If the address expires or the switch is moved to another network segment, you will lose management access to the switch. In this case, you can reboot the switch or submit a client request to restart DHCP service via the CLI.

If the address assigned by DHCP is no longer functioning, you will not be able to renew the IP settings via the web interface. You can only restart DHCP service via the web interface if the current address is still available.

To show the IPv4 address configured for an interface:

1. Click System, IP.
2. Select Configure Interface from the Step list.
3. Select Show Address from the Action list.
4. Select an entry from the VLAN list.

Figure 305: Showing the Configured IPv4 Address for an Interface



Setting the Switch's IP Address (IP Version 6)

This section describes how to configure an IPv6 interface for management access over the network. This switch supports both IPv4 and IPv6, and can be managed through either of these address types. For information on configuring the switch with an IPv4 address, see [“Setting the Switch's IP Address \(IP Version 4\)” on page 451](#).

Command Usage

- ◆ IPv6 includes two distinct address types – link-local unicast and global unicast. A link-local address makes the switch accessible over IPv6 for all devices attached to the same local subnet. Management traffic using this kind of address cannot be passed by any router outside of the subnet. A link-local address is easy to set up, and may be useful for simple networks or basic troubleshooting tasks. However, to connect to a larger network with multiple

segments, the switch must be configured with a global unicast address. Both link-local and global unicast address types can either be dynamically assigned (using the Configure Interface page) or manually configured (using the Add IPv6 Address page).

- ◆ An IPv6 global unicast or link-local address can be manually configured (using the Add IPv6 Address page), or a link-local address can be dynamically generated (using the Configure Interface page).

Configuring the IPv6 Default Gateway

Use the System > IPv6 Configuration (Configure Global) page to configure an IPv6 default gateway for the switch.

Parameters

These parameters are displayed:

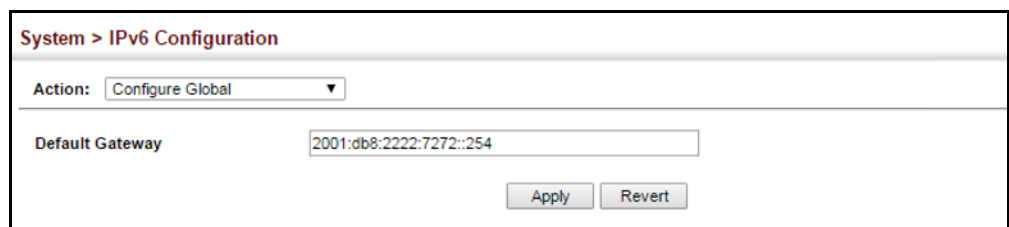
- ◆ **Default Gateway** – Sets the IPv6 address of the default next hop router to use when no routing information is known about an IPv6 address.
 - An IPv6 default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the switch.
 - An IPv6 address must be configured according to RFC 2373 “IPv6 Addressing Architecture,” using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

Web Interface

To configure an IPv6 default gateway for the switch:

1. Click System, IPv6 Configuration.
2. Select Configure Global from the Action list.
3. Enter the IPv6 default gateway.
4. Click Apply.

Figure 306: Configuring the IPv6 Default Gateway



The screenshot shows the 'System > IPv6 Configuration' web interface. At the top, there is a breadcrumb trail 'System > IPv6 Configuration'. Below it, there is a dropdown menu for 'Action:' with 'Configure Global' selected. The main configuration area has a label 'Default Gateway' followed by a text input field containing the IPv6 address '2001:db8:2222:7272::254'. At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

Configuring IPv6 Interface Settings

Use the System > IPv6 Configuration (Configure Interface) page to configure general IPv6 settings for the selected VLAN, including auto-configuration of a global unicast interface address, explicit configuration of a link local interface address, the MTU size, and neighbor discovery protocol settings for duplicate address detection and the neighbor solicitation interval.

Command Usage

- ◆ The switch must be configured with a link-local address. The switch's address auto-configuration function will automatically create a link-local address, as well as an IPv6 global address if router advertisements are detected on the local interface.
- ◆ The option to explicitly enable IPv6 creates a link-local address, but will not generate a global IPv6 address if auto-configuration is not enabled. In this case, you can manually configure a global unicast address (see ["Configuring an IPv6 Address" on page 461](#)).
- ◆ IPv6 Neighbor Discovery Protocol supersedes IPv4 Address Resolution Protocol in IPv6 networks. IPv6 nodes on the same network segment use Neighbor Discovery to discover each other's presence, to determine each other's link-layer addresses, to find routers and to maintain reachability information about the paths to active neighbors. The key parameters used to facilitate this process are the number of attempts made to verify whether or not a duplicate address exists on the same network segment, and the interval between neighbor solicitations used to verify reachability information.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of a configured VLAN that is to be used for management access. By default, all ports on the switch are members of VLAN 1. However, the management station can be attached to a port belonging to any VLAN, as long as that VLAN has been assigned an IP address. (Range: 1-4094)
- ◆ **Address Autoconfig** – Enables stateless autoconfiguration of an IPv6 address on an interface and enables IPv6 functionality on that interface. The network portion of the address is based on prefixes received in IPv6 router advertisement messages, and the host portion is automatically generated using the modified EUI-64 form of the interface identifier (i.e., the switch's MAC address).
 - If a link local address has not yet been assigned to this interface, this command will dynamically generate one. The link-local address is made with an address prefix in the range of FE80~FEBF and a host portion based the switch's MAC address in modified EUI-64 format. It will also generate a global unicast address if a global prefix is included in received router advertisements.
 - When DHCPv6 is started, the switch may attempt to acquire an IP address prefix through stateful address autoconfiguration. If router advertisements

have the “other stateful configuration” flag set, the switch will attempt to acquire other non-address configuration information (such as a default gateway).

- If auto-configuration is not selected, then an address must be manually configured using the Add IPv6 Address page described below.

- ◆ **Enable IPv6 Explicitly** – Enables IPv6 on an interface and assigns it a link-local address. Note that when an explicit address is assigned to an interface, IPv6 is automatically enabled, and cannot be disabled until all assigned addresses have been removed. (Default: Disabled)

Disabling this parameter does not disable IPv6 for an interface that has been explicitly configured with an IPv6 address.

- ◆ **MTU** – Sets the size of the maximum transmission unit (MTU) for IPv6 packets sent on an interface. (Range: 1280-65535 bytes; Default: 1500 bytes)
 - The maximum value set in this field cannot exceed the MTU of the physical interface, which is currently fixed at 1500 bytes.
 - If a non-default value is configured, an MTU option is included in the router advertisements sent from this device. This option is provided to ensure that all nodes on a link use the same MTU value in cases where the link MTU is not otherwise well known.
 - IPv6 routers do not fragment IPv6 packets forwarded from other routers. However, traffic originating from an end-station connected to an IPv6 router may be fragmented.
 - All devices on the same physical medium must use the same MTU in order to operate correctly.
 - IPv6 must be enabled on an interface before the MTU can be set. If an IPv6 address has not been assigned to the switch, “N/A” is displayed in the MTU field.
- ◆ **ND DAD Attempts** – The number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection. (Range: 0-600, Default: 3)
 - Configuring a value of 0 disables duplicate address detection.
 - Duplicate address detection determines if a new unicast IPv6 address already exists on the network before it is assigned to an interface.
 - Duplicate address detection is stopped on any interface that has been suspended (see [“Configuring VLAN Groups” on page 142](#)). While an interface is suspended, all unicast IPv6 addresses assigned to that interface are placed in a “pending” state. Duplicate address detection is automatically restarted when the interface is administratively re-activated.
 - An interface that is re-activated restarts duplicate address detection for all unicast IPv6 addresses on the interface. While duplicate address detection is performed on the interface’s link-local address, the other IPv6 addresses

remain in a "tentative" state. If no duplicate link-local address is found, duplicate address detection is started for the remaining IPv6 addresses.

- If a duplicate address is detected, it is set to "duplicate" state, and a warning message is sent to the console. If a duplicate link-local address is detected, IPv6 processes are disabled on the interface. If a duplicate global unicast address is detected, it is not used. All configuration commands associated with a duplicate address remain configured while the address is in "duplicate" state.
 - If the link-local address for an interface is changed, duplicate address detection is performed on the new link-local address, but not for any of the IPv6 global unicast addresses already associated with the interface.
- ◆ **ND NS Interval** – The interval between transmitting IPv6 neighbor solicitation messages on an interface. (Range: 1000-3600000 milliseconds)

Default: 1000 milliseconds is used for neighbor discovery operations,
0 milliseconds is advertised in router advertisements.

This attribute specifies the interval between transmitting neighbor solicitation messages when resolving an address, or when probing the reachability of a neighbor. Therefore, avoid using very short intervals for normal IPv6 operations.

When a non-default value is configured, the specified interval is used both for router advertisements and by the router itself.

- ◆ **ND Reachable-Time** – The amount of time that a remote IPv6 node is considered reachable after some reachability confirmation event has occurred. (Range: 0-3600000 milliseconds)

Default: 30000 milliseconds is used for neighbor discovery operations,
0 milliseconds is advertised in router advertisements.

- The time limit configured by this parameter allows the router to detect unavailable neighbors. During the neighbor discover process, an IPv6 node will multicast neighbor solicitation messages to search for neighbor nodes. For a neighbor node to be considered reachable, it must respond to the neighbor soliciting node with a neighbor advertisement message to become a confirmed neighbor, after which the reachable timer will be considered in effect for subsequent unicast IPv6 layer communications.
 - This time limit is included in all router advertisements sent out through an interface, ensuring that nodes on the same link use the same time value.
 - Setting the time limit to 0 means that the configured time is unspecified by this router.
- ◆ **Restart DHCPv6** – When DHCPv6 is restarted, the switch may attempt to acquire an IP address prefix through stateful address autoconfiguration. If the router advertisements have the "other stateful configuration" flag set, the switch may also attempt to acquire other non-address configuration information (such as a default gateway) when DHCPv6 is restarted.

Prior to submitting a client request to a DHCPv6 server, the switch should be configured with a link-local address using the Address Autoconfig option. The state of the Managed Address Configuration flag (M flag) and Other Stateful Configuration flag (O flag) received in Router Advertisement messages will determine the information this switch should attempt to acquire from the DHCPv6 server as described below.

- Both M and O flags are set to 1:
DHCPv6 is used for both address and other configuration settings.
This combination is known as DHCPv6 stateful autoconfiguration, in which a DHCPv6 server assigns stateful addresses to IPv6 hosts.
- The M flag is set to 0, and the O flag is set to 1:
DHCPv6 is used only for other configuration settings.
Neighboring routers are configured to advertise non-link-local address prefixes from which IPv6 hosts derive stateless addresses.
This combination is known as DHCPv6 stateless autoconfiguration, in which a DHCPv6 server does not assign stateful addresses to IPv6 hosts, but does assign stateless configuration settings.

Web Interface

To configure general IPv6 settings for the switch:

1. Click System, IPv6 Configuration.
2. Select Configure Interface from the Action list.
3. Specify the VLAN to configure.
4. Enable address auto-configuration, or enable IPv6 explicitly to automatically configure a link-local address and enable IPv6 on the selected interface. (To manually configure the link-local address, use the Add IPv6 Address page.) Set the MTU size, the maximum number of duplicate address detection messages, the neighbor solicitation message interval, and the amount of time that a remote IPv6 node is considered reachable.
5. Click Apply.

Figure 307: Configuring General Settings for an IPv6 Interface

The screenshot shows the 'System > IPv6 Configuration' page. At the top, there is a breadcrumb trail 'System > IPv6 Configuration' and an 'Action:' dropdown menu set to 'Configure Interface'. Below this, several configuration options are listed:

- VLAN:** A dropdown menu showing '1'.
- Address Autoconfig:** A checkbox labeled 'Enabled'.
- Enable IPv6 Explicitly:** A checkbox labeled 'Enabled'.
- MTU (1280-65535):** A text input field containing '1500' followed by 'bytes'.
- ND DAD Attempts (0-600):** A text input field containing '3'.
- ND NS Interval (1000-3600000):** A text input field containing '1000' followed by 'ms'.
- ND Reachable-Time (0-3600000):** A text input field containing '30000' followed by 'ms'.

At the bottom of the configuration area, there is a 'Restart DHCPv6' button with a tooltip that says 'Click this button to restart DHCPv6 service.' Below the configuration area are two buttons: 'Apply' and 'Revert'.

Configuring an IPv6 Address Use the System > IPv6 Configuration (Add IPv6 Address) page to configure an IPv6 interface for management access over the network.

Command Usage

- ◆ All IPv6 addresses must be formatted according to RFC 2373 “IPv6 Addressing Architecture,” using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.
- ◆ The switch must always be configured with a link-local address. Therefore any configuration process that enables IPv6 functionality, or assigns a global unicast address to the switch, including address auto-configuration or explicitly enabling IPv6 (see [“Configuring IPv6 Interface Settings” on page 457](#)), will also automatically generate a link-local unicast address. The prefix length for a link-local address is fixed at 64 bits, and the host portion of the default address is based on the modified EUI-64 (Extended Universal Identifier) form of the interface identifier (i.e., the physical MAC address). Alternatively, you can manually configure the link-local address by entering the full address with a network prefix in the range of FE80~FEBF.
- ◆ To connect to a larger network with multiple subnets, you must configure a global unicast address. There are several alternatives to configuring this address type:
 - The global unicast address can be automatically configured by taking the network prefix from router advertisements observed on the local interface, and using the modified EUI-64 form of the interface identifier to automatically create the host portion of the address (see [“Configuring IPv6 Interface Settings” on page 457](#)).
 - It can be manually configured by specifying the entire network prefix and prefix length, and using the EUI-64 form of the interface identifier to

automatically create the low-order 64 bits in the host portion of the address.

- You can also manually configure the global unicast address by entering the full address and prefix length.
- ◆ You can configure multiple IPv6 global unicast addresses per interface, but only one link-local address per interface.
- ◆ If a duplicate link-local address is detected on the local segment, this interface is disabled and a warning message displayed on the console. If a duplicate global unicast address is detected on the network, the address is disabled on this interface and a warning message displayed on the console.
- ◆ When an explicit address is assigned to an interface, IPv6 is automatically enabled, and cannot be disabled until all assigned addresses have been removed.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of a configured VLAN which is to be used for management access. By default, all ports on the switch are members of VLAN 1. However, the management station can be attached to a port belonging to any VLAN, as long as that VLAN has been assigned an IP address. (Range: 1-4094)
- ◆ **Address Type** – Defines the address type configured for this interface.
 - **Global** – Configures an IPv6 global unicast address with a full IPv6 address including the network prefix and host address bits, followed by a forward slash, and a decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).
 - **EUI-64** (Extended Universal Identifier) – Configures an IPv6 address for an interface using an EUI-64 interface ID in the low order 64 bits.
 - When using EUI-64 format for the low-order 64 bits in the host portion of the address, the value entered in the IPv6 Address field includes the network portion of the address, and the prefix length indicates how many contiguous bits (starting at the left) of the address comprise the prefix (i.e., the network portion of the address). Note that the value specified in the IPv6 Address field may include some of the high-order host bits if the specified prefix length is less than 64 bits. If the specified prefix length exceeds 64 bits, then the bits used in the network portion of the address will take precedence over the interface identifier.
 - IPv6 addresses are 16 bytes long, of which the bottom 8 bytes typically form a unique host identifier based on the device's MAC address. The EUI-64 specification is designed for devices that use an extended 8-byte MAC address. For devices that still use a 6-byte MAC address (also

known as EUI-48 format), it must be converted into EUI-64 format by inverting the universal/local bit in the address and inserting the hexadecimal number FFFE between the upper and lower three bytes of the MAC address.

For example, if a device had an EUI-48 address of 28-9F-18-1C-82-35, the global/local bit must first be inverted to meet EUI-64 requirements (i.e., 1 for globally defined addresses and 0 for locally defined addresses), changing 28 to 2A. Then the two bytes FFFE are inserted between the OUI (i.e., organizationally unique identifier, or company identifier) and the rest of the address, resulting in a modified EUI-64 interface identifier of 2A-9F-18-FF-FE-1C-82-35.

- This host addressing method allows the same interface identifier to be used on multiple IP interfaces of a single device, as long as those interfaces are attached to different subnets.
- **Link Local** – Configures an IPv6 link-local address.
 - The address prefix must be in the range of FE80~FEBF.
 - You can configure only one link-local address per interface.
 - The specified address replaces a link-local address that was automatically generated for the interface.
- ◆ **IPv6 Address** – IPv6 address assigned to this interface.

Web Interface

To configure an IPv6 address:

1. Click System, IPv6 Configuration.
2. Select Add IPv6 Address from the Action list.
3. Specify the VLAN to configure, select the address type, and then enter an IPv6 address and prefix length.
4. Click Apply.

Figure 308: Configuring an IPv6 Address

The screenshot shows the 'System > IPv6 Configuration' web interface. At the top, there is a dropdown menu for 'Action' set to 'Add IPv6 Address'. Below this, there are three rows of configuration options: 'VLAN' with a dropdown set to '1', 'Address Type' with a dropdown set to 'Global', and 'IPv6 Address' with a text input field containing '2001:db8:2222:7272::72/96'. At the bottom right of the form, there are two buttons: 'Apply' and 'Revert'.

Showing IPv6 Addresses Use the System > IPv6 Configuration (Show IPv6 Address) page to display the IPv6 addresses assigned to an interface.

Parameters

These parameters are displayed:

- ◆ **VLAN** – ID of a configured VLAN. By default, all ports on the switch are members of VLAN 1. However, the management station can be attached to a port belonging to any VLAN, as long as that VLAN has been assigned an IP address. (Range: 1-4094)
- ◆ **IPv6 Address Type** – The address type (Global, EUI-64, Link Local).
- ◆ **IPv6 Address** – An IPv6 address assigned to this interface.

In addition to the unicast addresses assigned to an interface, a node is also required to listen to the all-nodes multicast addresses FF01::1 (interface-local scope) and FF02::1 (link-local scope).

FF01::1/16 is the transient interface-local multicast address for all attached IPv6 nodes, and FF02::1/16 is the link-local multicast address for all attached IPv6 nodes. The interface-local multicast address is only used for loopback transmission of multicast traffic. Link-local multicast addresses cover the same types as used by link-local unicast addresses, including all nodes (FF02::1), all routers (FF02::2), and solicited nodes (FF02::1:FFXX:XXXX) as described below.

A node is also required to compute and join the associated solicited-node multicast addresses for every unicast and anycast address it is assigned. IPv6 addresses that differ only in the high-order bits, e.g. due to multiple high-order prefixes associated with different aggregations, will map to the same solicited-node address, thereby reducing the number of multicast addresses a node must join. In this example, FF02::1:FF90:0/104 is the solicited-node multicast address which is formed by taking the low-order 24 bits of the address and appending those bits to the prefix.

Note that the solicited-node multicast address (link-local scope FF02) is used to resolve the MAC addresses for neighbor nodes since IPv6 does not support the broadcast method used by the Address Resolution Protocol in IPv4.

These additional addresses are displayed by the “show ip interface” command described in the *CLI Reference Guide*.

- ◆ **Configuration Mode** – Indicates if this address was automatically generated or manually configured.

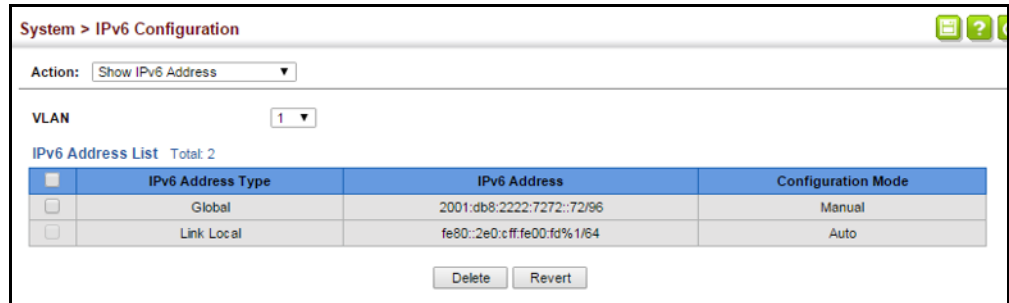
Web Interface

To show the configured IPv6 addresses:

1. Click System, IPv6 Configuration.
2. Select Show IPv6 Address from the Action list.

3. Select a VLAN from the list.

Figure 309: Showing Configured IPv6 Addresses



Showing the IPv6 Neighbor Cache Use the System > IPv6 Configuration (Show IPv6 Neighbor Cache) page to display the IPv6 addresses detected for neighbor devices.

Parameters

These parameters are displayed:

Table 32: Show IPv6 Neighbors - display description

Field	Description
IPv6 Address	IPv6 address of neighbor.
Age	The time since the address was verified as reachable (in seconds). A static entry is indicated by the value "Permanent."
Link-layer Address	Physical layer MAC address.
State	The following states are used for dynamic entries: <ul style="list-style-type: none"> ◆ Incomplete - Address resolution is being carried out on the entry. A neighbor solicitation message has been sent to the multicast address of the target, but it has not yet returned a neighbor advertisement message. ◆ Invalid - An invalidated mapping. Setting the state to invalid dis-associates the interface identified with this entry from the indicated mapping (RFC 4293). ◆ Reachable - Positive confirmation was received within the last ReachableTime interval that the forward path to the neighbor was functioning. While in Reachable state, the device takes no special action when sending packets. ◆ Stale - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. While in Stale state, the device takes no action until a packet is sent. ◆ Delay - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. A packet was sent within the last DELAY_FIRST_PROBE_TIME interval. If no reachability confirmation is received within this interval after entering the Delay state, the switch will send a neighbor solicitation message and change the state to Probe. ◆ Probe - A reachability confirmation is actively sought by re-sending neighbor solicitation messages every RetransTimer interval until confirmation of reachability is received. ◆ Unknown - Unknown state.

Table 32: Show IPv6 Neighbors - display description (Continued)

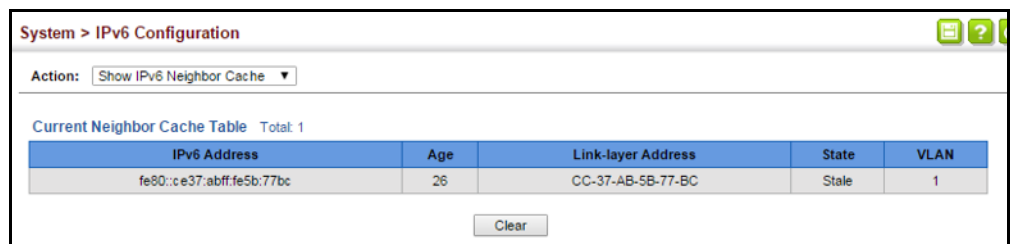
Field	Description
	The following states are used for static entries: <ul style="list-style-type: none"> ◆ Incomplete - The interface for this entry is down. ◆ Permanent - Indicates a static entry. ◆ Reachable - The interface for this entry is up. Reachability detection is not applied to static entries in the IPv6 neighbor discovery cache.
VLAN	VLAN interface from which the address was reached.

Web Interface

To show neighboring IPv6 devices:

1. Click System, IPv6 Configuration.
2. Select Show IPv6 Neighbors from the Action list.

Figure 310: Showing IPv6 Neighbors



Showing IPv6 Statistics Use the System > IPv6 Configuration (Show Statistics) page to display statistics about IPv6 traffic passing through this switch.

Command Usage

This switch provides statistics for the following traffic types:

- ◆ **IPv6** – The Internet Protocol for Version 6 addresses provides a mechanism for transmitting blocks of data (often called packets or frames) from a source to a destination, where these network devices (that is, hosts) are identified by fixed length addresses. The Internet Protocol also provides for fragmentation and reassembly of long packets, if necessary, for transmission through “small packet” networks.
- ◆ **ICMPv6** – Internet Control Message Protocol for Version 6 addresses is a network layer protocol that transmits message packets to report errors in processing IPv6 packets. ICMP is therefore an integral part of the Internet Protocol. ICMP messages may be used to report various situations, such as when a datagram cannot reach its destination, when the gateway does not have the buffering capacity to forward a datagram, and when the gateway can direct the host to send traffic on a shorter route. ICMP is also used by routers to

feed back information about more suitable routes (that is, the next hop router) to use for a specific destination.

- ◆ **UDP** – User Datagram Protocol provides a datagram mode of packet switched communications. It uses IP as the underlying transport mechanism, providing access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.

Parameters

These parameters are displayed:

Table 33: Show IPv6 Statistics - display description

Field	Description
IPv6 Statistics	
<i>IPv6 Received</i>	
Total	The total number of input datagrams received by the interface, including those received in error.
Header Errors	The number of input datagrams discarded due to errors in their IPv6 headers, including version number mismatch, other format errors, hop count exceeded, IPv6 options, etc.
Too Big Errors	The number of input datagrams that could not be forwarded because their size exceeded the link MTU of outgoing interface.
No Routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
Address Errors	The number of input datagrams discarded because the IPv6 address in their IPv6 header's destination field was not a valid address to be received at this entity. This count includes invalid addresses (e.g., ::0) and unsupported addresses (e.g., addresses with unallocated prefixes). For entities which are not IPv6 routers and therefore do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.
Unknown Protocols	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol. This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
Truncated Packets	The number of input datagrams discarded because datagram frame didn't carry enough data.
Discards	The number of input IPv6 datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). Note that this counter does not include any datagrams discarded while awaiting re-assembly.
Delivers	The total number of datagrams successfully delivered to IPv6 user-protocols (including ICMP). This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
Reassembly Request Datagrams	The number of IPv6 fragments received which needed to be reassembled at this interface. Note that this counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.

Table 33: Show IPv6 Statistics - display description (Continued)

Field	Description
Reassembled Succeeded	The number of IPv6 datagrams successfully reassembled. Note that this counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the fragments.
Reassembled Failed	The number of failures detected by the IPv6 re-assembly algorithm (for whatever reason: timed out, errors, etc.). Note that this is not necessarily a count of discarded IPv6 fragments since some algorithms (notably the algorithm in RFC 815) can lose track of the number of fragments by combining them as they are received. This counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.
<i>IPv6 Transmitted</i>	
Forwards Datagrams	The number of output datagrams which this entity received and forwarded to their final destinations. In entities which do not act as IPv6 routers, this counter will include only those packets which were Source-Routed via this entity, and the Source-Route processing was successful. Note that for a successfully forwarded datagram the counter of the outgoing interface is incremented.
Requests	The total number of IPv6 datagrams which local IPv6 user-protocols (including ICMP) supplied to IPv6 in requests for transmission. Note that this counter does not include any datagrams counted in <code>ipv6IfStatsOutForwDatagrams</code> .
Discards	The number of output IPv6 datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). Note that this counter would include datagrams counted in <code>ipv6IfStatsOutForwDatagrams</code> if any such packets met this (discretionary) discard criterion.
No Routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
Generated Fragments	The number of output datagram fragments that have been generated as a result of fragmentation at this output interface.
Fragment Succeeded	The number of IPv6 datagrams that have been successfully fragmented at this output interface.
Fragment Failed	The number of IPv6 datagrams that have been discarded because they needed to be fragmented at this output interface but could not be.
ICMPv6 Statistics	
<i>ICMPv6 received</i>	
Input	The total number of ICMP messages received by the interface which includes all those counted by <code>ipv6IfIcmpInErrors</code> . Note that this interface is the interface to which the ICMP messages were addressed which may not be necessarily the input interface for the messages.
Errors	The number of ICMP messages which the interface received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
Destination Unreachable Messages	The number of ICMP Destination Unreachable messages received by the interface.
Packet Too Big Messages	The number of ICMP Packet Too Big messages received by the interface.
Time Exceeded Messages	The number of ICMP Time Exceeded messages received by the interface.

Table 33: Show IPv6 Statistics - display description (Continued)

Field	Description
Parameter Problem Messages	The number of ICMP Parameter Problem messages received by the interface.
Echo Request Messages	The number of ICMP Echo (request) messages received by the interface.
Echo Reply Messages	The number of ICMP Echo Reply messages received by the interface.
Router Solicit Messages	The number of ICMP Router Solicit messages received by the interface.
Router Advertisement Messages	The number of ICMP Router Advertisement messages received by the interface.
Neighbor Solicit Messages	The number of ICMP Neighbor Solicit messages received by the interface.
Neighbor Advertisement Messages	The number of ICMP Neighbor Advertisement messages received by the interface.
Redirect Messages	The number of Redirect messages received by the interface.
Group Membership Query Messages	The number of ICMPv6 Group Membership Query messages received by the interface.
Group Membership Response Messages	The number of ICMPv6 Group Membership Response messages received by the interface.
Group Membership Reduction Messages	The number of ICMPv6 Group Membership Reduction messages received by the interface.
Multicast Listener Discovery Version 2 Reports	The number of MLDv2 reports received by the interface.
<i>ICMPv6 Transmitted</i>	
Output	The total number of ICMP messages which this interface attempted to send. Note that this counter includes all those counted by icmpOutErrors.
Destination Unreachable Messages	The number of ICMP Destination Unreachable messages sent by the interface.
Packet Too Big Messages	The number of ICMP Packet Too Big messages sent by the interface.
Time Exceeded Messages	The number of ICMP Time Exceeded messages sent by the interface.
Echo Request Messages	The number of ICMP Echo (request) messages sent by the interface.
Echo Reply Messages	The number of ICMP Echo Reply messages sent by the interface.
Router Solicit Messages	The number of ICMP Router Solicitation messages sent by the interface.
Router Advertisement Messages	The number of ICMP Router Advertisement messages sent by the interface.
Neighbor Solicit Messages	The number of ICMP Neighbor Solicit messages sent by the interface.
Neighbor Advertisement Messages	The number of ICMP Router Advertisement messages sent by the interface.
Redirect Messages	The number of Redirect messages sent. For a host, this object will always be zero, since hosts do not send redirects.
Group Membership Query Messages	The number of ICMPv6 Group Membership Query messages sent by the interface.
Group Membership Response Messages	The number of ICMPv6 Group Membership Response messages sent.

Table 33: Show IPv6 Statistics - display description (Continued)

Field	Description
Group Membership Reduction Messages	The number of ICMPv6 Group Membership Reduction messages sent.
Multicast Listener Discovery Version 2 Reports	The number of MLDv2 reports sent by the interface.
UDP Statistics	
Input	The total number of UDP datagrams delivered to UDP users.
No Port Errors	The total number of received UDP datagrams for which there was no application at the destination port.
Other Errors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
Output	The total number of UDP datagrams sent from this entity.

Web Interface

To show the IPv6 statistics:

1. Click System, IPv6 Configuration.
2. Select Show Statistics from the Action list.
3. Click IPv6, ICMPv6 or UDP.

Figure 311: Showing IPv6 Statistics (IPv6)

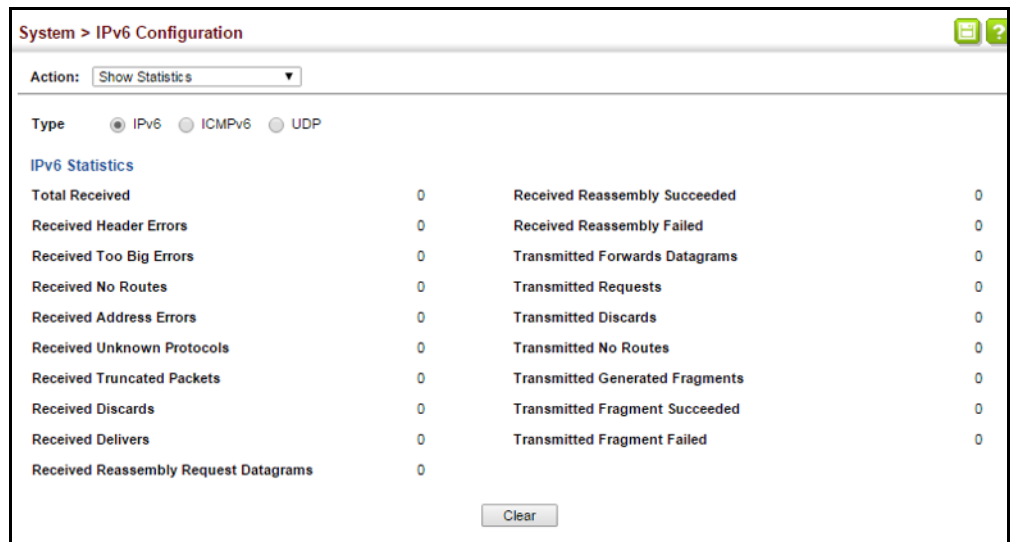


Figure 312: Showing IPv6 Statistics (ICMPv6)

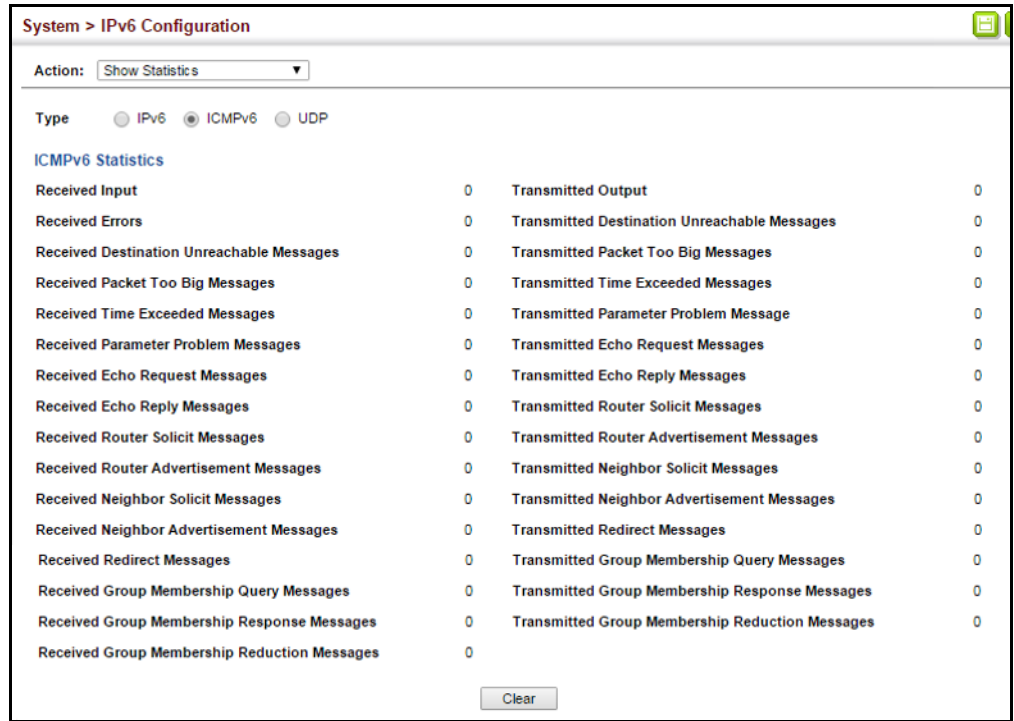
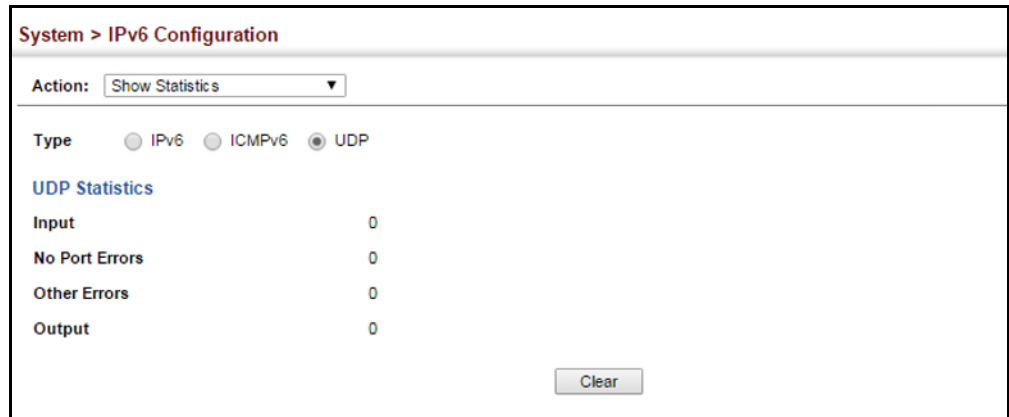


Figure 313: Showing IPv6 Statistics (UDP)



Showing the MTU for Responding Destinations Use the System > IPv6 Configuration (Show MTU) page to display the maximum transmission unit (MTU) cache for destinations that have returned an ICMP packet-too-big message along with an acceptable MTU to this switch.

Parameters

These parameters are displayed:

Table 34: Show MTU - display description

Field	Description
MTU	Adjusted MTU contained in the ICMP packet-too-big message returned from this destination, and now used for all traffic sent along this path.
Since	Time since an ICMP packet-too-big message was received from this destination.
Destination Address	Address which sent an ICMP packet-too-big message.

Web Interface

To show the MTU reported from other devices:

1. Click System, IPv6 Configuration.
2. Select Show MTU from the Action list.

Figure 314: Showing Reported MTU Values

System > IPv6 Configuration		
Action: Show MTU		
MTU Table Total: 2		
MTU	Since	Destination Address
1400	00:04:21	5000:1::3
1280	00:04:50	FE80::203:A0FF:FED6:141D

Section III

Appendices

This section provides additional information and includes these items:

- ◆ [“Software Specifications” on page 475](#)
- ◆ [“Troubleshooting” on page 479](#)
- ◆ [“License Information” on page 481](#)



Software Specifications

Software Features

Management Authentication Local, RADIUS, TACACS+, Port Authentication (802.1X), HTTPS, SSH, Port Security, IP Filter

General Security Measures Access Control Lists (512 rules), Port Authentication (802.1X), MAC Authentication, Port Security, DHCP Snooping, IP Source Guard

Port Configuration 1000BASE-T: 10/100 Mbps at half/full duplex, 1000 Mbps at full duplex
1000BASE-SX/LX/ZX: 1000 Mbps at full duplex (SFP)

Flow Control Full Duplex: IEEE 802.3-2005
Half Duplex: Back pressure

Storm Control Broadcast, multicast, or unknown unicast traffic throttled above a critical threshold

Port Mirroring 10 sessions, one or more source ports to one destination port

Rate Limits Input/Output Limits
Range configured per port

Port Trunking Static trunks (Cisco EtherChannel compliant)
Dynamic trunks (Link Aggregation Control Protocol)

Spanning Tree Algorithm Spanning Tree Protocol (STP, IEEE 802.1D-2004)
Rapid Spanning Tree Protocol (RSTP, IEEE 802.1D-2004)
Multiple Spanning Tree Protocol (MSTP, IEEE 802.1D-2004)

VLAN Support Up to 4094 groups; port-based, protocol-based, tagged (802.1Q), voice VLANs, MAC-based

Class of Service Supports four levels of priority
Strict, Weighted Round Robin (WRR), or a combination of strict and weighted queuing
Layer 3/4 priority mapping: IP DSCP

Quality of Service DiffServ¹² supports class maps, policy maps, and service policies

Multicast Filtering IGMP Snooping (Layer 2 IPv4)
MLD Snooping (Layer 2 IPv6)

IP Routing ARP, CIDR (Classless Inter-Domain Routing)

Additional Features BOOTP Client
DHCP Client, Option 82,
LLDP (Link Layer Discover Protocol)
RMON (Remote Monitoring, groups 1,2,3,9)
SMTP Email Alerts
SNMP (Simple Network Management Protocol)
SNTP (Simple Network Time Protocol)

Management Features

In-Band Management Telnet, web-based HTTP or HTTPS, SNMP manager, or Secure Shell

Out-of-Band Management RS-232 DB-9 console port

Software Loading HTTP or TFTP in-band, or XModem out-of-band

SNMP Management access via MIB database
Trap management to specified hosts

RMON Groups 1, 2, 3, 9 (Statistics, History, Alarm, Event)

¹². Only supported for IPv4.

Standards

IEEE 802.1AB Link Layer Discovery Protocol
IEEE 802.1D-2004 Spanning Tree Algorithm and traffic priorities
Spanning Tree Protocol
Rapid Spanning Tree Protocol
Multiple Spanning Tree Protocol
IEEE 802.1p Priority tags
IEEE 802.1Q VLAN
IEEE 802.1v Protocol-based VLANs
IEEE 802.1X Port Authentication
IEEE 802.3-2005
Ethernet, Fast Ethernet, Gigabit Ethernet
Link Aggregation Control Protocol (LACP)
Full-duplex flow control (ISO/IEC 8802-3)
IEEE 802.3ac VLAN tagging
ARP (RFC 826)
DHCP Client (RFC 2131)
HTTPS
ICMP (RFC 792)
IGMP (RFC 1112)
IGMPv2 (RFC 2236)
IGMP Proxy (RFC 4541)
IPv4 IGMP (RFC 3228)
MLD Snooping (RFC 4541)
NTP (RFC 1305)
RADIUS+ (RFC 2618)
RMON (RFC 2819 groups 1,2,3,9)
SNMP (RFC 1157)
SNMPv2c (RFC 1901, 2571)
SNMPv3 (RFC DRAFT 2273, 2576, 3410, 3411, 3413, 3414, 3415)
SNTP (RFC 2030)
SSH (Version 2.0)
TELNET (RFC 854, 855, 856)
TFTP (RFC 1350)

Management Information Bases

Bridge MIB (RFC 1493)
Differentiated Services MIB (RFC 3289)
DNS Resolver MIB (RFC 1612)
Entity MIB (RFC 2737)
Ether-like MIB (RFC 2665)

Extended Bridge MIB (RFC 2674)
Extensible SNMP Agents MIB (RFC 2742)
Forwarding Table MIB (RFC 2096)
IGMP MIB (RFC 2933)
Interface Group MIB (RFC 2233)
Interfaces Evolution MIB (RFC 2863)
IP MIB (RFC 2011)
IP Forwarding Table MIB (RFC 2096)
IP Multicasting related MIBs
IPV6-MIB (RFC 2065)
IPV6-ICMP-MIB (RFC 2066)
IPV6-TCP-MIB (RFC 2052)
IPV6-UDP-MIB (RFC2054)
Link Aggregation MIB (IEEE 802.3ad)
MAU MIB (RFC 3636)
MIB II (RFC 1213)
NTP (RFC 1305)
P-Bridge MIB (RFC 2674P)
Port Access Entity MIB (IEEE 802.1X)
Port Access Entity Equipment MIB
Power Ethernet MIB (RFC 3621)
Private MIB
Q-Bridge MIB (RFC 2674Q)
Quality of Service MIB
RADIUS Accounting Server MIB (RFC 2621)
RADIUS Authentication Client MIB (RFC 2619)
RMON MIB (RFC 2819)
RMON II Probe Configuration Group (RFC 2021, partial implementation)
SNMP Community MIB (RFC 3584)
SNMP Framework MIB (RFC 3411)
SNMP-MPD MIB (RFC 3412)
SNMP Target MIB, SNMP Notification MIB (RFC 3413)
SNMP User-Based SM MIB (RFC 3414)
SNMP View Based ACM MIB (RFC 3415)
SNMPv2 IP MIB (RFC 2011)
TACACS+ Authentication Client MIB
TCP MIB (RFC 2012)
Trap (RFC 1215)
UDP MIB (RFC 2013)



Troubleshooting

Problems Accessing the Management Interface

Table 35: Troubleshooting Chart

Symptom	Action
Cannot connect using Telnet, web browser, or SNMP software	<ul style="list-style-type: none">◆ Be sure the switch is powered on.◆ Check network cabling between the management station and the switch. Make sure the ends are properly connected and there is no damage to the cable. Test the cable if necessary.◆ Check that you have a valid network connection to the switch and that the port you are using has not been disabled.◆ Be sure you have configured the VLAN interface through which the management station is connected with a valid IP address, subnet mask and default gateway.◆ Be sure the management station has an IP address in the same subnet as the switch's IP interface to which it is connected.◆ If you are trying to connect to the switch via the IP address for a tagged VLAN group, your management station, and the ports connecting intermediate switches in the network, must be configured with the appropriate tag.◆ If you cannot connect using Telnet, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time.
Cannot connect using Secure Shell	<ul style="list-style-type: none">◆ If you cannot connect using SSH, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time.◆ Be sure the control parameters for the SSH server are properly configured on the switch, and that the SSH client software is properly configured on the management station.◆ Be sure you have generated both an RSA and DSA public key on the switch, exported this key to the SSH client, and enabled SSH service. Try using another SSH client or check for updates to your SSH client application.◆ Be sure you have set up an account on the switch for each SSH user, including user name, authentication level, and password.◆ Be sure you have imported the client's public key to the switch (if public key authentication is used).
Cannot access the on-board configuration program via a serial port connection	<ul style="list-style-type: none">◆ Check to see if you have set the terminal emulator program to VT100 compatible, 8 data bits, 1 stop bit, no parity, and the baud rate set to 115200 bps.◆ Verify that you are using the DB-9 null-modem serial cable supplied with the switch. If you use any other cable, be sure that it conforms to the pin-out connections provided in the Installation Guide.
Forgot or lost the password	<ul style="list-style-type: none">◆ Contact your local distributor.

Using System Logs

If a fault does occur, refer to the Installation Guide to ensure that the problem you encountered is actually caused by the switch. If the problem appears to be caused by the switch, follow these steps:

1. Enable logging.
2. Set the error messages reported to include all categories.
3. Enable SNMP.
4. Enable SNMP traps.
5. Designate the SNMP host that is to receive the error messages.
6. Repeat the sequence of commands or other actions that lead up to the error.
7. Make a list of the commands or circumstances that led to the fault. Also make a list of any error messages displayed.
8. Set up your terminal emulation software so that it can capture all console output to a file. Then enter the “show tech-support” command to record all system settings in this file.
9. Contact your distributor’s service engineer, and send a detailed description of the problem, along with the file used to record your system settings.

For example:

```
Console(config)#logging on
Console(config)#logging history flash 7
Console(config)#snmp-server host 192.168.1.23
:
```



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Glossary

ACL Access Control List. ACLs can limit network traffic and restrict access to certain users or devices by checking each packet for certain IP or MAC (i.e., Layer 2) information.

ARP Address Resolution Protocol converts between IP addresses and MAC (hardware) addresses. ARP is used to locate the MAC address corresponding to a given IP address. This allows the switch to use IP addresses for routing decisions and the corresponding MAC addresses to forward packets from one hop to the next.

BOOTP Boot Protocol. BOOTP is used to provide bootup information for network devices, including IP address information, the address of the TFTP server that contains the devices system files, and the name of the boot file.

CoS Class of Service is supported by prioritizing packets based on the required level of service, and then placing them in the appropriate output queue. Data is transmitted from the queues using weighted round-robin service to enforce priority service and prevent blockage of lower-level queues. Priority may be set according to the port default, the packet's priority bit (in the VLAN tag), TCP/UDP port number, IP Precedence bit, or DSCP priority bit.

DHCP Dynamic Host Control Protocol. Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

DHCP Option 82 A relay option for sending information about the requesting client (or an intermediate relay agent) in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server. This information can be used by DHCP servers to assign fixed IP addresses, or set other services or policies for clients.

DHCP Snooping A technique used to enhance network security by snooping on DHCP server messages to track the physical location of hosts, ensure that hosts only use the IP addresses assigned to them, and ensure that only authorized DHCP servers are accessible.

- DiffServ** Differentiated Services provides quality of service on large networks by employing a well-defined set of building blocks from which a variety of aggregate forwarding behaviors may be built. Each packet carries information (DS byte) used by each hop to give it a particular forwarding treatment, or per-hop behavior, at each network node. DiffServ allocates different levels of service to users on the network with mechanisms such as traffic meters, shapers/droppers, packet markers at the boundaries of the network.
- DNS** Domain Name Service. A system used for translating host names for network nodes into IP addresses.
- DSCP** Differentiated Services Code Point Service. DSCP uses a six-bit tag to provide for up to 64 different forwarding behaviors. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding. The DSCP bits are mapped to the Class of Service categories, and then into the output queues.
- EAPOL** Extensible Authentication Protocol over LAN. EAPOL is a client authentication protocol used by this switch to verify the network access rights for any device that is plugged into the switch. A user name and password is requested by the switch, and then passed to an authentication server (e.g., RADIUS) for verification. EAPOL is implemented as part of the IEEE 802.1X Port Authentication standard.
- EUI** Extended Universal Identifier is an address format used by IPv6 to identify the host portion of the network address. The interface identifier in EUI compatible addresses is based on the link-layer (MAC) address of an interface. Interface identifiers used in global unicast and other IPv6 address types are 64 bits long and may be constructed in the EUI-64 format. The modified EUI-64 format interface ID is derived from a 48-bit link-layer address by inserting the hexadecimal number FFFE between the upper three bytes (OUI field) and the lower 3 bytes (serial number) of the link layer address. To ensure that the chosen address is from a unique Ethernet MAC address, the 7th bit in the high-order byte is set to 1 (equivalent to the IEEE Global/Local bit) to indicate the uniqueness of the 48-bit address.
- GARP** Generic Attribute Registration Protocol. GARP is a protocol that can be used by endstations and switches to register and propagate multicast group membership information in a switched environment so that multicast data frames are propagated only to those parts of a switched LAN containing registered endstations. Formerly called Group Address Registration Protocol.
- GMRP** Generic Multicast Registration Protocol. GMRP allows network devices to register end stations with multicast groups. GMRP requires that any participating network devices or end stations comply with the IEEE 802.1p standard.
- GVRP** GARP VLAN Registration Protocol. Defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports along the Spanning Tree so that VLANs defined in each switch can work automatically over a Spanning Tree network.

- ICMP** Internet Control Message Protocol is a network layer protocol that reports errors in processing IP packets. ICMP is also used by routers to feed back information about better routing choices.
- IEEE 802.1D** Specifies a general method for the operation of MAC bridges, including the Spanning Tree Protocol.
- IEEE 802.1Q** VLAN Tagging—Defines Ethernet frame tags which carry VLAN information. It allows switches to assign endstations to different virtual LANs, and defines a standard way for VLANs to communicate across switched networks.
- IEEE 802.1p** An IEEE standard for providing quality of service (QoS) in Ethernet networks. The standard uses packet tags that define up to eight traffic classes and allows switches to transmit packets based on the tagged priority value.
- IEEE 802.1s** An IEEE standard for the Multiple Spanning Tree Protocol (MSTP) which provides independent spanning trees for VLAN groups.
- IEEE 802.1w** An IEEE standard for the Rapid Spanning Tree Protocol (RSTP) which reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard. (Now incorporated in IEEE 802.1D-2004)
- IEEE 802.1X** Port Authentication controls access to the switch ports by requiring users to first enter a user ID and password for authentication.
- IEEE 802.3ac** Defines frame extensions for VLAN tagging.
- IEEE 802.3x** Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links. (Now incorporated in IEEE 802.3-2002)
- IGMP** Internet Group Management Protocol. A protocol through which hosts can register with their local router for multicast services. If there is more than one multicast switch/router on a given subnetwork, one of the devices is made the “querier” and assumes responsibility for keeping track of group membership.
- IGMP Proxy** Proxies multicast group membership information onto the upstream interface based on IGMP messages monitored on downstream interfaces, and forwards multicast traffic based on that information. There is no need for multicast routing protocols in a simple tree that uses IGMP Proxy.

IGMP Query On each subnetwork, one IGMP-capable device will act as the querier — that is, the device that asks all hosts to report on the IP multicast groups they wish to join or to which they already belong. The elected querier will be the device with the lowest IP address in the subnetwork.

IGMP Snooping Listening to IGMP Query and IGMP Report packets transferred between IP Multicast Routers and IP Multicast host groups to identify IP Multicast group members.

In-Band Management Management of the network from a station attached directly to the network.

IP Multicast Filtering A process whereby this switch can pass multicast traffic along to participating hosts.

IP Precedence The Type of Service (ToS) octet in the IPv4 header includes three precedence bits defining eight different priority levels ranging from highest priority for network control packets to lowest priority for routine traffic. The eight values are mapped one-to-one to the Class of Service categories by default, but may be configured differently to suit the requirements for specific network applications.

LACP Link Aggregation Control Protocol. Allows ports to automatically negotiate a trunked link with LACP-configured ports on another device.

Layer 2 Data Link layer in the ISO 7-Layer Data Communications Protocol. This is related directly to the hardware interface for network devices and passes on traffic based on MAC addresses.

Layer 3 Network layer in the ISO 7-Layer Data Communications Protocol. This layer handles the routing functions for data moving from one open system to another.

Link Aggregation *See Port Trunk.*

LLDP Link Layer Discovery Protocol is used to discover basic information about neighboring devices in the local broadcast domain by using periodic broadcasts to advertise information such as device identification, capabilities and configuration settings.

MD5 MD5 Message-Digest is an algorithm that is used to create digital signatures. It is intended for use with 32 bit machines and is safer than the MD4 algorithm, which has been broken. MD5 is a one-way hash function, meaning that it takes a message and converts it into a fixed string of digits, also called a message digest.

MIB Management Information Base. An acronym for Management Information Base. It is a set of database objects that contains information about a specific device.

MRD Multicast Router Discovery is a protocol used by IGMP snooping and multicast routing devices to discover which interfaces are attached to multicast routers. This process allows IGMP-enabled devices to determine where to send multicast source and group membership messages.

MSTP Multiple Spanning Tree Protocol can provide an independent spanning tree for different VLANs. It simplifies network management, provides for even faster convergence than RSTP by limiting the size of each region, and prevents VLAN members from being segmented from the rest of the group.

Multicast Switching A process whereby the switch filters incoming multicast frames for services for which no attached host has registered, or forwards them to all ports contained within the designated multicast VLAN group.

NTP Network Time Protocol provides the mechanisms to synchronize time across the network. The time servers operate in a hierarchical-master-slave configuration in order to synchronize local clocks within the subnet and to national time standards via wire or radio.

Out-of-Band Management Management of the network from a station not attached to the network.

Port Authentication *See IEEE 802.1X.*

Port Mirroring A method whereby data on a target port is mirrored to a monitor port for troubleshooting with a logic analyzer or RMON probe. This allows data on the target port to be studied unobstructively.

Port Trunk Defines a network link aggregation and trunking method which specifies how to create a single high-speed logical link that combines several lower-speed physical links.

QoS Quality of Service. QoS refers to the capability of a network to provide better service to selected traffic flows using features such as data prioritization, queuing, congestion avoidance and traffic shaping. These features effectively provide preferential treatment to specific flows either by raising the priority of one flow or limiting the priority of another flow.

- RADIUS** Remote Authentication Dial-in User Service. RADIUS is a logon authentication protocol that uses software running on a central server to control access to RADIUS-compliant devices on the network.
- RMON** Remote Monitoring. RMON provides comprehensive network monitoring capabilities. It eliminates the polling required in standard SNMP, and can set alarms on a variety of traffic conditions, including specific error types.
- RSTP** Rapid Spanning Tree Protocol. RSTP reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard.
- SMTP** Simple Mail Transfer Protocol is a standard host-to-host mail transport protocol that operates over TCP, port 25.
- SNMP** Simple Network Management Protocol. The application protocol in the Internet suite of protocols which offers network management services.
- SNTP** Simple Network Time Protocol allows a device to set its internal clock based on periodic updates from a Network Time Protocol (NTP) server. Updates can be requested from a specific NTP server, or can be received via broadcasts sent by NTP servers.
- SSH** Secure Shell is a secure replacement for remote access functions, including Telnet. SSH can authenticate users with a cryptographic key, and encrypt data connections between management clients and the switch.
- STA** Spanning Tree Algorithm is a technology that checks your network for any loops. A loop can often occur in complicated or backup linked network systems. Spanning Tree detects and directs data along the shortest available path, maximizing the performance and efficiency of the network.
- TACACS+** Terminal Access Controller Access Control System Plus. TACACS+ is a logon authentication protocol that uses software running on a central server to control access to TACACS-compliant devices on the network.
- TCP/IP** Transmission Control Protocol/Internet Protocol. Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.
- Telnet** Defines a remote communication facility for interfacing to a terminal device over TCP/IP.

- TFTP** Trivial File Transfer Protocol. A TCP/IP protocol commonly used for software downloads.
- UDP** User Datagram Protocol. UDP provides a datagram mode for packet-switched communications. It uses IP as the underlying transport mechanism to provide access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.
- UTC** Universal Time Coordinate. UTC is a time scale that couples Greenwich Mean Time (based solely on the Earth's rotation rate) with highly accurate atomic time. The UTC does not have daylight saving time.
- VLAN** Virtual LAN. A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, and allows users to share information and resources as though located on the same LAN.
- XModem** A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

Index

Numerics

802.1X

- authenticator, configuring 294
- global settings 293
- port authentication 291
- port authentication accounting 231, 232

A

AAA

- accounting 802.1X port settings 231, 232
- accounting exec command privileges 231, 238
- accounting exec settings 232, 238
- accounting summary 233
- accounting update 231
- accounting, configuring 231
- authentication, authorization, and accounting 224
- authorization exec settings 238
- authorization method 238
- authorization settings 237
- RADIUS group settings 232
- TACACS+ group settings 232

acceptable frame type 145

ACL 261

- ARP 264, 275
- binding to a port 277
- IPv4 Extended 264, 267
- IPv4 Standard 264, 266
- IPv6 Extended 264, 271
- IPv6 Standard 264, 269
- MAC 264, 273
- time range 387

Address Resolution Protocol *See* ARP

address table 155

- aging time 159
- aging time, displaying 159
- aging time, setting 159

ARP

description 434

ARP ACL 275

ARP inspection 279

- ACL filter 282
- additional validation criteria 281
- ARP ACL 283
- enabling globally 281
- trusted ports 284

authentication

- MAC address authentication 243
- MAC, configuring ports 246
- network access 243
- public key 256

B

BOOTP 452

BPDU 166

- filter 179
- flooding when STA disabled on VLAN 170
- flooding when STA globally disabled 170
- ignoring superior BPDUs 178
- selecting protocol based on message format 179
- shut down port on receipt 179

bridge extension capabilities, displaying 65

broadcast storm, threshold 190, 191

C

canonical format indicator 202

class map

- DiffServ 206

Class of Service *See* CoS

committed information rate, QoS policy 211

community string 362

configuration files, restoring defaults 67

configuration settings

- restoring 69, 70
- saving 69

CoS 193

- configuring 193
- default mapping to internal values 201
- enabling 198
- layer 3/4 priorities 197
- priorities, mapping to internal values 201
- queue mode 194
- queue weights, assigning 195

CoS/CFI to PHB/drop precedence 201

CPU

- status 88
- utilization, showing 88

D

dashboard 42

Index

- default IPv4 gateway, configuration 451
 - default IPv6 gateway, configuration 456
 - default priority, ingress port 193
 - default settings, system 35
 - DHCP 443, 452
 - class identifier 445
 - client 452
 - client identifier 444, 445
 - dynamic provision 449
 - option 82 information 301, 448
 - relay service 445
 - relay service, enabling 448
 - DHCP snooping
 - information option, circuit ID 305
 - information option, remote ID 302
 - DHCPv4 snooping 299
 - enabling 302
 - global configuration 302
 - information option 302
 - information option policy 302
 - information option, enabling 302
 - policy selection 302
 - specifying trusted interfaces 304
 - verifying MAC addresses 302
 - VLAN configuration 304
 - DHCPv6 restart 459
 - Differentiated Code Point Service *See* DSCP
 - Differentiated Services *See* DiffServ
 - DiffServ 205
 - binding policy to interface 214
 - class map 206
 - classifying QoS traffic 206
 - configuring 205
 - metering, configuring 210
 - policy map 210
 - policy map, description 207
 - QoS policy 210
 - service policy 214
 - setting CoS for matching packets 211
 - setting PHB for matching packets 211
 - DNS
 - default domain name 437
 - displaying the cache 442
 - domain name list 437
 - enabling lookup 437
 - name server list 437
 - static entries, IPv4 441
 - Domain Name Service *See* DNS
 - downloading software 67
 - automatically 71
 - using FTP or TFTP 71
 - drop precedence
 - CoS priority mapping 202
 - DSCP ingress map 200
 - DSA encryption 258, 259
 - DSCP 197
 - enabling 198
 - ingress map, drop precedence 200
 - mapping to internal values 199
 - DSCP to PHB/drop precedence 200
 - dynamic addresses
 - clearing 161
 - displaying 159
 - dynamic QoS assignment 244
 - dynamic VLAN assignment 243, 246
- ## E
- edge port, STA 178, 181
 - encryption
 - DSA 258, 259
 - RSA 258, 259
 - engine ID 350, 351
 - event logging 316
 - exec command privileges, accounting 231, 238
 - exec settings
 - accounting 232
 - authorization 238
- ## F
- firmware
 - displaying version 63
 - upgrading 67
 - upgrading automatically 71
 - upgrading with FTP or TFTP 71
 - version, displaying 63
- ## G
- gateway, IPv4 default 451
 - gateway, IPv6 default 456
 - general security measures 223
- ## H
- hardware version, displaying 63
 - HTTPS 251, 252
 - configuring 251
 - replacing SSL certificate 252
 - secure-site certificate 252
 - HTTPS, secure server 251
- ## I
- IEEE 802.1D 165
 - IEEE 802.1s 165
 - IEEE 802.1w 165
 - IEEE 802.1X 291

- IGMP
 - filter profiles, configuration 417, 419
 - filter, parameters 417, 419
 - filtering & throttling 416
 - filtering & throttling, creating profile 417
 - filtering & throttling, enabling 416
 - filtering & throttling, interface configuration 419
 - filtering & throttling, status 416
 - groups, displaying 403
 - Layer 2 394
 - query 396
 - snooping 394
 - snooping & query, parameters 396
 - snooping, configuring 396
 - snooping, immediate leave 406
 - IGMP services, displaying 411
 - IGMP snooping
 - configuring 404
 - enabling per interface 404, 405
 - forwarding entries 411
 - immediate leave, status 406
 - interface attached to multicast router 402
 - last leave 395
 - last member query interval 408
 - proxy address 408
 - proxy reporting 407
 - querier timeout 399
 - query interval 407
 - query response interval 408
 - query suppression 395
 - router port expire time 399
 - static host interface 395
 - static multicast routing 400
 - static port assignment 402
 - static router interface 395
 - static router port, configuring 400
 - statistics, displaying 412
 - TCN flood 397
 - unregistered data flooding 398
 - version exclusive 398
 - version for interface, setting 407
 - version, setting 399
 - with proxy reporting 395
 - immediate leave, IGMP snooping 406
 - immediate leave, MLD snooping 423
 - importing user public keys 259
 - ingress filtering 145
 - IP address
 - BOOTP/DHCP 452
 - setting 451
 - IP filter, for management access 287
 - IP source guard
 - ACL table, learning mode 310
 - configuring static entries 311
 - learning mode, ACL table or MAC table 310
 - MAC table, learning mode 310
 - setting filter criteria 309
 - setting maximum bindings 310
 - IP statistics 466
 - IPv4 address
 - BOOTP/DHCP 452
 - setting 451
 - IPv6
 - displaying neighbors 465
 - duplicate address detection 465
 - enabling 458
 - MTU 458
 - IPv6 address
 - dynamic configuration (global unicast) 462
 - dynamic configuration (link-local) 458
 - EUI format 462
 - EUI-64 setting 462
 - explicit configuration 458
 - global unicast 462
 - link-local 463
 - manual configuration (global unicast) 462
 - manual configuration (link-local) 463
 - setting 455
- ## J
- jumbo frame 64
- ## K
- key
 - private 254
 - public 254
 - user public, importing 259
 - key pair
 - host 254
 - host, generating 258
- ## L
- LACP
 - configuration 115
 - group attributes, configuring 119
 - group members, configuring 117
 - load balancing 125
 - local parameters 122
 - partner parameters 124
 - protocol message statistics 121
 - protocol parameters 117
 - timeout, for LACPDU 116
 - last member query interval, IGMP snooping 408
 - license information 481
 - Link Layer Discovery Protocol - Media Endpoint Discovery
 - See LLDP-MED

Index

Link Layer Discovery Protocol *See* LLDP

link type, STA 177, 181

LLDP 321

- device statistics details, displaying 343
- device statistics, displaying 341
- display device information 333
- displaying remote information 333
- interface attributes, configuring 323
- message attributes 323
- message statistics 341
- remote information, displaying 340, 341
- remote port information, displaying 333
- timing attributes, configuring 321
- TLV 321, 324
- TLV, management address 324
- TLV, port description 324
- TLV, system capabilities 324
- TLV, system description 324
- TLV, system name 324

LLDP-MED 321

- notification, status 323
- TLV 325
- TLV, extended PoE 325
- TLV, inventory 325
- TLV, location 325
- TLV, MED capabilities 325
- TLV, network policy 326
- TLV, PoE 325

local engine ID 350

logging

- messages, displaying 317
- syslog traps 318
- to syslog servers 319

log-in, web interface 42

logon authentication 241

- encryption keys 228
- RADIUS client 227
- RADIUS server 227
- sequence 225
- settings 226, 228
- TACACS+ client 226
- TACACS+ server 226

loopback detection

- STA 167

M

MAC address authentication 243

- ports, configuring 246

main menu, web interface 46

management access, filtering per address 287

management access, IP filter 287

Management Information Bases (MIBs) 477

matching class settings, classifying QoS traffic 207

memory

status 90

utilization, showing 90

mirror port

- configuring 129
- configuring local traffic 129
- configuring remote traffic 130

MLD snooping 421

- configuring 421
- enabling 421
- groups, displaying 427, 428
- immediate leave 423
- immediate leave, status 423
- interface attached to multicast router 424, 425
- multicast static router port 424
- querier 421
- querier, enabling 421
- query interval 422
- query, maximum response time 422
- robustness value 422
- static port assignment 426
- static router port 424
- unknown multicast, handling 422
- version 422

MSTP 183

- global settings, configuring 169, 183
- global settings, displaying 174
- interface settings, configuring 175, 187
- interface settings, displaying 188
- path cost 187

MTU for IPv6 458

multicast filtering 393

- enabling IGMP snooping 405
- enabling IGMP snooping per interface 404
- enabling MLD snooping 421
- router configuration 400

multicast groups 403, 411, 427

- displaying 403, 411, 427
- static 402, 403, 426, 427

multicast router discovery 404

multicast router port, displaying 401, 425

multicast services

- configuring 402, 426
- displaying 403, 427

multicast static router port 400

- configuring 400
- configuring for MLD snooping 424

multicast storm, threshold 191

multicast, filtering and throttling 416

N

network access

- authentication 243
- dynamic VLAN assignment 246
- MAC address filter 247

- port configuration 246
- secure MAC information 249
- NTP
 - authentication keys, specifying 81
 - client, enabling 77
 - setting the system clock 79
 - specifying servers 79
- P**
- passwords 241
 - administrator setting 241
- path cost 181
 - method 171
 - STA 181
- per-hop behavior, DSCP ingress map 199
- PoE time range 387
- policing traffic, QoS policy 210, 211
- policy map
 - DiffServ 210
- port authentication 291
- port power
 - displaying status 347
 - inline 345
 - inline status 347
 - maximum allocation 345
 - priority 346
 - showing main power 347
- port priority
 - configuring 193
 - default ingress 193
 - STA 176
- port security, configuring 289
- port, statistics 100
- ports
 - autonegotiation 96
 - broadcast storm threshold 190, 191
 - capabilities 96
 - configuring 95
 - duplex mode 97
 - flow control 97
 - mirroring 129
 - mirroring local traffic 129
 - mirroring remote traffic 130
 - multicast storm threshold 191
 - speed 97
 - statistics 100
 - transceiver threshold, auto-set 110
 - transceiver threshold, trap 110
 - unknown unicast storm threshold 191
- power budgets
 - port 345
 - port priority 346
- power savings
 - configuring 127
 - enabling per port 127
- priority, default port ingress 193
- private key 254
- problems, troubleshooting 479
- protocol migration 179
- protocol VLANs 148
 - configuring 149
 - interface configuration 150
 - system configuration 149
- proxy address, IGMP snooping 408
- proxy reporting, IGMP snooping 407
- public key 254
- PVID, port native VLAN 145
- Q**
- QoS 205
 - configuring 205
 - CoS/CFI to PHB/drop precedence 201
 - DSCP to PHB/drop precedence 199
 - matching class settings 207
 - selecting DSCP, CoS 198
- QoS policy
 - policing flow 210, 211
- QoS policy, committed information rate 211
- Quality of Service *See* QoS
- query interval, IGMP snooping 407
- query response interval, IGMP snooping 408
- queue weight, assigning to CoS 195
- R**
- RADIUS
 - logon authentication 227
 - settings 227
- rate limit
 - port 189
 - setting 189
- remote engine ID 350
- remote logging 318
- restarting the system 91
 - at scheduled times 91
 - showing restart time 94
- RMON 376
 - alarm, displaying settings 379
 - alarm, setting thresholds 377
 - event settings, displaying 381
 - response to alarm setting 379
 - statistics history, collection 381
 - statistics history, displaying 383
 - statistics, collection 384
 - statistics, displaying 385
- RSA encryption 258, 259
- RSTP 165
 - global settings, configuring 169

Index

- global settings, displaying 174
- interface settings, configuring 175
- interface settings, displaying 180

S

- secure shell 254
 - configuration 254
- security, general measures 223
- serial port, configuring 85
- Simple Mail Transfer Protocol *See* SMTP
- Simple Network Management Protocol *See* SNMP
- SMTP
 - event handling 319
 - sending log events 319
- SNMP 347
 - community string 362
 - enabling traps 368
 - enabling traps, mac-address changes 162
 - filtering IP addresses 287
 - global settings, configuring 349
 - trap manager 368
 - users, configuring 363, 365
- SNMPv3 350–370
 - engine ID 350, 351
 - engine identifier, local 350
 - engine identifier, remote 350, 351
 - groups 355
 - local users, configuring 363
 - remote users, configuring 365
 - user configuration 363, 365
 - views 353
- SNTP
 - setting the system clock 77
 - specifying servers 78
- software
 - displaying version 63
 - downloading 67
 - version, displaying 63
- Spanning Tree Protocol *See* STA
- specifications, software 475
- SSH 254
 - authentication retries 257
 - configuring 254
 - downloading public keys for clients 259
 - generating host key pair 258
 - server, configuring 256
 - timeout 257
- SSL, replacing certificate 252
- STA 165
 - BPDU auto recovery 179
 - BPDU filter 179
 - BPDU flooding 170, 176
 - BPDU shutdown 179
 - detecting loopbacks 167
 - edge port 178, 181
 - global settings, configuring 169
 - global settings, displaying 174
 - interface settings, configuring 175
 - interface settings, displaying 180
 - link type 177, 181
 - loopback detection 167
 - MSTP interface settings, configuring 187
 - MSTP path cost 187
 - path cost 181
 - path cost method 171
 - port priority 176
 - port/trunk loopback detection 167
 - protocol migration 179
 - transmission limit 171
- standards, IEEE 477
- startup files
 - creating 67
 - displaying 67
 - setting 67
- static addresses, setting 157
- statistics
 - history for port 104
 - history for trunk 104
- statistics, port 100
- STP 169
- summary, accounting 233
- summer time, setting 83
- switch settings
 - restoring 69
 - saving 69
- system clock
 - setting 75
 - setting manually 76
 - setting the time zone 82
 - setting with NTP 79
 - setting with SNTP 77
 - summer time 83
- system software, downloading from server 67

T

- TACACS+
 - logon authentication 226
 - settings 228
- TCN
 - flood 397
 - general query solicitation 397
- Telnet
 - configuring 87
 - server, enabling 87
- time range, ACL 387
- time range, PoE 387
- time zone, setting 82
- time, setting 75

- traffic segmentation 135
 - assigning ports 135
 - enabling 135
 - sessions, assigning ports 137
 - sessions, creating 136
 - transceiver data, displaying 108
 - transceiver thresholds
 - configuring 109
 - displaying 109
 - trap manager 368
 - troubleshooting 479, 481
 - trunk
 - configuration 111
 - LACP 115
 - static 113
 - Type Length Value
 - See LLDP TLV
- ## U
- unknown unicast storm, threshold 191
 - unregistered data flooding, IGMP snooping 398
 - upgrading software 67
 - user account 241
 - user password 241
- ## V
- VLANs 139–152
 - acceptable frame type 145
 - adding static members 144
 - creating 142
 - description 139
 - displaying port members by interface 147
 - displaying port members by interface range 148
 - displaying port members by VLAN index 146
 - dynamic assignment 246
 - egress mode 144
 - ingress filtering 145
 - interface configuration 144
 - MAC-based 152
 - protocol 148
 - protocol, configuring 149
 - protocol, configuring groups 149
 - protocol, interface configuration 150
 - protocol, system configuration 149
 - PVID 145
 - voice 217
 - voice VLANs 217
 - detecting VoIP devices 218
 - enabling for ports 221
 - identifying client devices 219
 - VoIP traffic 217
 - ports, configuring 220
 - telephony OUI, configuring 219
 - voice VLAN, configuring 218
 - VoIP, detecting devices 221
- ## W
- web interface
 - access requirements 41
 - configuration buttons 44
 - home page 44
 - menu list 46
 - panel display 45

