DIGISOL™

10G Top-of-Rack Switches

DG-CS4554F

User Manual

V1.0

2015-10-20

As our products undergo continuous development the specifications are subject to change without prior notice.

Web Management Guide

DG-CS4554F

54-Port 10G Data Center Switch
with 48 10GBASE SFP+ Ports,
6 40GBASE QSFP Ports,
2 Power Supply Units,
and 5 Fan Trays (5 Fans – F2B and B2F Airflow)

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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 describes the switch's web browser interface. For more detailed information on the switch's key features refer to the *Administrator's 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.

Nov 2015 Revision

This is the first version of this guide.

Contents

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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:

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 FTP/TFTP server
Authentication	Console, Telnet, web – user name/password, RADIUS, TACACS+ SNMP v1/2c - Community strings SNMP version 3 – MD5 or SHA password Telnet – SSH Web – HTTPS
General Security Measures	IP Address Filtering Local and Remote User Accounts RADIUS Server Authentication Secure Shell
Access Control Lists	Supports up to 256 ACLs, up to 96 rules per ACL
DHCP	Client, Relay
DHCPv6	Client
DNS	Client service
Port Configuration	Speed, duplex mode and flow control
Port Trunking	Supports up to 8 trunks – static or dynamic trunking (LACP)
Port Mirroring	28 sessions, one or more source ports to one analysis port
Congestion Control	Rate Limiting Throttling for broadcast, multicast, unknown unicast storms

Table 1: Key Features (Continued)

Feature	Description
Address Table	32K MAC addresses in forwarding table, 1K static MAC addresses; 8K entries in ARP cache, 256 static ARP entries; 512 static IP routes, 512 IP interfaces; 12K IPv4 entries in host table; 8K IPv4 entries in routing table; 6K IPv6 entries in host table; 4K IPv6 entries in routing table 1K L2 IPv4 multicast groups; 1K L3 IPv4 multicast groups (shared with IPv6); 1K L3 IPv6 multicast groups (shared with IPv4)
IP Version 4 and 6	Supports IPv4 and IPv6 addressing, and management
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, and port-based VLANs
Traffic Prioritization	Default port priority, traffic class map, queue scheduling, IP Precedence, or Differentiated Services Code Point (DSCP), and TCP/UDP Port
Qualify of Service	Supports Differentiated Services (DiffServ)
Link Layer Discovery Protocol	Used to discover basic information about neighboring devices
Router Redundancy	Router backup is provided with the Virtual Router Redundancy Protocol (VRRP)
IP Routing	Open Shortest Path First (OSPFv2/v3*), Border Gateway Protocol (BGPv4)*, policy-based routing for BGP*, static routes, Equal-Cost Multipath Routing (ECMP)
ARP	Static and dynamic address configuration, proxy ARP
Multicast Filtering	Supports IGMP snooping and query for Layer 2
Multicast Routing	Static multicast routing

* These features are only available through the Command Line Interface

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. Broadcast storm suppression prevents broadcast 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 and routing 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 FTP/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+).

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. 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 by used to improve performance by blocking unnecessary network traffic or to implement security controls by restricting access to specific network resources or protocols.

DHCP

DHCP Relay Option 82 controls the processing of Option 82 information in DHCP request packets relayed by this device.

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).

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 32K 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 3 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 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.

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), 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 or TCP/UDP port numbers. 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.

IP Routing

The switch provides Layer 3 IP routing. To maintain a high rate of throughput, the switch forwards all traffic passing within the same segment, and routes only traffic that passes between different subnetworks. The wire-speed routing provided by this switch lets you easily link network segments or VLANs together without having to deal with the bottlenecks or configuration hassles normally associated with conventional routers.

Routing for unicast traffic is supported with static routing, Open Shortest Path First (OSPF) protocol, and Border Gateway Protocol (BGP).

Static Routing – Traffic is automatically routed between any IP interfaces configured on the switch. Routing to statically configured hosts or subnet addresses is provided based on next-hop entries specified in the static routing table.

OSPF – This approach uses a link state routing protocol to generate a shortest-path tree, then builds up its routing table based on this tree. OSPF produces a more stable network because the participating routers act on network changes predictably and simultaneously, converging on the best route more quickly than RIP.

BGP – This protocol uses a path vector approach to connect autonomous systems (AS) on the Internet. BGP maintains a table of IP network prefixes which designate network reachability among autonomous systems based the path of ASs to the destination, and next hop information. It makes routing decisions based on path, network policies and/or rule sets. For this reason, it is more appropriately termed a reachability protocol rather than a routing protocol.

Policy-based Routing for BGP – The next-hop behavior for ingress IP traffic can be determined based on matching criteria.

Equal-cost Multipath Load Balancing

When multiple paths to the same destination and with the same path cost are found in the routing table, the Equal-cost Multipath (ECMP) algorithm first checks if the cost is lower than that of any other routing entries. If the cost is the lowest in the table, the switch will use up to eight paths having the lowest path cost to balance traffic forwarded to the destination. ECMP uses either equal-cost unicast multipaths manually configured in the static routing table, or equal-cost multipaths dynamically detected by the Open Shortest Path Algorithm (OSPF). In other words, it uses either static or unicast routing entries, not both.

Router Redundancy

Virtual Router Redundancy Protocol (VRRP) uses a virtual IP address to support a primary router and multiple backup routers. The backups can be configured to take over the workload if the master fails or to load share the traffic. The primary goal of this protocol is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

Address Resolution Protocol

The switch uses ARP and Proxy 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. Either static or dynamic entries can be configured in the ARP cache.

Proxy ARP allows hosts that do not support routing to determine the MAC address of a device on another network or subnet. When a host sends an ARP request for a remote network, the switch checks to see if it has the best route. If it does, it sends its own MAC address to the host. The host then sends traffic for the remote destination via the switch, which uses its own routing table to reach the destination on the other network.

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.

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	115200bps
	Data bits	8
	Stop bits	1
	Parity	none
	Local Console Timeout	0 (disabled)
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
	MAC Authentication	Disabled
	HTTPS	Enabled
	SSH	Disabled
	IP Filtering	Disabled
Web Management	HTTP Server	Enabled
	HTTP Port Number	80
	HTTP Secure Server	Enabled
	HTTP Secure Server Port	443
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)

Table 2: System Defaults (Continued)

Function	Parameter	Default
Port Configuration	Admin Status	Enabled
	Auto-negotiation	Enabled
	Flow Control	Disabled
Port Trunking	Static Trunks	None
	LACP (all ports)	Disabled
Congestion Control	Storm Control	Broadcast: Enabled (500 packets/sec) Multicast: Disabled Unknown Unicast: Disabled
Address Table	Aging Time	300 seconds
Spanning Tree Algorithm	Status	Enabled, RSTP (Defaults: RSTP standard)
	Edge Ports	Disabled
LLDP	Status	Enabled
Virtual LANs	Default VLAN	1
	PVID	1
	Acceptable Frame Type	All
	Ingress Filtering	Disabled
	Switchport Mode (Egress Mode)	Hybrid
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 Precedence Priority	Disabled
	IP DSCP Priority	Disabled
	IP Port Priority	Disabled
IP Settings	Management. VLAN	VLAN 1
	IP Address	DHCP assigned
	Subnet Mask	255.255.255.0
	Default Gateway	0.0.0.0
	DHCP	Client: Enabled
	DNS	Client/Proxy service: Disabled
	ARP	Enabled Cache Timeout: 20 minutes Proxy: Disabled

Table 2: System Defaults (Continued)

Function	Parameter	Default
Unicast Routing	OSPF	Disabled
	OSPFv3	Disabled
	BGPv4	Disabled
Multicast Routing	Static	Disabled
Router Redundancy	VRRP	Disabled
Multicast Filtering	IGMP Snooping (Layer 2)	Snooping: Enabled Querier: Disabled
System Log	Status	Enabled
	Messages Logged to RAM	Levels 0-7 (all)
	Messages Logged to Flash	Levels 0-3
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:

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 8, or Mozilla Firefox 37, Google Chrome 42, or laterversions).

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 or DHCP protocol. (See 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 the *CLI Reference Guide*.)

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 149.

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

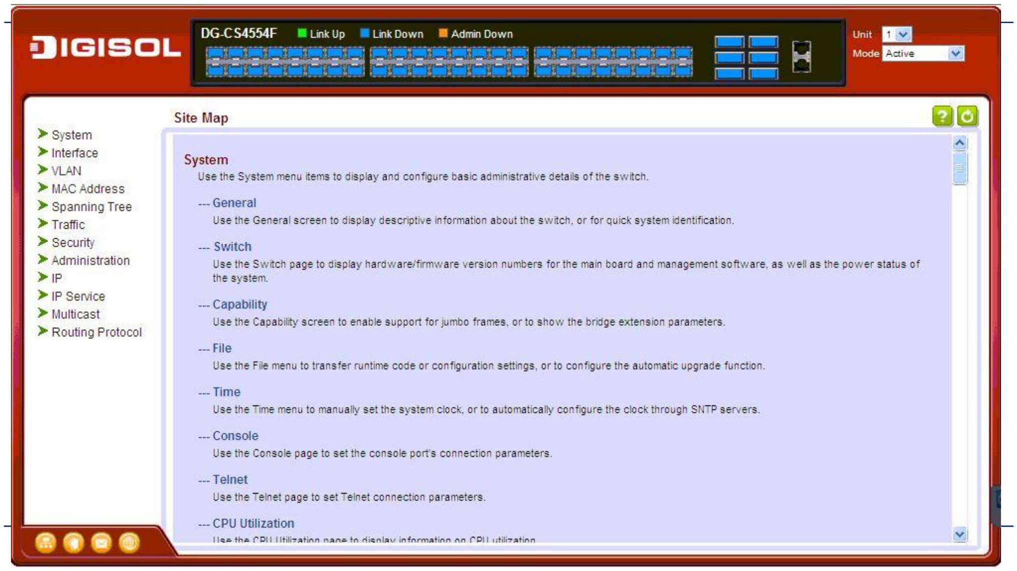
Navigating the Web Browser Interface

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.”

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 1: Home Page

Note: This manual covers the DG-CS4554F 10G Ethernet switch.



Site Map

System
Use the System menu items to display and configure basic administrative details of the switch.

--- General
Use the General screen to display descriptive information about the switch, or for quick system identification.

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

--- Capability
Use the Capability screen to enable support for jumbo frames, or to show the bridge extension parameters.

--- File
Use the File menu to transfer runtime code or configuration settings, or to configure the automatic upgrade function.

--- Time
Use the Time menu to manually set the system clock, or to automatically configure the clock through SNTP servers.

--- Console
Use the Console page to set the console port's connection parameters.

--- Telnet
Use the Telnet page to set Telnet connection parameters.

--- CPU Utilization
Use the CPU Utilization page to display information on CPU utilization.

Configuration Options

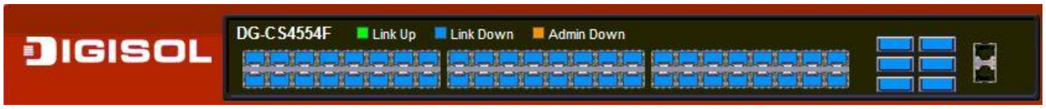
Configurable parameters have a dialog box or a drop-down list. Once a configuration change has been made on a page, be sure to click on the Apply button to confirm the new setting. The following table summarizes the web page configuration buttons.

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."
?	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).



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
System		
General	Provides basic system description, including contact information	55
Switch	Shows the number of ports, hardware version, power status, and firmware version numbers	56
Capability	Enables support for jumbo frames; shows the bridge extension parameters	58, 59
File		60
Copy	Allows the transfer and copying files	60
Set Startup	Sets the startup file	63
Show	Shows the files stored in flash memory; allows deletion of files	64
Automatic Operation Code Upgrade	Automatically upgrades operation code if a newer version is found on the server	65
Time		69
Configure General		
Manual	Manually sets the current time	69
SNTP	Configures SNTP polling interval	70
NTP	Configures NTP authentication parameters	71
Configure Time Server	Configures a list of NTP or SNTP servers	72
Configure SNTP Server	Sets the IP address for SNTP time servers	72
Add NTP Server	Adds NTP time server and index of authentication key	72
Show NTP Server	Shows list of configured NTP time servers	72
Add NTP Authentication Key	Adds key index and corresponding MD5 key	74
Show NTP Authentication Key	Shows list of configured authentication keys	74
Configure Time Zone	Sets the local time zone for the system clock	75
Console	Sets console port connection parameters	76
Telnet	Sets Telnet connection parameters	78
CPU Utilization	Displays information on CPU utilization	80
Memory Status	Shows memory utilization parameters	80
Reset	Restarts the switch immediately, at a specified time, after a specified delay, or at a periodic interval	81

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Interface		85
Port		85
General		
Configure by Port List	Configures connection settings per port	85
Configure by Port Range	Configures connection settings for a range of ports	88
Show Information	Displays port connection status	89
Mirror		90
Add	Sets the source and target ports for mirroring	90
Show	Shows the configured mirror sessions	90
Statistics	Shows Interface, Etherlike, and RMON port statistics	92
Chart	Shows Interface, Etherlike, and RMON port statistics	92
History	Shows statistical history for the specified interfaces	
Transceiver	Configures thresholds for alarm and warning messages for optical transceivers which support DDM	101
Trunk		
Static		104
Configure Trunk		104
Add	Creates a trunk, along with the first port member	104
Show	Shows the configured trunk identifiers	104
Add Member	Specifies ports to group into static trunks	104
Show Member	Shows the port members for the selected trunk	104
Configure General		104
Configure	Configures trunk connection settings	104
Show Information	Displays trunk connection settings	104
Dynamic		107
Configure Aggregator	Configures administration key and timeout for specific LACP groups	107
Configure Aggregation Port		104
Configure		104
General	Allows ports to dynamically join trunks	107
Actor	Configures parameters for link aggregation group members on the local side	107
Partner	Configures parameters for link aggregation group members on the remote side	107
Show Information		113
Counters	Displays statistics for LACP protocol messages	113

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Internal	Displays configuration settings and operational state for the local side of a link aggregation	114
Neighbors	Displays configuration settings and operational state for the remote side of a link aggregation	116
Configure Trunk		107
Configure	Configures connection settings	107
Show	Displays port connection status	107
Show Member	Shows the active members in a trunk	107
Statistics	Shows Interface, Etherlike, and RMON port statistics	92
Chart	Shows Interface, Etherlike, and RMON port statistics	92
Load Balance	Sets the load-distribution method among ports in aggregated links	
History	Shows statistical history for the specified interfaces	
Traffic Segmentation		119
Configure Global	Enables traffic segmentation globally	119
Configure Session	Configures the uplink and down-link ports for a segmented group of ports	120
Add	Assign the downlink and uplink ports to use in a segmented group	120
Show	Shows the assigned ports and direction (uplink/downlink)	120
VLAN	Virtual LAN	123
Static		
Add	Creates VLAN groups	125
Show	Displays configured VLAN groups	125
Modify	Configures group name and administrative status	125
Edit Member by VLAN	Specifies VLAN attributes per VLAN	128
Edit Member by Interface	Specifies VLAN attributes per interface	128
Edit Member by Interface Range	Specifies VLAN attributes per interface range	128
MAC Address		133
Learning Status	Enables MAC address learning on selected interfaces	133
Static		135
Add	Configures static entries in the address table	135
Show	Displays static entries in the address table	135
Dynamic		
Configure Aging	Sets timeout for dynamically learned entries	136
Show Dynamic MAC	Displays dynamic entries in the address table	137
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	138

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
MAC Notification		
Configure Global	Issues a trap when a dynamic MAC address is added or removed	139
Configure Interface	Enables MAC authentication traps on the current interface	139
Spanning Tree		141
STA	Spanning Tree Algorithm	
Configure Global		
Configure	Configures global bridge settings for STP, RSTP and MSTP	143
Show Information	Displays STA values used for the bridge	148
Configure Interface		
Configure	Configures interface settings for STA	149
Show Inform at on	Displays interface settings for STA	152
MSTP	Multiple Spanning Tree Algorithm	155
Configure Global		155
Add	Configures initial VLAN and priority for an MST instance	155
Show	Configures global settings for an MST instance	155
Modify	Configures the priority or an MST instance	155
Add Member	Adds VLAN members for an MST instance	155
Show Member	Adds or deletes VLAN members for an MST instance	155
Show Information	Displays MSTP values used for the bridge	
Configure Interface		159
Configure	Configures interface settings for an MST instance	159
Show Information	Displays interface settings for an MST instance	159
Traffic		
Storm Control	Sets the broadcast storm threshold for each interface	163
Priority		
Default Priority	Sets the default priority for each port or trunk	165
Queue	Sets queue mode for the switch; sets the service weight for each queue that will use a weighted or hybrid mode	166
Trust Mode	Selects DSCP or CoS priority processing	172
DSCP to DSCP		173
Add	Maps DSCP values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	173
Show	Shows the DSCP to DSCP mapping list	173

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
CoS to DSCP		176
Configure	Maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for priority processing	176
Show	Shows the CoS to DSCP mapping list	176
DSCP to CoS		178
Add	Maps internal per-hop behavior and drop precedence value pairs to CoS values used in tagged egress packets on a Layer 2 interface	178
Show	Shows the DSCP to CoS mapping list	178
IP Precedence to DSCP		180
Add	Maps IP precedence values in incoming packets to per-hop behavior and drop precedence values for priority processing	180
Show	Shows the IP Precedence to DSCP mapping list	180
IP Port to DSCP		182
Add	Sets TCP/UDP port priority, defining the socket number and associated per-hop behavior and drop precedence	182
Show	Shows the IP Port to DSCP mapping list	182
PHB to Queue		169
Configure	Maps internal per-hop behavior values to hardware queues	169
Show	Shows the PHB to Queue mapping list	169
DiffServ		185
Configure Class		186
Add	Creates a class map for a type of traffic	186
Show	Shows configured class maps	186
Modify	Modifies the name of a class map	186
Add Rule	Configures the criteria used to classify ingress traffic	186
Show Rule	Shows the traffic classification rules for a class map	186
Configure Policy		190
Add	Creates a policy map to apply to multiple interfaces	190
Show	Shows configured policy maps	190
Modify	Modifies the name of a policy map	190
Add Rule	Sets the boundary parameters used for monitoring inbound traffic, and the action to take for conforming and non-conforming traffic	190
Show Rule	Shows the rules used to enforce bandwidth policing for a policy map	190
Configure Interface	Applies a policy map to an ingress port	199
Security		201
AAA	Authentication, Authorization and Accounting	201
System Authentication	Configures authentication sequence – local, RADIUS, and TACACS	202

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Server	Configures RADIUS and TACACS server message exchange settings	203
User Accounts		209
Add	Configures user names, passwords, and access levels	209
Show	Shows authorized users	209
Modify	Modifies user attributes	209
HTTPS	Secure HTTP	211
Configure Global	Enables HTTPs, and specifies the UDP port to use	211
Copy Certificate	Replaces the default secure-site certificate	212
SSH	Secure Shell	214
Configure Global	Configures SSH server settings	217
Configure Host Key		218
Generate	Generates the host key pair (public and private)	218
Show	Displays RSA and DSA host keys; deletes host keys	218
Configure User Key		220
Copy	Imports user public keys from TFTP server	220
Show	Displays RSA and DSA user keys; deletes user keys	220
ACL	Access Control Lists	222
Configure Time Range	Configures the time to apply an ACL	223
Add	Specifies the name of a time range	223
Show	Shows the name of configured time ranges	223
Add Rule		223
Absolute	Sets exact time or time range	223
Periodic	Sets a recurrent time	223
Show Rule	Shows the time specified by a rule	223
Configure ACL		227
Show TCAM	Shows utilization parameters for TCAM	226
Add	Adds an ACL based on IP or MAC address filtering	227
Show	Shows the name and type of configured ACLs	227
Add Rule	Configures packet filtering based on IP or MAC addresses and other packet attributes	227
Show Rule	Shows the rules specified for an ACL	227
Configure Interface	Binds a port to the specified ACL and time range	237
IP Filter		238
Add	Sets IP addresses of clients allowed management access via the web, SNMP, and Telnet	238

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Show	Shows the addresses to be allowed management access	238
Administration		241
Log		241
System		241
Configure Global	Stores error messages in local memory	241
Show System Logs	Shows logged error messages	241
Remote	Configures the logging of messages to a remote logging process	244
LLDP		245
Configure Global	Configures global LLDP timing parameters	245
Configure Interface	Sets the message transmission mode; enables SNMP notification; and sets the LLDP attributes to advertise	247
Show Local Device Information		253
General	Displays general information about the local device	253
Port/Trunk	Displays information about each interface	253
Show Remote Device Information		256
Port/Trunk	Displays information about a remote device connected to a port on this switch	256
Port/Trunk Details	Displays detailed information about a remote device connected to this switch	256
Show Device Statistics		264
General	Displays statistics for all connected remote devices	264
Port/Trunk	Displays statistics for remote devices on a selected port or trunk	264
SNMP	Simple Network Management Protocol	266
Configure Global	Enables SNMP agent status, and sets related trap functions	268
Configure Engine		269
Set Engine ID	Sets the SNMP v3 engine ID on this switch	269
Add Remote Engine	Sets the SNMP v3 engine ID for a remote device	270
Show Remote Engine	Shows configured engine ID for remote devices	270
Configure View		271
Add View	Adds an SNMP v3 view of the OID MIB	271
Show View	Shows configured SNMP v3 views	271
Add OID Subtree	Specifies a part of the subtree for the selected view	271
Show OID Subtree	Shows the subtrees assigned to each view	271
Configure Group		274
Add	Adds a group with access policies for assigned users	274
Show	Shows configured groups and access policies	274

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Configure User		
Add Community	Configures community strings and access mode	278
Show Community	Shows community strings and access mode	278
Add SNMPv3 Local User	Configures SNMPv3 users on this switch	279
Show SNMPv3 Local User	Shows SNMPv3 users configured on this switch	279
Change SNMPv3 Local User Group	Assign a local user to a new group	279
Add SNMPv3 Remote User	Configures SNMPv3 users from a remote device	281
Show SNMPv3 Remote User	Shows SNMPv3 users set from a remote device	279
Configure Trap		284
Add	Configures trap managers to receive messages on key events that occur this switch	284
Show	Shows configured trap managers	284
Configure Notify Filter		288
Add	Creates an SNMP notification log	288
Show	Shows the configured notification logs	288
Show Statistics	Shows the status of SNMP communications	290
RMON	Remote Monitoring	292
Configure Global		
Add		
Alarm	Sets threshold bounds for a monitored variable	292
Event	Creates a response event for an alarm	295
Show		
Alarm	Shows all configured alarms	292
Event	Shows all configured events	295
Configure Interface		
Add		
History	Periodically samples statistics on a physical interface	297
Statistics	Enables collection of statistics on a physical interface	300
Show		
History	Shows sampling parameters for each entry in the history group	297
Statistics	Shows sampling parameters for each entry in the statistics group	300
Show Details		
History	Shows sampled data for each entry in the history group	297
Statistics	Shows sampled data for each entry in the history group	300

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
UDLD	UniDirectional Link Detection	302
Configure Global	Configures the message probe interval, detection interval, and recovery interval	303
Configure Interface	Enables UDLD and aggressive mode which reduces the shut-down delay after loss of bidirectional connectivity is detected	304
Show Information	Displays UDLD neighbor information, including neighbor state, expiration time, and protocol intervals	306
IP		
General		
Routing Interface		
Add Address	Configures an IP interface for a VLAN	339
Show Address	Shows the IP interfaces assigned to a VLAN	339
Ping	Sends ICMP echo request packets to another node on the network	369
Trace Route	Shows the route packets take to the specified destination	370
ARP	Address Resolution Protocol	372
Configure Static Address		373
Add	Statically maps a physical address to an IP address	373
Show	Shows the MAC to IP address static table	373
Show Information		375
Dynamic Address	Shows dynamically learned entries in the IP routing table	375
Other Address	Shows internal addresses used by the switch	375
Statistics	Shows statistics on ARP requests sent and received	375
Routing		
Static Routes		376
Add	Configures static routing entries	376
Show	Shows static routing entries	376
Routing Table		378
Show Information	Shows all routing entries, including local, static and dynamic routes	378
Configure ECMP Number	Sets the maximum number of equal-cost paths to the same destination that can be installed in the routing table	379
VRRP	Virtual Router Redundancy Protocol	383
Configure Group ID		384
Add	Adds a VRRP group identifier to a VLAN	384
Show	Shows the VRRP group identifier list	384
Add IP Address	Sets a virtual interface address for a VRRP group	384

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Show IP Address	Shows the virtual interface address assigned to a VRRP group	384
Configure Detail	Configure detailed settings, such as advertisement interval, preemption, priority, and authentication	384
Show Statistics		
Global Statistics	Displays global statistics for VRRP protocol packet errors	390
Group Statistics	Displays statistics for VRRP protocol events and errors on the specified VRRP group and interface	391
IPv6 Configuration		343
Configure Global	Sets an IPv6 default gateway for traffic with no known next hop	343
Configure Interface	Configures IPv6 interface address using auto-configuration or link-local address, and sets related protocol settings	344
Add IPv6 Address	Adds an global unicast, EUI-64, or link-local IPv6 address to an interface	348
Show IPv6 Address	Show the IPv6 addresses assigned to an interface	351
Show IPv6 Neighbor Cache	Displays information in the IPv6 neighbor discovery cache	352
Show Statistics		353
IPv6	Shows statistics about IPv6 traffic	353
ICMPv6	Shows statistics about ICMPv6 messages	353
UDP	Shows statistics about UDP messages	353
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	360
IP Service		361
DHCP	Dynamic Host Configuration Protocol	
Client	Specifies the DHCP client identifier for an interface	361
Relay	Specifies DHCP relay servers	363
Multicast		309
IGMP Snooping		311
General	Enables multicast filtering; configures parameters for IPv4 multicast snooping	313
Multicast Router		316
Add Static Multicast Router	Assigns ports that are attached to a neighboring multicast router	316
Show Static Multicast Router	Displays ports statically configured as attached to a neighboring multicast router	316
Show Current Multicast Router	Displays ports attached to a neighboring multicast router, either through static or dynamic configuration	316
IGMP Member		319
Add Static Member	Statically assigns multicast addresses to the selected VLAN	319

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Show Static Member	Shows multicast addresses statically configured on the selected VLAN	319
Show Current Member	Shows multicast addresses associated with the selected VLAN, either through static or dynamic configuration	319
Interface		320
Configure VLAN	Configures IGMP snooping per VLAN interface	320
Show VLAN Information	Shows IGMP snooping settings per VLAN interface	320
Forwarding Entry	Displays the current multicast groups learned through IGMP Snooping	327
Filter		332
Configure General	Enables IGMP filtering for the switch	332
Configure Profile		333
Add	Adds IGMP filter profile; and sets access mode	333
Show	Shows configured IGMP filter profiles	333
Add Multicast Group Range	Assigns multicast groups to selected profile	333
Show Multicast Group Range	Shows multicast groups assigned to a profile	333
Configure Interface	Assigns IGMP filter profiles to port interfaces and sets throttling action	335
Statistics		328
Show Query Statistics	Shows statistics for query-related messages	328
Show VLAN Statistics	Shows statistics for protocol messages and number of active groups	328
Show Port Statistics	Shows statistics for protocol messages and number of active groups	328
Show Trunk Statistics	Shows statistics for protocol messages and number of active groups	328
Routing Protocol		393
OSPF	Open Shortest Path First (Version 2)	393
Network Area		395
Add	Defines OSPF area address, area ID, and process ID	395
Show	Shows configured areas	395
Show Process	Show configured processes	395
System		398
Configure	Configures the Router ID, global settings, and default information	398
Show	Shows LSA statistics, administrative status, ABR/ASBR, area count, and version number	401
Area		
Configure Area		403
Add Area	Adds NSSA or stub	403
Show Area	Shows configured NSSA or stub	403

Table 4: Switch Main Menu (Continued)

Menu	Description	Page
Configure NSSA Area	Configures settings for importing routes into or exporting routes out of not-so-stubby areas	404
Configure Stub Area	Configures default cost, and settings for importing routes into a stub	407
Show Information	Shows statistics for each area, including SPF startups, ABR/ASBR count, LSA count, and LSA checksum	409
Area Range		410
Add	Configures route summaries to advertise at an area boundary	410
Show	Shows route summaries advertised at an area boundary	410
Modify	Modifies route summaries advertised at an area boundary	410
Redistribute		412
Add	Redistributes routes from one routing domain to another	412
Show	Shows route types redistributed to another domain	412
Modify	Modifies configuration settings for redistributed routes	412
Summary Address		414
Add	Aggregates routes learned from other protocols for advertising into other autonomous systems	414
Show	Shows configured summary addresses	414
Interface		416
Show	Shows area ID and designated router settings for each interface	416
Configure by VLAN	Configures OSPF protocol settings and authentication for specified VLAN	416
Configure by Address	Configures OSPF protocol settings and authentication for specified interface address	416
Show MD5 Key	Shows MD5 key ID used for each area	416
Virtual Link		421
Add	Configures a virtual link through a transit area to the backbone	421
Show	Shows virtual links, neighbor address, and state	421
Configure Detailed Settings	Configures detailed protocol and authentication settings	421
Show MD5 Key	Shows the MD5 key ID used for each neighbor	421
Information		424
LSDB	Shows information about different OSPF Link State Advertisements (LSAs)	424
Neighbor	Shows information about each OSPF neighbor	426
Passive Interface	Suppresses OSPF routing traffic on the specified interface	427
Add	Adds passive interface	427
Show	Shows passive interfaces	427

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.
- 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

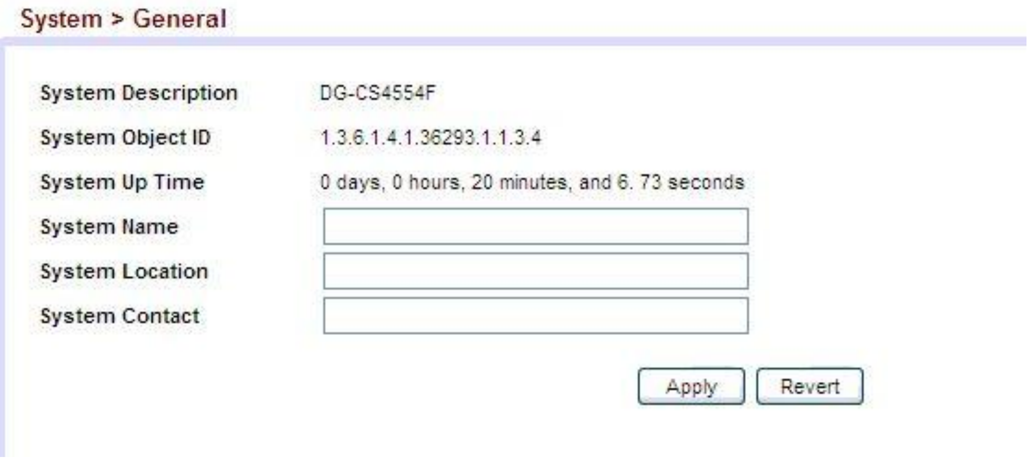
To configure general system information:

1. Click System, General.

2. Specify the system name, location, and contact information for the system administrator.

3. Click Apply.

Figure 3: System Information



System > General

System Description DG-CS4554F
System Object ID 1.3.6.1.4.1.36293.1.1.3.4
System Up Time 0 days, 0 hours, 20 minutes, and 6. 73 seconds
System Name
System Location
System Contact

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.
- **Redundant Power Status** – Displays the status of the redundant power supply.

Management Software Information

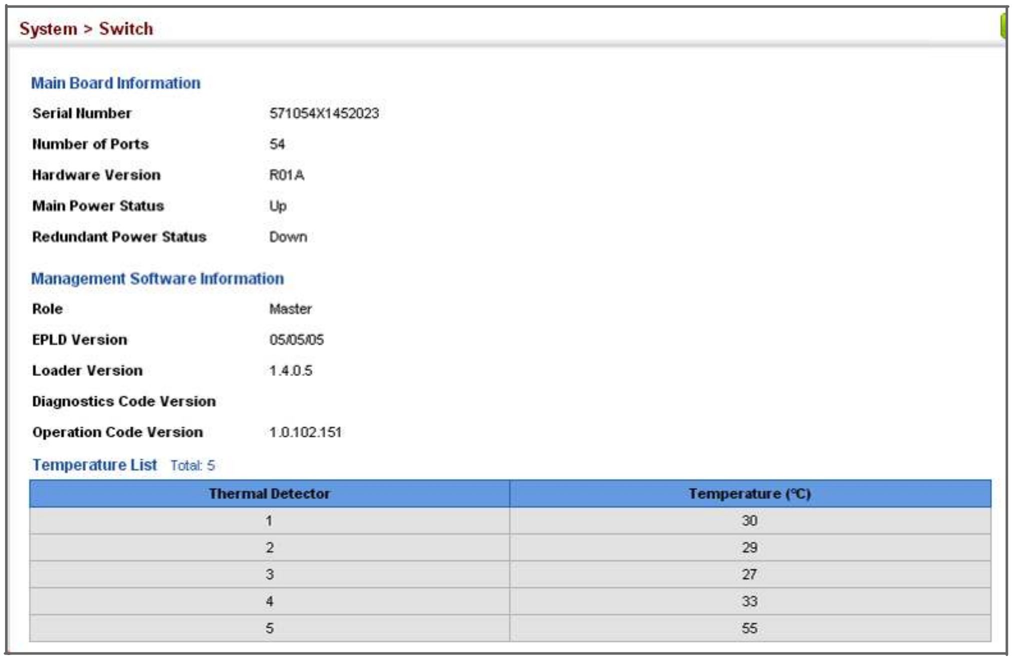
- **Role** – Shows that this switch is operating as Master or Slave.
- **EPLD Version** – Version number of EEPROM Programmable Logic Device.
- **Loader Version** – Version number of loader code.
- **Diagnostics Code Version** – Version of Power-On Self-Test (POST) and boot code.
- **Operation Code Version** – Version number of runtime code.
- **Thermal Detector** – The DG-CS4554F has five detectors
- **Temperature** – Temperature at specified thermal detection point.

Web Interface

To view hardware and software version information.

1. Click System, then Switch.

Figure 4: General Switch Information
(Diagnostics Code Version should be replaced with Linux Kernel Version)



System > Switch

Main Board Information

Serial Number	571054X1452023
Number of Ports	54
Hardware Version	R01A
Main Power Status	Up
Redundant Power Status	Down

Management Software Information

Role	Master
EPLD Version	05/05/05
Loader Version	1.4.0.5
Diagnostics Code Version	
Operation Code Version	1.0.102.151

Temperature List Total: 5

Thermal Detector	Temperature (°C)
1	30
2	29
3	27
4	33
5	55

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 of up to 9216 bytes for Gigabit, 10 Gigabit, and 40 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.

- This command globally enables support for jumbo frames on all Gigabit and 10 Gigabit ports and trunks. To set the MTU for a specific interface, enable jumbo frames on this page, and then specify the required size of the MTU on the port or trunk interface configuration page (see "Port Configuration" on page 85 or "Trunk Configuration" on page 103).

Parameters

The following parameters are displayed:

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

Web Interface

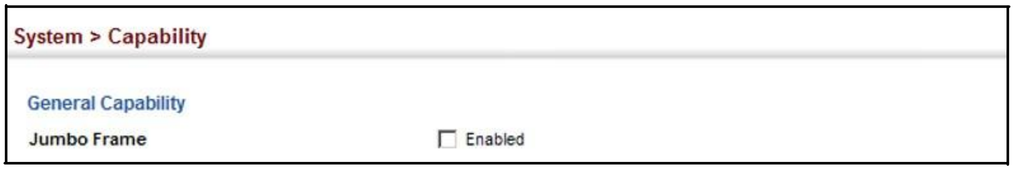
To configure support for jumbo frames:

1. Click System, then Capability.

2. Enable or disable support for jumbo frames.

3. Click Apply.

Figure 5: Configuring Support for Jumbo Frames



System > Capability

General Capability

Jumbo Frame □ Enabled

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:

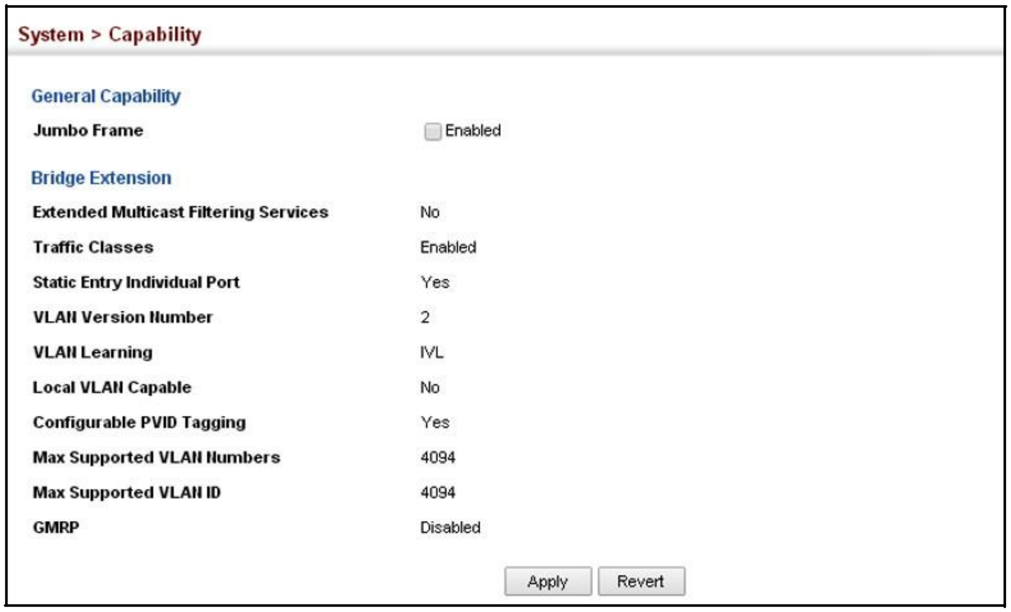
- **Extended Multicast Filtering Services** – This switch does not support the filtering of individual multicast addresses based on GMRP (GARP Multicast Registration Protocol).
- **Traffic Classes** – This switch provides mapping of user priorities to multiple traffic classes. (Refer to "Class of Service" on page 165.)
- **Static Entry Individual Port** – This switch allows static filtering for unicast and multicast addresses. (Refer to "Setting Static Addresses" on page 135.)
- **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 123.)
- **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.
- **GMRP** – GARP Multicast Registration Protocol (GMRP) allows network devices to register end stations with multicast groups. This switch does not support GMRP; it uses the Internet Group Management Protocol (IGMP) to provide automatic multicast filtering.

Web Interface

To view Bridge Extension information:

1. Click System, then Capability.

Figure 6: Displaying Bridge Extension Configuration



System > Capability

General Capability

Jumbo Frame	□ Enabled

Bridge Extension

Extended Multicast Filtering Services	No
Traffic Classes	Enabled
Static Entry Individual Port	Yes
VLAN Version Number	2
VLAN Learning	IVL
Local VLAN Capable	No
Configurable PVID Tagging	Yes
Max Supported VLAN Numbers	4094
Max Supported VLAN ID	4094
GMRP	Disabled

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.

Parameters

The following parameters are displayed:

- **Copy Type** – The firmware copy operation includes these options:
  - FTP Upload – Copies a file from an FTP server to the switch.

  - FTP Download – Copies a file from the switch to an FTP server.
  - 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/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.
- **File Name** – The file name should not contain slashes (\ or /), and the maximum length for file names is 32 characters for files on the switch or 128 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

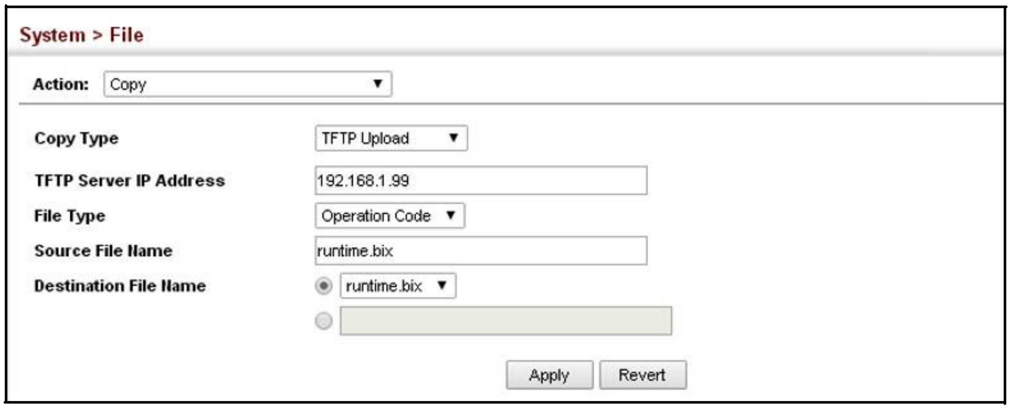
To copy firmware files:

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 upload.

8. Select a file on the switch to overwrite or specify a new file name.

9. Then click Apply.

Figure 7: Copy Firmware



System > File

Action: Copy

Copy Type	TFTP Upload
TFTP Server IP Address	192.168.1.99
File Type	Operation Code
Source File Name	runtime.bix
Destination File Name	● runtime.bix ○

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 /), and the maximum length for file names is 32 characters for files on the switch. (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.

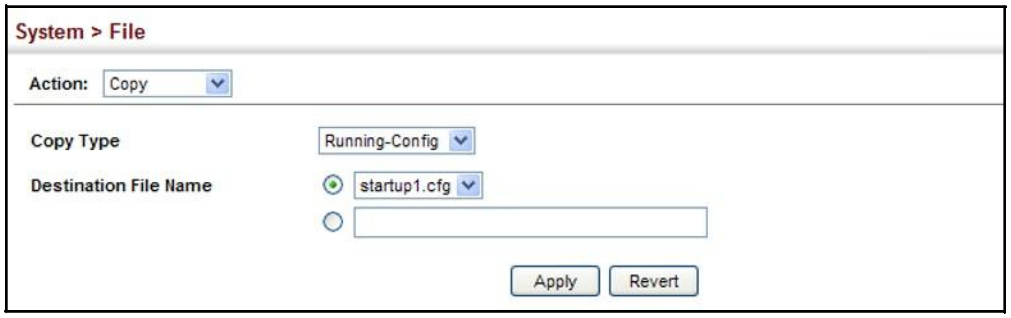
2. Select Copy from the Action list.

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 8: Saving the Running Configuration



System > File

Action: Copy

Copy Type: Running-Config

Destination File Name: ● startup1.cfg

○

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:

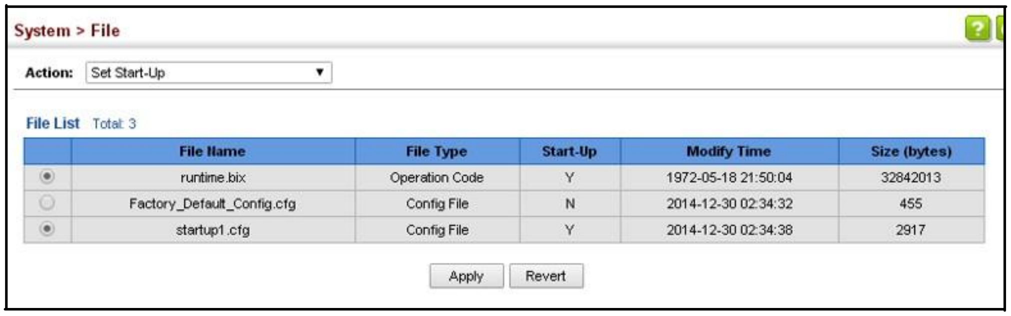
1. Click System, then File.

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 9: Setting Start-Up Files



System > File

Action: Set Start-Up

File List Total: 3

	File Name	File Type	Start-Up	Modify Time	Size (bytes)
●	runtime.bix	Operation Code	Y	1972-05-18 21:50:04	32842013
○	Factory_Default_Config.cfg	Config File	N	2014-12-30 02:34:32	455
●	startup1.cfg	Config File	Y	2014-12-30 02:34:38	2917

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.

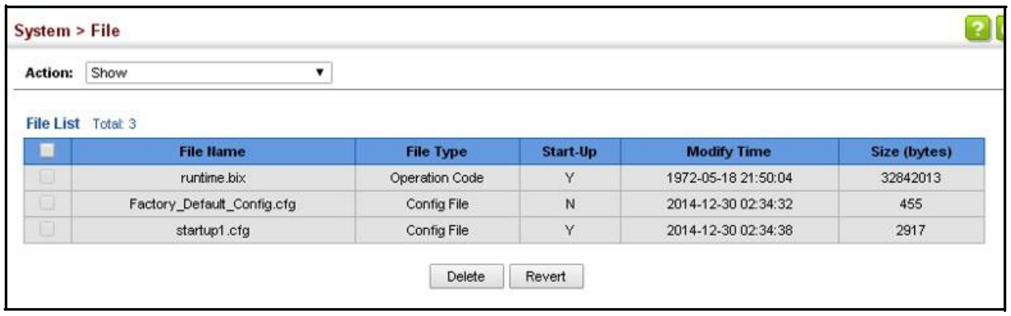
Note: Files designated for start-up, and the Factory_Default_Config.cfg file, cannot be deleted.

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 10: Displaying System Files



System > File

Action: Show

File List Total: 3

□	File Name	File Type	Start-Up	Modify Time	Size (bytes)
□	runtime.bix	Operation Code	Y	1972-05-18 21:50:04	32842013
□	Factory_Default_Config.cfg	Config File	N	2014-12-30 02:34:32	455
□	startup1.cfg	Config File	Y	2014-12-30 02:34:38	2917

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 aos5700-54x.bix (using 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 *AOS5700-54X.BIX* from the server even though *AOS5700-54X.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, *aos5700-54x.bix* and *AOS5700-54X.BIX* are considered to be unique files. Thus, if the upgrade file is stored as *AOS5700-54X.BIX* (or even *Aos5700-54x.bix*) on a case-sensitive server, then the switch (requesting *AOS5700-54X.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 *ECS4660-28F.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.
- *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.

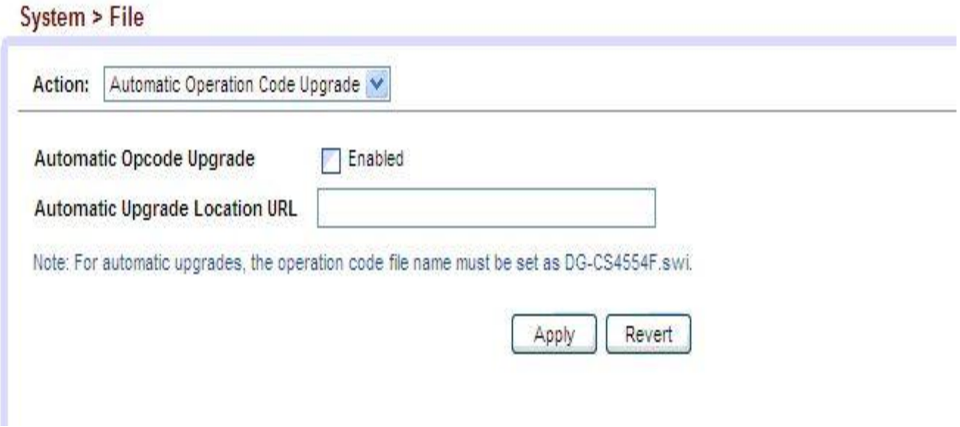
2. Select Automatic Operation Code Upgrade from the Action list.

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 11: Configuring Automatic Code Upgrade



System > File

Action: Automatic Operation Code Upgrade

Automatic Opcode Upgrade □ Enabled

Automatic Upgrade Location URL

Note: For automatic upgrades, the operation code file name must be set as DG-CS4554F.swi.

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 1.1.1.0; new version 1.1.1.2
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:

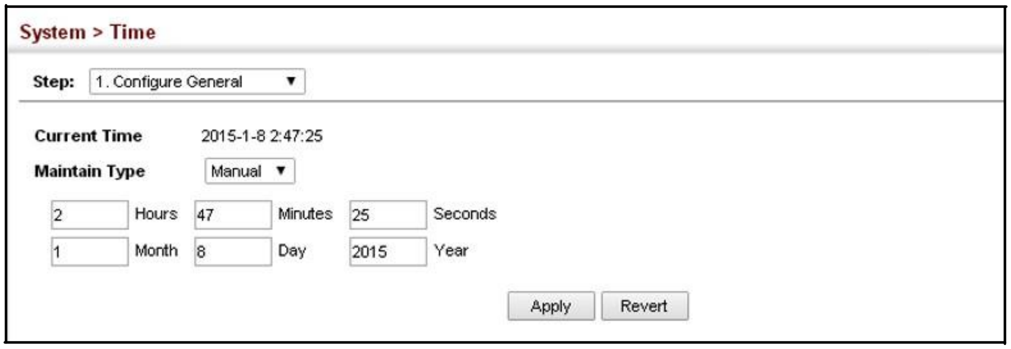
- **Current Time** – Shows the current time set on the switch.
- **Hours** – Sets the hour. (Range: 0-23)
- **Minutes** – Sets the minute value. (Range: 0-59)
- **Seconds** – Sets the second value. (Range: 0-59)
- **Month** – Sets the month. (Range: 1-12)
- **Day** – Sets the day of the month. (Range: 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 12: Manually Setting the System Clock



System > Time

Step: 1. Configure General

Current Time 2015-1-8 2:47:25

Maintain Type: Manual

2 Hours 47 Minutes 25 Seconds

1 Month 8 Day 2015 Year

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:

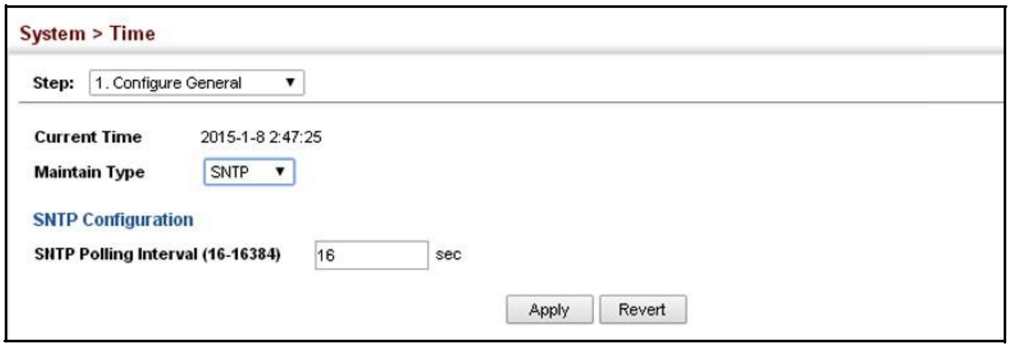
- **Current Time** – Shows the current time set on the switch.
- **SNTP Polling Interval** – Sets the interval between sending requests for a time update from a time server. (Range: 16-16384 seconds; Default: 16 seconds)

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 13: Setting the Polling Interval for SNTP



System > Time

Step: 1. Configure General

Current Time 2015-1-8 2:47:25

Maintain Type: SNTP

SNTP Configuration

SNTP Polling Interval (16-16384) 16 sec

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)

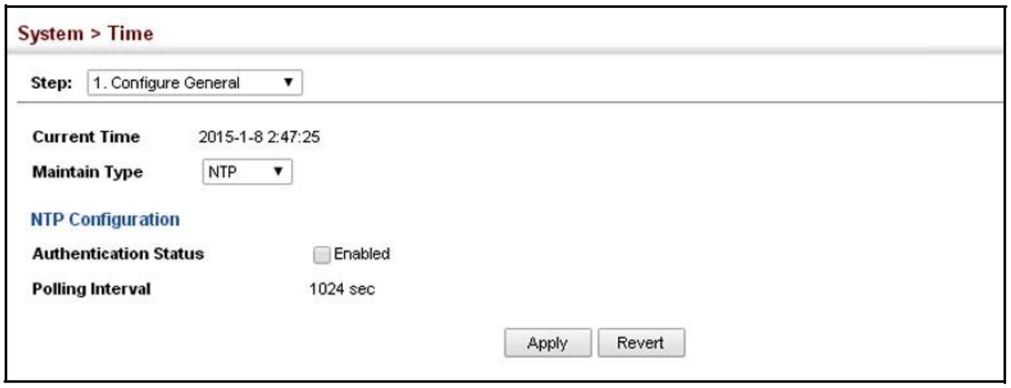
  You can enable NTP authentication to ensure that reliable updates are received from only authorized NTP servers. The authentication keys and their associated key number must be centrally managed and manually distributed to NTP servers and clients. The key numbers and key values must match on both the 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 14: Configuring NTP



System > Time

Step: 1. Configure General

Current Time 2015-1-8 2:47:25

Maintain Type NTP

NTP Configuration

Authentication Status □ Enabled

Polling Interval 1024 sec

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:

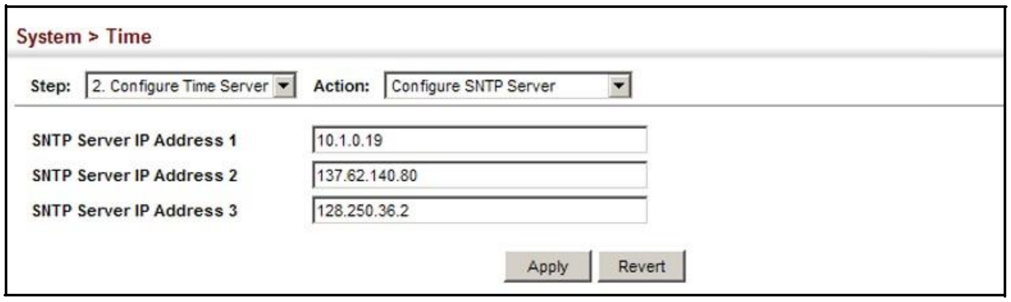
- **SNTP Server IP Address** – Sets the IPv4 or IPv6 address for up to three time servers. The switch attempts to update the time from the first server, if this fails it attempts an update from the next server in the sequence.

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 15: Specifying SNTP Time Servers



System > Time

Step: 2. Configure Time Server
Action: Configure SNTP Server

SNTP Server IP Address 1: 10.1.0.19
SNTP Server IP Address 2: 137.62.140.80
SNTP Server IP Address 3: 128.250.36.2

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.

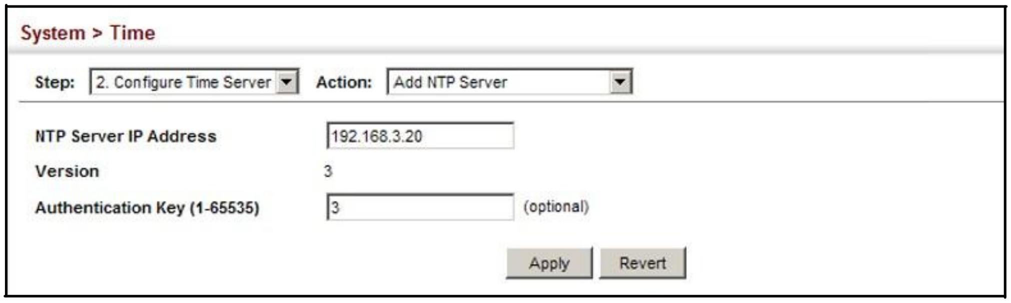
- **Version** – Specifies the NTP version supported by the server. (Fixed: Version 3)
- **Authentication Key** – Specifies the number of the key in the NTP Authentication Key List to use for authentication with the configured server. NTP authentication is optional. If enabled on the System > Time (Configure 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 16: Adding an NTP Time Server



System > Time

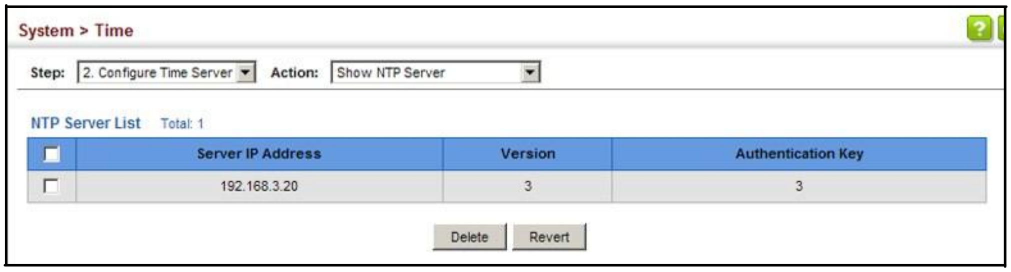
Step: 2. Configure Time Server
Action: Add NTP Server

NTP Server IP Address: 192.168.3.20
Version: 3
Authentication Key (1-65535): 3 (optional)

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 17: Showing the NTP Time Server List



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

NTP Server List Total: 1

□	Server IP Address	Version	Authentication Key
□	192.168.3.20	3	3

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).

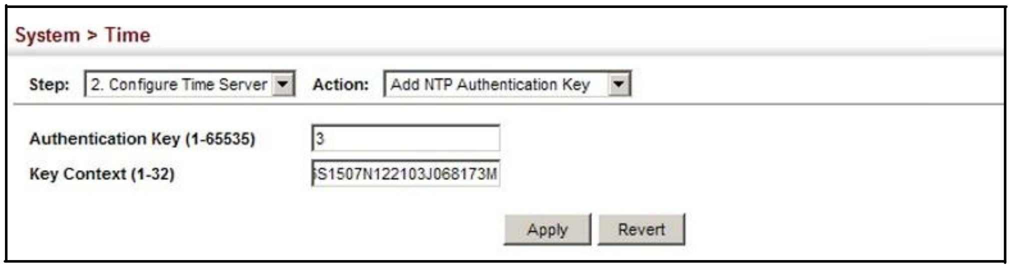
  NTP authentication key numbers and values must match on both the server and client.

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 18: Adding an NTP Authentication Key



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

Authentication Key (1-65535): 3
Key Context (1-32): S1507N122103J068173M

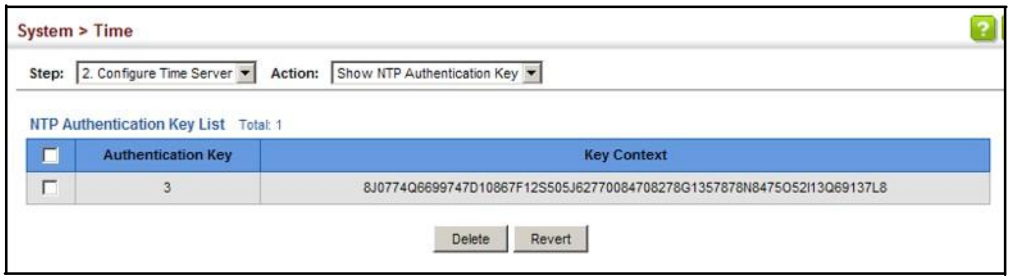
To show the list of configured NTP authentication keys:

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 19: Showing the NTP Authentication Key List



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

NTP Authentication Key List Total: 1

□	Authentication Key	Key Context
□	3	8J0774Q6699747D10867F12S505J62770084708278G1357878N8475O52I13Q69137L8

Setting the Time Zone

Use the System > Time (Configure Time Server) 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 west (before) or east (after) of UTC. You can choose one of the 80 predefined time zone definitions, or your 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 it's 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.

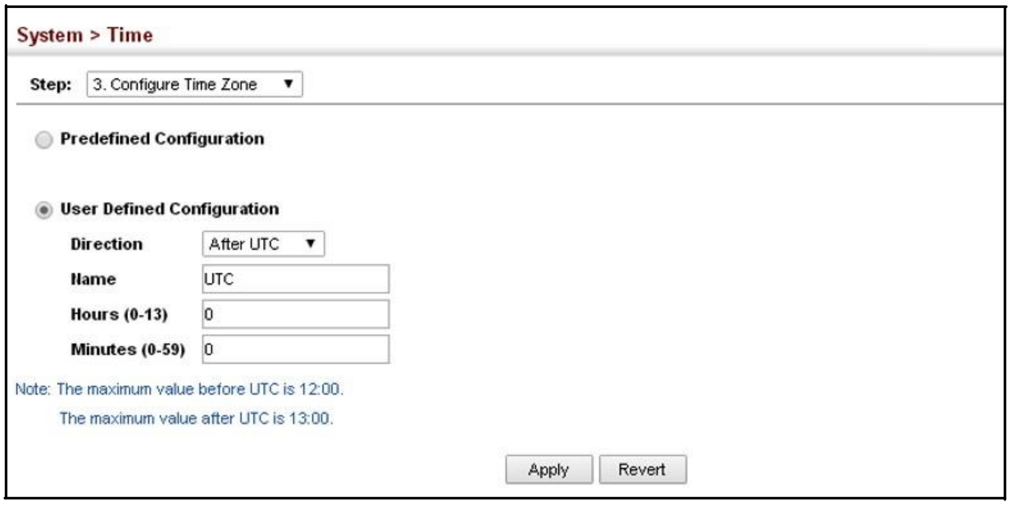
- **Name** – Assigns a name to the time zone. (Range: 1-30 characters)
- **Hours** (0-13) – The number of hours before or after UTC. The maximum value before UTC is 12. The maximum value after UTC is 13.
- **Minutes** (0-59) – The number of minutes before/after UTC.

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 20: 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.

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 "password" in the *CLI Reference Guide*).

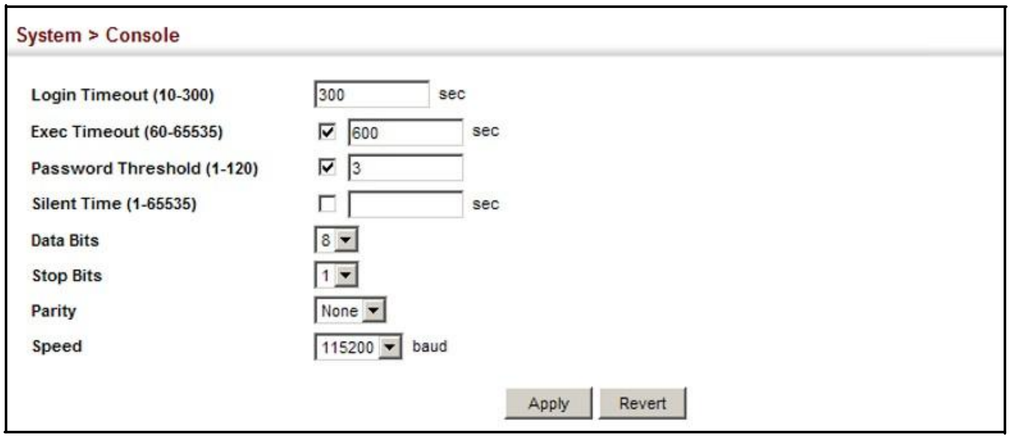
Note: Password checking can be enabled or disabled for logging in to the console connection (see "login" in the *CLI Reference Guide*). You can select authentication by a single global password as configured for the password command, or by passwords set up for specific user-name accounts. The default 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 21: Console Port Settings



System > Console

Login Timeout (10-300) 300 sec

Exec Timeout (60-65535) ☑ 600 sec

Password Threshold (1-120) ☑ 3

Silent Time (1-65535) □ sec

Data Bits 8

Stop Bits 1

Parity None

Speed 115200 baud

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 or 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: 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

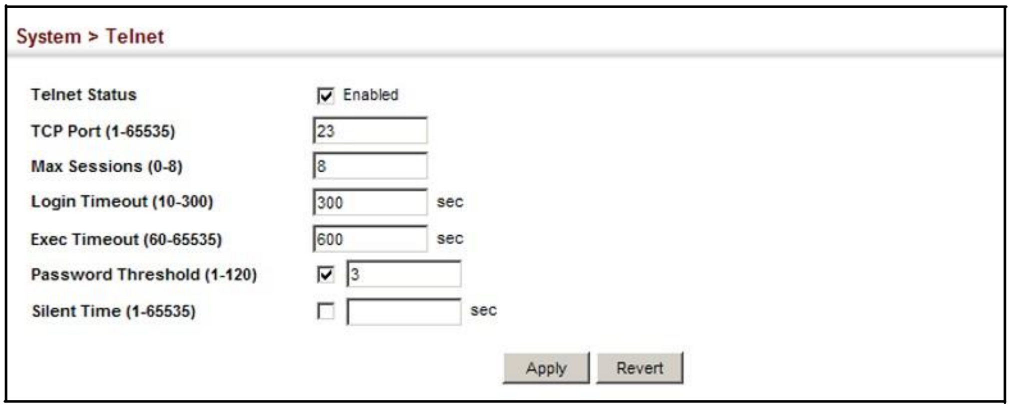
To configure parameters for the console port:

1. Click System, then Telnet.

2. Specify the connection parameters as required.

3. Click Apply

Figure 22: Telnet Connection Settings



System > Telnet

Telnet Status	☑ Enabled	
TCP Port (1-65535)	23	
Max Sessions (0-8)	8	
Login Timeout (10-300)	300	sec
Exec Timeout (60-65535)	600	sec
Password Threshold (1-120)	☑ 3	
Silent Time (1-65535)	□	sec

Displaying CPU Utilization

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

Parameters

The following parameters are displayed:

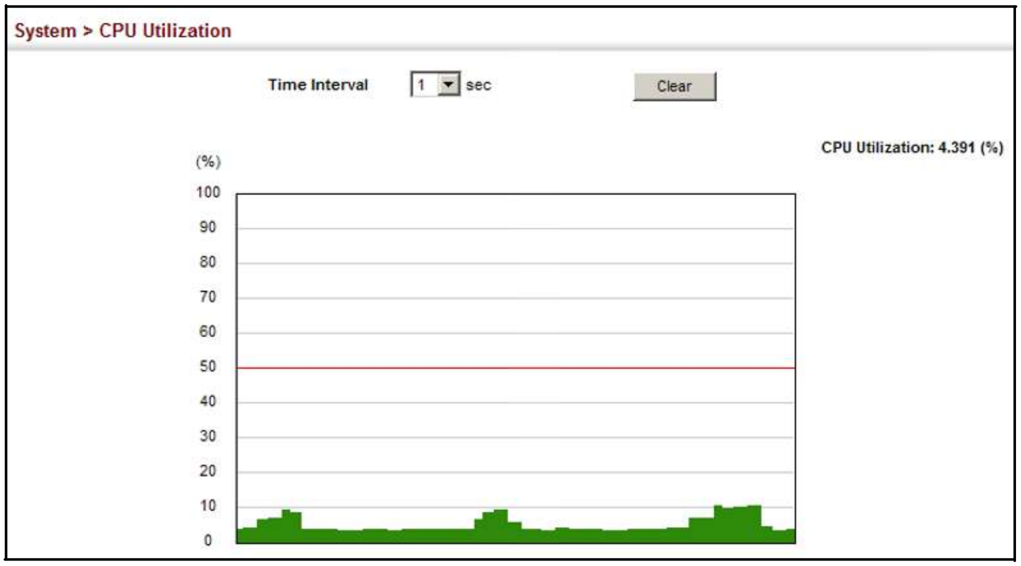
- **Time Interval** – The interval at which to update the displayed utilization rate. (Options: 1, 5, 10, 30, 60 seconds; Default: 1 second)
- **CPU Utilization** – CPU utilization over specified interval.

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 23: Displaying CPU Utilization



System > CPU Utilization

Time Interval 1 sec

CPU Utilization: 4.391 (%)

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.

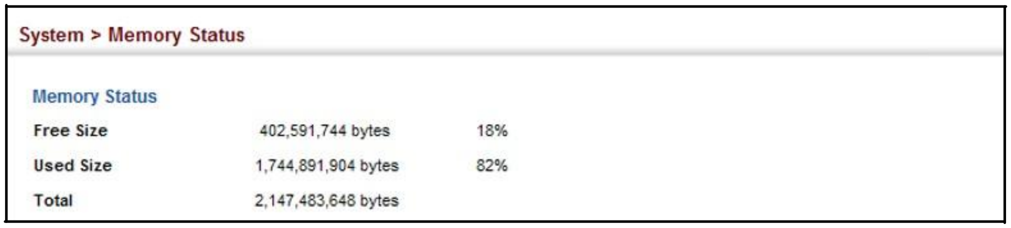
- **Used Size** – The amount of memory allocated to active processes.
- **Total** – The total amount of system memory.

Web Interface

To display memory utilization:

1. Click System, then Memory Status.

Figure 24: Displaying Memory Utilization



System > Memory Status

Memory Status

Free Size	402,591,744 bytes	18%
Used Size	1,744,891,904 bytes	82%
Total	2,147,483,648 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 by the “copy running-config startup-config” command in the *CLI Reference Guide*.

Parameters

The following parameters are displayed:

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

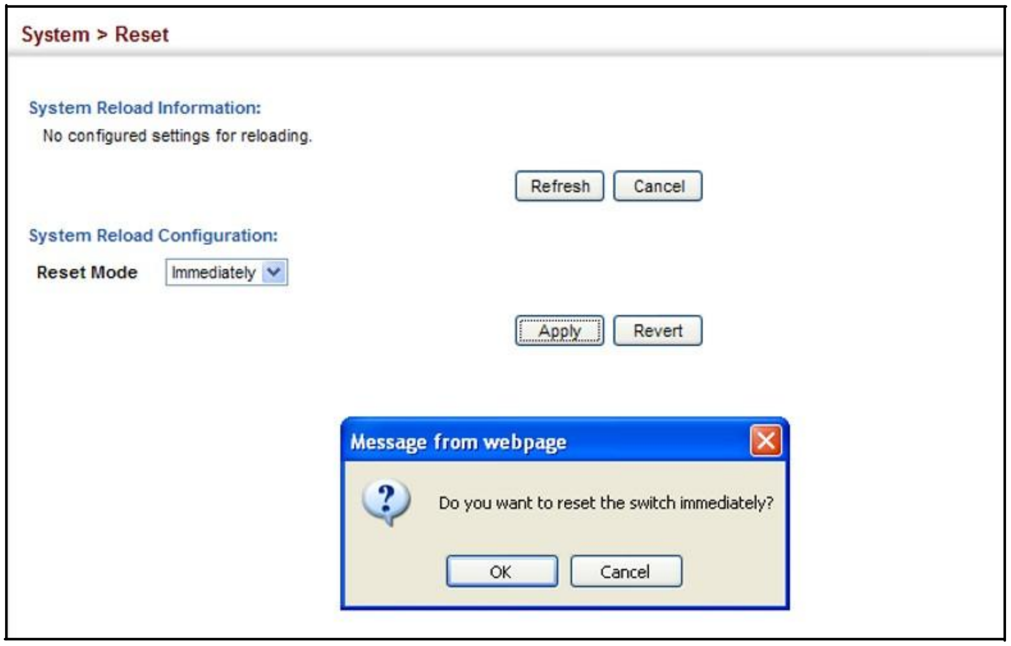
  - Daily - Every day.
  - Weekly - Day of the week at which to reload.
    (Range: Sunday ... Saturday)
  - Monthly - Day of the month at which to reload. (Range: 1-31)

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 25: Restarting the Switch (Immediately)



System > Reset

System Reload Information:

No configured settings for reloading.

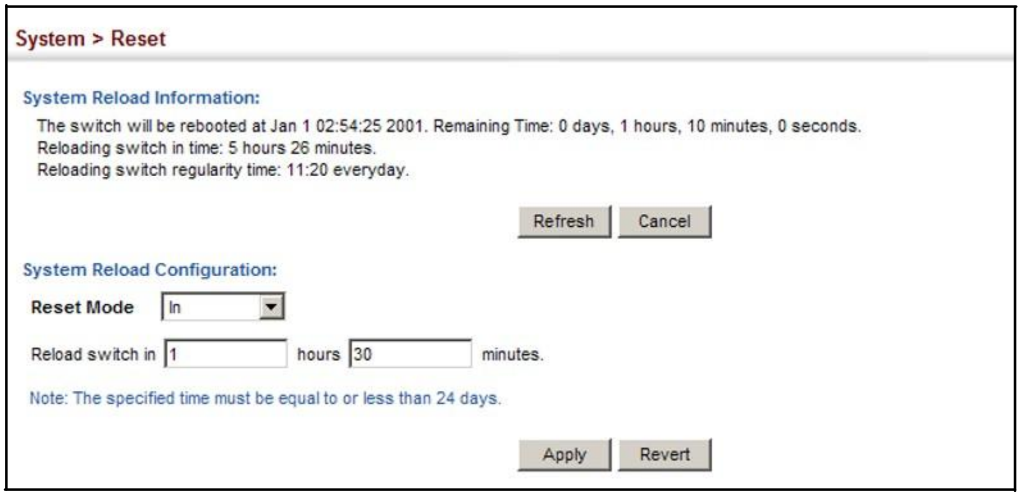
System Reload Configuration:

Reset Mode: Immediately

Message from webpage

Do you want to reset the switch immediately?

Figure 26: Restarting the Switch (In)



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.

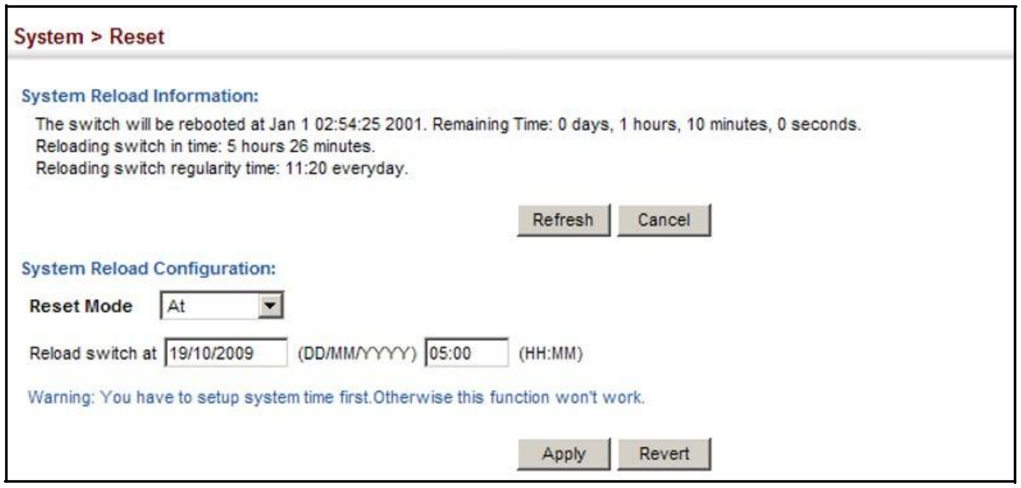
System Reload Configuration:

Reset Mode: In

Reload switch in 1 hours 30 minutes.

Note: The specified time must be equal to or less than 24 days.

Figure 27: 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.

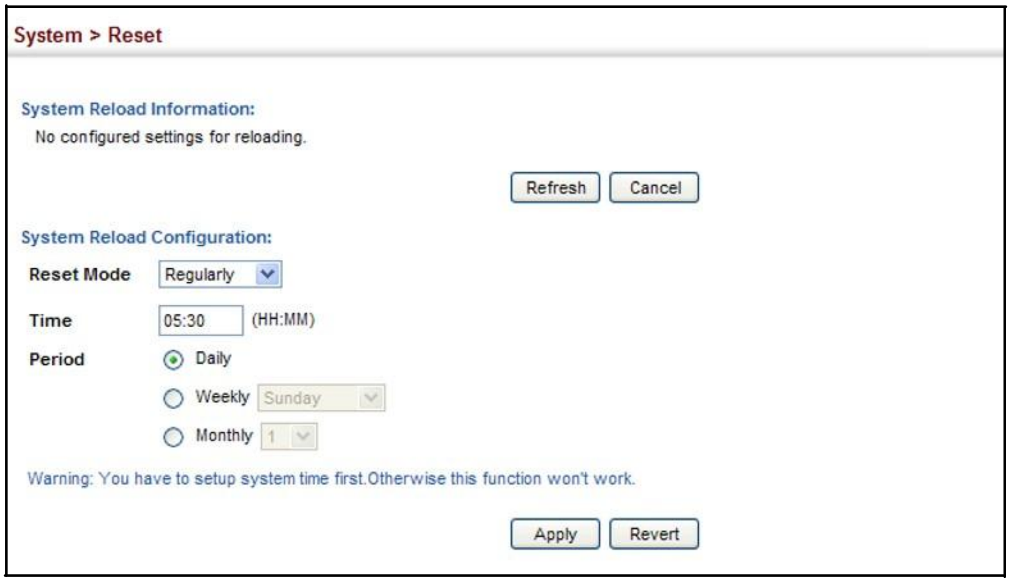
System Reload Configuration:

Reset Mode: At

Reload switch at 19/10/2009 (DD/MM/YYYY) 05:00 (HH:MM)

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

Figure 28: Restarting the Switch (Regularly)



System > Reset

System Reload Information:

No configured settings for reloading.

System Reload Configuration:

Reset Mode: Regularly

Time: 05:30 (HH:MM)

Period: ● Daily
○ Weekly Sunday
○ Monthly 1

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.
- Local Port Mirroring – Sets the source and target ports for mirroring on the local switch.
- 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.
- 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

- 10GBASE-SFP+ connections are fixed at 10G - full duplex, and 40GBASE-QSFP+ connections at 40G - full duplex. Auto-negotiation must be disabled before you can configure or force an RJ-45 interface to use the Flow Control option.

- When using auto-negotiation[1], the optimal settings will be negotiated between the link partners based on their advertised capabilities. To set flow control and symmetric pause frames under auto-negotiation, the required operation modes must be specified in the capabilities list for an interface.

- The Speed/Duplex mode is fixed at 100full for 100BASE-FX transceivers, 1000full for Gigabit transceivers, and 10Gfull for 10 Gigabit transceivers. When auto-negotiation is enabled[1], the only attributes which can be advertised include flow control and symmetric pause frames.

Using Jumbo Frames

- Use the jumbo frame attribute on the System > Capability page to enable or disable jumbo frames for all 10 Gigabit and 40 Gigabit Ethernet ports. Then specify the required MTU size for a specific interface on the port configuration page.

- The comparison of packet size against the configured port MTU considers only the incoming packet size, and is not affected by the fact that an ingress port is a tagged port or a QinQ ingress port. In other words, any additional size (for example, a tagged field of 4 bytes added by the chip) will not be considered when comparing the egress packet's size against the configured MTU.

- When pinging the switch from an external device, information added for the Ethernet header can increase the packet size by at least 42 bytes for an untagged packet, and 46 bytes for a tagged packet. If the adjusted frame size exceeds the configured port MTU, the switch will not respond to the ping message.

- For other traffic types, calculation of overall frame size is basically the same, including the additional header fields SA(6) + DA(6) + Type(2) + VLAN-Tag(4) (for tagged packets, for untaqged packets, the 4-byte field will not be added by switch), and the payload. This should all be less than the configured port MTU, including the CRC at the end of the frame.

- For QinQ, the overall frame size is still calculated as described above, and does not add the length of the second tag to the frame.

Parameters

These parameters are displayed:

- **Port** – Port identifier. (Range: 1-32/54)

- **Type** – Indicates the port type. (1000BASE SFP, 10GBASE SFP+, 40GBASE QSFP)

- **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-

[1] Support for auto-negotiation depends on transceiver type, such as 1G SFP.

enable it after the problem has been resolved. You may also disable an interface for security reasons. (Default: Enabled)

- **Media Type** – Configures the forced transceiver mode for SFP+ ports.
  - **None** - Forced transceiver mode is not used for SFP+ ports. (This is the default setting for RJ-45 ports and SFP+ ports.)
  - **SFP-Forced 1000SFP** - Always uses the SFP+ port at 1000 Mbps, full duplex.
  - **SFP-Forced 10GSFP** - Always uses the SFP+ port at 10 Gbps, full duplex.
- **Autonegotiation** (Port Capabilities) – Not supported on this switch. Forced mode is used for all ports.

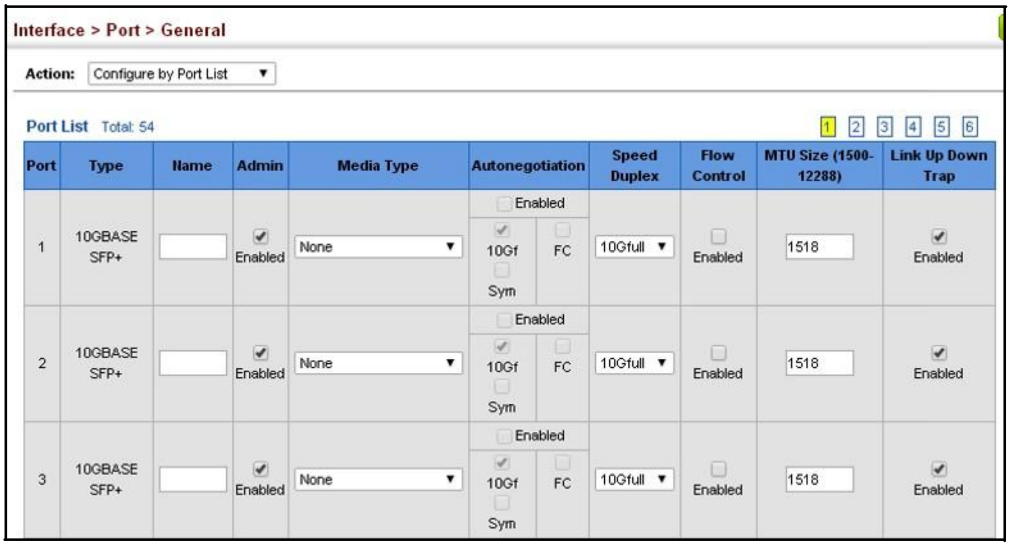
  Default: Autonegotiation disabled;
  Forced mode capabilities for -
  1000BASE-SX/LX (SFP+) – 1000full
  10GBASE-CR/SR/LR/LRM (SFP+) – 10Gfull
  40GBASE-T-CR4 (QSFP+) – 40Gfull
- **Speed/Duplex** – Shows the port speed and duplex mode.
- **Flow Control** – Allows automatic or manual selection of flow control.
- **MTU Size** – The maximum transfer unit (MTU) allowed for layer 2 packets crossing a 1G/10G/40G Ethernet port or trunk. (Range: 1500-12288 bytes; Default: 1518 bytes)
- **Link Up/Down Trap** – Issues link-up or link-down notifications. (Default: Enabled)

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 29: Configuring Connections by Port List



Interface > Port > General

Action: Configure by Port List ▼

Port List Total: 54

Port	Type	Name	Admin	Media Type	Autonegotiation	Speed Duplex	Flow Control	MTU Size (1500-12288)	Link Up Down Trap
1	10GBASE SFP+		☑ Enabled	None ▼	□ Enabled ☑ 10Gf □ FC □ Sym	10Gfull ▼	□ Enabled	1518	☑ Enabled
2	10GBASE SFP+		☑ Enabled	None ▼	□ Enabled ☑ 10Gf □ FC □ Sym	10Gfull ▼	□ Enabled	1518	☑ Enabled
3	10GBASE SFP+		☑ Enabled	None ▼	□ Enabled ☑ 10Gf □ FC □ Sym	10Gfull ▼	□ Enabled	1518	☑ 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.

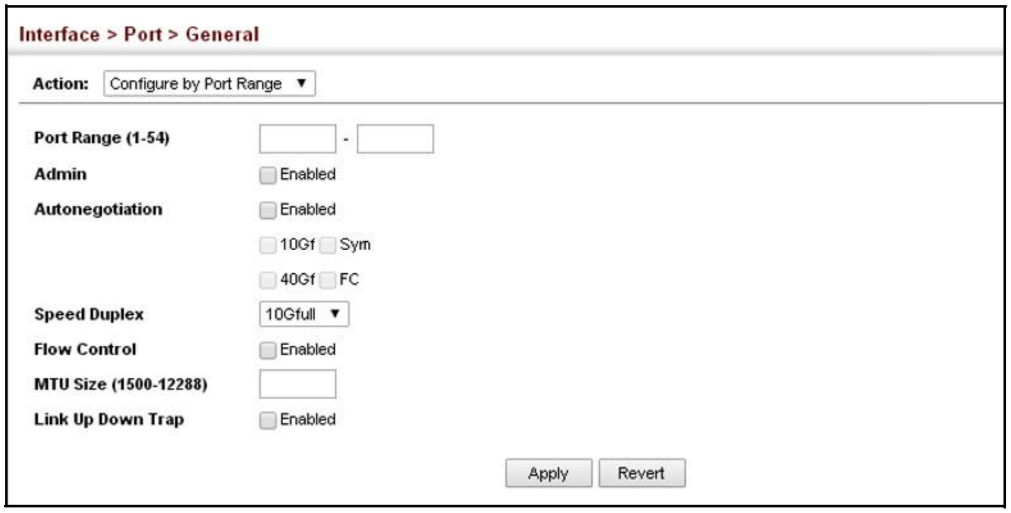
For more information on command usage and a description of the parameters, refer to "Configuring by Port List" on page 85.

Web Interface

To configure port connection parameters:

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

Figure 30: Configuring Connections by Port Range



Interface > Port > General

Action: Configure by Port Range ▼

Port Range (1-54) [ ] - [ ]

Admin □ Enabled

Autonegotiation □ Enabled

□ 10Gf □ Sym

□ 40Gf □ FC

Speed Duplex 10Gfull ▼

Flow Control □ Enabled

MTU Size (1500-12288) [ ]

Link Up Down Trap □ Enabled

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.
- **Type** – Indicates the port type. (1000BASE SFP, 10GBASE SFP+, 40GBASE QSFP)
- **Name** – Interface label.
- **Admin** – Shows if the port is enabled or disabled.
- **Oper Status** – Indicates if the link is Up or Down.
- **Media Type** – Shows the forced transceiver mode.
- **Autonegotiation** – Shows that auto-negotiation is disabled.
- **Oper Speed Duplex** – Shows the current speed and duplex mode.
- **Oper Flow Control** – Shows the flow control type used.
- **MTU Size** – The maximum transfer unit (MTU) allowed for layer 2 packets crossing a Gigabit or 10 Gigabit Ethernet port or trunk.
- **Link Up/Down Trap** – Shows if link-up or link-down notifications are enabled.

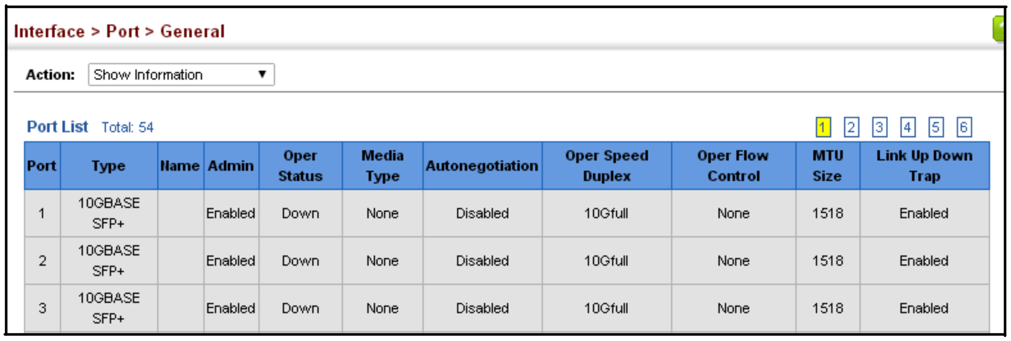
Web Interface

To display port connection parameters:

1. Click Interface, Port, General.

2. Select Show Information from the Action List.

Figure 31: Displaying Port Information



Interface > Port > General

Action: Show Information ▼

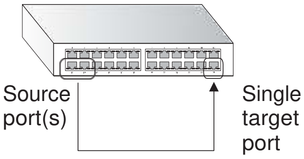
Port List Total: 54 1 2 3 4 5 6

Port	Type	Name	Admin	Oper Status	Media Type	Autonegotiation	Oper Speed Duplex	Oper Flow Control	MTU Size	Link Up Down Trap
1	10GBASE SFP+		Enabled	Down	None	Disabled	10Gfull	None	1518	Enabled
2	10GBASE SFP+		Enabled	Down	None	Disabled	10Gfull	None	1518	Enabled
3	10GBASE SFP+		Enabled	Down	None	Disabled	10Gfull	None	1518	Enabled

Configuring Local Port Mirroring

Use the Interface > Port > 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 32: 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).

- Monitor port speed should match or exceed source port speed, otherwise traffic may be dropped from the monitor port.

- When mirroring port traffic, the target port must be included in the same VLAN as the source port when using MSTP (see "Spanning Tree Algorithm" on page 141).

- 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.

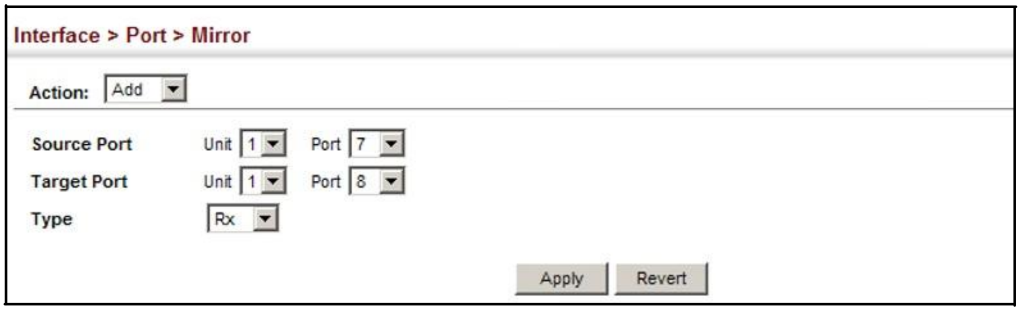
- **Target Port** – The port that will mirror the traffic on the source port.
- **Type** – Allows you to select which traffic to mirror to the target port, Rx (receive), Tx (transmit), or Both. (Default: Both)

Web Interface

To configure a local mirror session:

1. Click Interface, Port, 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 33: Configuring Local Port Mirroring



Interface > Port > Mirror

Action: Add

Source Port Unit 1 Port 7

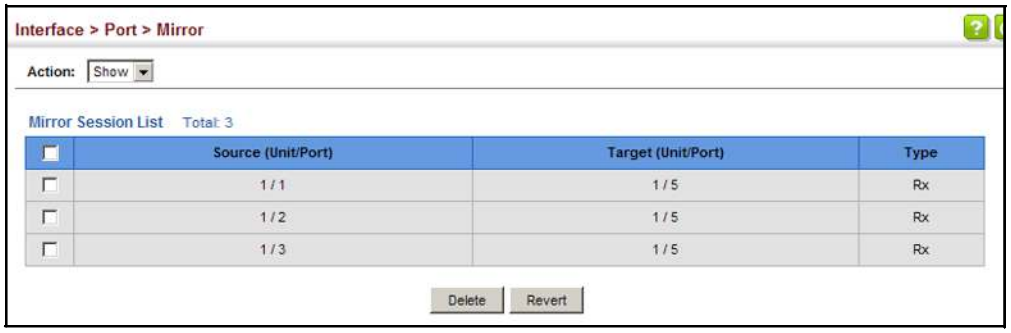
Target Port Unit 1 Port 8

Type Rx

To display the configured mirror sessions:

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

Figure 34: Displaying Local Port Mirror Sessions



Interface > Port > Mirror

Action: Show

Mirror Session List Total: 3

□	Source (Unit/Port)	Target (Unit/Port)	Type
□	1 / 1	1 / 5	Rx
□	1 / 2	1 / 5	Rx
□	1 / 3	1 / 5	Rx

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 traffic). 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 5: Port Statistics

Parameter	Description
Interface Statistics	
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.
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.

Table 5: Port Statistics (Continued)

Parameter	Description
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.
Etherlike Statistics	
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.
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.
RMON Statistics	
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.

Table 5: Port Statistics (Continued)

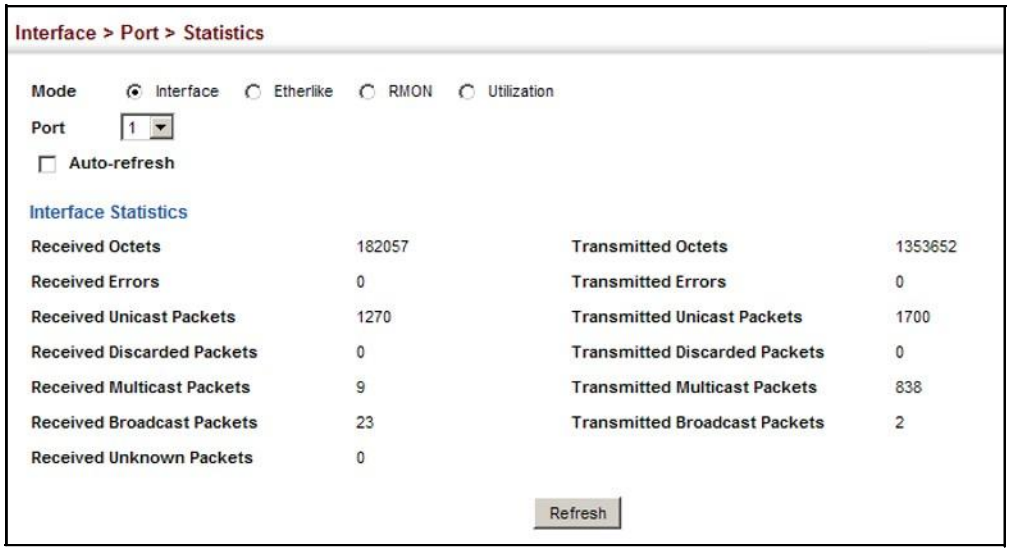
Parameter	Description
Broadcast Packets	The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Packets	The total number of good packets received that were directed to this multicast address.
Undersize Packets	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 128-255 Byte Packets 256-511 Byte Packets 512-1023 Byte Packets 1024-1518 Byte Packets 1519-1536 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).
Utilization Statistics	
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.
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 at the bottom of the page if you need to update the screen.

Figure 35: Showing Port Statistics (Table)



Interface > Port > Statistics

Mode ● Interface ○ Etherlike ○ RMON ○ Utilization

Port 1

□ Auto-refresh

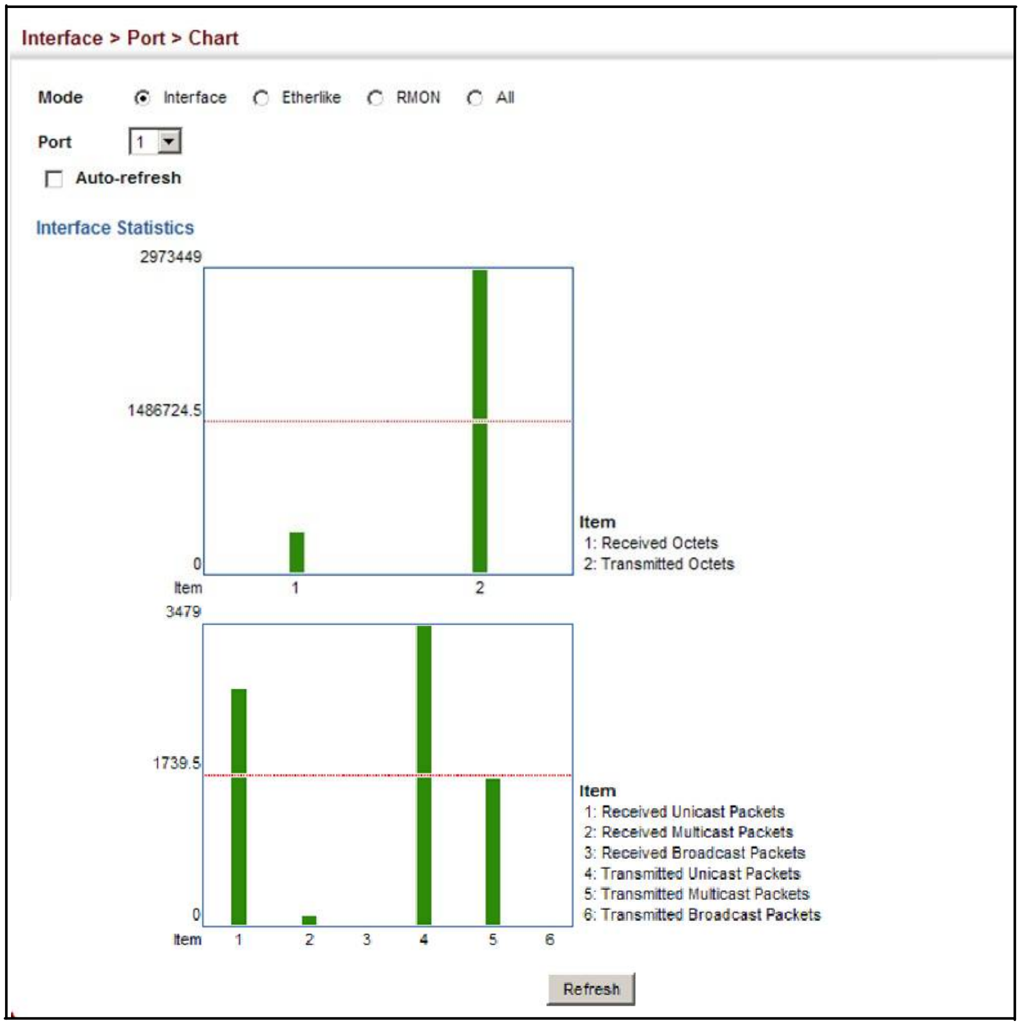
Interface Statistics

Received Octets	182057	Transmitted Octets	1353652
Received Errors	0	Transmitted Errors	0
Received Unicast Packets	1270	Transmitted Unicast Packets	1700
Received Discarded Packets	0	Transmitted Discarded Packets	0
Received Multicast Packets	9	Transmitted Multicast Packets	838
Received Broadcast Packets	23	Transmitted Broadcast Packets	2
Received Unknown Packets	0		

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)



Interface > Port > Chart

Mode ● Interface ○ Etherlike ○ RMON ○ All

Port 1

□ Auto-refresh

Interface Statistics

2973449
1486724.5
0
Item
1
2
Item
1: Received Octets
2: Transmitted Octets
3479
1739.5
0
Item
1
2
3
4
5
6
Item
1: Received Unicast Packets
2: Received Multicast Packets
3: Received Broadcast Packets
4: Transmitted Unicast Packets
5: Transmitted Multicast Packets
6: Transmitted Broadcast Packets
Refresh

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 92.

Parameters

These parameters are displayed:

Add

- **Port** – Port number. (Range: 1-32/54)
- **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: 1-32/54)
- **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: 1-32/54)
- **Name** – Name of sample interval.

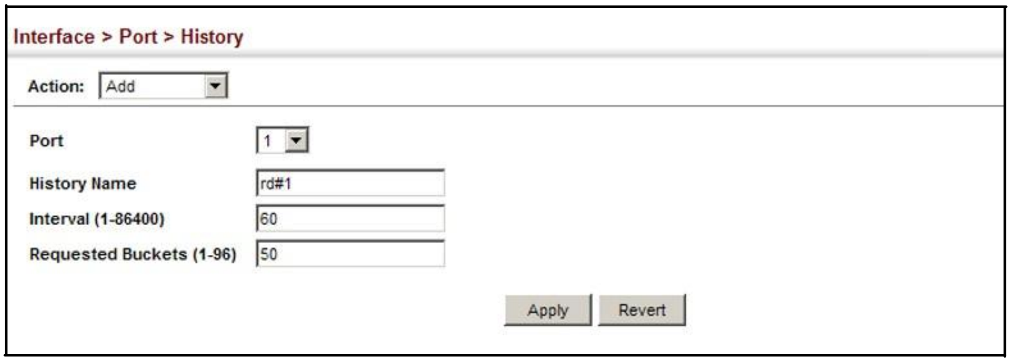
Web Interface

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

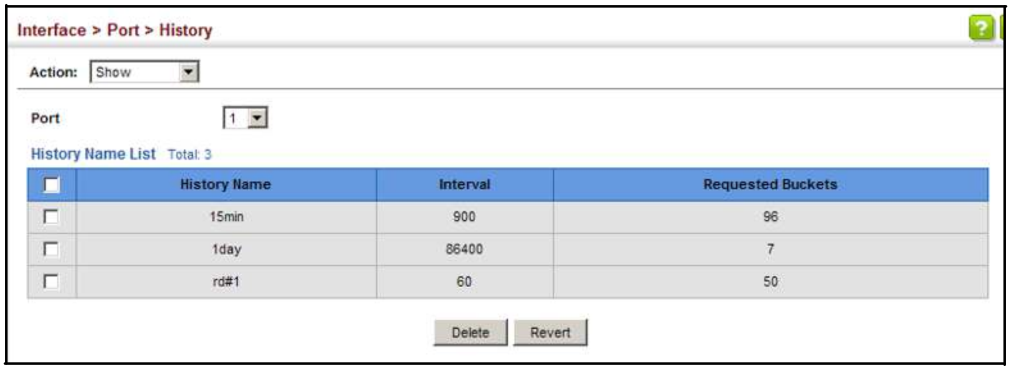
Interval (1-86400): 60

Requested Buckets (1-96): 50

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

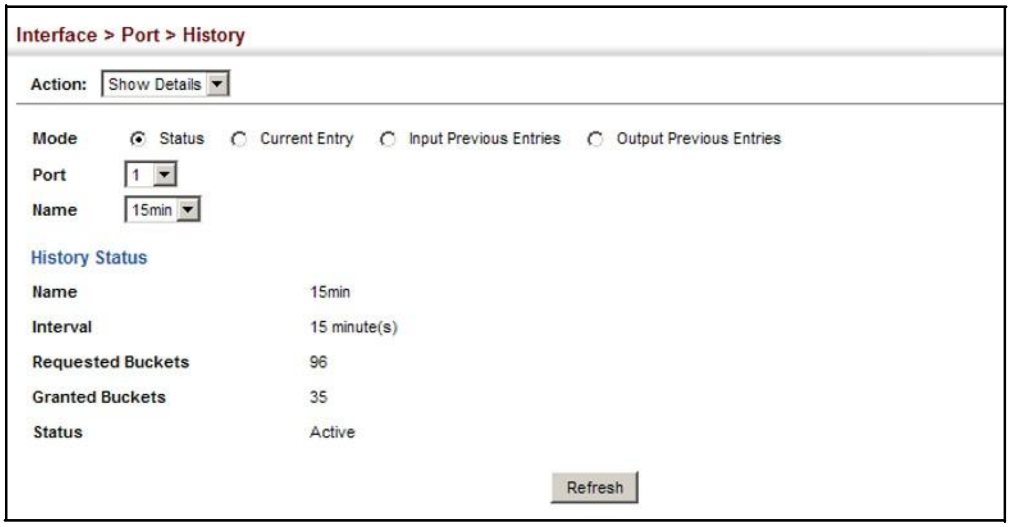
History Name List Total: 3

□	History Name	Interval	Requested Buckets
□	15min	900	96
□	1day	86400	7
□	rd#1	60	50

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



Interface > Port > History

Action: Show Details

Mode ● Status ○ Current Entry ○ Input Previous Entries ○ Output Previous Entries

Port 1

Name 15min

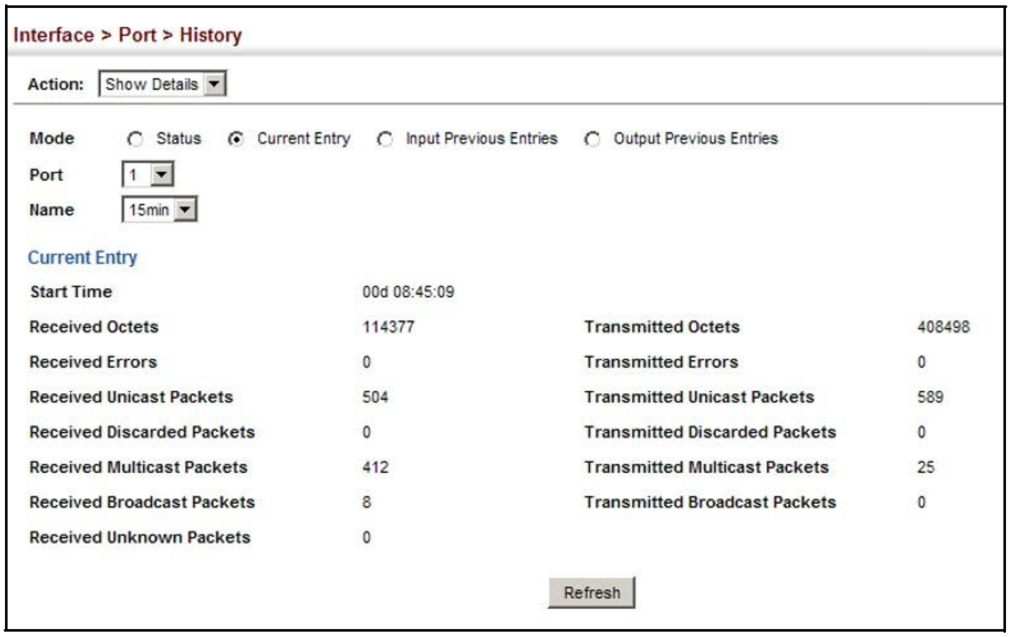
History Status

Name	15min
Interval	15 minute(s)
Requested Buckets	96
Granted Buckets	35
Status	Active

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



Interface > Port > History

Action: Show Details

Mode ○ Status ● Current Entry ○ Input Previous Entries ○ Output Previous Entries

Port 1

Name 15min

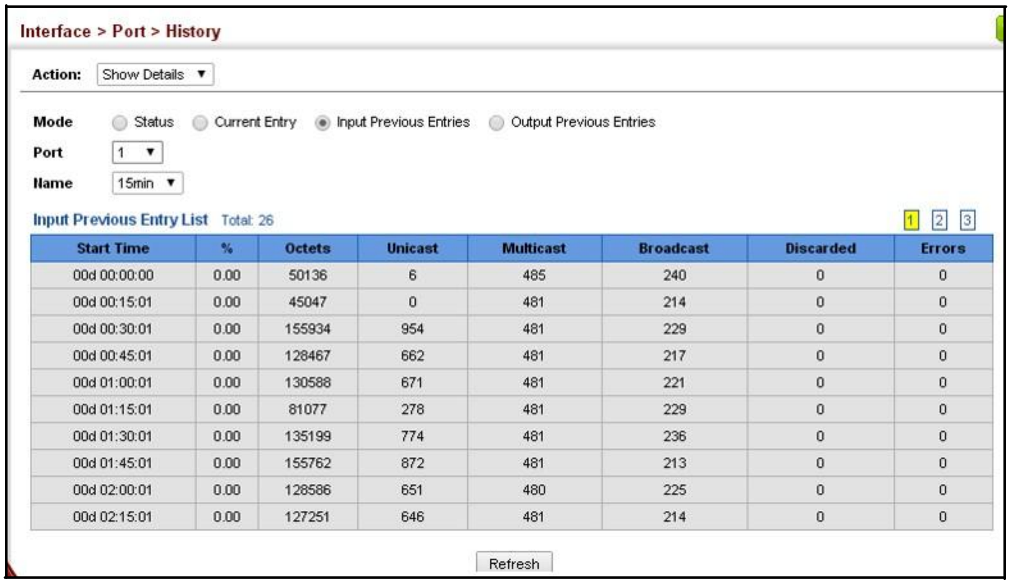
Current Entry

Start Time	00d 08:45:09		
Received Octets	114377	Transmitted Octets	408498
Received Errors	0	Transmitted Errors	0
Received Unicast Packets	504	Transmitted Unicast Packets	589
Received Discarded Packets	0	Transmitted Discarded Packets	0
Received Multicast Packets	412	Transmitted Multicast Packets	25
Received Broadcast Packets	8	Transmitted Broadcast Packets	0
Received Unknown Packets	0		

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: 26

Start Time	%	Octets	Unicast	Multicast	Broadcast	Discarded	Errors
00d 00:00:00	0.00	50136	6	485	240	0	0
00d 00:15:01	0.00	45047	0	481	214	0	0
00d 00:30:01	0.00	155934	954	481	229	0	0
00d 00:45:01	0.00	128467	662	481	217	0	0
00d 01:00:01	0.00	130588	671	481	221	0	0
00d 01:15:01	0.00	81077	278	481	229	0	0
00d 01:30:01	0.00	135199	774	481	236	0	0
00d 01:45:01	0.00	155762	872	481	213	0	0
00d 02:00:01	0.00	128586	651	480	225	0	0
00d 02:15:01	0.00	127251	646	481	214	0	0

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: 1-32/54)
- **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.

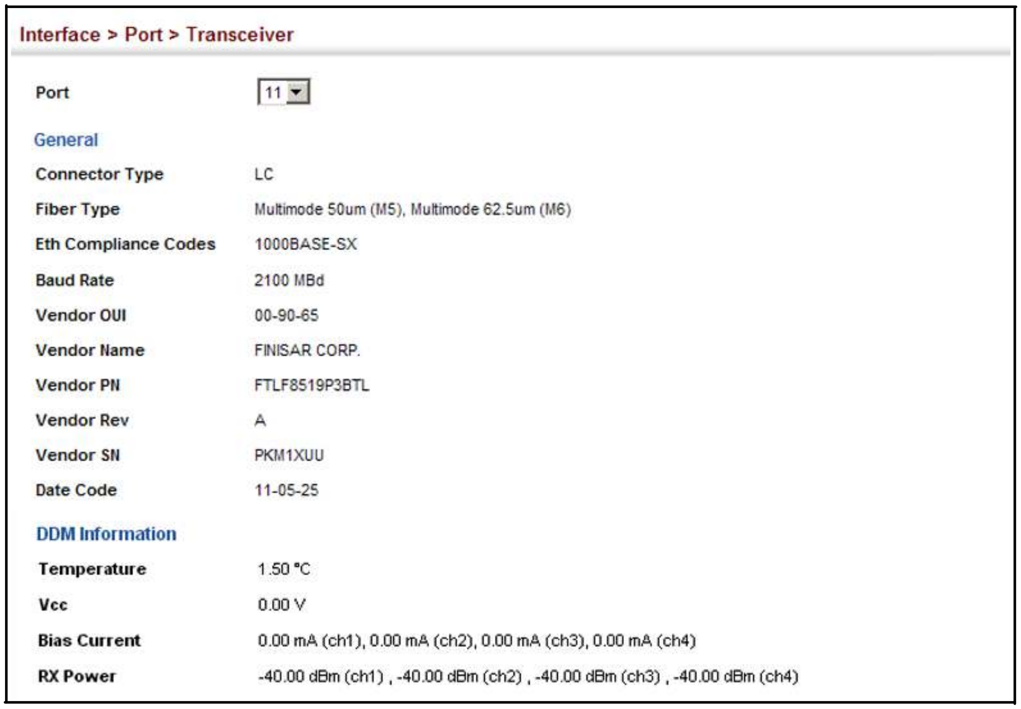
  The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic 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	1.50 °C
Vcc	0.00 V
Bias Current	0.00 mA (ch1), 0.00 mA (ch2), 0.00 mA (ch3), 0.00 mA (ch4)
RX Power	-40.00 dBm (ch1) , -40.00 dBm (ch2) , -40.00 dBm (ch3) , -40.00 dBm (ch4)

Configuring Transceiver Thresholds

Use the Interface > Port > Transceiver page to configure thresholds for alarm and warning messages for optical transceivers which support DDM.

Parameters

These parameters are displayed:

- **Port** – Port number. (Range: 1-32/54)
- **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.
  - **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**: -200.00-200.00 °C
  - **Voltage**: 1.00-255.00 Volts
  - **Current**: 1.00-255.00 mA
  - **Power**: -99.99-99.99 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, for example, if the power level were to fluctuate just above and below either the high threshold or the low threshold.

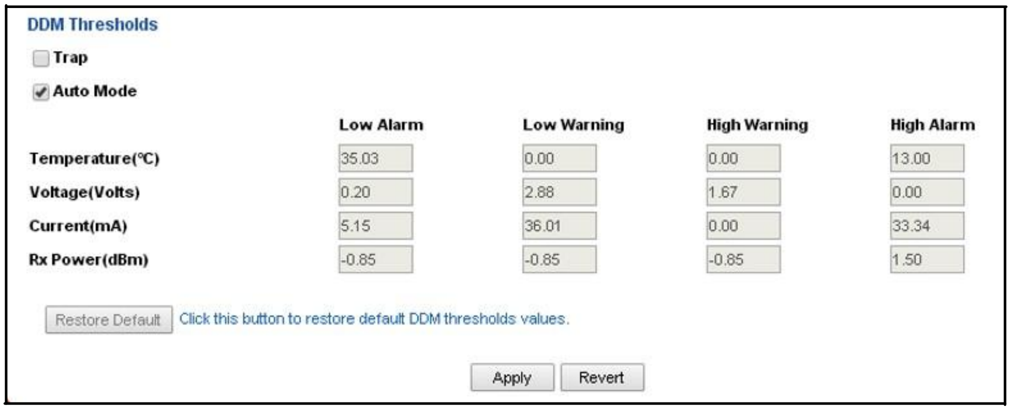
- Trap messages configured by this command are sent to any management station configured as an SNMP trap manager using the Administration > SNMP (Configure Trap) page.

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

	Low Alarm	Low Warning	High Warning	High Alarm
Temperature(℃)	35.03	0.00	0.00	13.00
Voltage(Volts)	0.20	2.88	1.67	0.00
Current(mA)	5.15	36.01	0.00	33.34
Rx Power(dBm)	-0.85	-0.85	-0.85	1.50

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 8 trunks at a time on the switch.

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

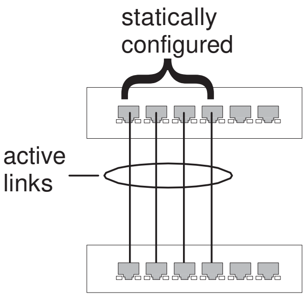
Besides balancing the load across each port in the trunk, the other ports provide redundancy by taking over the load if a port in the trunk fails. However, before making any physical connections between devices, use the web interface or CLI to specify the trunk on the devices at both ends. When using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

- Finish configuring port trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- You can create up to 8 trunks on a switch, 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.
- Trunk groups are limited to either all 10G ports or all 40G ports. When using an LAG composed of all 10G ports, different transceiver types may be used as long as the speed of each member port is the same.
- 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. (1-~~16/~~27)

- **Member** – The initial trunk member. Use the Add Member page to configure additional members.

  - **Unit** – Unit identifier. (Range: 1)

  - **Port** – Port identifier. (Range: 1-32/54)

Web Interface

To create a static trunk:

1. Click Interface, Trunk, Static.

2. Select Configure Trunk from the Step list.

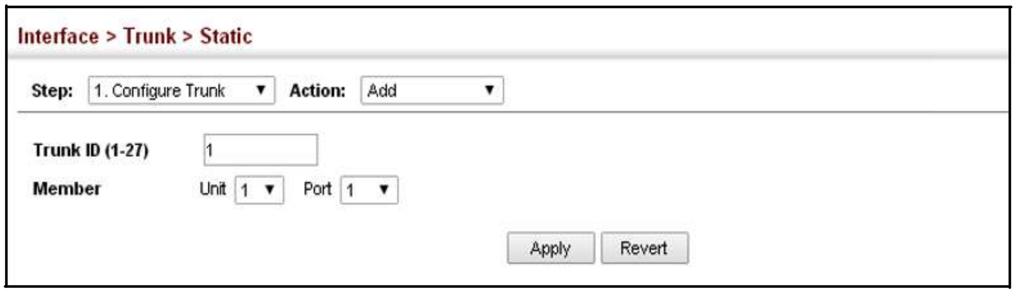
3. Select Add from the Action list.

4. Enter a trunk identifier.

5. Set the unit and port for the initial trunk member.

6. Click Apply.

Figure 45: Creating Static Trunks



Interface > Trunk > Static

Step: 1. Configure Trunk Action: Add

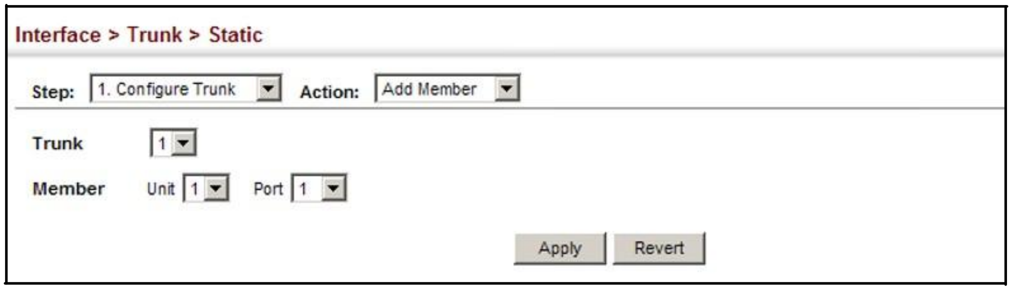
Trunk ID (1-27) 1

Member Unit 1 Port 1

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



Interface > Trunk > Static

Step: 1. Configure Trunk   Action: Add Member

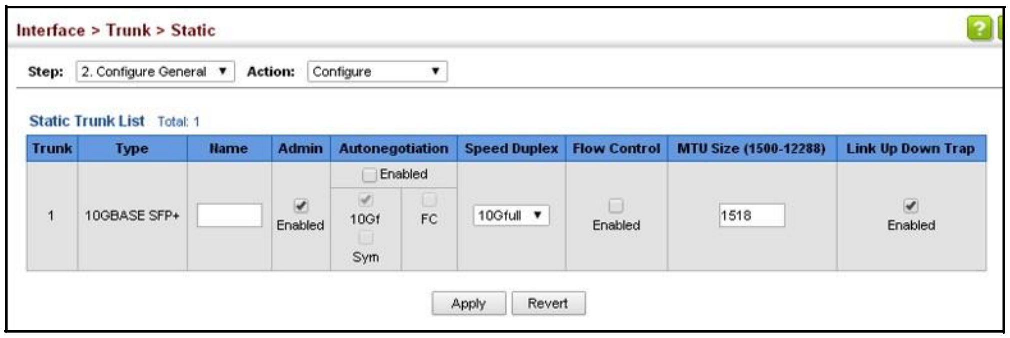
Trunk: 1

Member: Unit 1 Port 1

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 85 for a description of the parameters.)
5. Click Apply.

Figure 47: Configuring Connection Parameters for a Static Trunk



Interface > Trunk > Static

Step: 2. Configure General   Action: Configure

Static Trunk List Total: 1

Trunk	Type	Name	Admin	Autonegotiation	Speed Duplex	Flow Control	MTU Size (1500-12288)	Link Up Down Trap
1	10GBASE SFP+		☑ Enabled	□ Enabled ☑ 10Gf □ FC □ Sym	10Gfull	□ Enabled	1518	☑ Enabled

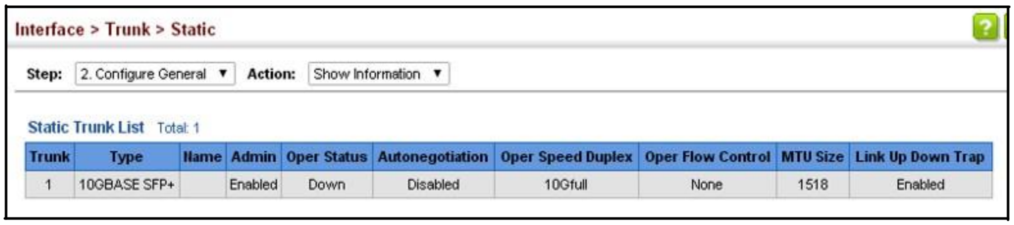
To display trunk connection parameters:

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



Interface > Trunk > Static

Step: 2. Configure General Action: Show Information

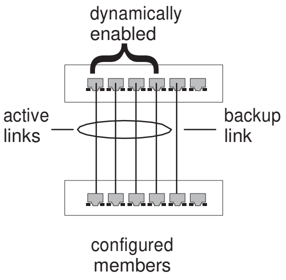
Static Trunk List Total: 1

Trunk	Type	Name	Admin	Oper Status	Autonegotiation	Oper Speed Duplex	Oper Flow Control	MTU Size	Link Up Down Trap
1	10GBASE SFP+		Enabled	Down	Disabled	10Gfull	None	1518	Enabled

Configuring a Dynamic Trunk

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

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)
- **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 LACPDUs. 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.

Configure Aggregation Port - General

- **Port** – Port identifier. (Range: 1-32/54)
- **LACP Status** – Enables or disables LACP on a port.

Configure Aggregation Port - Actor/Partner

- **Port** – Port number. (Range: 1-32/54)
- **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)

  By default, the Actor Admin Key is determined by port's link speed, and copied to Oper Key. The Partner Admin Key is assigned to zero, and the Oper Key is set based upon LACP PDUs received from the Partner.

- **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.

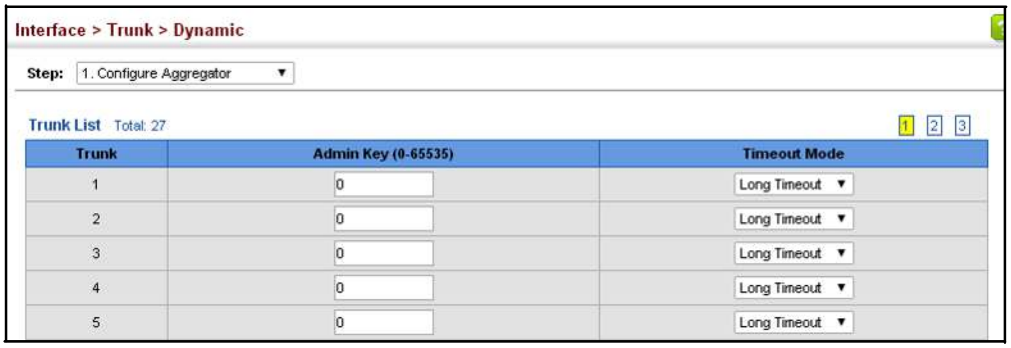
Note: Configuring the port partner sets the remote side of an aggregate link; i.e., the ports on the attached device. The command attributes have the same meaning as those used for the port actor.

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



Interface > Trunk > Dynamic

Step: 1. Configure Aggregator

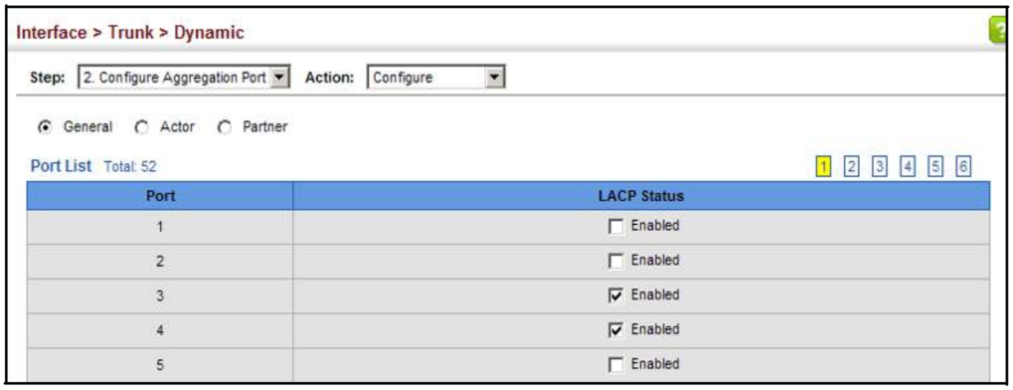
Trunk List Total: 27

Trunk	Admin Key (0-65535)	Timeout Mode
1	0	Long Timeout
2	0	Long Timeout
3	0	Long Timeout
4	0	Long Timeout
5	0	Long Timeout

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



Interface > Trunk > Dynamic

Step: 2. Configure Aggregation Port Action: Configure

● General ○ Actor ○ Partner

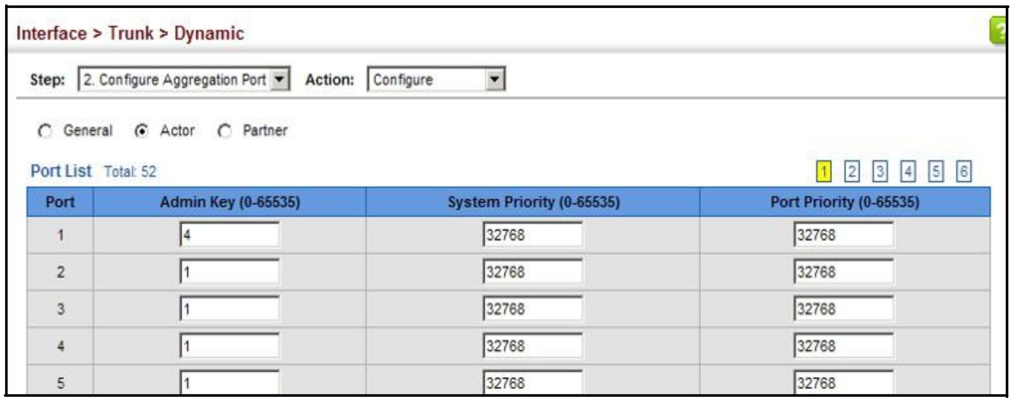
Port List Total: 52

Port	LACP Status
1	□ Enabled
2	□ Enabled
3	☑ Enabled
4	☑ Enabled
5	□ Enabled

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



Interface > Trunk > Dynamic

Step: 2. Configure Aggregation Port Action: Configure

○ General ● Actor ○ Partner

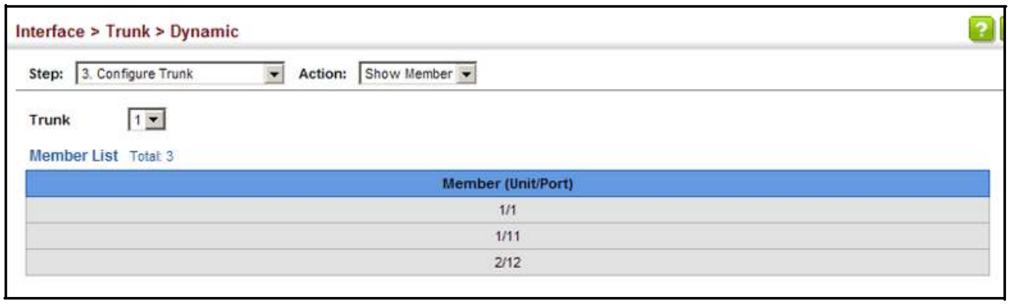
Port List Total: 52

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



Interface > Trunk > Dynamic

Step: 3. Configure Trunk Action: Show Member

Trunk 1

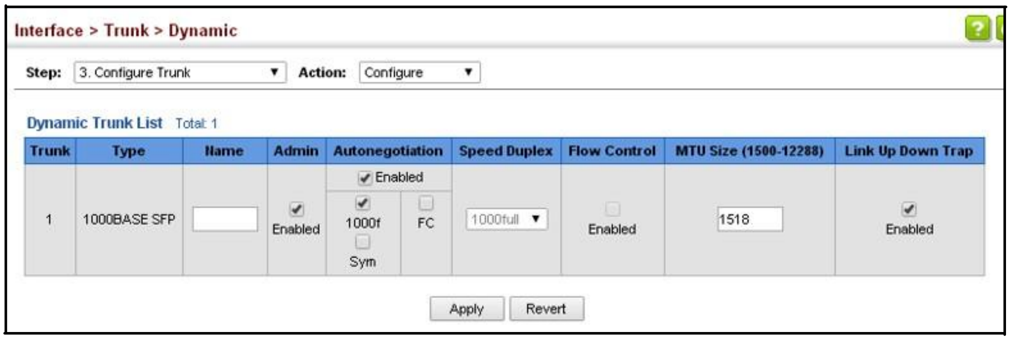
Member List Total: 3

Member (Unit/Port)
1/1
1/11
2/12

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 85 for a description of the interface settings.)
5. Click Apply.

Figure 54: Configuring Connection Settings for Dynamic Trunks



Interface > Trunk > Dynamic

Step: 3. Configure Trunk Action: Configure

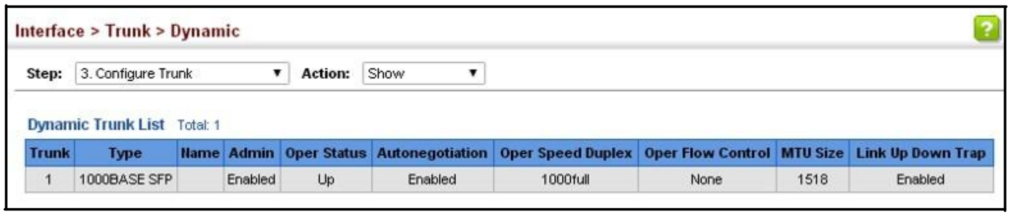
Dynamic Trunk List Total: 1

Trunk	Type	Name	Admin	Autonegotiation	Speed Duplex	Flow Control	MTU Size (1500-12288)	Link Up Down Trap
1	1000BASE SFP		☑ Enabled	☑ Enabled ☑ 1000f □ FC □ Sym	1000full	□ Enabled	1518	☑ Enabled

To display 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: Displaying Connection Parameters for Dynamic Trunks



Interface > Trunk > Dynamic

Step: 3. Configure Trunk Action: Show

Dynamic Trunk List Total: 1

Trunk	Type	Name	Admin	Oper Status	Autonegotiation	Oper Speed Duplex	Oper Flow Control	MTU Size	Link Up Down Trap
1	1000BASE SFP		Enabled	Up	Enabled	1000full	None	1518	Enabled

Displaying LACP Port Counters

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

Parameters

These parameters are displayed:

Table 6: LACP Port Counters

Parameter	Description
LACPDUs Sent	Number of valid LACPDUs transmitted from this channel group.
LACPDUs 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.

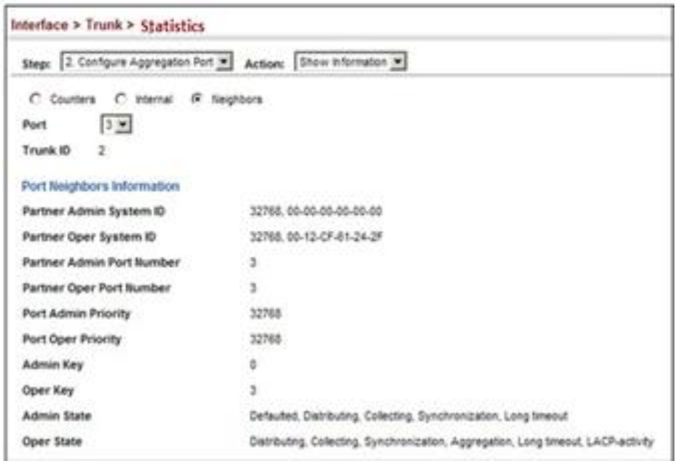
Web Interface

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



Interface > Trunk > Statistics

Step: 2. Configure Aggregation Port   Action: Show Information

○ Counters ○ Internal ● Neighbors

Port: 3

Trunk ID: 2

Port Neighbors Information

Partner Admin System ID	32768, 00-00-00-00-00-00
Partner Oper System ID	32768, 00-12-CF-61-24-2F
Partner Admin Port Number	3
Partner Oper Port Number	3
Port Admin Priority	32768
Port Oper Priority	32768
Admin Key	0
Oper Key	3
Admin State	Defaulted, Distributing, Collecting, Synchronization, Long timeout
Oper State	Distributing, Collecting, Synchronization, Aggregation, Long timeout, LACP-activity

Displaying LACP Settings and Status for the Local Side

Use the Interface > Trunk > statistics (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 7: 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.
Admin State, Oper State	Administrative or operational values of the actor's state parameters: ♦ 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.

Table 7: LACP Internal Configuration Information (Continued)

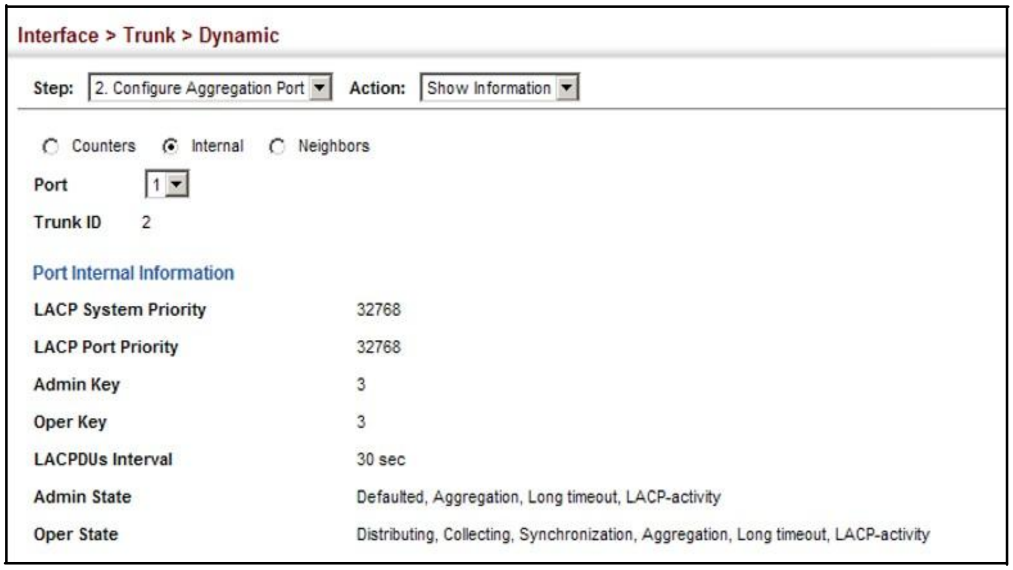
Parameter	Description
	♦ Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation. ♦ Long timeout – Periodic transmission of LACPDUs uses a slow transmission rate. ♦ LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)

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



Interface > Trunk > Dynamic

Step: 2. Configure Aggregation Port   Action: Show Information

○ Counters ● Internal ○ Neighbors

Port: 1
Trunk ID: 2

Port Internal Information

LACP System Priority	32768
LACP Port Priority	32768
Admin Key	3
Oper Key	3
LACPDUs Interval	30 sec
Admin State	Defaulted, Aggregation, Long timeout, LACP-activity
Oper State	Distributing, Collecting, Synchronization, Aggregation, Long timeout, LACP-activity

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 8: LACP Remote Device Configuration Information

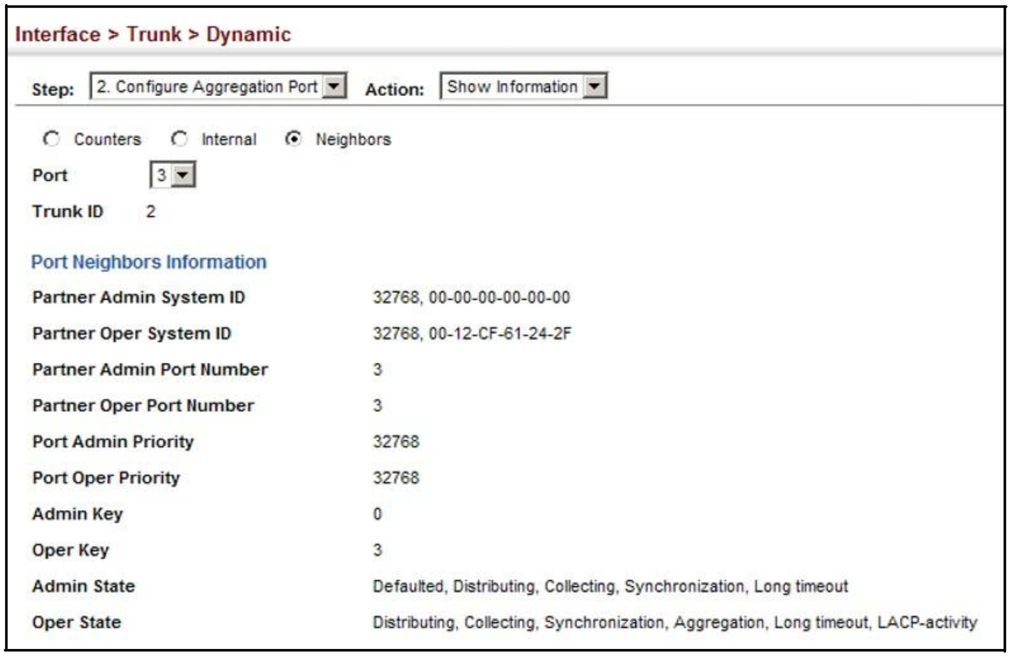
Parameter	Description
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.
Partner Admin Port Number	Current administrative value of the port number for the protocol Partner.
Partner Oper Port Number	Operational 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 Internal.
5. Select a group member from the Port list.

Figure 58: Displaying LACP Port Remote Information



Interface > Trunk > Dynamic

Step: 2. Configure Aggregation Port Action: Show Information

○ Counters ○ Internal ● Neighbors

Port 3

Trunk ID 2

Port Neighbors Information

Partner Admin System ID	32768, 00-00-00-00-00-00
Partner Oper System ID	32768, 00-12-CF-61-24-2F
Partner Admin Port Number	3
Partner Oper Port Number	3
Port Admin Priority	32768
Port Oper Priority	32768
Admin Key	0
Oper Key	3
Admin State	Defaulted, Distributing, Collecting, Synchronization, Long timeout
Oper State	Distributing, Collecting, Synchronization, Aggregation, Long timeout, LACP-activity

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:

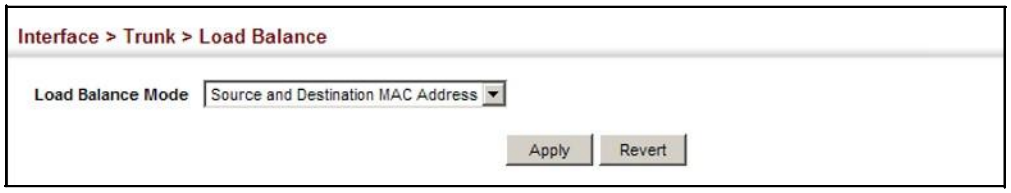
- **Destination IP Address** - Load balancing based on destination IP address.
- **Destination MAC Address** - Load balancing based on destination MAC address.
- **Source and Destination IP Address** - Load balancing based on source and destination IP address. (This is the default setting.)
- **Source 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



Interface > Trunk > Load Balance

Load Balance Mode: Source and Destination MAC Address

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.

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:

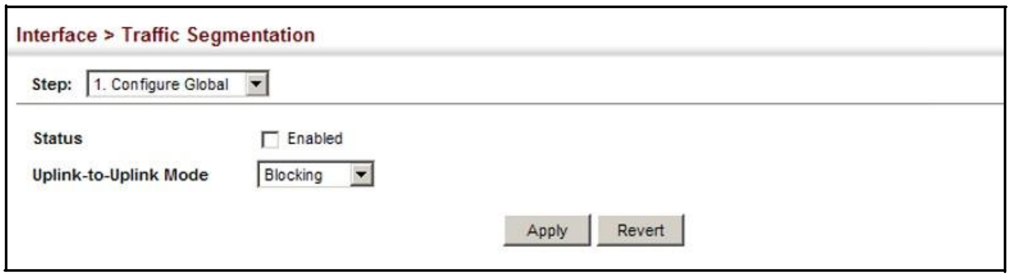
- **Status** – Enables port-based traffic segmentation. (Default: Disabled)
- **Uplink-to-Uplink Mode** – Specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions.
  - **Blocking** – Blocks traffic between uplink ports assigned to different sessions.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



Interface > Traffic Segmentation

Step: 1. Configure Global

Status □ Enabled

Uplink-to-Uplink Mode Blocking

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 9: 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 119).

- 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:

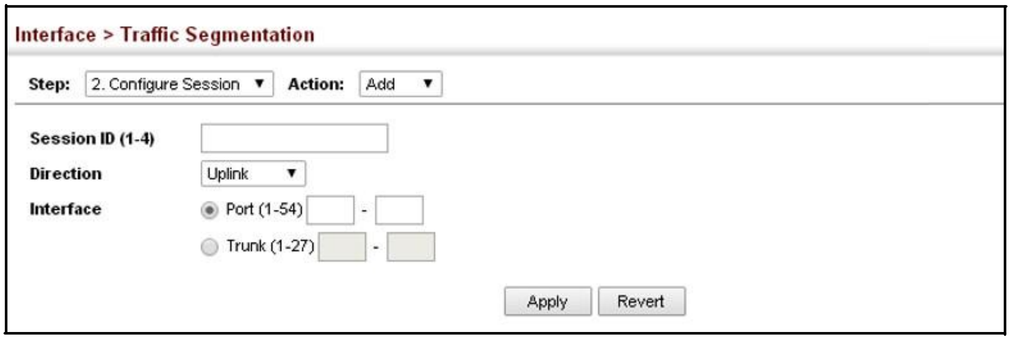
- **Session ID** – Traffic segmentation session. (Range: 1-4)
- **Direction** – Adds an interface to the segmented group by setting the direction to uplink or downlink. (Default: Uplink)
- **Interface** – Displays a list of ports or trunks.
- **Port** – Port Identifier. (Range: 1-32/54)
- **Trunk** – Trunk Identifier. (Range: 1-~~16/~~27)

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 61: Configuring Members for Traffic Segmentation



Interface > Traffic Segmentation

Step: 2. Configure Session ▾ Action: Add ▾

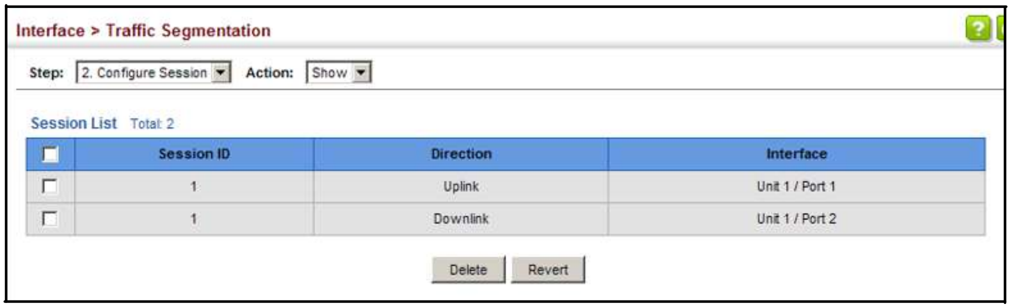
Session ID (1-4)
Direction: Uplink ▾
Interface: ● Port (1-54) - ○ Trunk (1-27) -

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 62: Showing Traffic Segmentation Members



Interface > Traffic Segmentation

Step: 2. Configure Session Action: Show

Session List Total: 2

□	Session ID	Direction	Interface
□	1	Uplink	Unit 1 / Port 1
□	1	Downlink	Unit 1 / Port 2

5

VLAN Configuration

This chapter includes the following topics:

- IEEE 802.1Q VLANs – Configures static and dynamic VLANs.

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.

This switch supports the following VLAN features:

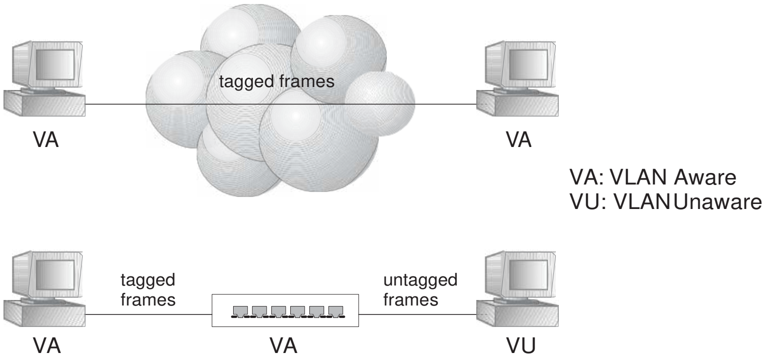
- Up to 4094 VLANs based on the IEEE 802.1Q standard
- Distributed VLAN learning across multiple switches using explicit or implicit tagging
- Port overlapping, allowing a port to participate in multiple VLANs
- End stations can belong to multiple VLANs
- Passing traffic between VLAN-aware and VLAN-unaware 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 manually assign ports on the other VLAN-aware network devices along the path that will carry this traffic to the same VLAN(s). 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 63: 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 whenever possible to 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, or set administrative status. 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).

  Up to 4094 VLAN groups can be defined. VLAN 1 is the default untagged VLAN.

- **Status** – Enables or disables the specified VLAN.

- **L3 Interface** – Sets the interface to support Layer 3 configuration, and reserves memory space required to maintain additional information about this interface type. This parameter must be enabled before you can assign an IP address to a VLAN (see "Setting the Switch's IP Address (IP Version 4)" on page 339).

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.

- **L3 Interface** – Sets the interface to support Layer 3 configuration, and reserves memory space required to maintain additional information about this interface type. This parameter must be enabled before you can assign an IP address to a VLAN.

Show

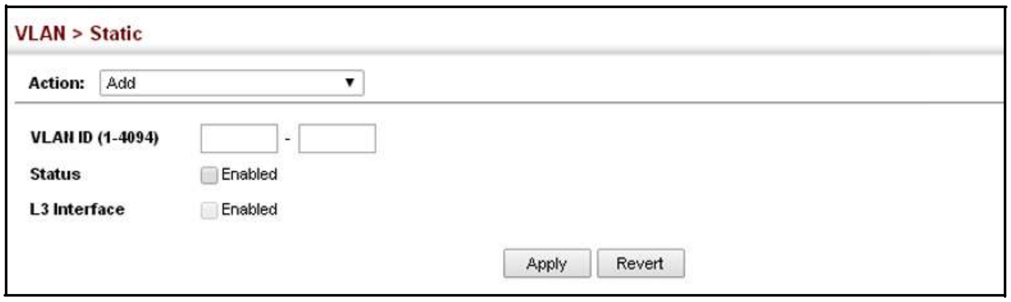
- **VLAN ID** – ID of configured VLAN.
- **VLAN Name** – Name of the VLAN.
- **Status** – Operational status of configured VLAN.
- **L3 Interface** – Shows if the interface supports Layer 3 configuration.

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. Enable the Status field to configure the VLAN as operational.
5. Enable the L3 Interface field to specify that a VLAN will be used as a Layer 3 interface.
6. Click Apply.

Figure 64: Creating Static VLANs



VLAN > Static

Action: Add

VLAN ID (1-4094) -

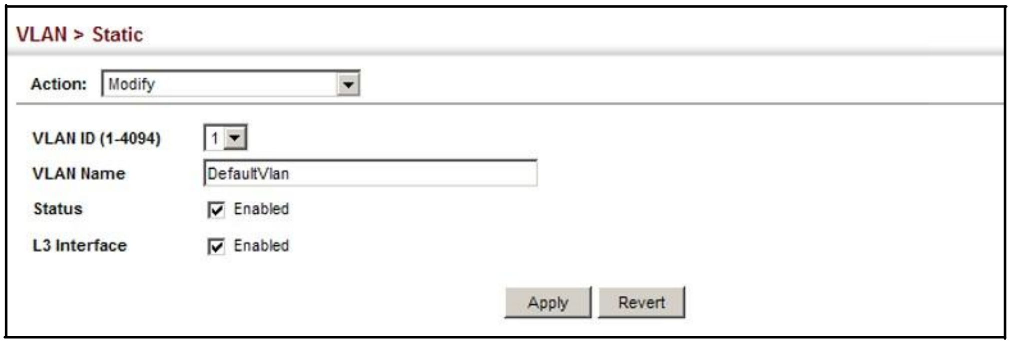
Status □ Enabled

L3 Interface □ Enabled

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, operational status, or Layer 3 Interface status as required.
5. Click Apply.

Figure 65: Modifying Settings for Static VLANs



VLAN > Static

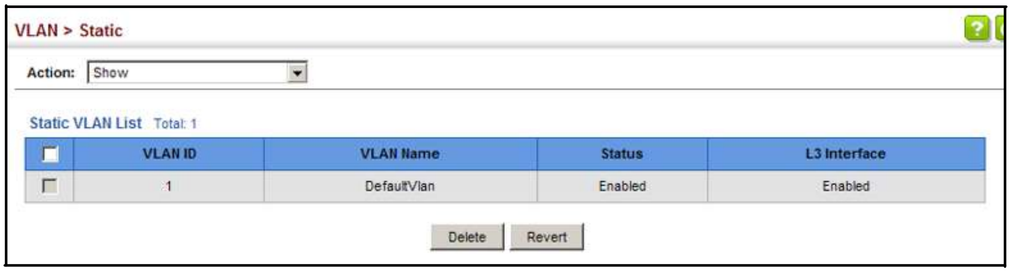
Action: Modify

VLAN ID (1-4094): 1
VLAN Name: DefaultVlan
Status: ☑ Enabled
L3 Interface: ☑ Enabled

To show the configuration settings for VLAN groups:

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

Figure 66: Showing Static VLANs



VLAN > Static

Action: Show

Static VLAN List Total: 1

□	VLAN ID	VLAN Name	Status	L3 Interface
□	1	DefaultVlan	Enabled	Enabled

Adding Static Members to VLANs

Use the VLAN > Static page 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: 1-32/54)
- **Trunk** – Trunk Identifier. (Range: 1-~~16/~~27)
- **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.

    Access mode is mutually exclusive with VLAN trunking (see "VLAN Trunking" on page 159). If VLAN trunking is enabled on an interface, then that interface cannot be set to access mode, and vice versa.
  - **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: Disabled)
  - 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.
  - **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.

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: 1-32/54)

- **Trunk Range** – Displays a list of ports. (Range: 1-~~16/~~27)

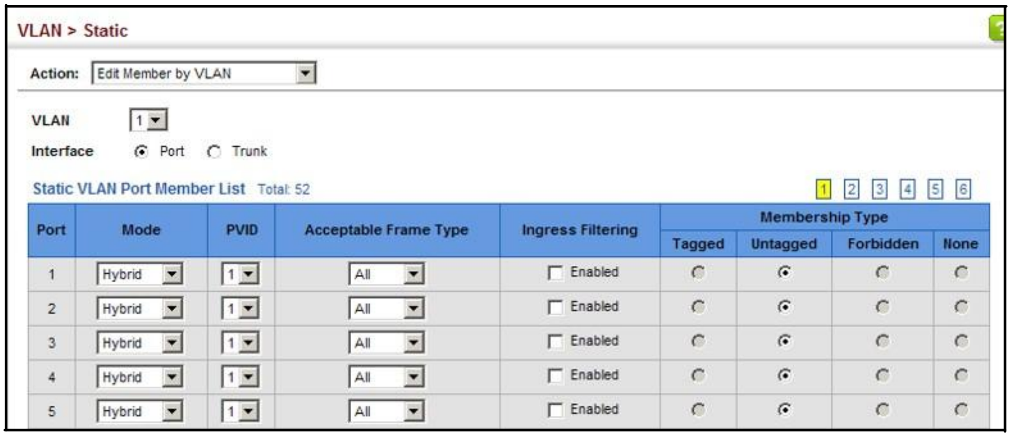
Note: The PVID, acceptable frame type, and ingress filtering parameters for each interface within the specified range must be configured on either the Edit Member by VLAN or Edit Member by Interface page.

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. Set the Interface type to display as Port or Trunk.
4. Modify the settings for any interface as required.
5. Click Apply.

Figure 67: Configuring Static Members by VLAN Index



VLAN > Static

Action: Edit Member by VLAN

VLAN 1

Interface ● Port ○ Trunk

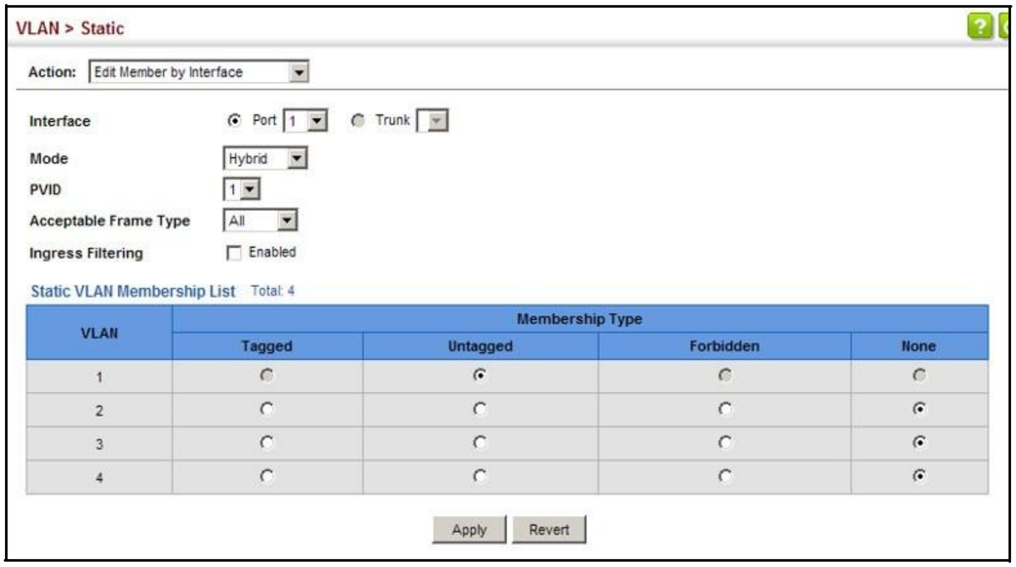
Static VLAN Port Member List Total: 52

Port	Mode	PVID	Acceptable Frame Type	Ingress Filtering	Membership Type			
					Tagged	Untagged	Forbidden	None
1	Hybrid	1	All	□ Enabled	○	●	○	○
2	Hybrid	1	All	□ Enabled	○	●	○	○
3	Hybrid	1	All	□ Enabled	○	●	○	○
4	Hybrid	1	All	□ Enabled	○	●	○	○
5	Hybrid	1	All	□ Enabled	○	●	○	○

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 68: Configuring Static VLAN Members by Interface



Action: Edit Member by Interface

Interface ● Port 1 ○ Trunk

Mode: Hybrid

PVID: 1

Acceptable Frame Type: All

Ingress Filtering: □ Enabled

Static VLAN Membership List Total: 4

VLAN	Membership Type			
	Tagged	Untagged	Forbidden	None
1	○	●	○	○
2	○	○	○	●
3	○	○	○	●
4	○	○	○	●

To configure static members by interface range:

1. Click VLAN, Static.

2. Select Edit Member by Interface Range from the Action list.

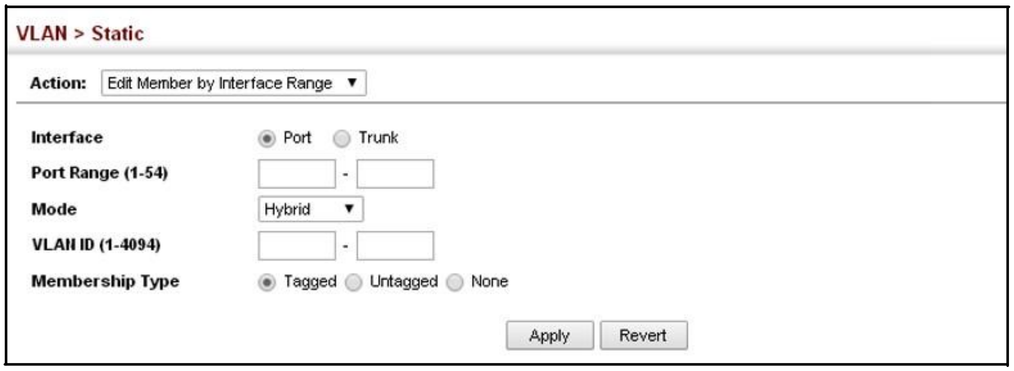
3. Set the Interface type to display as Port or Trunk.

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 69: Configuring Static VLAN Members by Interface Range



Action: Edit Member by Interface Range

Interface ● Port ○ Trunk

Port Range (1-54) _____ - _____

Mode: Hybrid

VLAN ID (1-4094) _____ - _____

Membership Type ● Tagged ○ Untagged ○ None

6

AddressTable 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 135) 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.

Parameters

These parameters are displayed:

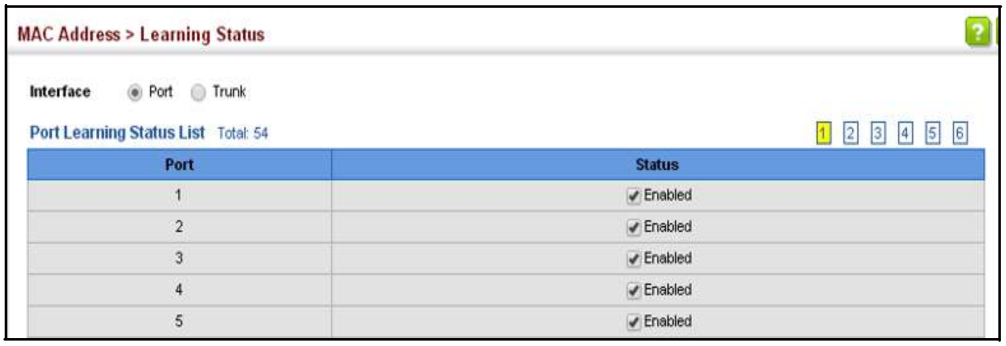
- **Interface** – Displays a list of ports or trunks.
- **Port** – Port Identifier. (Range: 1-32/54)
- **Trunk** – Trunk Identifier. (Range: 1-~~16/~~27)
- **Status** – The status of MAC address learning. (Default: Enabled)

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 70: Configuring MAC Address Learning



MAC Address > Learning Status

Interface ● Port ○ Trunk

Port Learning Status List Total: 54

Port	Status
1	☑ Enabled
2	☑ Enabled
3	☑ Enabled
4	☑ Enabled
5	☑ 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:

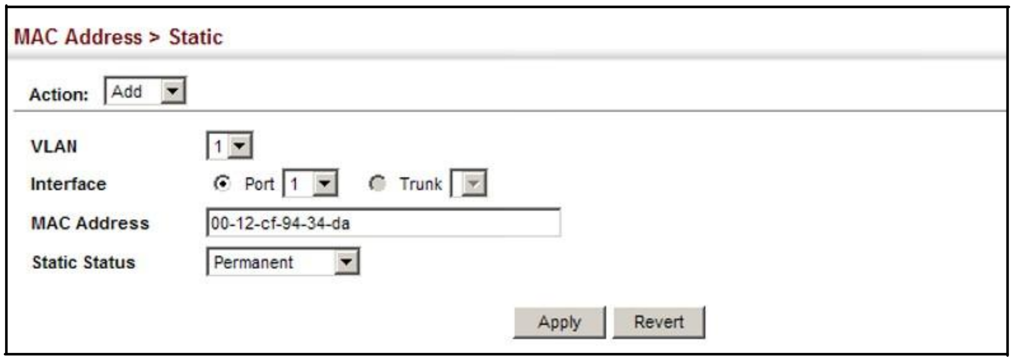
- **VLAN** – ID of configured VLAN. (Range: 1-4094)
- **Interface** – Port or trunk associated with the device assigned a static address.
- **MAC Address** – Physical address of a device mapped to this interface. Enter an address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.
- **Static Status** – 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.)

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 71: Configuring Static MAC Addresses



MAC Address > Static

Action: Add

VLAN 1

Interface ● Port 1 ○ Trunk

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

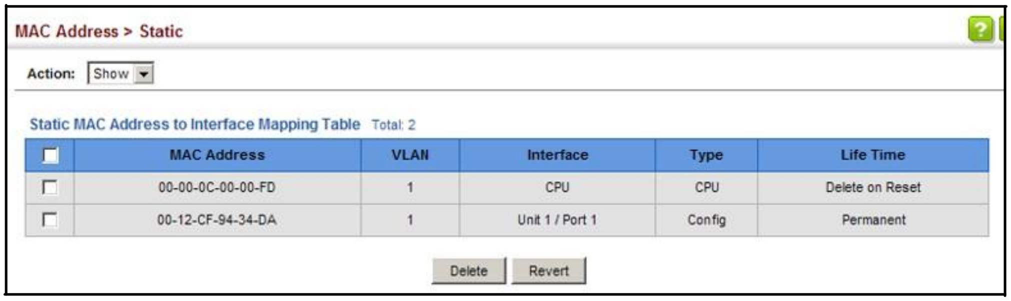
Static Status Permanent

To show the static addresses in MAC address table:

1. Click MAC Address, Static.

2. Select Show from the Action list.

Figure 72: Displaying Static MAC Addresses



MAC Address > Static

Action: Show

Static MAC Address to Interface Mapping Table Total: 2

□	MAC Address	VLAN	Interface	Type	Life Time
□	00-00-0C-00-00-FD	1	CPU	CPU	Delete on Reset
□	00-12-CF-94-34-DA	1	Unit 1 / Port 1	Config	Permanent

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.

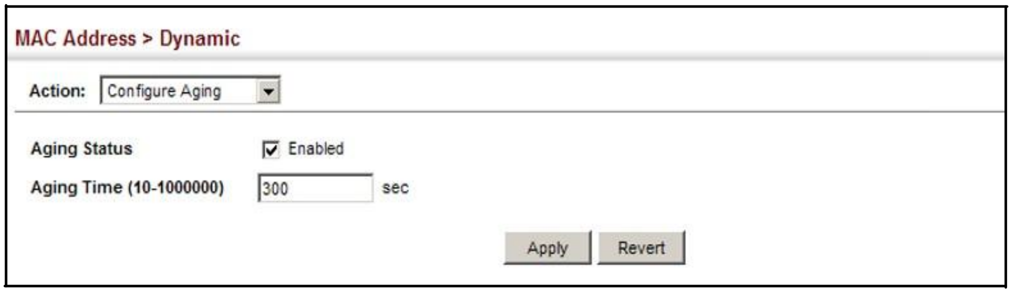
- **Aging Time** – The time after which a learned entry is discarded. (Range: 10-1000000 seconds; Default: 300 seconds)

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 73: Setting the Address Aging Time



MAC Address > Dynamic

Action: Configure Aging

Aging Status ☑ Enabled

Aging Time (10-1000000) 300 sec

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.
- **Life Time** – Shows the time to retain the specified address.

Web Interface

To show the dynamic address table:

1. Click MAC Address, Dynamic.

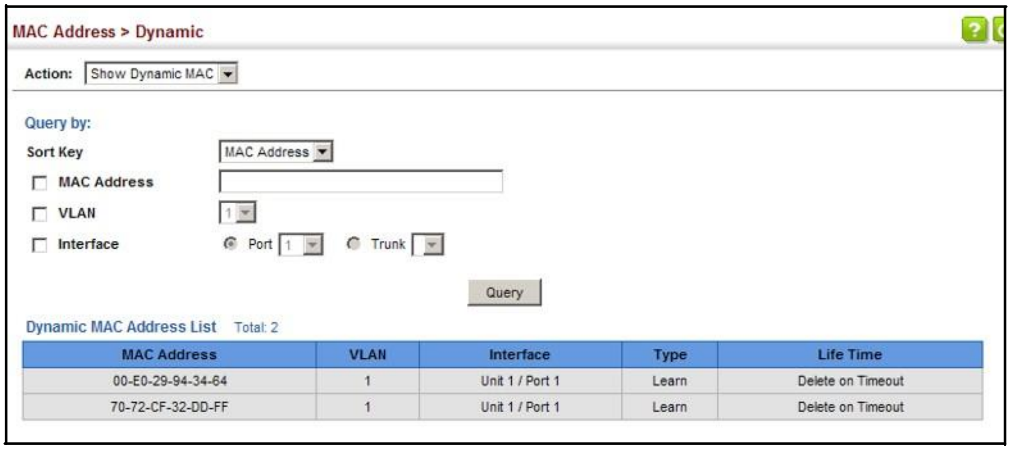
2. Select Show Dynamic MAC from the Action list.

3. Select the Sort Key (MAC Address, VLAN, or Interface).

4. Enter the search parameters (MAC Address, VLAN, or Interface).

5. Click Query.

Figure 74: Displaying the Dynamic MAC Address Table



MAC Address > Dynamic

Action: Show Dynamic MAC

Query by:

Sort Key: MAC Address

□ MAC Address

□ VLAN: 1

□ Interface: ● Port 1 ○ Trunk

Dynamic MAC Address List Total: 2

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.

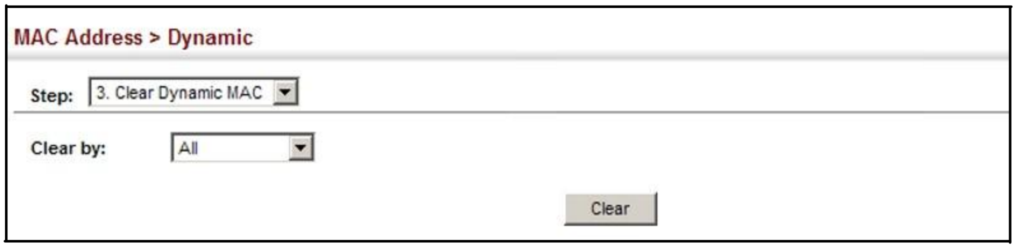
2. Select Clear Dynamic MAC from the Action list.

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 75: Clearing Entries in the Dynamic MAC Address Table



MAC Address > Dynamic

Step: 3. Clear Dynamic MAC

Clear by: All

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: 1-32/54)

- **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:

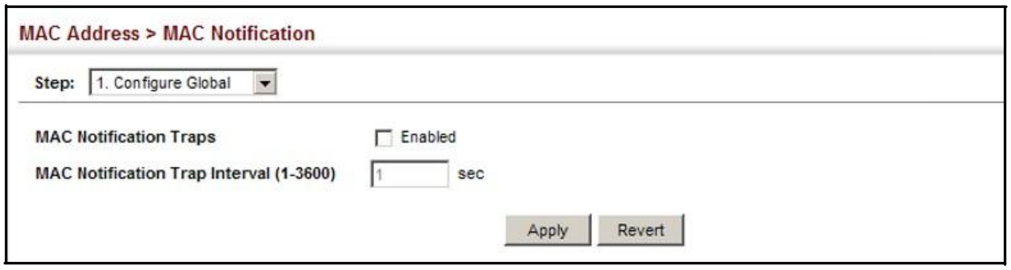
1. Click MAC Address, MAC Notification.

2. Select Configure Global from the Step list.

3. Configure MAC notification traps and the transmission interval.

4. Click Apply.

Figure 76: Issuing MAC Address Traps (Global Configuration)



MAC Address > MAC Notification

Step: 1. Configure Global

MAC Notification Traps □ Enabled

MAC Notification Trap Interval (1-3600) 1 sec

To enable MAC address traps at the interface level:

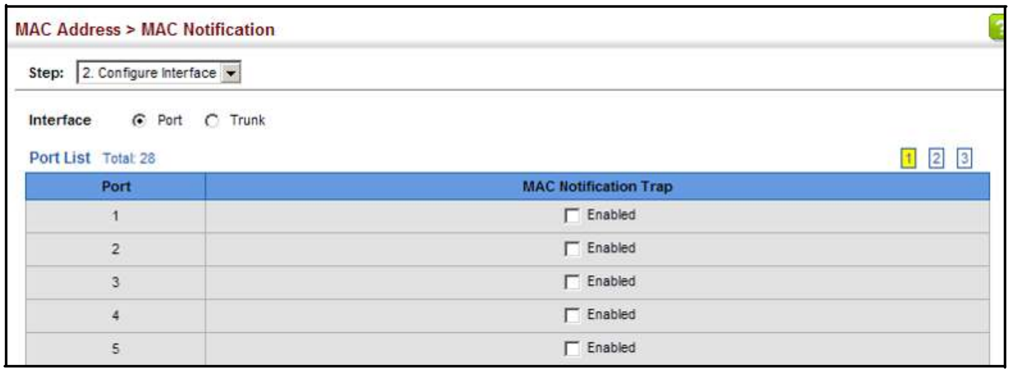
1. Click MAC Address, MAC Notification.

2. Select Configure Interface from the Step list.

3. Enable MAC notification traps for the required ports.

4. Click Apply.

Figure 77: Issuing MAC Address Traps (Interface Configuration)



MAC Address > MAC Notification

Step: 2. Configure Interface

Interface ● Port ○ Trunk

Port List Total: 28

Port	MAC Notification Trap
1	□ Enabled
2	□ Enabled
3	□ Enabled
4	□ Enabled
5	□ Enabled

7 Spanning Tree Algorithm

This chapter describes the following basic topics:

- 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

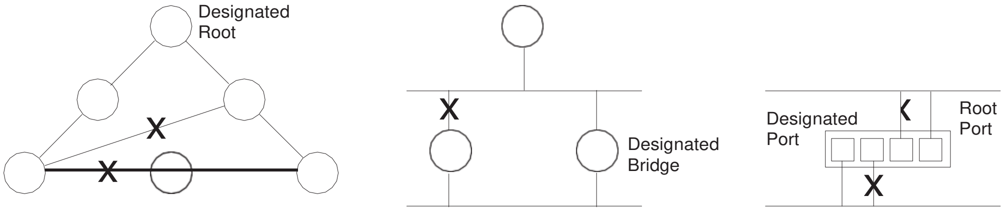
The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only 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 78: STP Root Ports and Designated Ports

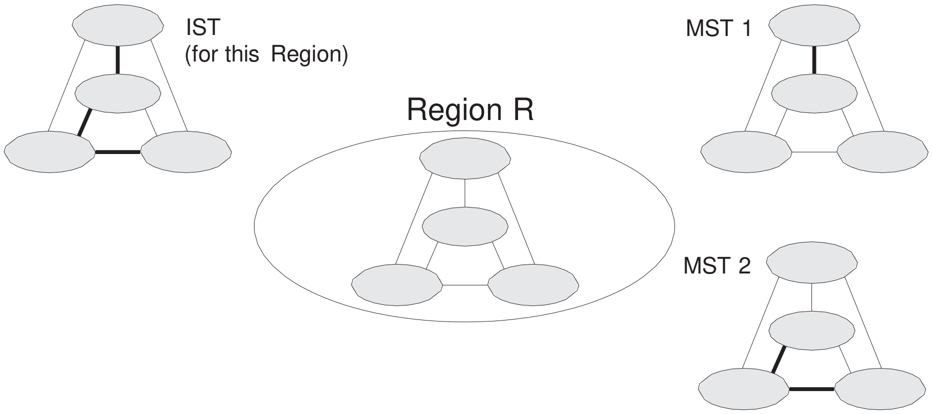


Once a stable network topology has been established, all bridges listen for Hello BPDUs (Bridge Protocol Data Units) transmitted from the Root Bridge. If a bridge does not get a Hello BPDU after a predefined interval (Maximum Age), the bridge assumes that the link to the Root Bridge is down. This bridge 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 a Internal Spanning Tree (IST) for the Region containing all commonly configured MSTP bridges.

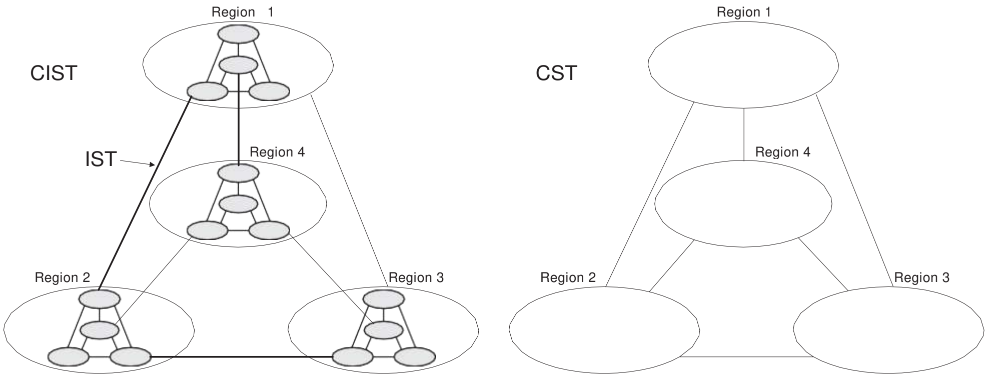
Figure 79: MSTP Region, Internal Spanning Tree, Multiple Spanning Tree



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 155). 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 80: Common Internal Spanning Tree, Common Spanning Tree, Internal Spanning Tree



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 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 Protocol[2]

  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.

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

- Rapid Spanning Tree Protocol[2]

  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, 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: Enabled)

- **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

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 [(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 x (Hello Time + 1)]
  - Maximum: The lower of 40 or [2 x (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 [(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**[3] – The revision for this MSTI. (Range: 0-65535; Default: 0)
- **Region Name**[3] – The name for this MSTI. (Maximum length: 32 characters; 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)

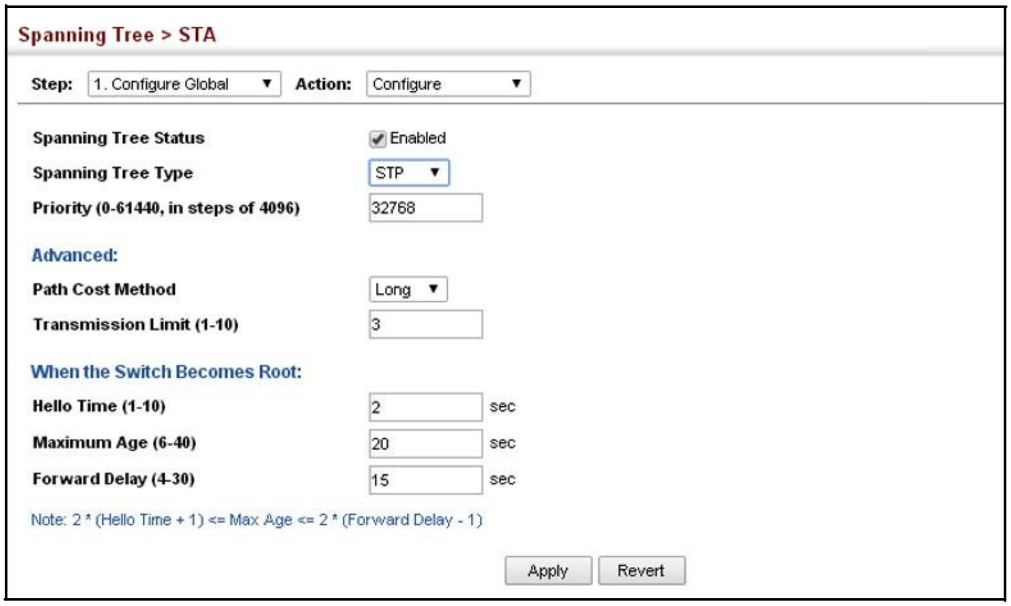
Web Interface

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. 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

[3] The MST name and revision number are both required to uniquely identify an MST region.

Figure 81: Configuring Global Settings for STA (STP)



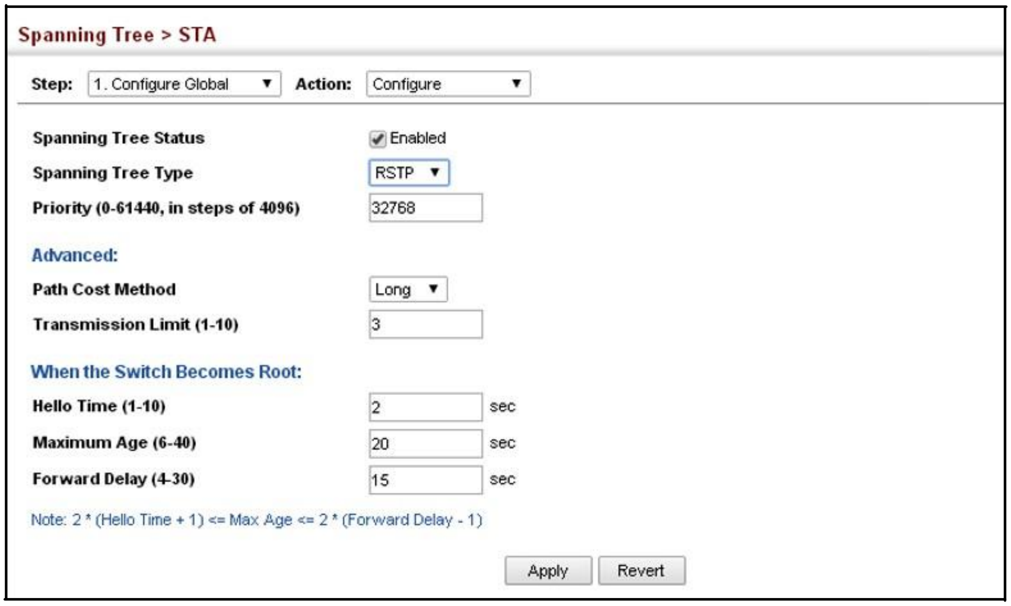
Spanning Tree Status ☑ Enabled
Spanning Tree Type STP
Priority (0-61440, in steps of 4096) 32768

Advanced:
Path Cost Method Long
Transmission Limit (1-10) 3

When the Switch Becomes Root:
Hello Time (1-10) 2 sec
Maximum Age (6-40) 20 sec
Forward Delay (4-30) 15 sec

Note: 2 * (Hello Time + 1) <= Max Age <= 2 * (Forward Delay - 1)

Figure 82: Configuring Global Settings for STA (RSTP)



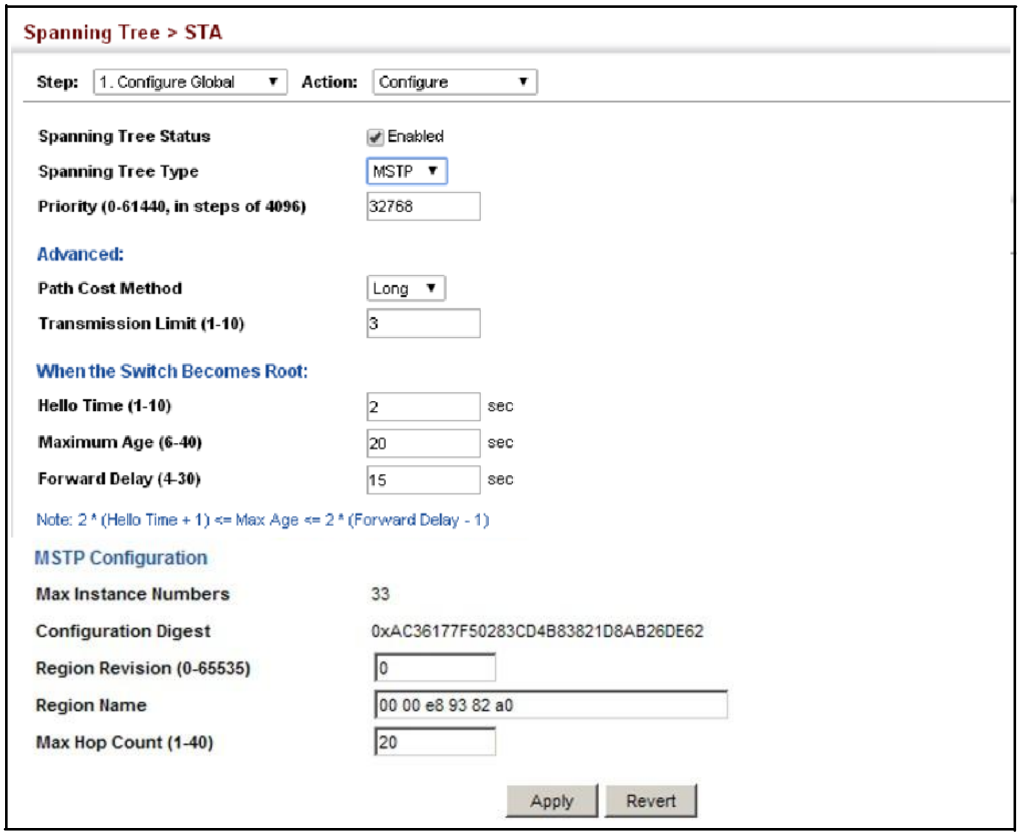
Spanning Tree Status ☑ Enabled
Spanning Tree Type RSTP
Priority (0-61440, in steps of 4096) 32768

Advanced:
Path Cost Method Long
Transmission Limit (1-10) 3

When the Switch Becomes Root:
Hello Time (1-10) 2 sec
Maximum Age (6-40) 20 sec
Forward Delay (4-30) 15 sec

Note: 2 * (Hello Time + 1) <= Max Age <= 2 * (Forward Delay - 1)

Figure 83: Configuring Global Settings for STA (MSTP)



Spanning Tree > STA

Step: 1. Configure Global ▼ Action: Configure ▼

Spanning Tree Status	☑ Enabled
Spanning Tree Type	MSTP ▼
Priority (0-61440, in steps of 4096)	32768

Advanced:

Path Cost Method	Long ▼
Transmission Limit (1-10)	3

When the Switch Becomes Root:

Hello Time (1-10)	2 sec
Maximum Age (6-40)	20 sec
Forward Delay (4-30)	15 sec

Note: 2 * (Hello Time + 1) <= Max Age <= 2 * (Forward Delay - 1)

MSTP Configuration

Max Instance Numbers	33
Configuration Digest	0xAC36177F50283CD4B83821D8AB26DE62
Region Revision (0-65535)	0
Region Name	00 00 e8 93 82 a0
Max Hop Count (1-40)	20

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.

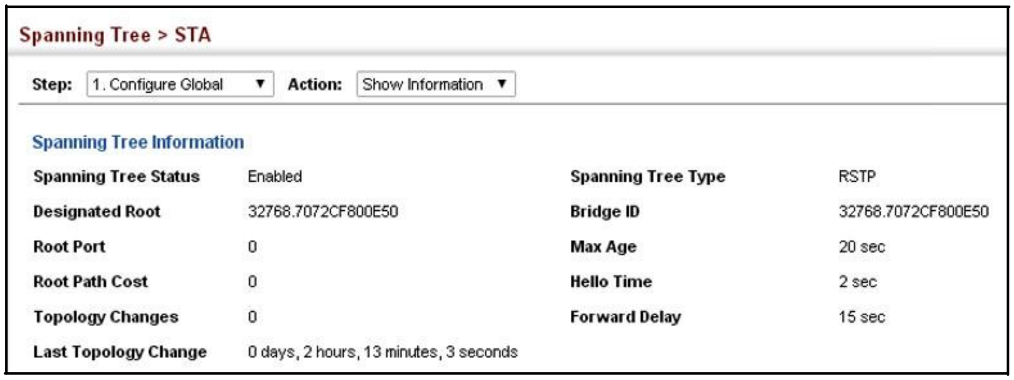
- **Root Path Cost** – The path cost from the root port on this switch to the root device.
- **Topology Changes** – The number of times the Spanning Tree has been reconfigured.
- **Last Topology Change** – Time since the Spanning Tree was last reconfigured.

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 84: Displaying Global Settings for STA



Spanning Tree > STA

Step: 1. Configure Global ▼ Action: Show Information ▼

Spanning Tree Information

Spanning Tree Status	Enabled	Spanning Tree Type	RSTP
Designated Root	32768.7072CF800E50	Bridge ID	32768.7072CF800E50
Root Port	0	Max Age	20 sec
Root Path Cost	0	Hello Time	2 sec
Topology Changes	0	Forward Delay	15 sec
Last Topology Change	0 days, 2 hours, 13 minutes, 3 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)

- **BPDU Flooding** - Enables/disables the flooding of BPDUs to other ports when global spanning tree is disabled (page 143) or when spanning tree is disabled on 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 143).

- **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 method[4], 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 10: 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
Gigabit Ethernet	3-10	2,000-200,000
10G Ethernet	1-5	200-20,000
40G Ethernet	1-65535[1]	20-2,000[1]

[1] Undefined in standard.

Table 11: Default STA Path Costs

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

[4] Refer to "Configuring Global Settings for STA" on page 143 for information on setting the path cost method.

Table 11: Default STA Path Costs

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (802.1D-2004)
Gigabit Ethernet	10,000	10,000
10G Ethernet	1,000	1,000
40G Ethernet	65535[1]	2,000,000[2]

[1] Undefined in standard, but recommended setting is 250.

[2] Code does not support 40G path cost, and therefore defaults to 10M half duplex cost.

- **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.)
- **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 143).

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

  - If spanning tree mode is set to STP (page 143), edge-port mode cannot automatically transition to operational edge-port state using the automatic setting.
  - 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 152).

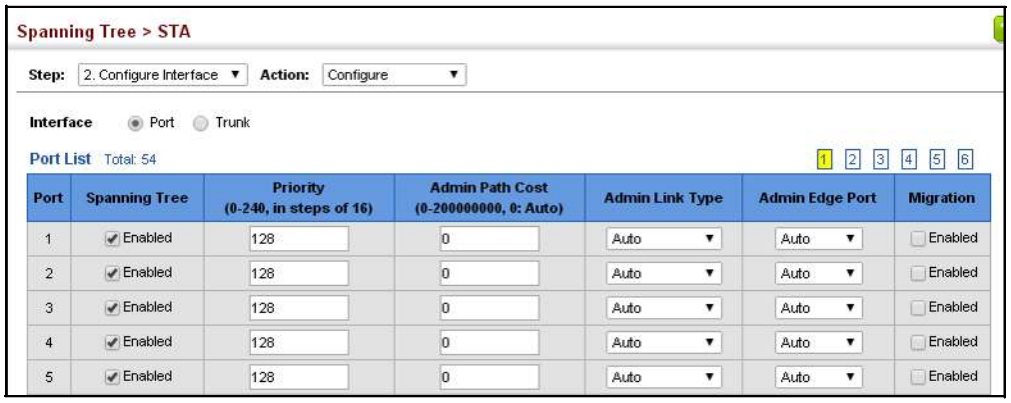
- **Migration** – If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the Protocol Migration button to manually re-check the appropriate BPDU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

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 85: Configuring Interface Settings for STA



Spanning Tree > STA

Step: 2. Configure Interface ▼ Action: Configure ▼

Interface ● Port ○ Trunk

Port List Total: 54

Port	Spanning Tree	Priority (0-240, in steps of 16)	Admin Path Cost (0-200000000, 0: Auto)	Admin Link Type	Admin Edge Port	Migration
1	☑ Enabled	128	0	Auto ▼	Auto ▼	□ Enabled
2	☑ Enabled	128	0	Auto ▼	Auto ▼	□ Enabled
3	☑ Enabled	128	0	Auto ▼	Auto ▼	□ Enabled
4	☑ Enabled	128	0	Auto ▼	Auto ▼	□ Enabled
5	☑ Enabled	128	0	Auto ▼	Auto ▼	□ 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.

- **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.

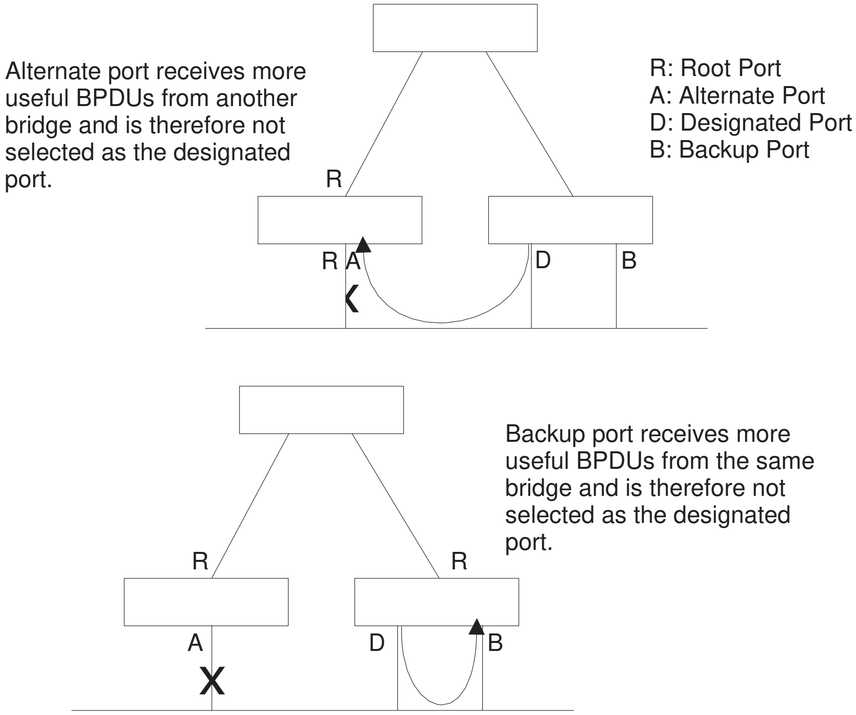
  The rules defining port status are:

  - 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 149.
- **Oper Edge Port** – This parameter is initialized to the setting for Admin Edge Port in STA Port Configuration on page 149 (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 connecting the 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 86: STA Port Roles

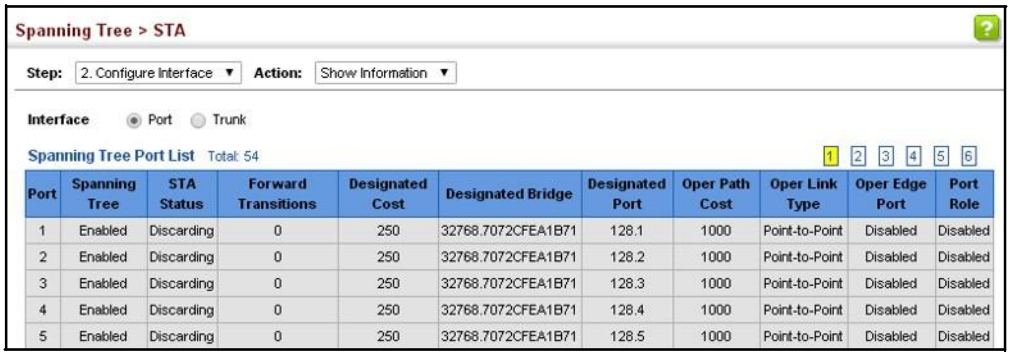

Alternate port receives more useful BPDUs from another bridge and is therefore not selected as the designated port.
R: Root Port
A: Alternate Port
D: Designated Port
B: Backup Port
R
R
A
D
B
Backup port receives more useful BPDUs from the same bridge and is therefore not selected as the designated port.
R
R
A
D
B
X

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 87: Displaying Interface Settings for STA



Spanning Tree > STA

Step: 2. Configure Interface Action: Show Information

Interface ● Port ○ Trunk

Spanning Tree Port List Total: 54

Port	Spanning Tree	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Path Cost	Oper Link Type	Oper Edge Port	Port Role
1	Enabled	Discarding	0	250	32768.7072CFEA1B71	128.1	1000	Point-to-Point	Disabled	Disabled
2	Enabled	Discarding	0	250	32768.7072CFEA1B71	128.2	1000	Point-to-Point	Disabled	Disabled
3	Enabled	Discarding	0	250	32768.7072CFEA1B71	128.3	1000	Point-to-Point	Disabled	Disabled
4	Enabled	Discarding	0	250	32768.7072CFEA1B71	128.4	1000	Point-to-Point	Disabled	Disabled
5	Enabled	Discarding	0	250	32768.7072CFEA1B71	128.5	1000	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 143) 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 143).

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:

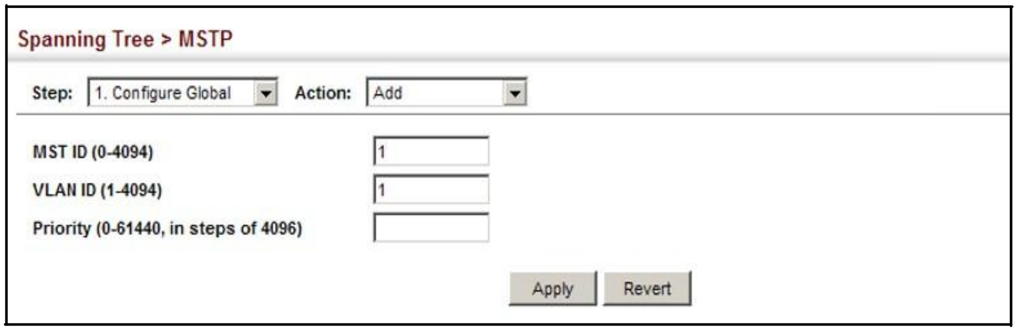
- **MST ID** – Instance identifier to configure. (Range: 0-4094)
- **VLAN ID** – VLAN to assign to this MST instance. (Range: 1-4094)
- **Priority** – The priority of a spanning tree instance. (Range: 0-61440 in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 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 88: Creating an MST Instance



Spanning Tree > MSTP

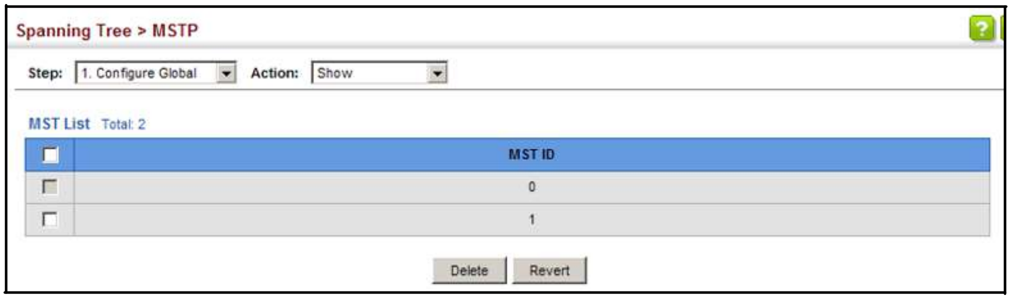
Step: 1. Configure Global Action: Add

MST ID (0-4094)	1
VLAN ID (1-4094)	1
Priority (0-61440, in steps of 4096)	

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 89: Displaying MST Instances



Spanning Tree > MSTP

Step: 1. Configure Global Action: Show

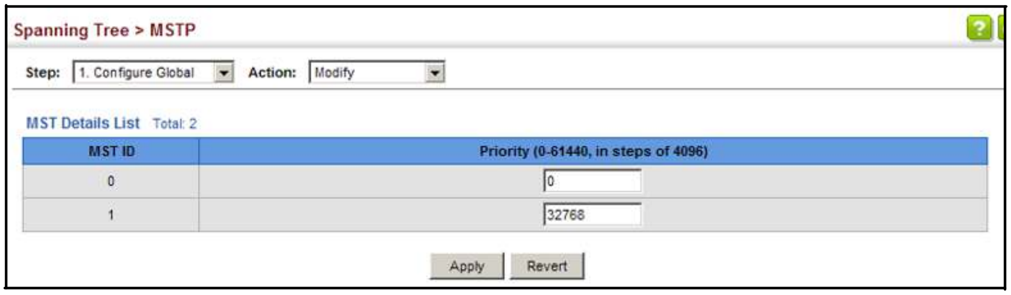
MST List Total: 2

□	MST ID
□	0
□	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 90: Modifying the Priority for an MST Instance



Spanning Tree > MSTP

Step: 1. Configure Global Action: Modify

MST Details List Total: 2

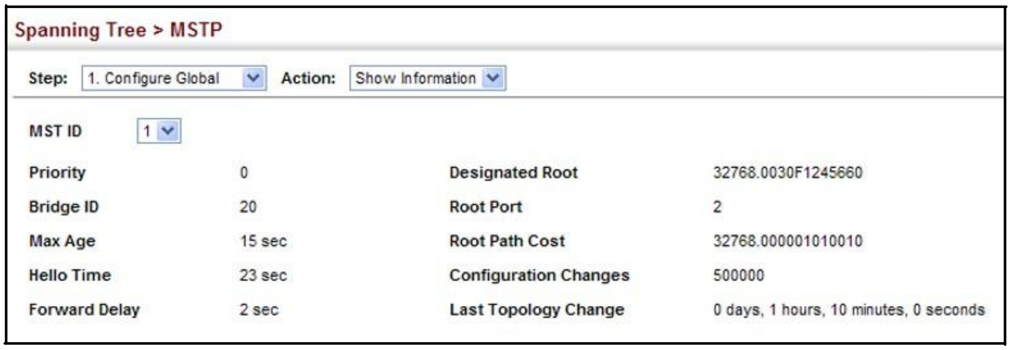
MST ID	Priority (0-61440, in steps of 4096)
0	0
1	32768

To display 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 148.

Figure 91: Displaying Global Settings for an MST Instance



Spanning Tree > MSTP

Step: 1. Configure Global Action: Show Information

MST ID 1

Priority	0	Designated Root	32768.0030F1245660
Bridge ID	20	Root Port	2
Max Age	15 sec	Root Path Cost	32768.000001010010
Hello Time	23 sec	Configuration Changes	500000
Forward Delay	2 sec	Last Topology Change	0 days, 1 hours, 10 minutes, 0 seconds

To add additional VLAN groups to an MSTP instance:

1. Click Spanning Tree, MSTP.

2. Select Configure Global from the Step list.

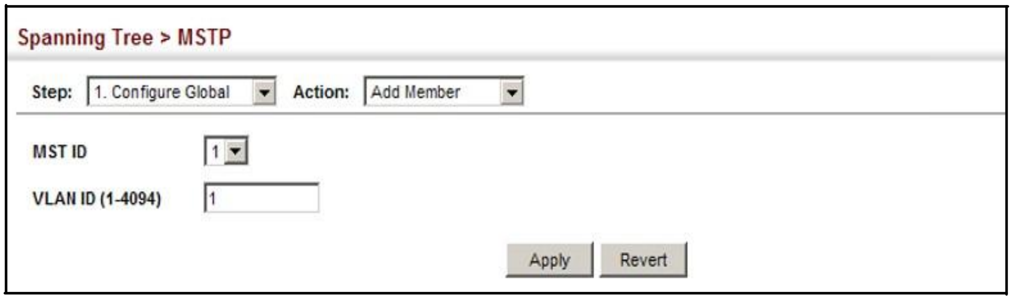
3. Select Add Member from the Action list.

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 92: Adding a VLAN to an MST Instance



Spanning Tree > MSTP

Step: 1. Configure Global Action: Add Member

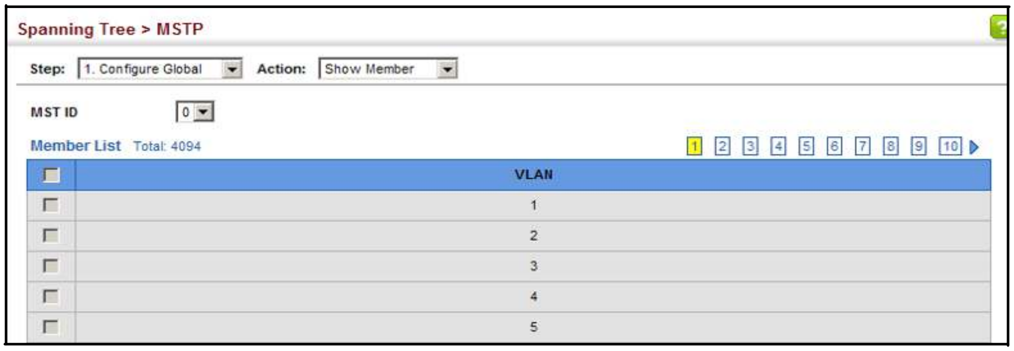
MST ID 1

VLAN ID (1-4094) 1

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 93: Displaying Members of an MST Instance



Spanning Tree > MSTP

Step: 1. Configure Global Action: Show Member

MST ID 0

Member List Total: 4094

□	VLAN
□	1
□	2
□	3
□	4
□	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 152 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 3-63), 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 10 on page 150.

  The default path costs are listed in Table 11 on page 150.

Web Interface

To configure MSTP parameters for a port or trunk:

1. Click Spanning Tree, MSTP.

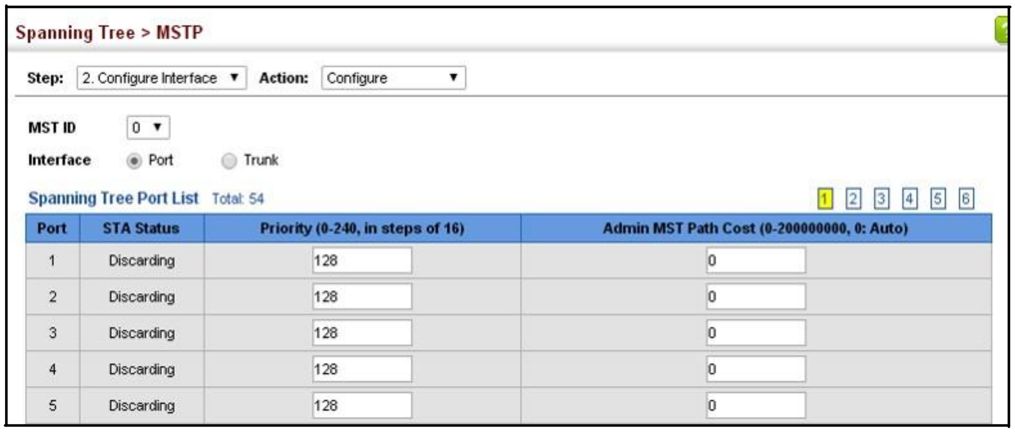
2. Select Configure Interface from the Step list.

3. Select Configure from the Action list.

4. Enter the priority and path cost for an interface

5. Click Apply.

Figure 94: Configuring MSTP Interface Settings



Spanning Tree > MSTP

Step: 2. Configure Interface ▼ Action: Configure ▼

MST ID 0 ▼

Interface ● Port ○ Trunk

Spanning Tree Port List Total: 54

Port	STA Status	Priority (0-240, in steps of 16)	Admin MST Path Cost (0-200000000, 0: Auto)
1	Discarding	128	0
2	Discarding	128	0
3	Discarding	128	0
4	Discarding	128	0
5	Discarding	128	0

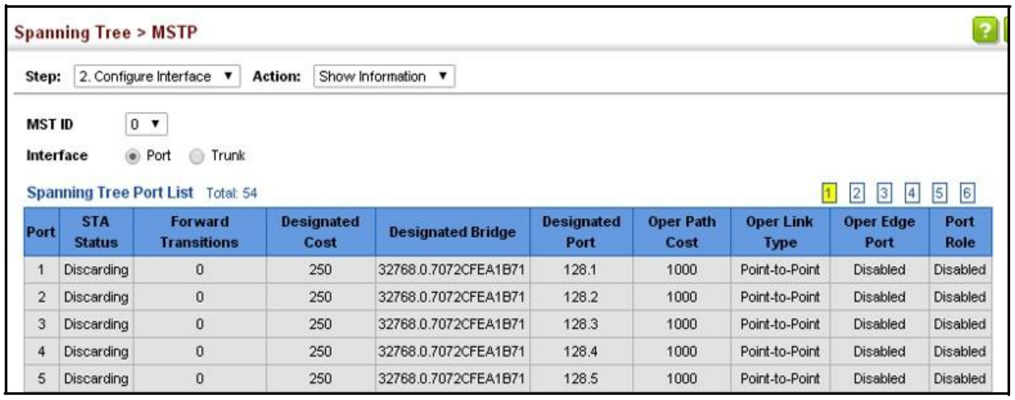
To display MSTP parameters for a port or trunk:

1. Click Spanning Tree, MSTP.

2. Select Configure Interface from the Step list.

3. Select Show Information from the Action list.

Figure 95: Displaying MSTP Interface Settings



Spanning Tree > MSTP

Step: 2. Configure Interface Action: Show Information

MST ID 0

Interface ● Port ○ Trunk

Spanning Tree Port List Total: 54

Port	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Path Cost	Oper Link Type	Oper Edge Port	Port Role
1	Discarding	0	250	32768.0.7072CFEA1B71	128.1	1000	Point-to-Point	Disabled	Disabled
2	Discarding	0	250	32768.0.7072CFEA1B71	128.2	1000	Point-to-Point	Disabled	Disabled
3	Discarding	0	250	32768.0.7072CFEA1B71	128.3	1000	Point-to-Point	Disabled	Disabled
4	Discarding	0	250	32768.0.7072CFEA1B71	128.4	1000	Point-to-Point	Disabled	Disabled
5	Discarding	0	250	32768.0.7072CFEA1B71	128.5	1000	Point-to-Point	Disabled	Disabled

8 Congestion Control

The switch can control traffic storms by setting a maximum threshold for broadcast traffic or multicast traffic.

Congestion Control includes following options:

- Storm Control – Sets the traffic storm threshold for each interface.

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.

Parameters

These parameters are displayed:

- **Interface** – Displays a list of ports or trunks.
- **Type** – Indicates interface type. (1000BASE SFP, 10GBASE SFP+, 40GBASE 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: Enabled for broadcast storm control, disabled for multicast and unknown unicast storm control)

- **Rate** – Threshold level as a rate; i.e., packets per second. (Range: 500-14880000 pps for 10G ports, 500-59520000 pps for 40G ports; Default: Disabled for unknown unicast and multicast traffic, 500 pps for broadcast traffic)

Web Interface

To configure broadcast storm control:

1. Click Traffic, Storm Control.

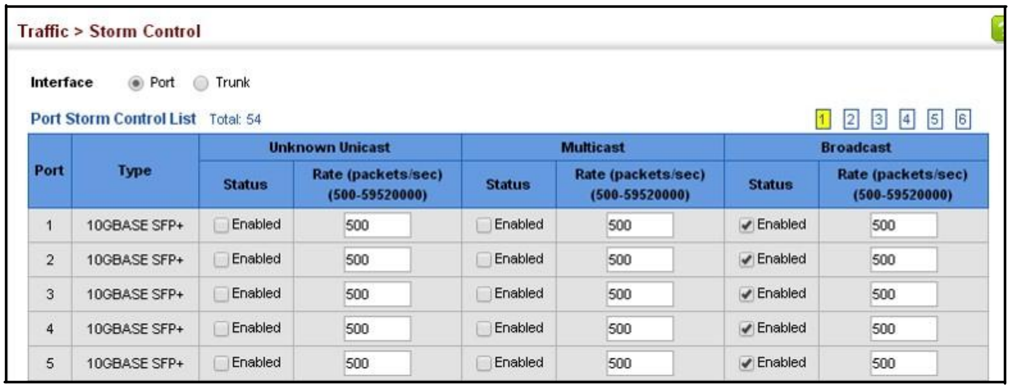
2. Set the interface type to Port or Trunk.

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 96: Configuring Storm Control



Traffic > Storm Control

Interface ● Port ○ Trunk

Port Storm Control List Total: 54

Port	Type	Unknown Unicast		Multicast		Broadcast	
		Status	Rate (packets/sec) (500-59520000)	Status	Rate (packets/sec) (500-59520000)	Status	Rate (packets/sec) (500-59520000)
1	10GBASE SFP+	□ Enabled	500	□ Enabled	500	☑ Enabled	500
2	10GBASE SFP+	□ Enabled	500	□ Enabled	500	☑ Enabled	500
3	10GBASE SFP+	□ Enabled	500	□ Enabled	500	☑ Enabled	500
4	10GBASE SFP+	□ Enabled	500	□ Enabled	500	☑ Enabled	500
5	10GBASE SFP+	□ Enabled	500	□ Enabled	500	☑ Enabled	500

9

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:

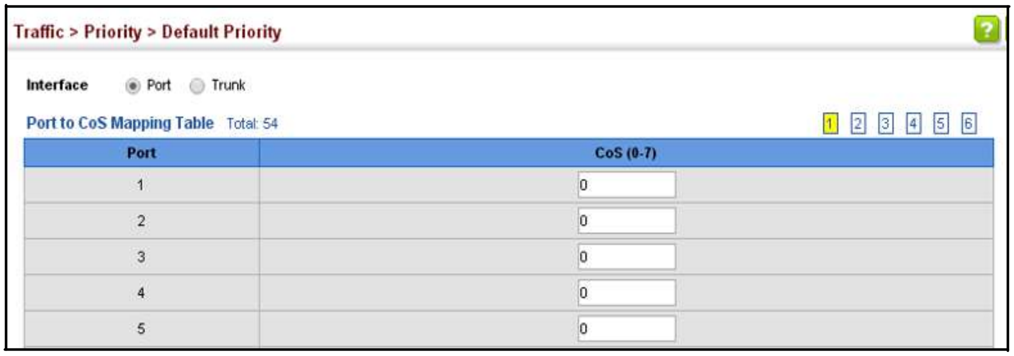
- **Interface** – Displays a list of ports or trunks.
- **CoS** – The priority that is assigned to untagged frames received on the specified interface. (Range: 0-7; Default: 0)

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 97: Setting the Default Port Priority



Traffic > Priority > Default Priority

Interface ● Port ○ Trunk

Port to CoS Mapping Table Total: 54

Port	CoS (0-7)
1	0
2	0
3	0
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 and weighted service is used as specified for each queue. 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 the queuing modes that use a combination of strict and weighted queuing. Service time is allocated to each queue by calculating a precise number of bytes per second that will be serviced on each round.

Parameters

These parameters are displayed:

- **Interface** – Port or trunk identifier.

- **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 or weighted service as specified for each queue.

- **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 and weighted service is used as specified for each queue. Use this parameter to specify the queues assigned to use strict priority when using the strict-weighted queuing mode. (Default: Enabled on queue 1, disabled on all others)

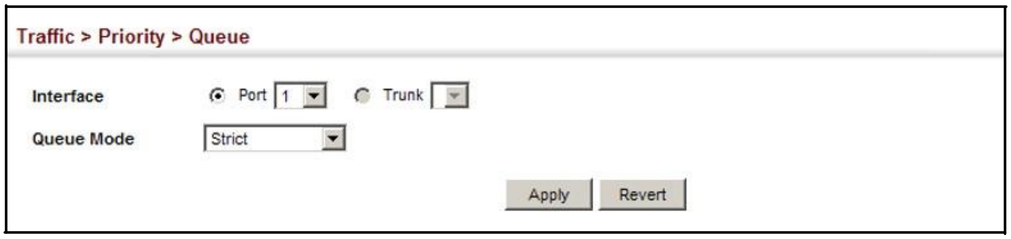
- **Weight** – Sets a weight for each queue which is used by the WRR scheduler. (Range: 1-15; Default: Weights 1, 2, 4, 6, 8, 10, 12 and 14 are assigned to queues 0 - 7 respectively)

Web Interface

To configure the queue mode:

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

Figure 98: Setting the Queue Mode (Strict)

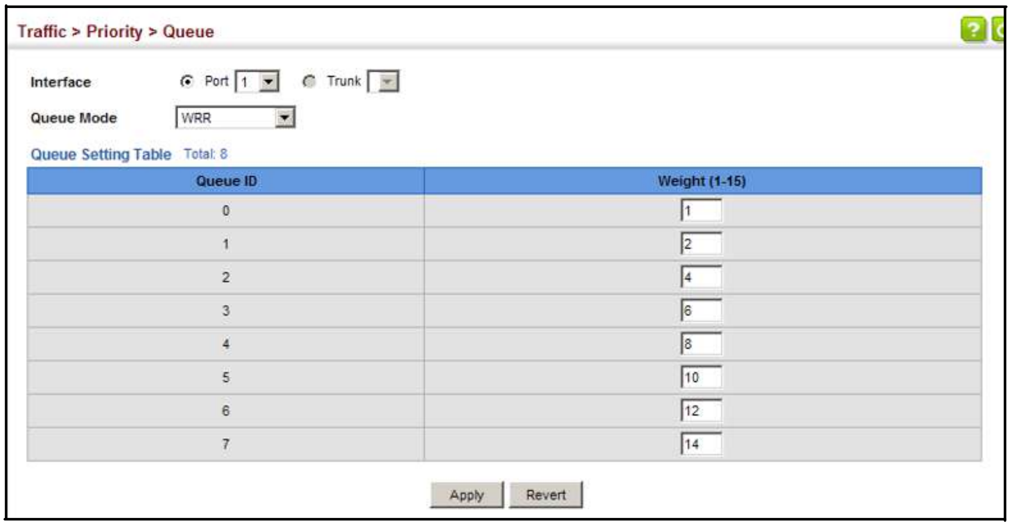


Traffic > Priority > Queue

Interface ● Port 1 ○ Trunk

Queue Mode Strict

Figure 99: Setting the Queue Mode (WRR)



Traffic > Priority > Queue

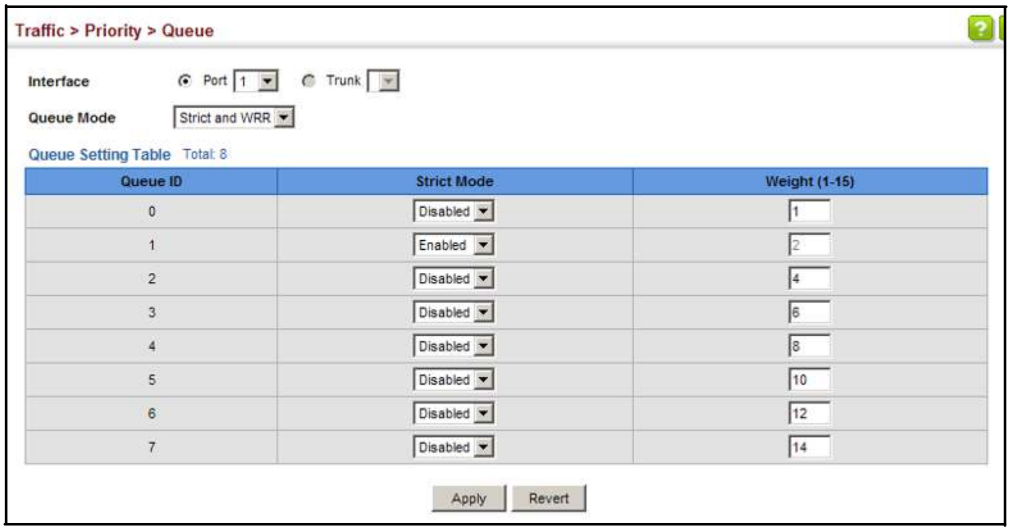
Interface ● Port 1 ○ Trunk

Queue Mode WRR

Queue Setting Table Total: 8

Queue ID	Weight (1-15)
0	1
1	2
2	4
3	6
4	8
5	10
6	12
7	14

Figure 100: Setting the Queue Mode (Strict and WRR)



Traffic > Priority > Queue

Interface ● Port 1 ○ Trunk

Queue Mode Strict and WRR

Queue Setting Table Total: 8

Queue ID	Strict Mode	Weight (1-15)
0	Disabled	1
1	Enabled	2
2	Disabled	4
3	Disabled	6
4	Disabled	8
5	Disabled	10
6	Disabled	12
7	Disabled	14

Mapping CoS Values to Egress Queues

Use the Traffic > Priority > PHB to Queue page to specify the hardware output queues to use based on the internal per-hop behavior value. (For more information on exact manner in which the ingress priority tags are mapped to egress queues for internal processing, see "Mapping CoS Priorities to Internal DSCP Values" on page 176).

The switch processes Class of Service (CoS) priority tagged traffic by using eight priority queues for each port, with service schedules based on strict priority, Weighted Round-Robin (WRR), or a combination of strict and weighted queuing. Up to eight separate traffic priorities are defined in IEEE 802.1p. Default priority levels are assigned according to recommendations in the IEEE 802.1p standard as shown in Table 12. The following table indicates the default mapping of internal per-hop behavior to the hardware queues. The actual mapping may differ if the CoS priorities to internal DSCP values have been modified (page 176).

Table 12: IEEE 802.1p Egress Queue Priority Mapping

Priority	0	1	2	3	4	5	6	7
Queue	2	0	1	3	4	5	6	7

The priority levels recommended in the IEEE 802.1p standard for various network applications are shown in Table 13. However, priority levels can be mapped to the switch's output queues in any way that benefits application traffic for the network.

Table 13: CoS Priority Levels

Priority Level	Traffic Type
1	Background
2	(Spare)
0 (default)	Best Effort
3	Excellent Effort
4	Controlled Load
5	Video, less than 100 milliseconds latency and jitter
6	Voice, less than 10 milliseconds latency and jitter
7	Network Control

Command Usage

- Egress packets are placed into the hardware queues according to the mapping defined by this command.
- The default internal PHB to output queue mapping is shown below.

Table 14: Mapping Internal Per-hop Behavior to Hardware Queues

Per-hop Behavior	0	1	2	3	4	5	6	7
Hardware Queues	2	0	1	3	4	5	6	7

- The specified mapping applies to all interfaces.

Parameters

These parameters are displayed:

- **PHB** – Per-hop behavior, or the priority used for this router hop. (Range: 0-7, where 7 is the highest priority)
- **Queue** – Output queue buffer. (Range: 0-7, where 7 is the highest CoS priority queue)

Web Interface

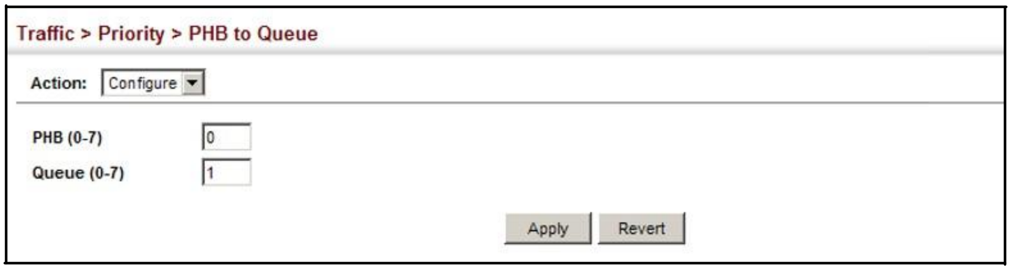
To map internal PHB to hardware queues:

1. Click Traffic, Priority, PHB to Queue.
2. Select Configure from the Action list.

3. Map an internal PHB to a hardware queue. Depending on how an ingress packet is processed internally based on its CoS value, and the assigned output queue, the mapping done on this page can effectively determine the service priority for different trafficclasses.

4. ClickApply.

Figure 101: Mapping CoS Values to Egress Queues



Traffic > Priority > PHB to Queue

Action: Configure

PHB (0-7): 0

Queue (0-7): 1

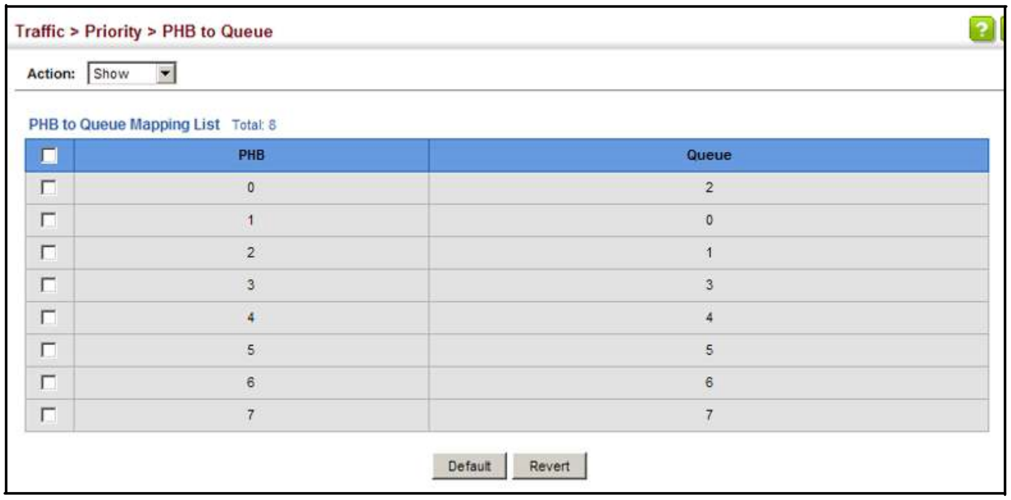
To show the internal PHB to hardware queue map:

1. Click Traffic, Priority, PHB toQueue.

2. Select Show from the Action list.

3. Select an interface.

Figure 102: Showing CoS Values to Egress Queue Mapping



Traffic > Priority > PHB to Queue

Action: Show

PHB to Queue Mapping List Total: 8

□	PHB	Queue
□	0	2
□	1	0
□	2	1
□	3	3
□	4	4
□	5	5
□	6	6
□	7	7

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 IP Precedence/DSCP or CoS

The switch allows a choice between using IP Precedence, 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 IP Precedence, and the ingress packet type is IPv4, then priority processing will be based on the IP Precedence value in the ingress packet.

- 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 either IP Precedence or 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 165) 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 165) is used for priority processing.

Parameters

These parameters are displayed:

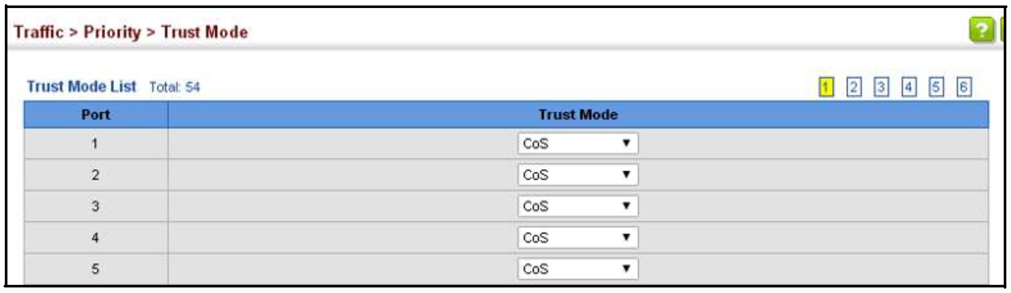
- **Interface** – Specifies a port or trunk.
- **Trust Mode**
  - **CoS** – Maps layer 3/4 priorities using Class of Service values. (This is the default setting.)
  - **DSCP** – Maps layer 3/4 priorities using Differentiated Services Code Point values.
  - **IP Precedence** – Maps layer 3/4 priorities using IP Precedence values.

Web Interface

To configure the trust mode:

1. Click Traffic, Priority, Trust Mode.
2. Select the interface type to display (Port or Trunk).
3. Set the trust mode.
4. Click Apply.

Figure 103: Setting the Trust Mode



Traffic > Priority > Trust Mode

Trust Mode List Total: 54

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 172), 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 15: 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, ingress-dscp = ingress-dscp10 * 10 + ingress-dscp1);
and the corresponding internal-dscp is shown at the intersecting cell in the table.

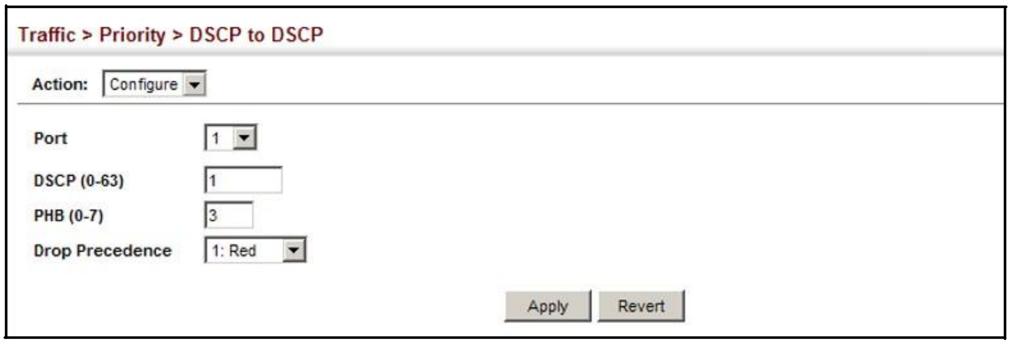
The ingress DSCP is bitwise ANDed with the binary value 11 to determine the drop precedence. If the resulting value is 10 binary, then the drop precedence is set to 0.

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 a port.
4. Set the PHB and drop precedence for any DSCP value.
5. Click Apply.

Figure 104: Configuring DSCP to DSCP Internal Mapping



Traffic > Priority > DSCP to DSCP

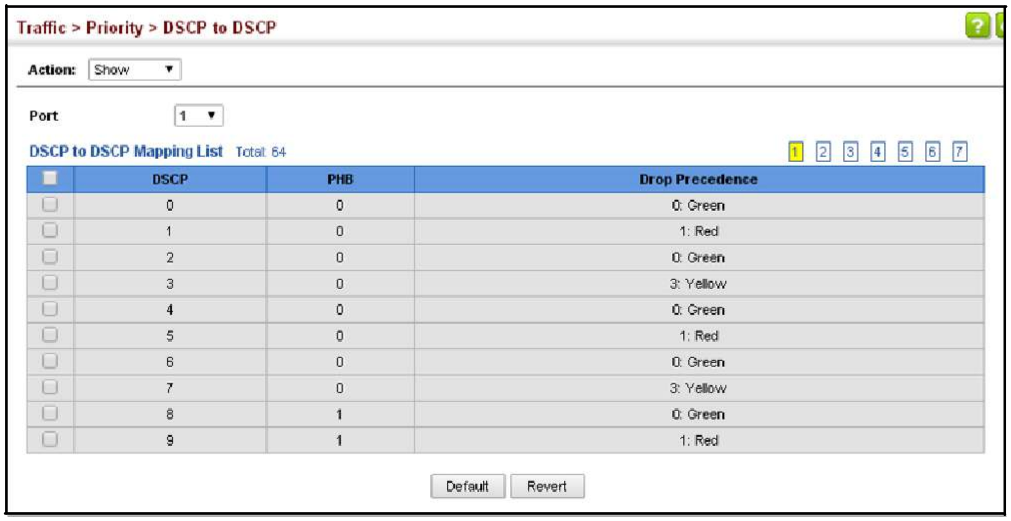
Action: Configure

Port: 1
DSCP (0-63): 1
PHB (0-7): 3
Drop Precedence: 1: Red

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

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

Figure 105: Showing DSCP to DSCP Internal Mapping



Traffic > Priority > DSCP to DSCP

Action: Show

Port: 1

DSCP to DSCP Mapping List Total: 64

□	DSCP	PHB	Drop Precedence
□	0	0	0: Green
□	1	0	1: Red
□	2	0	0: Green
□	3	0	3: Yellow
□	4	0	0: Green
□	5	0	1: Red
□	6	0	0: Green
□	7	0	3: Yellow
□	8	1	0: Green
□	9	1	1: Red

Mapping CoS Priorities to Internal DSCP Values

Use the Traffic > Priority > CoS to DSCP page to maps 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 16 on page 176.
- 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 specified mapping applies to all interfaces.

Parameters

These parameters are displayed:

- **Port** – Specifies a port.
- **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 for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

Table 16: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence

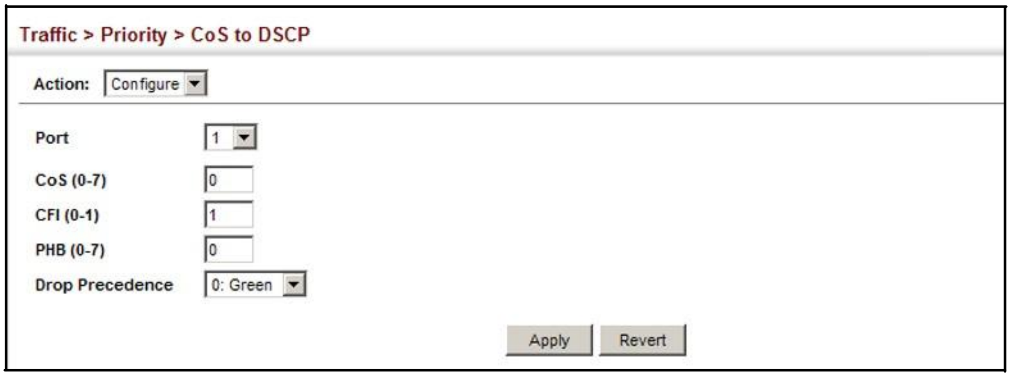
CFI	0	1
CoS		
0	(0,0)	(0,1)
1	(1,0)	(1,1)
2	(2,0)	(2,1)
3	(3,0)	(3,1)
4	(4,0)	(4,1)
5	(5,0)	(5,1)
6	(6,0)	(6,1)
7	(7,0)	(7,1)

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. Select a port.
4. Set the PHB and drop precedence for any of the CoS/CFI combinations.
5. Click Apply.

Figure 106: Configuring CoS to DSCP Internal Mapping



Traffic > Priority > CoS to DSCP

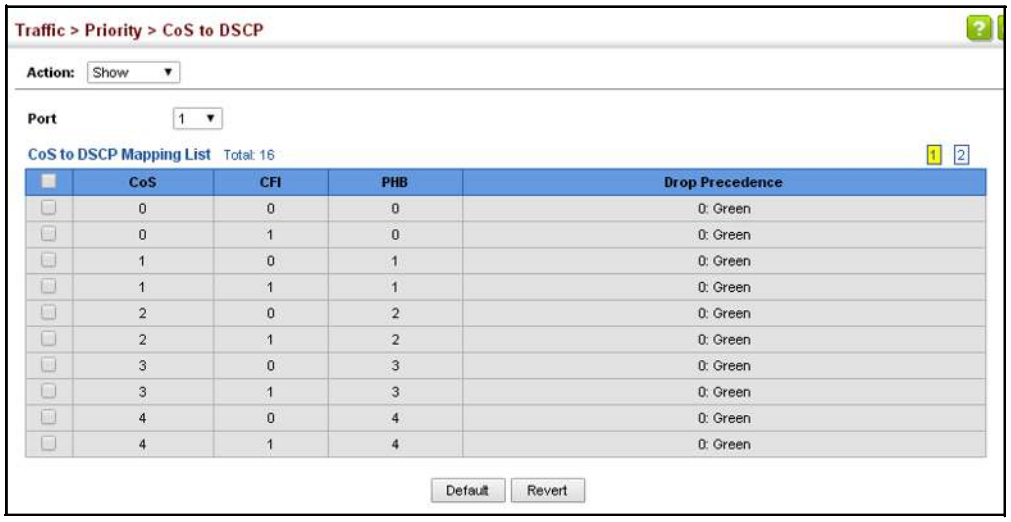
Action: Configure

Port	1
CoS (0-7)	0
CFI (0-1)	1
PHB (0-7)	0
Drop Precedence	0: Green

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.
3. Select a port.

Figure 107: Showing CoS to DSCP Internal Mapping



Traffic > Priority > CoS to DSCP

Action: Show

Port 1

CoS to DSCP Mapping List Total: 16

□	CoS	CFI	PHB	Drop Precedence
□	0	0	0	0: Green
□	0	1	0	0: Green
□	1	0	1	0: Green
□	1	1	1	0: Green
□	2	0	2	0: Green
□	2	1	2	0: Green
□	3	0	3	0: Green
□	3	1	3	0: Green
□	4	0	4	0: Green
□	4	1	4	0: Green

Mapping Internal DSCP Values to Egress CoS Values

Use the Traffic > Priority > DSCP to CoS page to map internal per-hop behavior and drop precedence value pairs to CoS values used in tagged egress packets on a Layer 2 interface.

Command Usage

- Enter any per-hop behavior and drop precedence pair within the internal priority map, and then enter the corresponding CoS/CFI pair.
- If the packet is forwarded with an 8021.Q tag, the priority value in the egress packet is modified based on the default values shown in Table 17 on page 179, or on the values modified by this function.

Parameters

These parameters are displayed in the web interface:

- **Interface** – Specifies a port or trunk.
- **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)
- **CoS** – Class-of-Service value. (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)

Table 17: Mapping Internal PHB/Drop Precedence to CoS/CFI Values

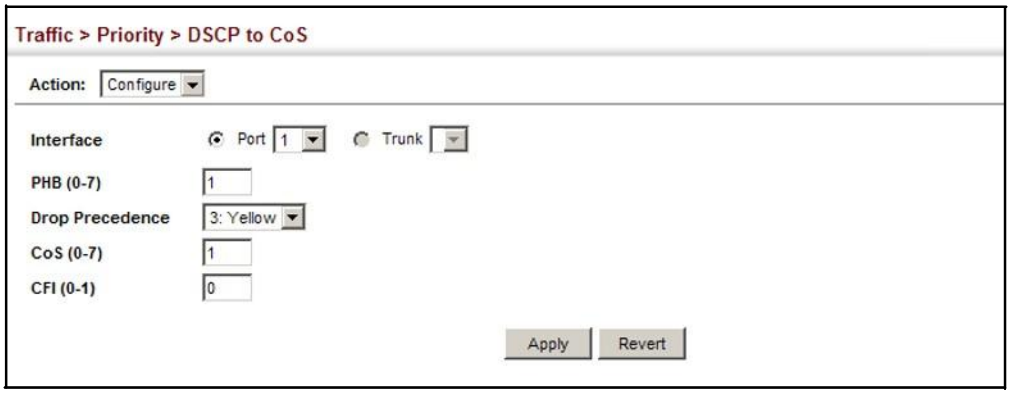
Drop Precedence	0 (green)	1 (red)	3 (yellow)
Per-hop Behavior			
0	(0,0)	(0,1)	(0,1)
1	(1,0)	(1,1)	(1,1)
2	(2,0)	(2,1)	(2,1)
3	(3,0)	(3,1)	(3,1)
4	(4,0)	(4,1)	(4,1)
5	(5,0)	(5,1)	(5,1)
6	(6,0)	(6,1)	(6,1)
7	(7,0)	(7,1)	(7,1)

Web Interface

To map internal per-hop behavior and drop precedence values to CoS values in the web interface:

1. Click Traffic, Priority, DSCP to CoS.
2. Select Configure from the Action list.
3. Select an interface.
4. Select any PHB and drop precedence pair within the internal priority map, and then set the corresponding CoS/CFI pair.
5. Click Apply.

Figure 108: Configuring DSCP to CoS Egress Mapping



Traffic > Priority > DSCP to CoS

Action: Configure

Interface ● Port 1 ○ Trunk

PHB (0-7) 1

Drop Precedence 3: Yellow

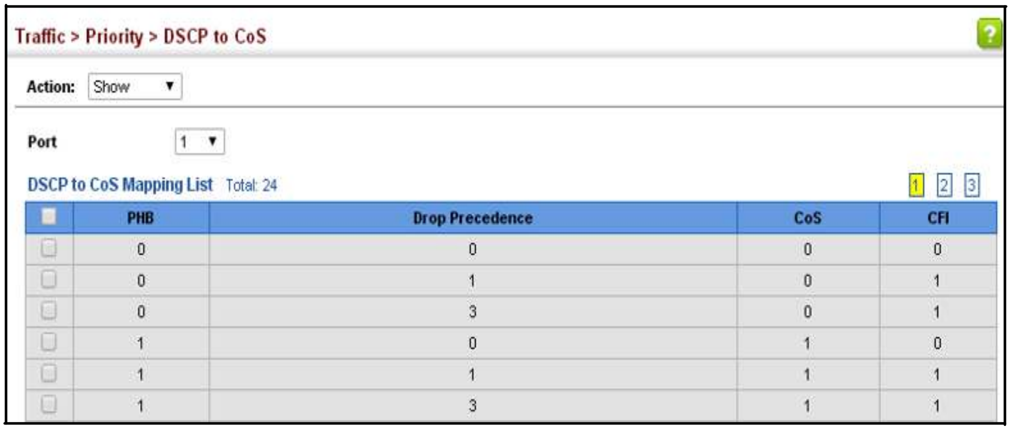
CoS (0-7) 1

CFI (0-1) 0

To show the DSCP to CoS egress map in the web interface:

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

Figure 109: Showing DSCP to CoS Egress Mapping



Traffic > Priority > DSCP to CoS
?
Action: Show
Port 1
DSCP to CoS Mapping List Total: 24
1 2 3

□	PHB	Drop Precedence	CoS	CFI
□	0	0	0	0
□	0	1	0	1
□	0	3	0	1
□	1	0	1	0
□	1	1	1	1
□	1	3	1	1

Mapping IP Precedence Values to Internal DSCP Values

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

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 default IP Precedence values map one-to-one to the Class of Service values (that is, Precedence value 0 maps to PHB value 0, and so forth). Bits 6 and 7 are used for network control, and the other bits for various application types. The ToS bits are defined in Table 18.

Table 18: Mapping IP Precedence

Priority Level	Traffic Type
7	Network Control
6	Internetwork Control
5	Critical
4	Flash Override
3	Flash
2	Immediate
1	Priority
0	Routine

Command Usage

- Enter per-hop behavior and drop precedence for any of the IP Precedence values 0 - 7.
- If the priority mapping mode is set the IP Precedence and the ingress packet type is IPv4, then the IP Precedence-to-PHB/Drop Precedence mapping table is used to generate priority and drop precedence values for internal processing.

Parameters

These parameters are displayed in the web interface:

- **Interface** – Specifies a port or trunk.
- **IP Precedence** – IP Precedence value in ingress packets. (Range: 0-7)
- **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 19: Default Mapping of IP Precedence to Internal PHB/Drop Values

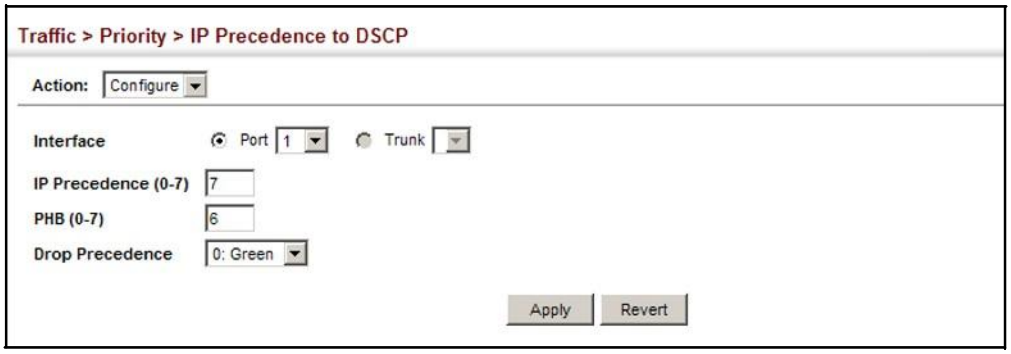
IP Precedence Value	0	1	2	3	4	5	6	7
Per-hop Behavior	0	1	2	3	4	5	6	7
Drop Precedence	0	0	0	0	0	0	0	0

Web Interface

To map IP Precedence to internal PHB/drop precedence in the web interface:

1. Click Traffic, Priority, IP Precedence to DSCP.
2. Select Configure from the Action list.
3. Select an interface.
4. Set the PHB and drop precedence for any of the IP Precedence values.
5. Click Apply.

Figure 110: Configuring IP Precedence to DSCP Internal Mapping



Traffic > Priority > IP Precedence to DSCP

Action: Configure

Interface ● Port 1 ○ Trunk

IP Precedence (0-7) 7

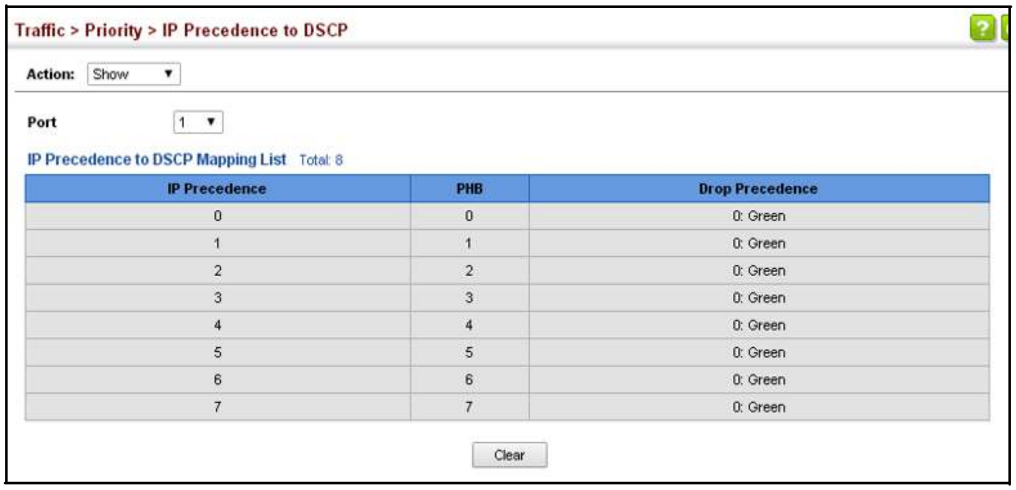
PHB (0-7) 6

Drop Precedence 0: Green

To show the IP Precedence to internal PHB/drop precedence map in the web interface:

1. Click Traffic, Priority, IP Precedence to DSCP.
2. Select Show from the Action list.
3. Select an interface.

Figure 111: Showing the IP Precedence to DSCP Internal Map



Traffic > Priority > IP Precedence to DSCP

Action: Show

Port 1

IP Precedence to DSCP Mapping List Total: 8

IP Precedence	PHB	Drop Precedence
0	0	0: Green
1	1	0: Green
2	2	0: Green
3	3	0: Green
4	4	0: Green
5	5	0: Green
6	6	0: Green
7	7	0: Green

Mapping IP Port Priority to Internal DSCP Values

Use the Traffic > Priority > IP Port to DSCP page to map network applications designated by a TCP/UDP destination port number in the frame header to per-hop behavior and drop precedence values for internal priority processing.

Command Usage

- This mapping table is only used if the protocol type of the arriving packet is TCP or UDP. Some of the more common TCP service ports include: HTTP: 80, FTP: 21, Telnet: 23 and POP3: 110.
- No default mapping is defined for ingress TCP/UDP port types.

Parameters

These parameters are displayed in the web interface:

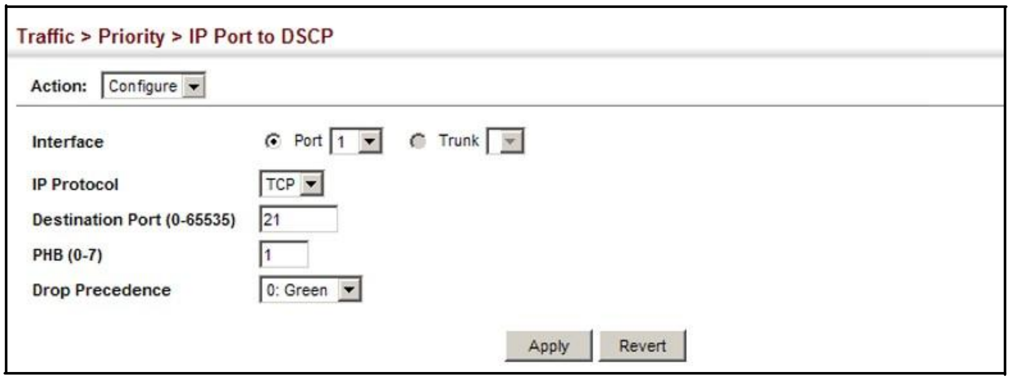
- **Interface** – Specifies a port or trunk.
- **IP Protocol**
  - **TCP** – Transport Control Protocol
  - **UDP** – User Datagram Protocol
- **Destination Port Number** – 16-bit TCP/UDP destination port number. (Range: 0-65535)
- **PHB** – Per-hop behavior, or the priority used for this router hop. (Range: 0-7)
- **Drop Precedence** – Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

Web Interface

To map TCP/UDP port number to per-hop behavior and drop precedence in the web interface:

1. Click Traffic, Priority, IP Port to DSCP.
2. Select Configure from the Action list.
3. Select an interface.
4. Set the PHB and drop precedence for any TCP or UDP port.
5. Click Apply.

Figure 112: Configuring IP Port Number to DSCP Internal Mapping



Traffic > Priority > IP Port to DSCP

Action: Configure

Interface ● Port 1 ○ Trunk

IP Protocol TCP

Destination Port (0-65535) 21

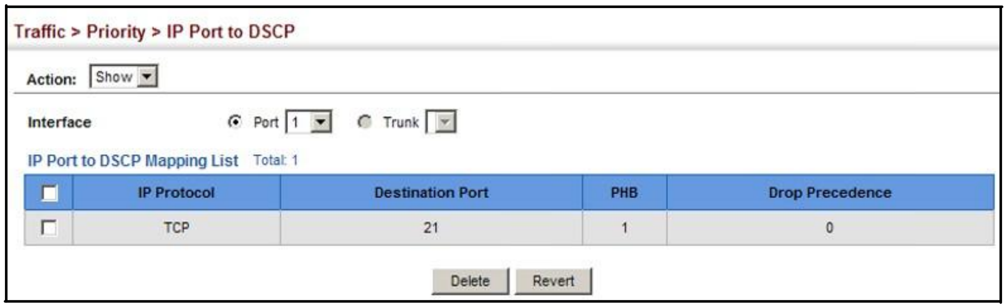
PHB (0-7) 1

Drop Precedence 0: Green

To show the TCP/UDP port number to per-hop behavior and drop precedence map in the web interface:

1. Click Traffic, Priority, IP Port to DSCP.
2. Select Show from the Action list.
3. Select an interface.

Figure 113: Showing IP Port Number to DSCP Internal Mapping



Traffic > Priority > IP Port to DSCP

Action: Show

Interface ● Port 1 ○ Trunk

IP Port to DSCP Mapping List Total: 1

□	IP Protocol	Destination Port	PHB	Drop Precedence
□	TCP	21	1	0

10 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, or CoS values. 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 190).

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.

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 190) to create a service policy (page 199) 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

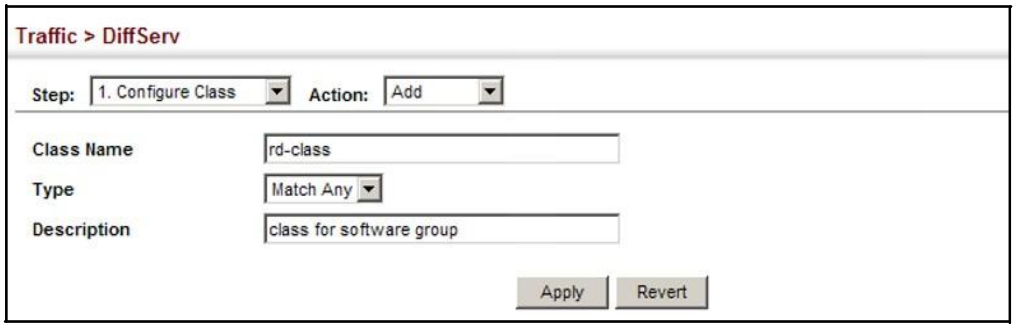
- **Class Name** – Name of the class map.
- **Type** – Only one match command is permitted per class map, so the match-any field refers to the criteria specified by the lone match command.
- **ACL** – Name of an access control list. Any type of ACL can be specified, including standard or extended IPv4/IPv6 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 114: Configuring a Class Map



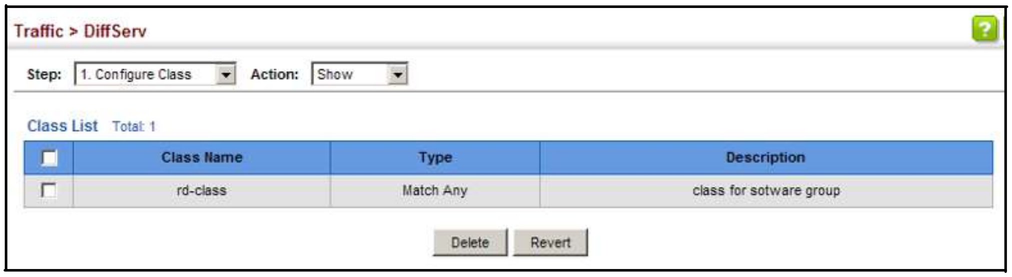
Step: 1. Configure Class Action: Add

Class Name: rd-class
Type: Match Any
Description: class for software group

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 115: Showing Class Maps



Traffic > DiffServ

Step: 1. Configure Class   Action: Show

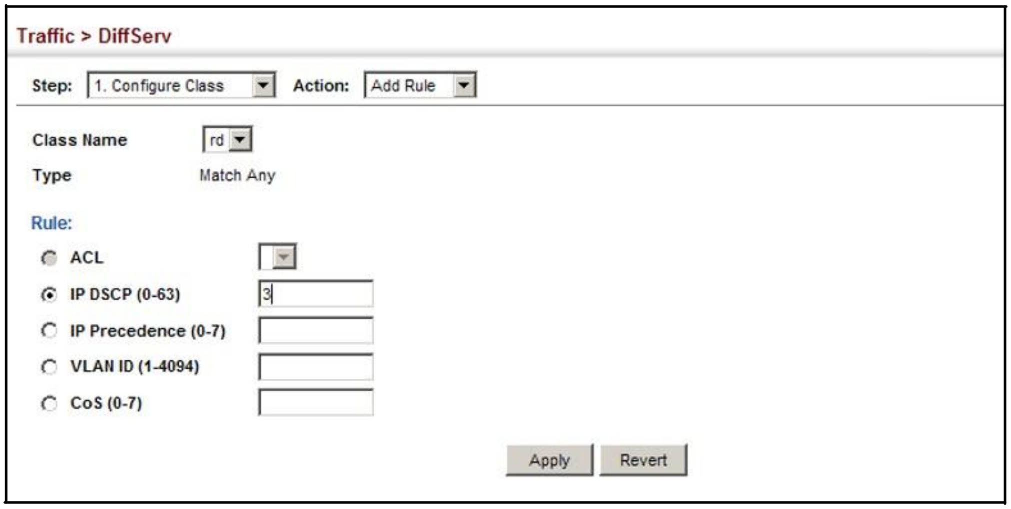
Class List Total: 1

□	Class Name	Type	Description
□	rd-class	Match Any	class for sotware group

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, a DSCP or IP Precedence value, a VLAN, or a CoS value. You can specify up to 16 items to match when assigning ingress traffic to a class map.
6. Click Apply.

Figure 116: Adding Rules to a Class Map



Traffic > DiffServ

Step: 1. Configure Class Action: Add Rule

Class Name rd

Type Match Any

Rule:

○ ACL

● IP DSCP (0-63) 3

○ IP Precedence (0-7)

○ VLAN ID (1-4094)

○ CoS (0-7)

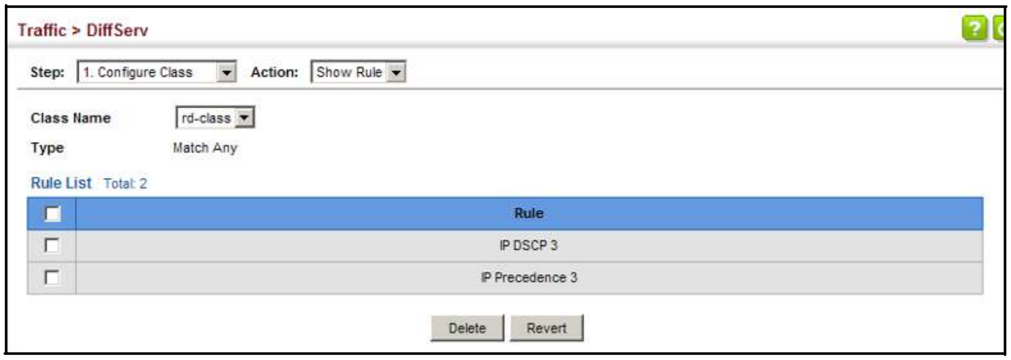
To show the rules for a class map:

1. Click Traffic, DiffServ.

2. Select Configure Class from the Step list.

3. Select Show Rule from the Action list.

Figure 117: Showing the Rules for a Class Map



Traffic > DiffServ

Step: 1. Configure Class Action: Show Rule

Class Name rd-class

Type Match Any

Rule List Total: 2

□	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 186), modify service tagging, and enforce bandwidth policing. A policy map can then be bound by a service policy to one or more interfaces (page 199).

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 specific VLAN. A policy map is then configured which indicates the boundary parameters used for monitoring inbound traffic, and the action to take for conforming and non-conforming 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. In addition, the flow rate of inbound traffic can be monitored and the response to conforming and non-conforming traffic based by one of three distinct policing methods as described below.

Police Flow Meter – Defines the committed information rate (maximum throughput), committed burst size (burst rate), and the action to take for conforming and non-conforming traffic.

Policing is based on a token bucket, where bucket depth (that is, the maximum burst before the bucket overflows) is specified by the “burst” field (BC), and the average rate tokens are removed from the bucket is specified by the “rate” option (CIR). Action may be taken for traffic conforming to the maximum throughput, or exceeding the maximum throughput.

srTCM Police Meter – Defines an enforcer for classified traffic based on a single rate three color meter scheme defined in RFC 2697. This metering policy monitors a traffic stream and processes its packets according to the committed information rate (CIR, or maximum throughput), committed burst size (BC, or burst rate), and excess burst size (BE). Action may taken for traffic conforming to the maximum throughput, exceeding the maximum throughput, or exceeding the excess burst size.

- 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. In addition to the actions defined by this command to transmit, remark the DSCP service value, or drop a packet, the switch will also mark the two color bits used to set the drop precedence of a packet. A packet is marked green if it doesn't exceed the committed information rate and committed burst size, yellow if it does exceed the committed information rate and committed burst size, but not the excess burst size, and red otherwise.

- The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.

- 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 Tc(0) = BC and the token count Te(0) = BE. Thereafter, the token counts Tc and Te are updated CIR times per second as follows:

  - If Tc is less than BC, Tc is incremented by one, else
  - if Te is less then BE, Te is incremented by one, else
  - neither Tc nor Te 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 Tc(t)-B ≥ 0, the packet is green and Tc is decremented by B down to the minimum value of 0, else
  - if Te(t)-B ≥ 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.

  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 Tc(t)-B ≥ 0, the packet is green and Tc 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 ≥ 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.

  The metering policy guarantees a deterministic behavior where the volume of green packets is never smaller than what has been determined by the CIR and BC, that is, tokens of a given color are always spent on packets of that color. Refer to RFC 2697 for more information on other aspects of srTCM.

trTCM Police Meter – Defines an enforcer for classified traffic based on a two rate three color meter scheme defined in RFC 2698. This metering policy monitors a traffic stream and processes its packets according to the committed information rate (CIR, or maximum throughput), peak information rate (PIR), and their associated burst sizes – committed burst size (BC, or burst rate), and peak burst size

(BP). Action may taken for traffic conforming to the maximum throughput, exceeding the maximum throughput, or exceeding the peak burst size.

- 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. In addition to the actions defined by this command to transmit, remark the DSCP service value, or drop a packet, the switch will also mark the two color bits used to set the drop precedence of a packet. A packet is marked red if it exceeds the PIR. Otherwise it is marked either yellow or green depending on whether it exceeds or doesn't exceed the CIR.

  The trTCM is useful for ingress policing of a service, where a peak rate needs to be enforced separately from a committed rate.

- The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.

- The behavior of the meter is specified in terms of its mode and two token buckets, P and C, which are based on the rates PIR and CIR, respectively. The maximum size of the token bucket P is BP and the maximum size of the token bucket C is BC.

  The token buckets P and C are initially (at time 0) full, that is, the token count Tp(0) = BP and the token count Tc(0) = BC. Thereafter, the token count Tp is incremented by one PIR times per second up to BP and the token count Tc is incremented by one CIR times per second up to BC.

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

  - If Tp(t)-B < 0, the packet is red, else
  - if Tc(t)-B < 0, the packet is yellow and Tp is decremented by B, else
  - the packet is green and both Tp and Tc are decremented by B.

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

  - If the packet has been precolored as red or if Tp(t)-B < 0, the packet is red, else
  - if the packet has been precolored as yellow or if Tc(t)-B < 0, the packet is yellow and Tp is decremented by B, else
  - the packet is green and both Tp and Tc are decremented by B.

- The trTCM can be used to mark a IP packet stream in a service, where different, decreasing levels of assurances (either absolute or relative) are given to packets which are green, yellow, or red. Refer to RFC 2698 for more information on other aspects of trTCM.

Command Usage

- A policy map can contain 16 class statements that can be applied to the same interface (page 199). Up to 32 policy maps can be configured for ingress ports.
- After using the policy map to define packet classification, service tagging, and bandwidth policing, it must be assigned to a specific interface by a service policy (page 199) to take effect.

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: 1-256 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.
- **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 16, “Default Mapping of CoS/CFI to Internal PHB/Drop Precedence,” on page 176).
  - **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 16, “Default Mapping of CoS/CFI to Internal PHB/Drop Precedence,” on page 176).
- **Meter** – Check this to define the maximum throughput, burst rate, and the action that results from a policy violation.

- **Meter Mode** – Selects one of the following policing methods.
  - **Flow** (Police Flow) – Defines the committed information rate (CIR, or maximum throughput), committed burst size (BC, or burst rate), and the action to take for conforming and non-conforming traffic. Policing is based on a token bucket, where bucket depth (that is, the maximum burst before the bucket overflows) is specified by the "burst" field, and the average rate tokens are removed from the bucket is by specified by the "rate" option.
    - **Committed Information Rate** (CIR) – Rate in kilobits per second. (Range: 0-40000000 kbps or maximum port speed, whichever is lower)

      The rate cannot exceed the configured interface speed.
    - **Committed Burst Size** (BC) – Burst in bytes. (Range: 1000-128000000)
    - **Conform** – Specifies that traffic conforming to the maximum rate (CIR) will be transmitted without any change to the DSCP service level.
      - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range: 0-63)
      - **Transmit** – Transmits in-conformance traffic without any change to the DSCP service level.
    - **Violate** – Specifies whether the traffic that exceeds the maximum rate (CIR) will be dropped or the DSCP service level will be reduced.
      - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range: 0-63)
      - **Drop** – Drops out of conformance traffic.
  - **srTCM** (Police Meter) – Defines the committed information rate (CIR, or maximum throughput), committed burst size (BC, or burst rate) and excess burst size (BE), and the action to take for traffic conforming to the maximum throughput, exceeding the maximum throughput but within the excess burst size, or exceeding the excess burst size. In addition to the actions defined by this command to transmit, remark the DSCP service value, or drop a packet, the switch will also mark the two color bits used to set the drop precedence of a packet.

    The color modes include "Color-Blind" which assumes that the packet stream is uncolored, and "Color-Aware" which assumes that the incoming packets are pre-colored. The functional differences between these modes is described at the beginning of this section under "srTCM Police Meter."
    - **Committed Information** Rate (CIR) – Rate in kilobits per second. (Range: 0-40000000 kbps or maximum port speed, whichever is lower)

      The rate cannot exceed the configured interface speed.
    - **Committed Burst Size** (BC) – Burst in bytes. (Range: 1000-128000000)

- **Excess Burst Size** (BE) – Burst in excess of committed burst size. (Range:1000-12800000 bytes)
- **Conform** – Specifies that traffic conforming to the maximum rate (CIR) will be transmitted without any change to the DSCP service level.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range: 0-63)
  - **Transmit** – Transmits in-conformance traffic without any change to the DSCP service level.
- **Exceed** – Specifies whether traffic that exceeds the maximum rate (CIR) but is within the excess burst size (BE) will be dropped or the DSCP service level will be reduced.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range: 0-63)
  - **Drop** – Drops out of conformance traffic.
- **Violate** – Specifies whether the traffic that exceeds the excess burst size (BE) will be dropped or the DSCP service level will be reduced.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range: 0-63)
  - **Drop** – Drops out of conformance traffic.

- **trTCM** (Police Meter) – Defines the committed information rate (CIR, or maximum throughput), peak information rate (PIR), and their associated burst sizes – committed burst size (BC, or burst rate) and peak burst size (BP), and the action to take for traffic conforming to the maximum throughput, exceeding the maximum throughput but within the peak information rate, or exceeding the peak information rate. In addition to the actions defined by this command to transmit, remark the DSCP service value, or drop a packet, the switch will also mark the two color bits used to set the drop precedence of a packet.

  The color modes include “Color-Blind” which assumes that the packet stream is uncolored, and “Color-Aware” which assumes that the incoming packets are pre-colored. The functional differences between these modes is described at the beginning of this section under “trTCM Police Meter.”

  - **Committed Information Rate** (CIR) – Rate in kilobits per second. (Range: 0-40000000 kbps or maximum port speed, whichever is lower)

    The rate cannot exceed the configured interface speed.

  - **Committed Burst Size** (BC) – Burst in bytes. (Range: 1000-128000000)

  - **Peak Information Rate** (PIR) – Rate in kilobits per second. (Range: 0-40000000 kbps or maximum port speed, whichever is lower)

    The rate cannot exceed the configured interface speed.

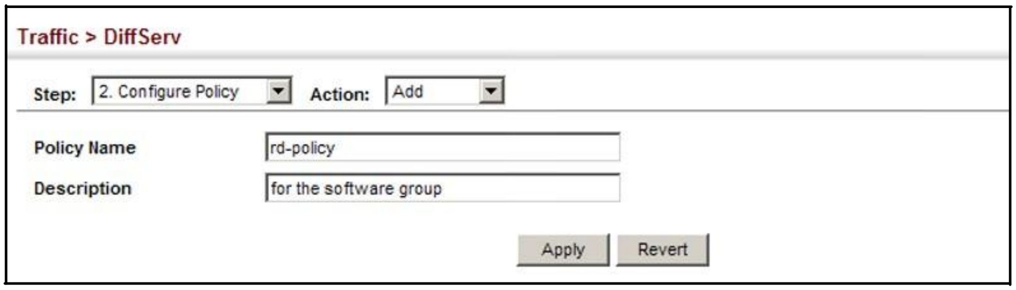
- **Peak Burst Size** (BP) – Burst size in bytes. (Range: 1000-128000000 bytes)
- **Conform** – Specifies that traffic conforming to the maximum rate (CIR) will be transmitted without any change to the DSCP service level.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range:0-63).
  - **Transmit** – Transmits in-conformance traffic without any change to the DSCP service level.
- **Exceed** – Specifies whether traffic that exceeds the maximum rate (CIR) but is within the peak information rate (PIR) will be dropped or the DSCP service level will be reduced.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range:0-63).
  - **Drop** – Drops out of conformance traffic.
- **Violate** – Specifies whether the traffic that exceeds the peak information rate (PIR) will be dropped or the DSCP service level will be reduced.
  - **Set IP DSCP** – Decreases DSCP priority for out of conformance traffic. (Range:0-63).
  - **Drop** – Drops out of conformance traffic.

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 Add.

Figure 118: Configuring a Policy Map



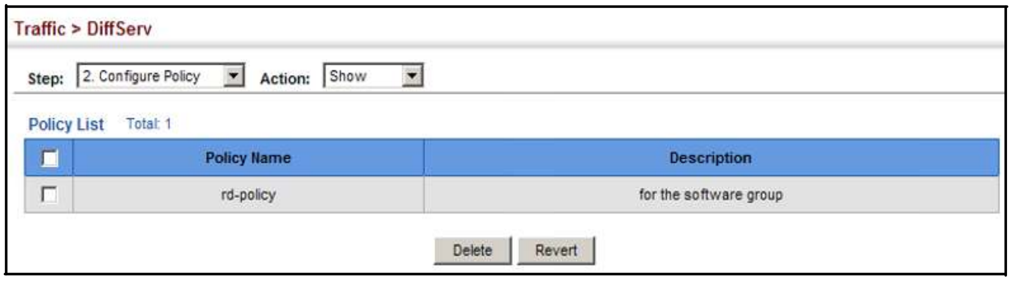
Step: 2. Configure Policy
Action: Add

Policy Name: rd-policy
Description: for the software group

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 119: Showing Policy Maps



Step: 2. Configure Policy
Action: Show

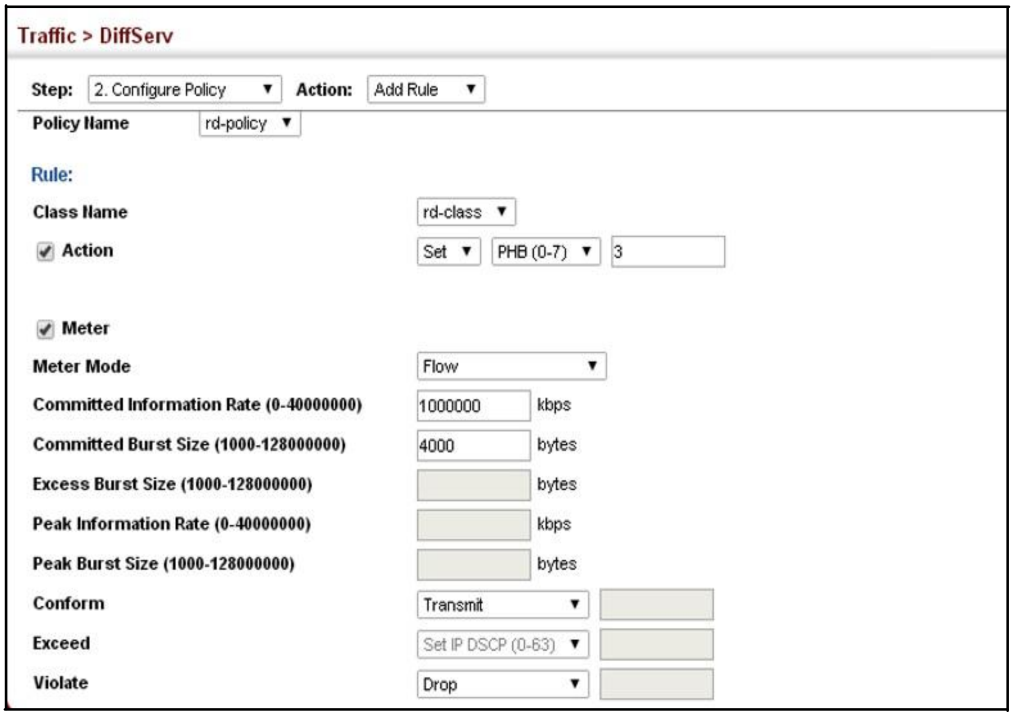
Policy List Total: 1

□	Policy Name	Description
□	rd-policy	for the software group

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. Set the CoS or per-hop behavior for matching packets to specify the quality of service to be assigned to the matching traffic class. Use one of the metering options to define parameters such as the maximum throughput and burst rate. Then specify the action to take for conforming traffic, the action to tack for traffic in excess of the maximum rate but within the peak information rate, or the action to take for a policy violation.
6. Click Apply.

Figure 120: Adding Rules to a Policy Map



Traffic > DiffServ

Step: 2. Configure Policy ▾ Action: Add Rule ▾

Policy Name: rd-policy ▾

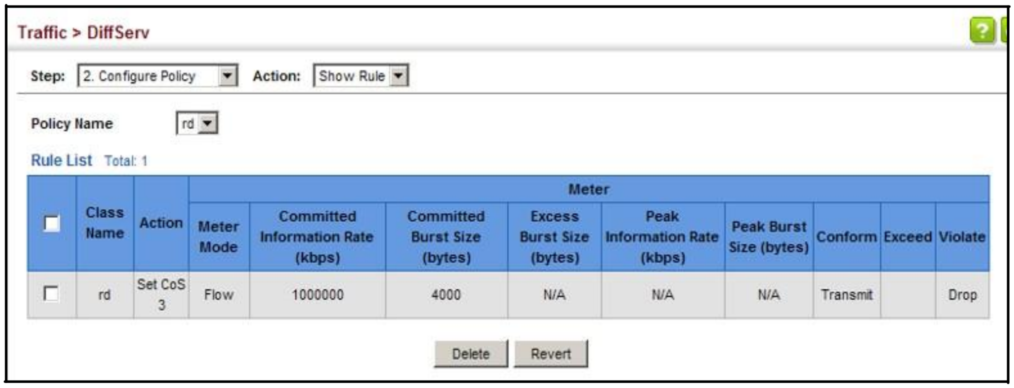
Rule:

Class Name	rd-class ▾
☑ Action	Set ▾ PHB (0-7) ▾ 3
☑ Meter	
Meter Mode	Flow ▾
Committed Information Rate (0-40000000)	1000000 kbps
Committed Burst Size (1000-128000000)	4000 bytes
Excess Burst Size (1000-128000000)	bytes
Peak Information Rate (0-40000000)	kbps
Peak Burst Size (1000-128000000)	bytes
Conform	Transmit ▾
Exceed	Set IP DSCP (0-63) ▾
Violate	Drop ▾

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 121: Showing the Rules for a Policy Map



Traffic > DiffServ

Step: 2. Configure Policy   Action: Show Rule

Policy Name: rd

Rule List Total: 1

			Meter								
☐	Class Name	Action	Meter Mode	Committed Information Rate (kbps)	Committed Burst Size (bytes)	Excess Burst Size (bytes)	Peak Information Rate (kbps)	Peak Burst Size (bytes)	Conform	Exceed	Violate
☐	rd	Set CoS 3	Flow	1000000	4000	N/A	N/A	N/A	Transmit		Drop

Attaching a Policy Map to a Port

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

Command Usage

- First define a class map, define a policy map, and bind the service policy to the required interface.
- The switch does not allow a policy map to be bound to an interface for egress traffic.

Parameters

These parameters are displayed:

- **Port** – Specifies a port.
- **Ingress** – Applies the selected rule to ingress traffic.
- **Egress** – Applies the selected rule to egress traffic.

Web Interface

To bind a policy map to a port:

1. Click Traffic, DiffServ.

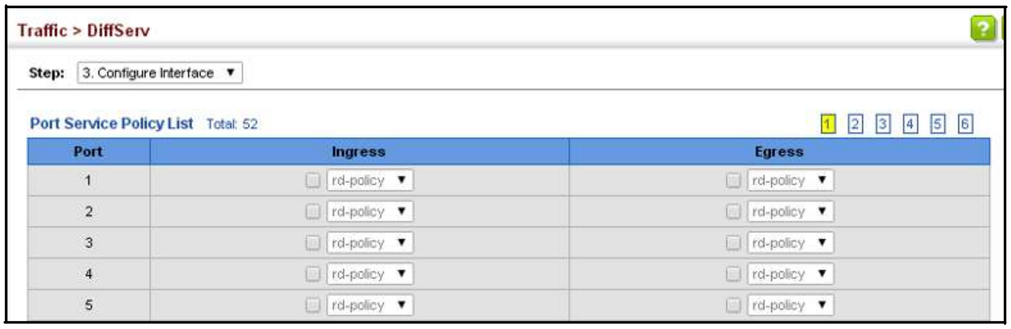
2. Select Configure Interface from the Step list.

3. Check the box under the Ingress or egress field to enable a policy map for a port.

4. Select a policy map from the scroll-down box.

5. Click Apply.

Figure 122: Attaching a Policy Map to a Port



Traffic > DiffServ

Step: 3. Configure Interface ▼

Port Service Policy List Total: 52

Port	Ingress	Egress
1	□ rd-policy ▼	□ rd-policy ▼
2	□ rd-policy ▼	□ rd-policy ▼
3	□ rd-policy ▼	□ rd-policy ▼
4	□ rd-policy ▼	□ rd-policy ▼
5	□ rd-policy ▼	□ rd-policy ▼

11

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, and specify authentication servers.
- User Accounts – Manually configure access rights on the switch for specified users.
- 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).
- IP Filter – Filters management access to the web, SNMP or Telnet interface.

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 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:

- Authentication 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 202.
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:

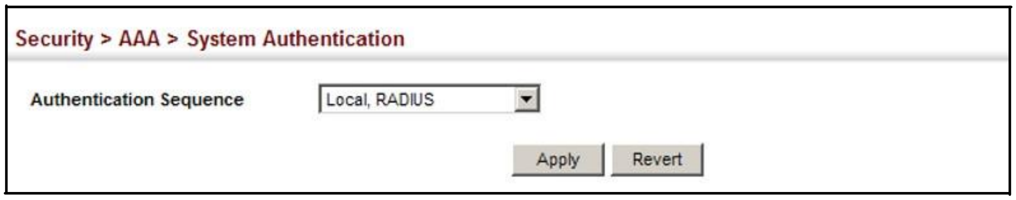
- **Authentication Sequence** – Select the authentication, or authentication sequence required:
  - **Local** – User authentication is performed only locally by the switch.
  - **RADIUS** – User authentication is performed using a RADIUS server only.
  - **TACACS** – User authentication is performed 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 123: Configuring the Authentication Sequence



Security > AAA > System Authentication

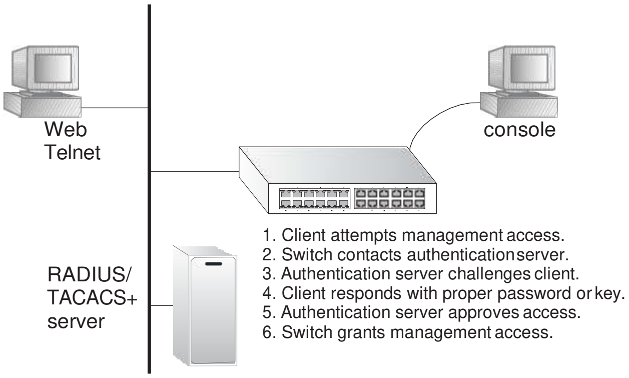
Authentication Sequence: Local, RADIUS

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 124: Authentication Server Operation


Web
Telnet
console
RADIUS/
TACACS+
server
1. Client attempts management access.
2. Switch contacts authentication server.
3. Authentication server challenges client.
4. Client responds with proper password or key.
5. Authentication server approves access.
6. Switch grants management access.

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: 1-60; ~~Default: 5~~)

- **Authentication Retries** – Number of times the switch tries to authenticate logon access via the authentication server. (Range: 1-5; ~~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. Do not use blank spaces in the string. (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 RADIUS server before it resends the request. (Range: 1-60; ~~Default: 5~~)

- **Authentication Retries** – Number of times the switch tries to authenticate logon access via the authentication server. (Range: 1-5; ~~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. Do not use blank spaces in the string. (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 202).

Web Interface

To configure the parameters for RADIUS or TACACS+ authentication:

1. Click Security, AAA, Server.

2. Select Configure Server from the Step list.

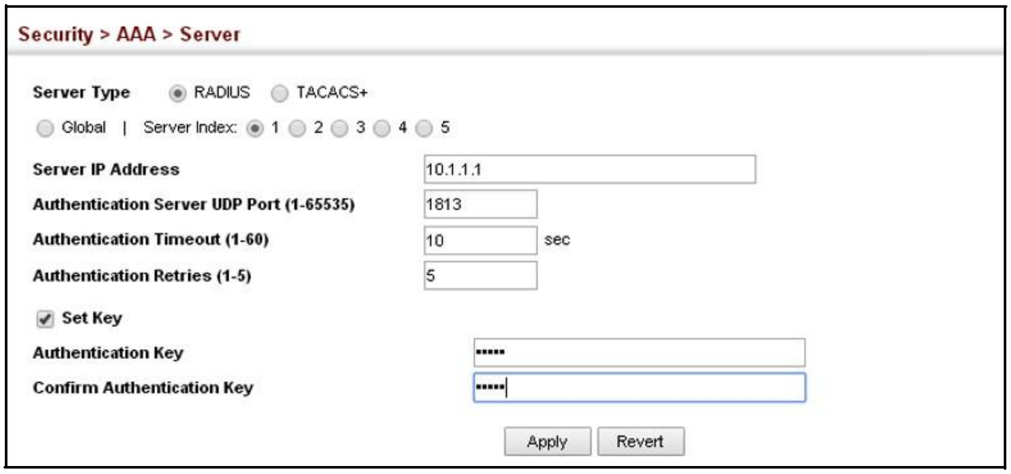
3. Select RADIUS or TACACS+ server type.

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 125: Configuring Remote Authentication Server (RADIUS)



Security > AAA > Server

Server Type ● RADIUS ○ TACACS+

○ Global | Server Index: ● 1 ○ 2 ○ 3 ○ 4 ○ 5

Server IP Address 10.1.1.1

Authentication Server UDP Port (1-65535) 1813

Authentication Timeout (1-60) 10 sec

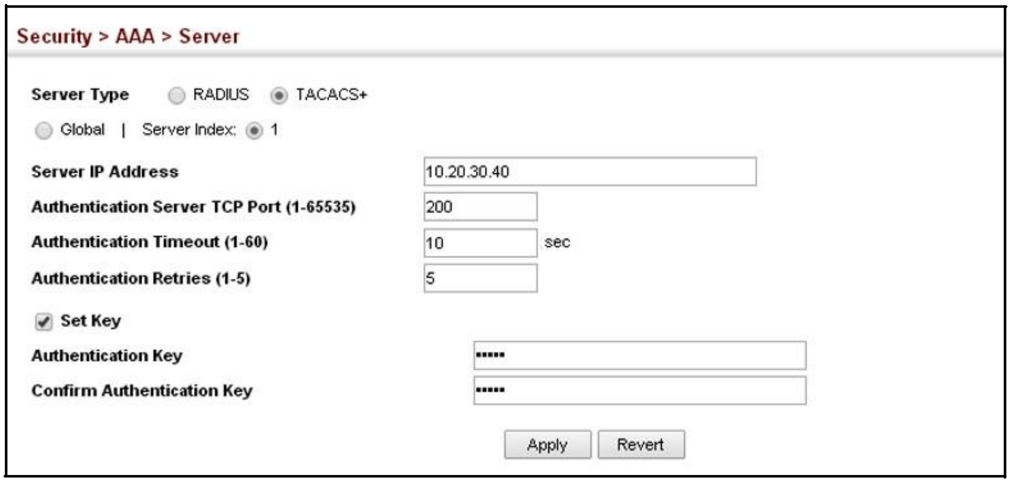
Authentication Retries (1-5) 5

☑ Set Key

Authentication Key •••••

Confirm Authentication Key •••••

Figure 126: Configuring Remote Authentication Server (TACACS+)



Security > AAA > Server

Server Type ○ RADIUS ● TACACS+

○ Global | Server Index: ● 1

Server IP Address 10.20.30.40

Authentication Server TCP Port (1-65535) 200

Authentication Timeout (1-60) 10 sec

Authentication Retries (1-5) 5

☑ Set Key

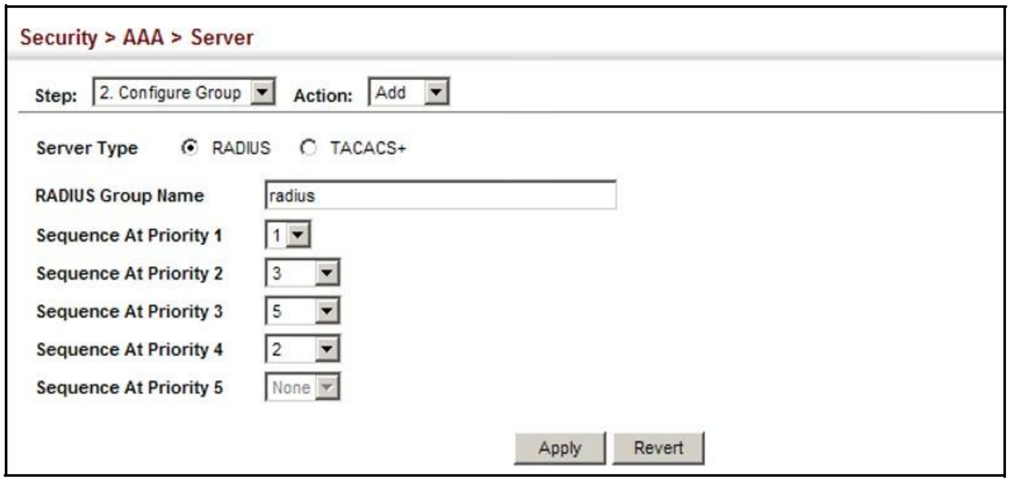
Authentication Key •••••

Confirm Authentication Key •••••

~~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 127: Configuring AAA Server Groups~~



Security > AAA > Server

Step: 2. Configure Group Action: Add

Server Type ● RADIUS ○ TACACS+

RADIUS Group Name: radius

Sequence At Priority 1: 1

Sequence At Priority 2: 3

Sequence At Priority 3: 5

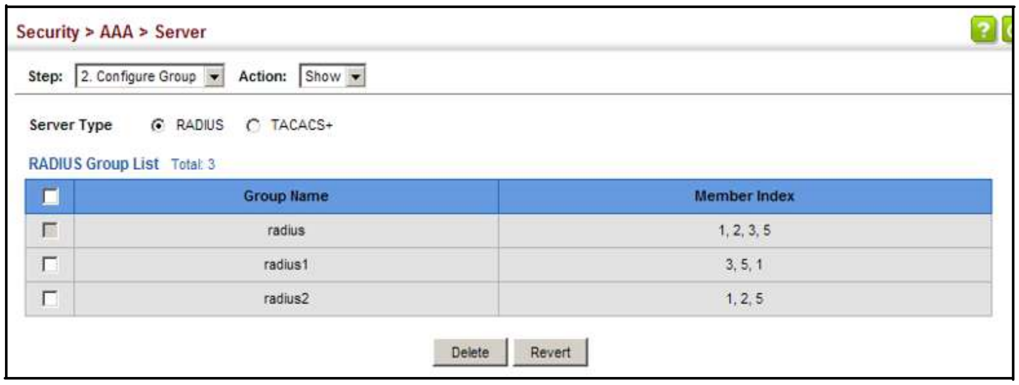
Sequence At Priority 4: 2

Sequence At Priority 5: None

~~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 128: Showing AAA Server Groups~~



Security > AAA > Server

Step: 2. Configure Group Action: Show

Server Type ● RADIUS ○ TACACS+

RADIUS Group List Total: 3

□	Group Name	Member Index
□	radius	1, 2, 3, 5
□	radius1	3, 5, 1
□	radius2	1, 2, 5

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 the user level. (Options: 0 - Normal, 15 - Privileged)

  Normal privilege level provides access to a limited number of the commands which display the current status of the switch, as well as several database clear and reset functions. Privileged level provides full access to all commands.
- **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.

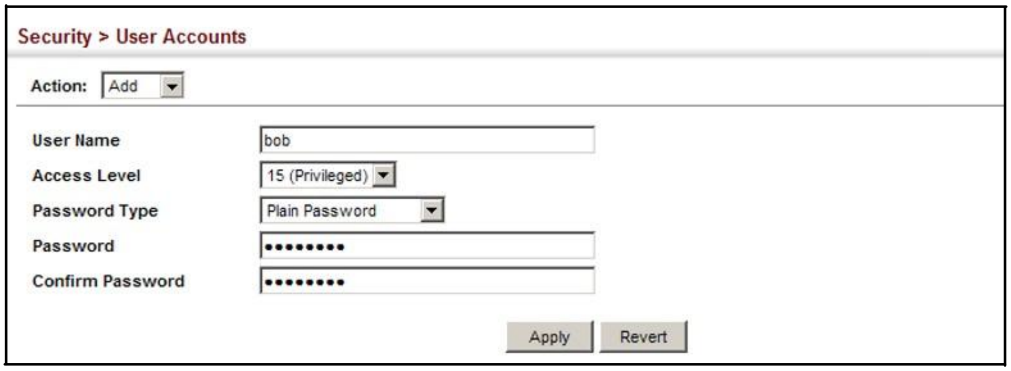
    The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup. There is no need for you to manually configure encrypted passwords.
- **Password** – Specifies the user password. (Range: 0-32 characters, 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 129: Configuring User Accounts



Security > User Accounts

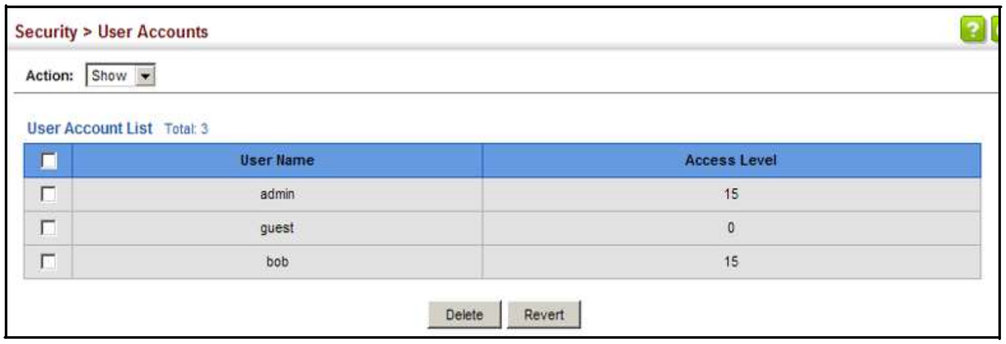
Action: Add

User Name	bob
Access Level	15 (Privileged)
Password Type	Plain Password
Password	••••••••
Confirm Password	••••••••

To show user accounts:

1. Click Security, User Accounts.
2. Select Show from the Action list.

Figure 130: Showing User Accounts



Security > User Accounts

Action: Show

User Account List Total: 3

□	User Name	Access Level
□	admin	15
□	guest	0
□	bob	15

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 UDP 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 UDP 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 8.x or above, or Mozilla Firefox 37.x or above.
- The following web browsers and operating systems currently support HTTPS:

Table 20: HTTPS System Support

Web Browser	Operating System
Internet Explorer 8.x or later	Windows 98,Windows NT (with service pack 6a), Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8
Mozilla Firefox 37.x or later	Windows 2000, Windows XP, Windows Vista, Windows 7, Windows 8, Linux
Google Chrome 42.x or later	Windows 7, Windows 8, Linux

- To specify a secure-site certificate, see "Replacing the Default Secure-site Certificate" on page 212.

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

Parameters

These parameters are displayed:

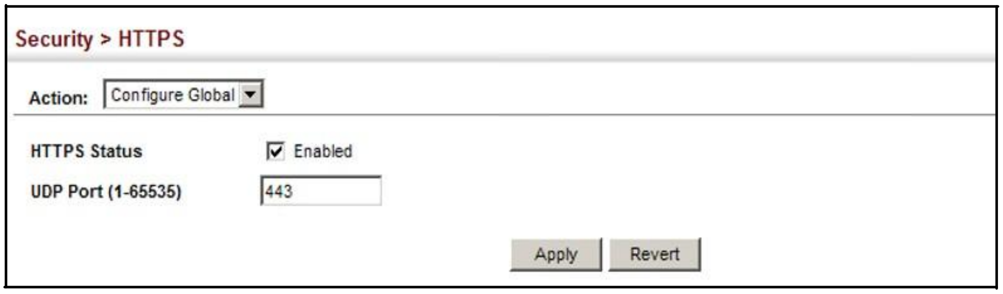
- **HTTPS Status** – Allows you to enable/disable the HTTPS server feature on the switch. (Default: Enabled)
- **HTTPS Port** – Specifies the UDP port number used for HTTPS connection to the switch's web interface. (Default: Port 443)

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 131: Configuring HTTPS



Security > HTTPS

Action: Configure Global

HTTPS Status ☑ Enabled

UDP Port (1-65535) 443

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 81 or type "reload" at the command prompt: `Console#reload`

Parameters

These parameters are displayed:

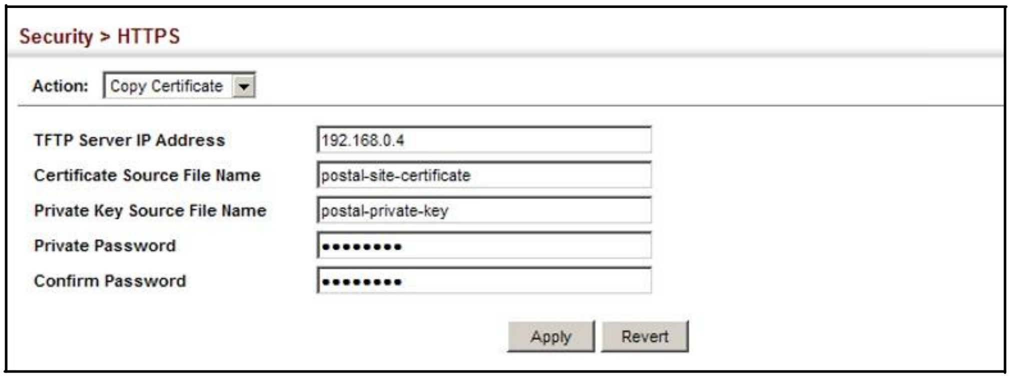
- **TFTP Server IP Address** – IP address of TFTP server which contains the certificate file.
- **Certificate Source File Name** – Name of certificate file stored on the TFTP server.
- **Private Key Source File Name** – Name of private key file stored on the TFTP server.
- **Private Password** – Password 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 132: Downloading the Secure-Site Certificate



Security > HTTPS

Action: Copy Certificate

TFTP Server IP Address	192.168.0.4
Certificate Source File Name	postal-site-certificate
Private Key Source File Name	postal-private-key
Private Password	••••••••
Confirm Password	••••••••

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 202). 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 220, or use the "copy tftp public-key" command (see the "copy" command in the *CLI Reference Guide*) 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 209.) 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 four 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: A host key pair must be configured on the switch before you can enable the SSH server. See "Generating the Host Key Pair" on page 218.

Parameters

These parameters are displayed:

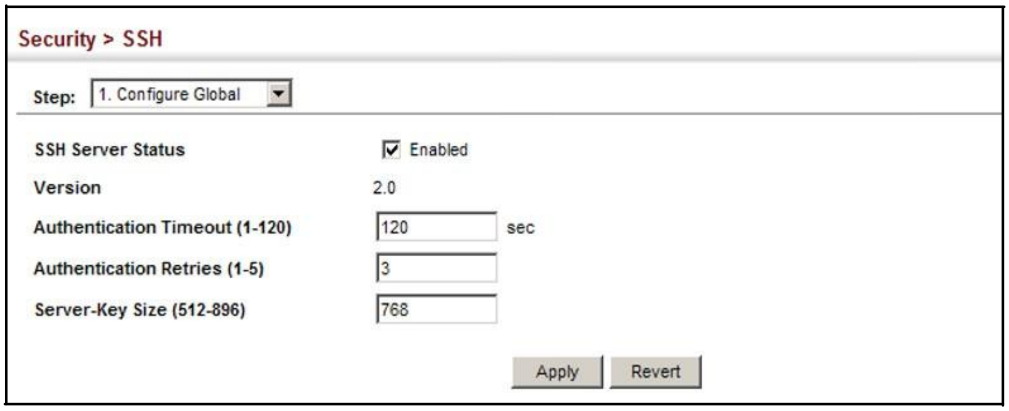
- **SSH Server Status** – Allows you to enable/disable the SSH server on the switch. (Default: Disabled)
- **Version** – The Secure Shell version number. Version 2.0 is displayed, but the switch supports management access via either SSH Version 1.5 or 2.0 clients.
- **Authentication Timeout** – Specifies 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 133: Configuring the SSH Server



Security > SSH

Step: 1. Configure Global

SSH Server Status ☑ Enabled

Version 2.0

Authentication Timeout (1-120) 120 sec

Authentication Retries (1-5) 3

Server-Key Size (512-896) 768

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 220.

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 217.

Parameters

These parameters are displayed:

Generate Host Key

- **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.

Show Host Key

- **Public-Key of Host-Key** – The host public key generated by the switch.

- **Save Host-Key from Memory to Flash** – 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 prior to generating the host-key pair. (Default: Disabled)

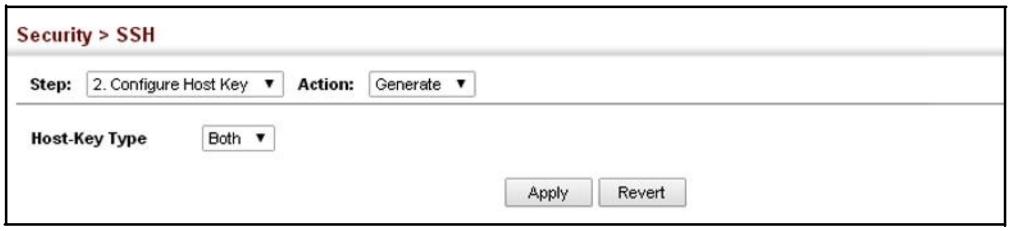
- **Clear** – Clears the RSA or DSA public keys when the check box is selected.

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 134: Generating the SSH Host Key Pair



Security > SSH

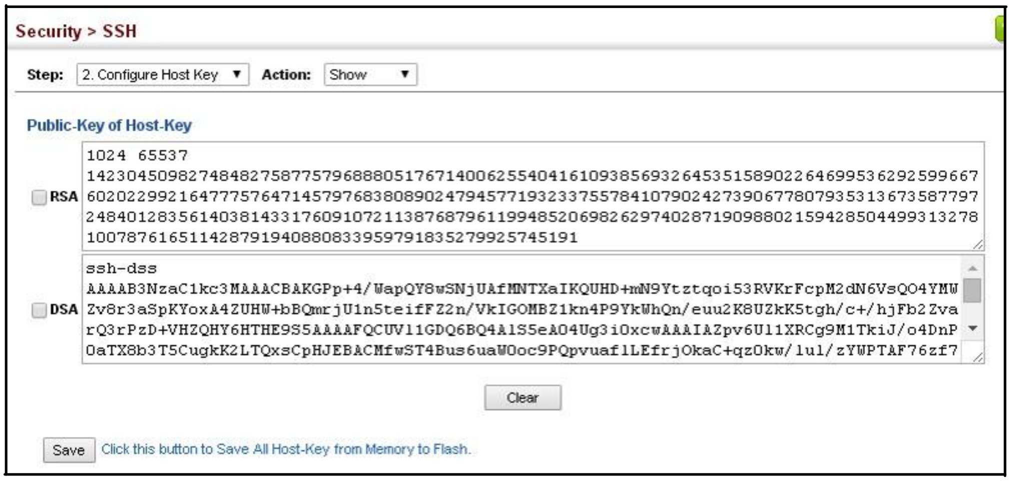
Step: 2. Configure Host Key Action: Generate

Host-Key Type: Both

To display or clear the SSH host key pair, or it to flash:

1. Click Security, SSH.
2. Select Configure Host Key from the Step list.
3. Select Show from the Action list.
4. Select the host-key type to clear, and click Clear.
5. Select the option to save the host key from memory to flash if required.

Figure 135: Showing the SSH Host Key Pair



Security > SSH
Step: 2. Configure Host Key ▼
Action: Show ▼
Public-Key of Host-Key
□ RSA
□ DSA
Clear
Save
Click this button to Save All Host-Key from Memory to Flash.

```
1024 65537
142304509827484827587757968880517671400625540416109385693264535158902264699536292599667
602022992164777576471457976838089024794577193233755784107902427390677807935313673587797
248401283561403814331760910721138768796119948520698262974028719098802159428504499313278
100787616511428791940880833959791835279925745191
```

```
ssh-dss
AAAAB3NzaC1kc3MAAACBAKGPp+4/WapQY8wSNjUAfMNTXaIKQUHD+mN9Ytztqoi53RVKrFcpM2dN6VsQO4YMW
Zv8r3aSpKYoxA4ZUHW+bBQmrjU1n5teifFZ2n/VkIGOMBZ1kn4P9YkWhQn/euu2K8UZkK5tgh/c+/hjFb2Zva
rQ3rPzD+VHZQHY6HTHE9S5AAAAFQCUV11GDQ6BQ4A1S5eAO4Ug3iOxcwAAAIAZpv6U11XRCg9M1TkiJ/o4DnP
OaTX8b3T5CugkK2LTQxsCpHJEBACMfwST4Bus6uaWOoc9PQpvuaf1LEfrjOkaC+qzOkw/1ul/zYWPTAF76zf7
```

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 209).
- **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.

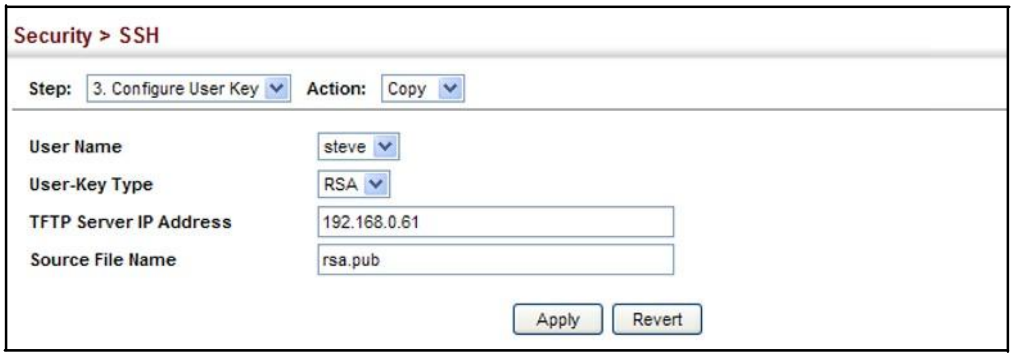
  The switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 for SSHv2 clients.
- **TFTP Server IP Address** – The IP address of the TFTP server that contains the public key file you wish to import.
- **Source File Name** – The public key file to upload.

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 136: Copying the SSH User's Public Key



Security > SSH

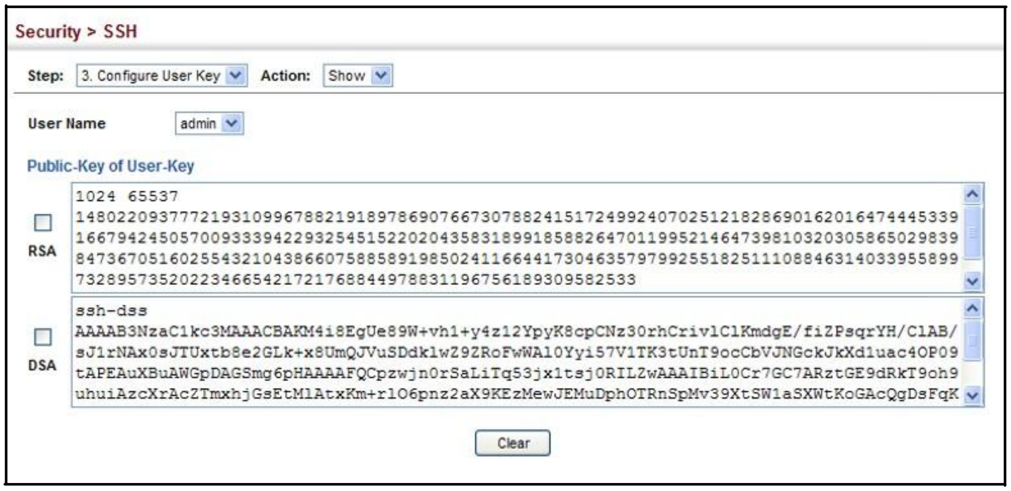
Step: 3. Configure User Key Action: Copy

User Name: steve
User-Key Type: RSA
TFTP Server IP Address: 192.168.0.61
Source File Name: rsa.pub

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 137: Showing the SSH User's Public Key



User Name: admin

Public-Key of User-Key

□ RSA

```
1024 65537
1480220937772193109967882191897869076673078824151724992407025121828690162016474445339
1667942450570093339422932545152202043583189918588264701199521464739810320305865029839
8473670516025543210438660758858919850241166441730463579799255182511108846314033955899
732895735202234665421721768844978831196756189309582533
```

□ DSA

```
ssh-dss
AAAAB3NzaC1kc3MAAACBAKM4i8EgUe89W+vh1+y4z12YpyK8cpCNz30rhCrivlClKmdgE/fiZPsqrYH/ClAB/
sJ1rNAx0sJTUxtb8e2GLk+x8UmQJVuSDdklwZ9ZRoFwWAl0Yyi57V1TK3tUnT9ocCbVJNGckJkXd1uac4OP09
tAPEAuXBuAWGpDAGSmg6pHAAAAFQCpzwjn0rSaLiTq53jx1tsj0RILZwAAAIBiL0Cr7GC7ARztGE9dRkT9oh9
uhuiAzcXrAcZTmxhjGsEtMlAtxKm+rlO6pnz2aX9KEzMewJEMuDphOTRnSpMv39XtSW1aSXWtKoGAcQgDsFqK
```

Access Control Lists

Access Control Lists (ACL) provide packet filtering for IPv4 frames (based on address, protocol, Layer 4 protocol port number or TCP control code), IPv6 frames (based on address, DSCP, next header type, or flow label), 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 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 256.
- The maximum number of rules per ACL is 96.
- An ACL can have up to 96 rules. However, due to resource restrictions, the average number of rules bound to the ports should not exceed 20.
- 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.

The order in which active ACLs are checked is as follows:

1. User-defined rules in IP and MAC ACLs for ingress 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.

~~Setting A Time Range~~

Use the Security > ACL (Configure Time Range) page to sets a time range during which ACL functions are applied.

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.

Parameters

These parameters are displayed:

Add

- **Time-Range Name** – Name of a time range. (Range: 1-16 characters)

Add Rule

- **Time-Range** – Name of a time range.

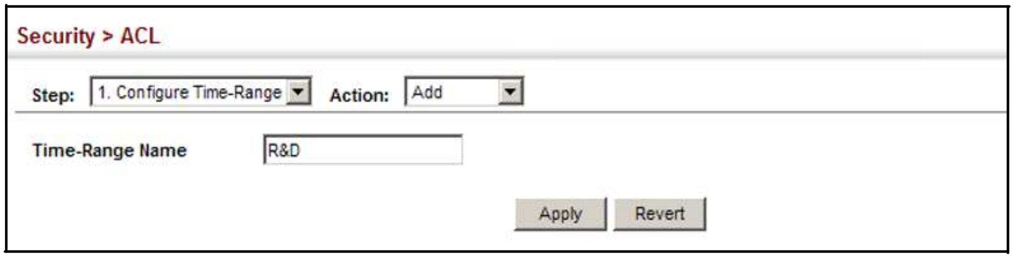
- **Mode**
  - **Absolute** – Specifies a specific time or time range.
    - **Start/End** – Specifies the hours, minutes, month, day, and year at which to start or end.
  - **Periodic** – Specifies a periodic interval.
    - **Start/To** – Specifies the days of the week, hours, and minutes at which to start or end.

Web Interface

To configure a time range:

1. Click Security, ACL.
2. Select Configure Time Range from the Step list.
3. Select Add from the Action list.
4. Enter the name of a time range.
5. Click Apply.

Figure 138: Setting the Name of a Time Range


Security > ACL

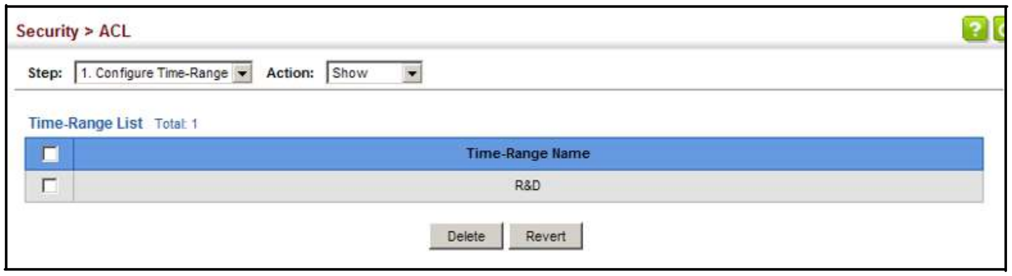
Step: 1. Configure Time-Range Action: Add

Time-Range Name: R&D

To show a list of time ranges:

1. Click Security, ACL.
2. Select Configure Time Range from the Step list.
3. Select Show from the Action list.

Figure 139: Showing a List of Time Ranges



Security > ACL

Step: 1. Configure Time-Range Action: Show

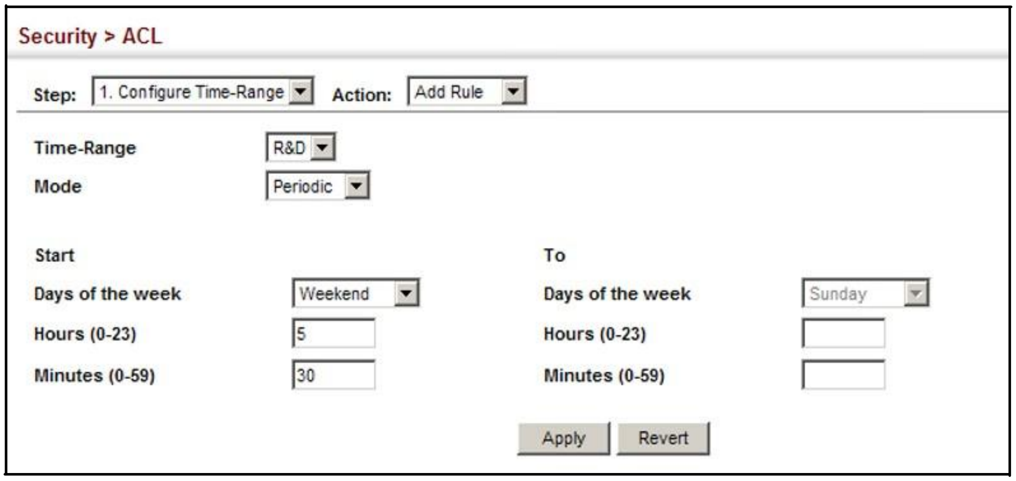
Time-Range List Total: 1

□	Time-Range Name
□	R&D

To configure a rule for a time range:

1. Click Security, ACL.
2. Select Configure Time Range from the Step list.
3. Select Add Rule from the Action list.
4. Select the name of time range from the drop-down list.
5. Select a mode option of Absolute or Periodic.
6. Fill in the required parameters for the selected mode.
7. Click Apply.

Figure 140: Add a Rule to a Time Range



Security > ACL

Step: 1. Configure Time-Range Action: Add Rule

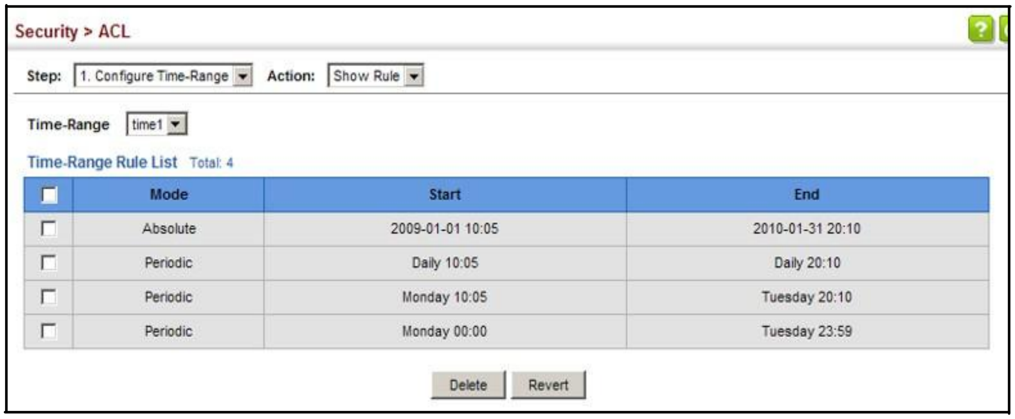
Time-Range R&D
Mode Periodic

Start		To	
Days of the week	Weekend	Days of the week	Sunday
Hours (0-23)	5	Hours (0-23)	
Minutes (0-59)	30	Minutes (0-59)	

To show the rules configured for a time range:

1. Click Security, ACL.
2. Select Configure Time Range from the Step list.
3. Select Show Rule from the Action list.

Figure 141: Showing the Rules Configured for a Time Range



□	Mode	Start	End
□	Absolute	2009-01-01 10:05	2010-01-31 20:10
□	Periodic	Daily 10:05	Daily 20:10
□	Periodic	Monday 10:05	Tuesday 20:10
□	Periodic	Monday 00:00	Tuesday 23:59

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), Quality of Service (QoS) processes, or traps.

For example, when binding an ACL to a port, each rule in an ACL will use two PCEs.

Parameters

These parameters are displayed:

- **Total Policy Control Entries** – The number policy control entries in use.
- **Free Policy Control Entries** – The number of policy control entries available for use.
- **Entries Used by System** – The number of policy control entries used by the operating system.
- **Entries Used by User** – The number of policy control entries used by configuration settings, such as access control lists.
- **TCAM Utilization** – The overall percentage of TCAM in use.

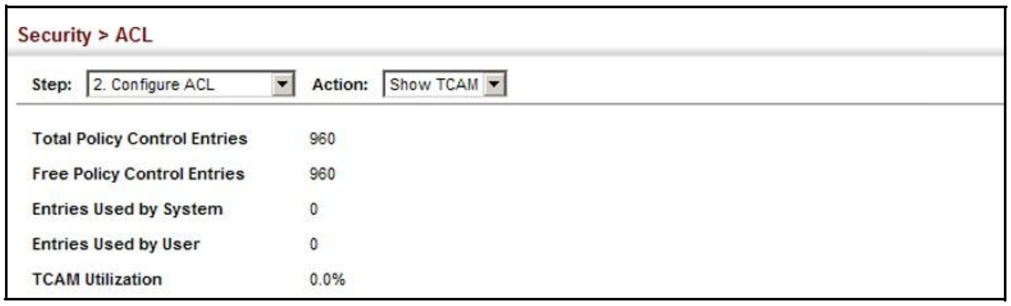
Web Interface

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 142: Showing TCAM Utilization



Security > ACL

Step: 2. Configure ACL Action: Show TCAM

Total Policy Control Entries	960
Free Policy Control Entries	960
Entries Used by System	0
Entries Used by User	0
TCAM Utilization	0.0%

Setting the ACL Name and Type

Use the Security > ACL (Configure ACL - Add) page to create an ACL.

Parameters

These parameters are displayed:

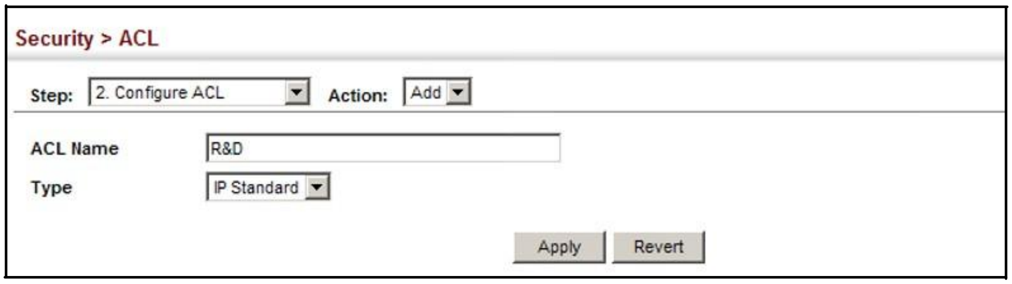
- **ACL Name** – Name of the ACL. (Maximum length: 32 characters)
- **Type** – The following filter modes are supported:
  - **IP Standard**: IPv4 ACL mode filters packets based on the source IPv4 address.
  - **IP Extended**: IPv4 ACL mode filters packets based on the source or destination IPv4 address, 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.
  - **MAC** – MAC ACL mode filters packets based on the source or destination MAC address and the Ethernet frame type (RFC 1060).

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 143: Creating an ACL



Security > ACL

Step: 2. Configure ACL Action: Add

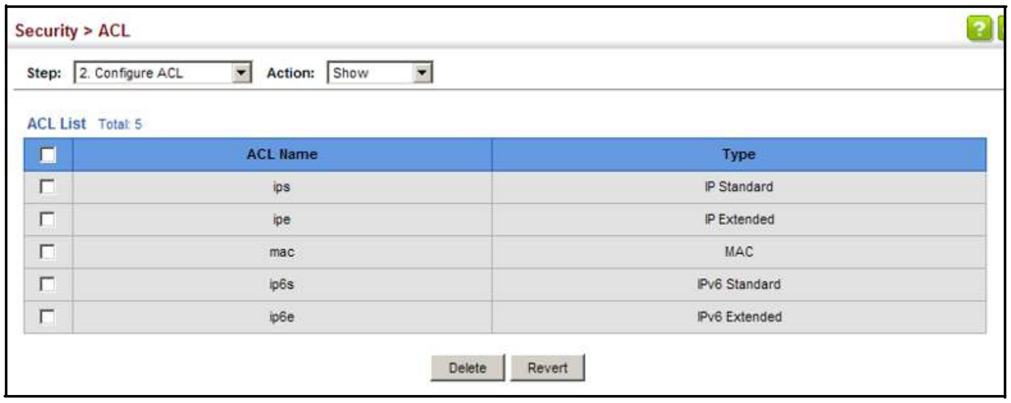
ACL Name: R&D

Type: IP Standard

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 144: Showing a List of ACLs



Security > ACL

Step: 2. Configure ACL Action: Show

ACL List Total: 5

□	ACL Name	Type
□	ips	IP Standard
□	ipe	IP Extended
□	mac	MAC
□	ip6s	IPv6 Standard
□	ip6e	IPv6 Extended

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:

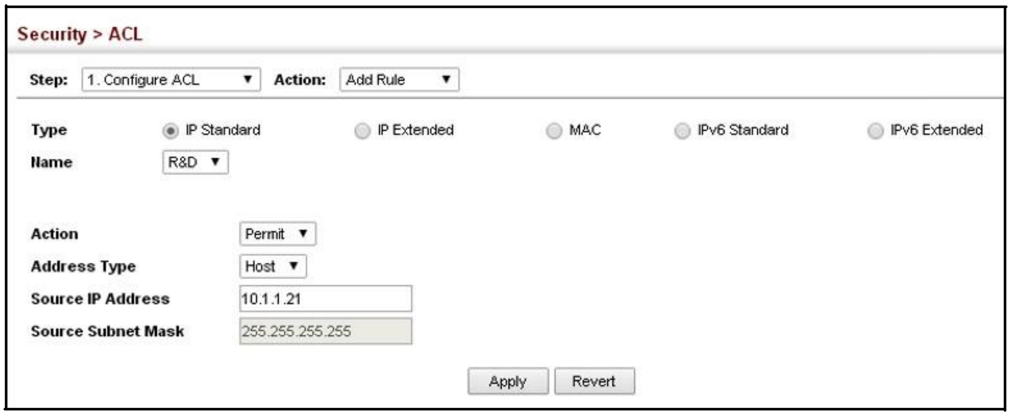
- **Type** – Selects the type of ACLs to show in the Name list.
- **Name** – Shows the names of ACLs matching the selected type.
- **Action** – An ACL can contain any combination of permit or deny rules.
- **Address Type** – Specifies the source IP address. Use “Any” to include all possible addresses, “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 a Standard IPv4 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 145: Configuring a Standard IPv4 ACL



Security > ACL

Step: 1. Configure ACL Action: Add Rule

Type ● IP Standard ○ IP Extended ○ MAC ○ IPv6 Standard ○ IPv6 Extended

Name R&D

Action Permit

Address Type Host

Source IP Address 10.1.1.21

Source Subnet Mask 255.255.255.255

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 229.)

- **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)

- **Service Type** – Packet priority settings based on the following criteria:
  - **ToS** – Type of Service level. (Range: 0-15)

  - **Precedence** – IP precedence level. (Range: 0-7)
  - **DSCP** – DSCP priority level. (Range: 0-63)

- **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

- ~~**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).

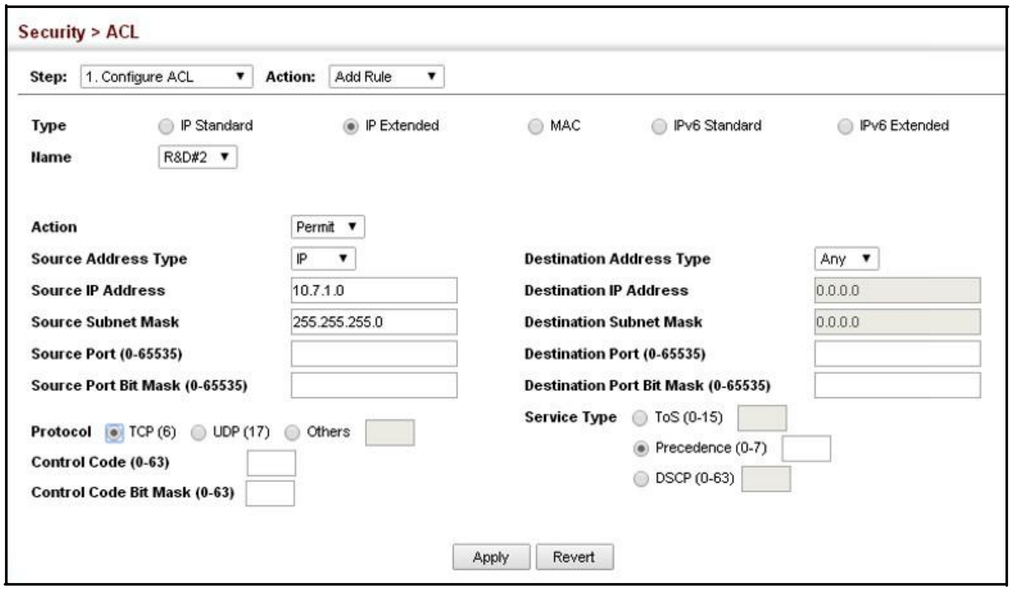
7. Select the address type (Any, Host, or IP).

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 146: Configuring an Extended IPv4 ACL



Security > ACL

Step: 1. Configure ACL ▼ Action: Add Rule ▼

Type	○ IP Standard ● IP Extended ○ MAC ○ IPv6 Standard ○ IPv6 Extended
Name	R&D#2 ▼
Action	Permit ▼
Source Address Type	IP ▼
Source IP Address	10.7.1.0
Source Subnet Mask	255.255.255.0
Source Port (0-65535)	
Source Port Bit Mask (0-65535)	
Protocol	● TCP (6) ○ UDP (17) ○ Others
Control Code (0-63)	
Control Code Bit Mask (0-63)	
Destination Address Type	Any ▼
Destination IP Address	0.0.0.0
Destination Subnet Mask	0.0.0.0
Destination Port (0-65535)	
Destination Port Bit Mask (0-65535)	
Service Type	○ ToS (0-15) ● Precedence (0-7) ○ DSCP (0-63)

Configuring a Standard IPv6 ACL

Use the Security > ACL (Configure ACL - Add Rule - IPv6 Standard) page to configure a Standard IPv6ACL.

Parameters

These parameters are displayed in the web interface:

- **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.

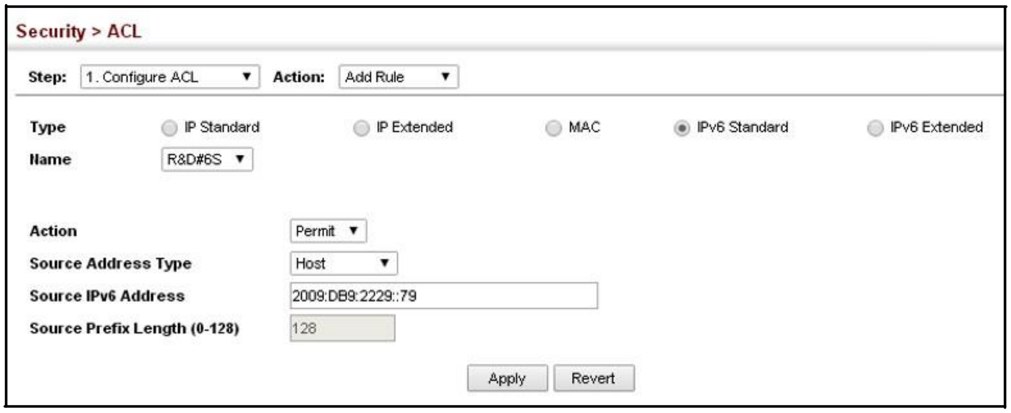
- **Source Prefix-Length** – A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address). (Range: 0-128 bits)
- ~~**Time Range** – Name of a time range.~~

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 147: Configuring a Standard IPv6 ACL



Security > ACL

Step: 1. Configure ACL ▼ Action: Add Rule ▼

Type ○ IP Standard ○ IP Extended ○ MAC ● IPv6 Standard ○ IPv6 Extended

Name R&D#6S ▼

Action Permit ▼

Source Address Type Host ▼

Source IPv6 Address 2009:DB9:2229::79

Source Prefix Length (0-128) 128

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:

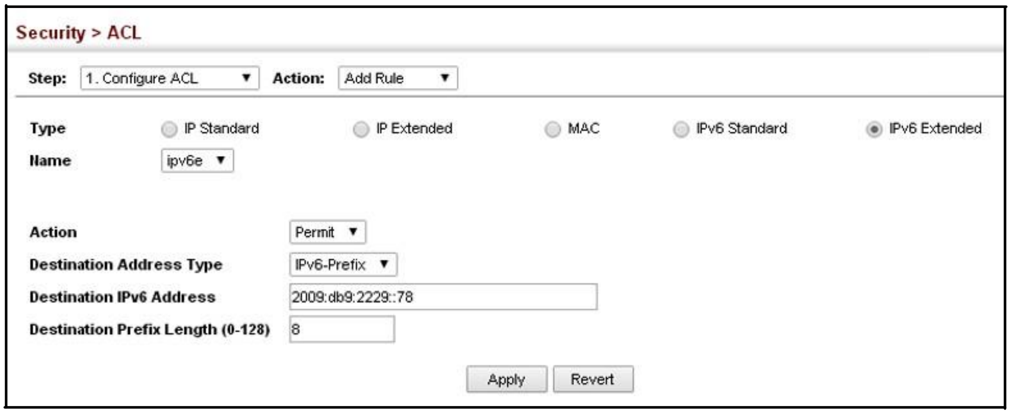
- **Type** – Selects the type of ACLs to show in the Name list.
- **Name** – Shows the names of ACLs matching the selected type.
- **Action** – An ACL can contain any combination of permit or deny rules.
- **Destination Address Type** – Specifies the destination IP address type. Use “Any” to include 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 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.
- **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)

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, Host 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. Click Apply.

Figure 148: Configuring an Extended IPv6 ACL



Security > ACL

Step: 1. Configure ACL Action: Add Rule

Type ○ IP Standard ○ IP Extended ○ MAC ○ IPv6 Standard ● IPv6 Extended

Name ipv6e

Action Permit

Destination Address Type IPv6-Prefix

Destination IPv6 Address 2009:db9:2229::78

Destination Prefix Length (0-128) 8

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.)

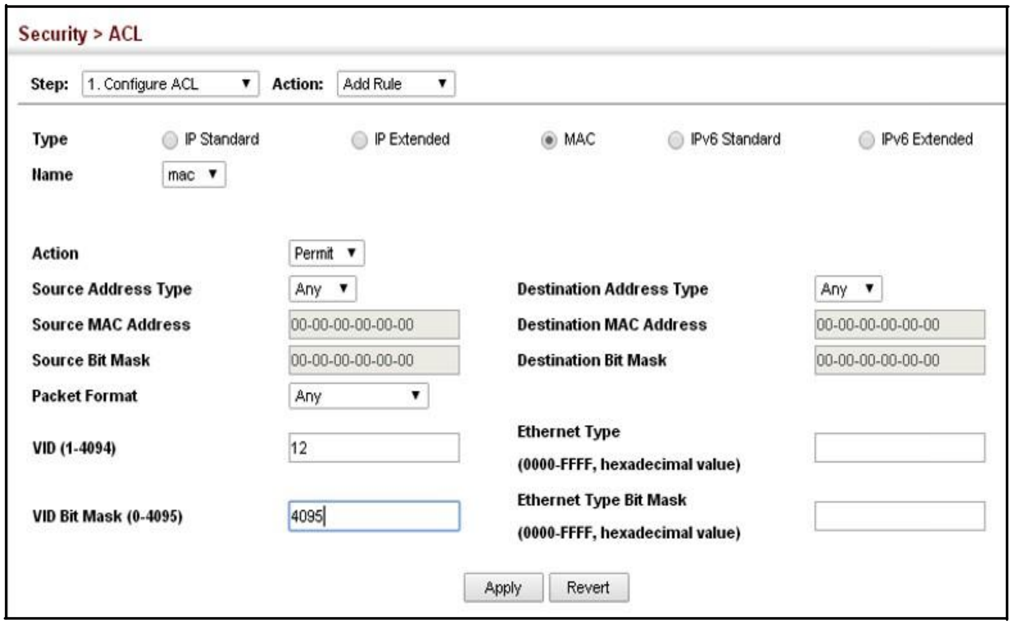
- ~~**Time Range** – Name of a time range.~~

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 149: Configuring a MAC ACL



Security > ACL

Step: 1. Configure ACL ▼ Action: Add Rule ▼

Type ○ IP Standard ○ IP Extended ● MAC ○ IPv6 Standard ○ IPv6 Extended

Name mac ▼

Action	Permit ▼		
Source Address Type	Any ▼	Destination Address Type	Any ▼
Source MAC Address	00-00-00-00-00-00	Destination MAC Address	00-00-00-00-00-00
Source Bit Mask	00-00-00-00-00-00	Destination Bit Mask	00-00-00-00-00-00
Packet Format	Any ▼		
VID (1-4094)	12	Ethernet Type (0000-FFFF, hexadecimal value)	
VID Bit Mask (0-4095)	4095	Ethernet Type Bit Mask (0000-FFFF, hexadecimal value)	

Binding a Port to an Access Control List

After configuring ACLs, use the Security > ACL (Configure Interface) page to bind the ports that need to filter traffic to the appropriate ACLs. You can assign one IP access list and one MAC access list to any port.

Command Usage

- This switch supports ACLs for ingress filtering only.
- ~~You only bind one ACL to any port for ingress filtering.~~

Parameters

These parameters are displayed:

- **Type** – Selects the type of ACLs to bind to a port.
- **Port** – Port identifier.
- **ACL** – ACL used for ingress or egress packets.
- **Counter** – Enables counter for ACL statistics.
- ~~**Time Range** – Name of a time range.~~

Web Interface

To bind an ACL to a port:

1. Click Security, ACL.

2. Select Configure Interface from the Step list.

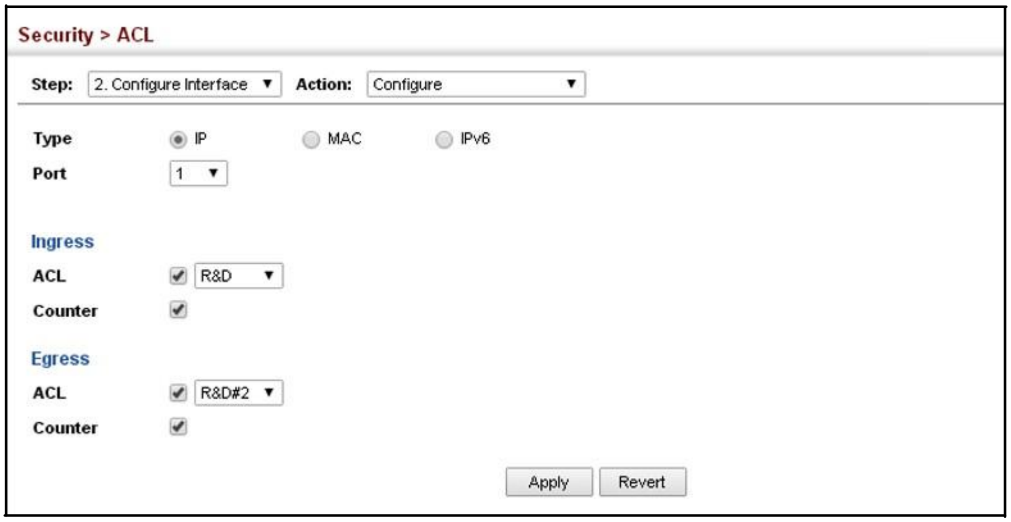
3. Select IP, MAC or IPv6 from the Type list.

4. Select a port.

5. Select the name of an ACL from the ACL list.

6. Click Apply.

Figure 150: Binding a Port to an ACL



Security > ACL

Step: 2. Configure Interface ▼ Action: Configure ▼

Type ● IP ○ MAC ○ IPv6

Port 1 ▼

Ingress

ACL ☑ R&D ▼

Counter ☑

Egress

ACL ☑ R&D#2 ▼

Counter ☑

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.

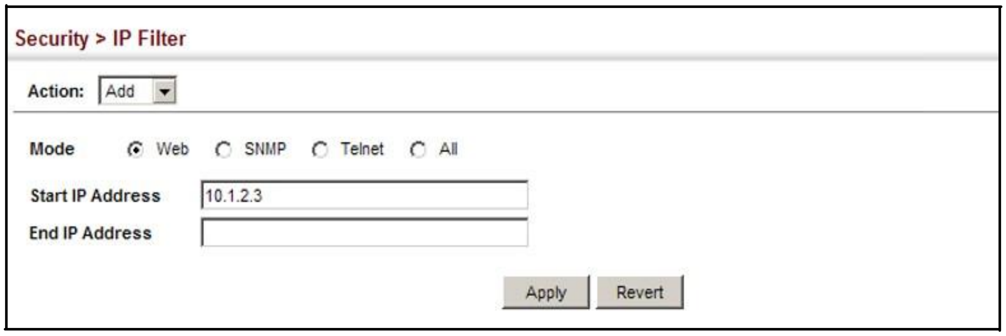
2. Select Add from the Action list.

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 151: Creating an IP Address Filter for Management Access



Security > IP Filter

Action: Add

Mode ● Web ○ SNMP ○ Telnet ○ All

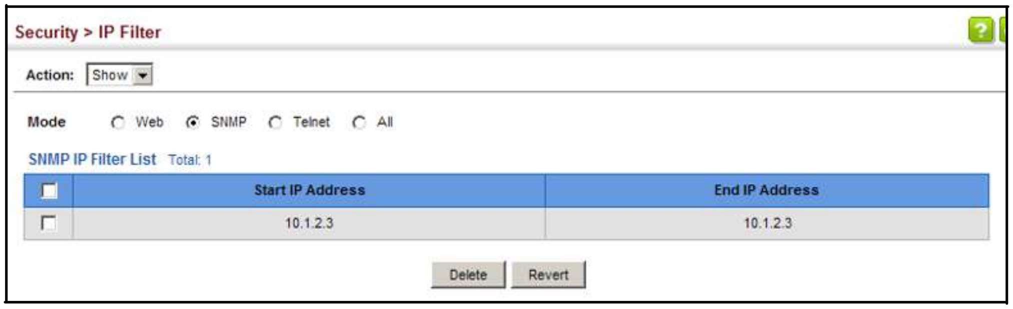
Start IP Address: 10.1.2.3

End IP Address:

To show a list of IP addresses authorized for management access:

1. Click Security, IP Filter.
2. Select Show from the Action list.

Figure 152: Showing IP Addresses Authorized for Management Access



Security > IP Filter

Action: Show

Mode ○ Web ● SNMP ○ Telnet ○ All

SNMP IP Filter List Total: 1

□	Start IP Address	End IP Address
□	10.1.2.3	10.1.2.3

12 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.
- 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.
- UniDirectional Link Detection (UDLD) – 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 21: 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).

Web Interface

To configure the logging of error messages to system memory:

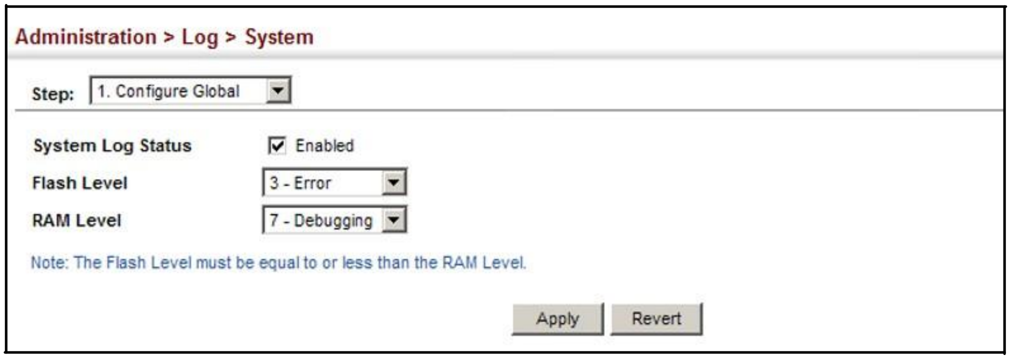
1. Click Administration, Log, System.

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 153: 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.

To show the error messages logged to system or flash memory:

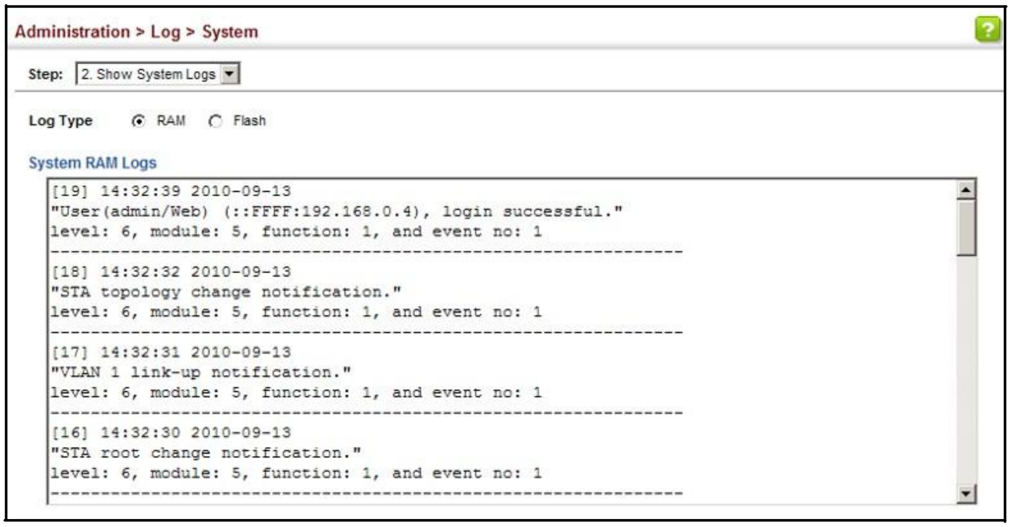
1. Click Administration, Log, System.

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 154: Showing Error Messages Logged to System Memory


Administration > Log > System

Step: 2. Show System Logs

Log Type ● RAM ○ Flash

System RAM Logs

```
[19] 14:32:39 2010-09-13
"User(admin/Web) (::FFFF:192.168.0.4), login successful."
level: 6, module: 5, function: 1, and event no: 1
---------------------------------------------------------------
[18] 14:32:32 2010-09-13
"STA topology change notification."
level: 6, module: 5, function: 1, and event no: 1
---------------------------------------------------------------
[17] 14:32:31 2010-09-13
"VLAN 1 link-up notification."
level: 6, module: 5, function: 1, and event no: 1
---------------------------------------------------------------
[16] 14:32:30 2010-09-13
"STA root change notification."
level: 6, module: 5, function: 1, and event no: 1
---------------------------------------------------------------
```

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.

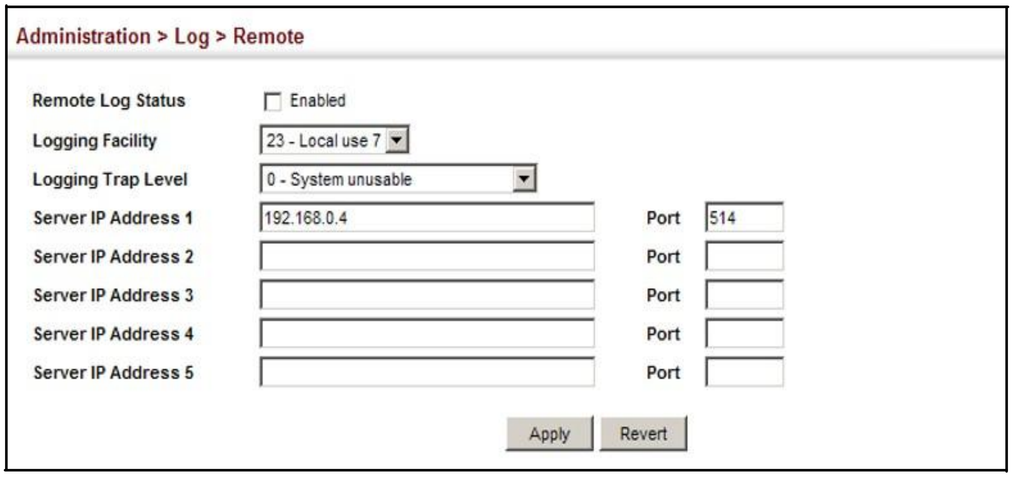
  The attribute specifies the facility type tag sent in syslog messages (see RFC 3164). This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to process messages, such as sorting or storing messages in the corresponding database. (Range: 16-23, 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)

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 155: Configuring Settings for Remote Logging of Error Messages



Administration > Log > Remote

Remote Log Status	□ 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	

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 * Delay Interval) ≤ 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 lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange 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)

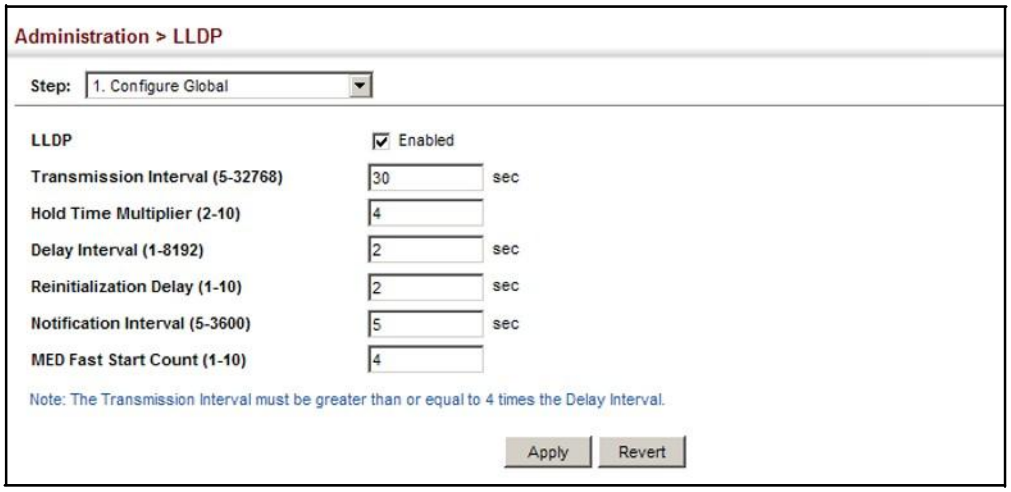
  The MED Fast Start Count parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

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 156: Configuring LLDP Timing Attributes



Administration > LLDP

Step: 1. Configure Global

LLDP	☑ Enabled	
Transmission Interval (5-32768)	30	sec
Hold Time Multiplier (2-10)	4	
Delay Interval (1-8192)	2	sec
Reinitialization Delay (1-10)	2	sec
Notification Interval (5-3600)	5	sec
MED Fast Start Count (1-10)	4	

Note: The Transmission Interval must be greater than or equal to 4 times the Delay Interval.

Configuring LLDP Interface Attributes

Use the Administration > LLDP (Configure Interface) 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 284.

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 lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange 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 55. (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. (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 123). (Default: Enabled)

  - **VLAN Name** – The name of all VLANs to which this interface has been assigned (see "IEEE 802.1Q VLANs" on page 123). (Default: Enabled)

  - **Port and Protocol VLAN ID** – The port-based protocol VLANs configured on this interface. (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 58 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)

- **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)

  - **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:

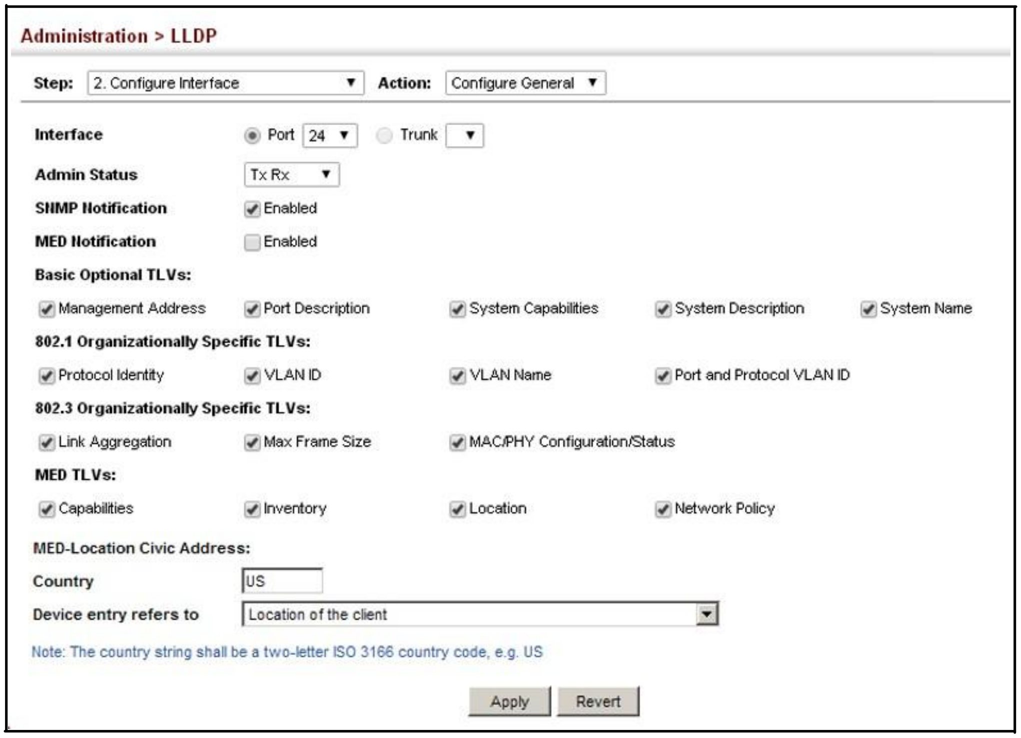
1. Click Administration, LLDP.

2. Select Configure Interface from the Step list.

3. Set the LLDP transmit/receive mode, specify whether or not to send SNMP trap messages, and select the information to advertise in LLDP messages.

4. Click Apply.

Figure 157: Configuring LLDP Interface Attributes



Administration > LLDP

Step: 2. Configure Interface ▼ Action: Configure General ▼

Interface ● Port 24 ▼ ○ Trunk ▼

Admin Status Tx Rx ▼

SNMP Notification ☑ Enabled

MED Notification □ Enabled

Basic Optional TLVs:

☑ Management Address ☑ Port Description ☑ System Capabilities ☑ System Description ☑ System Name

802.1 Organizationally Specific TLVs:

☑ Protocol Identity ☑ VLAN ID ☑ VLAN Name ☑ Port and Protocol VLAN ID

802.3 Organizationally Specific TLVs:

☑ Link Aggregation ☑ Max Frame Size ☑ MAC/PHY Configuration/Status

MED TLVs:

☑ Capabilities ☑ Inventory ☑ Location ☑ Network Policy

MED-Location Civic Address:

Country US

Device entry refers to Location of the client ▼

Note: The country string shall be a two-letter ISO 3166 country code, e.g. US

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 22: 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 22: 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 in the web interface:

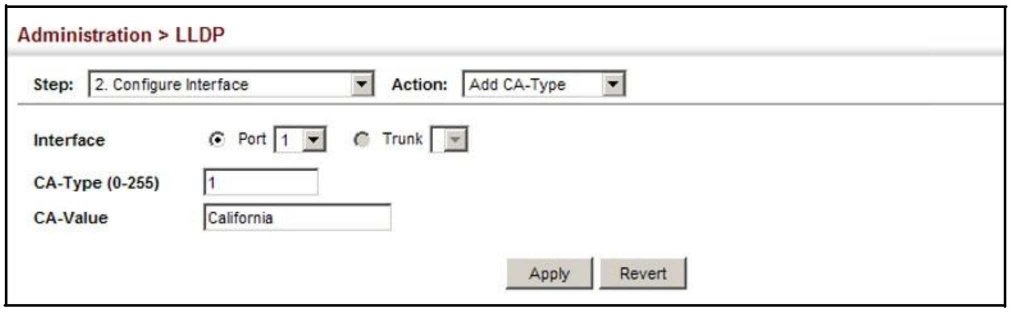
- **CA-Type** – Descriptor of the data civic address value. (Range: 0-255)
- **CA-Value** – Description of a location. (Range: 1-32 characters)

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 158: 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

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 23: 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 55).
- **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 24: System Capabilities

ID Basis	Reference
Other	—
Repeater	IETF RFC 2108
Bridge	IETF RFC 2674
WLAN Access Point	IEEE 802.11 MIB

Table 24: System Capabilities (Continued)

ID Basis	Reference
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 25: 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)

Table 25: Port ID Subtype (Continued)

ID Basis	Reference
Agent circuit ID	agent circuit ID (IETF RFC 3046)
Locally assigned	locally assigned

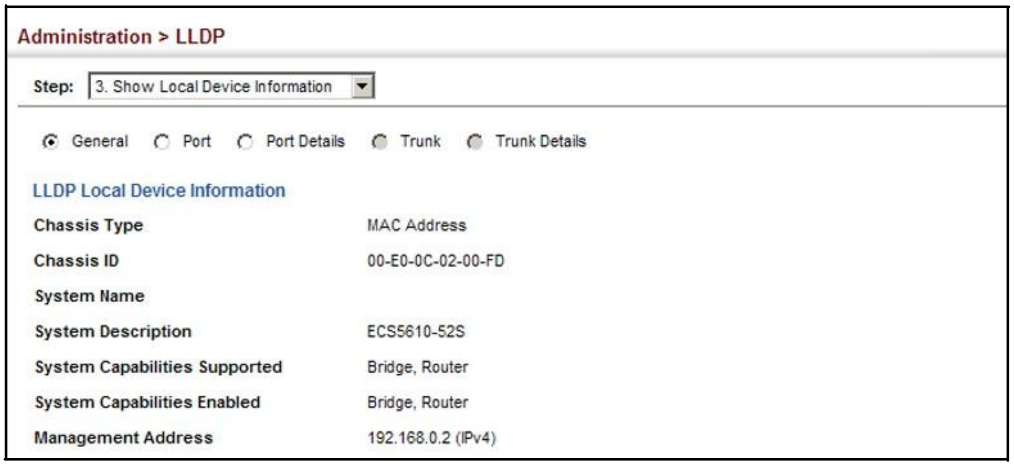
- **Port/Trunk ID** – A string that contains the specific identifier for the local interface based on interface subtype used by this switch.
- **Port/Trunk Description** – A string that indicates the port or trunk description. If RFC 2863 is implemented, the ifDescr object should be used for this field.
- **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 159: Displaying Local Device Information for LLDP (General)



Administration > LLDP

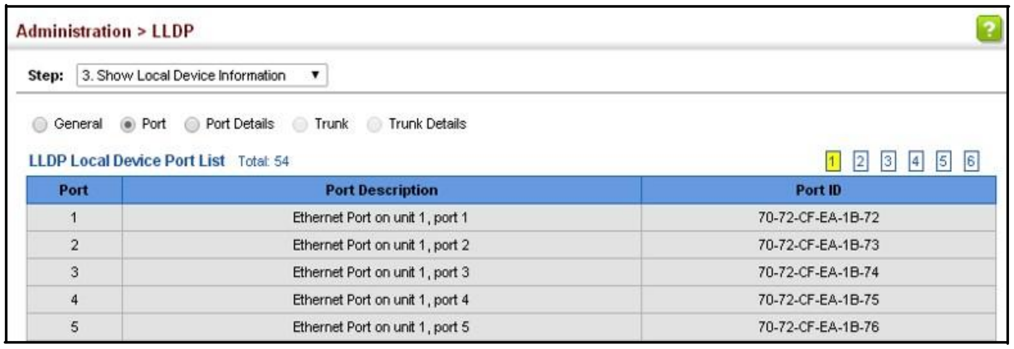
Step: 3. Show Local Device Information

● General ○ Port ○ Port Details ○ Trunk ○ Trunk Details

LLDP Local Device Information

Chassis Type	MAC Address
Chassis ID	00-E0-0C-02-00-FD
System Name	
System Description	ECS5610-52S
System Capabilities Supported	Bridge, Router
System Capabilities Enabled	Bridge, Router
Management Address	192.168.0.2 (IPv4)

Figure 160: Displaying Local Device Information for LLDP (Port)



Administration > LLDP
Step: 3. Show Local Device Information
○ General ● Port ○ Port Details ○ Trunk ○ Trunk Details
1 2 3 4 5 6

LLDP Local Device Port List Total: 54

Port	Port Description	Port ID
1	Ethernet Port on unit 1, port 1	70-72-CF-EA-1B-72
2	Ethernet Port on unit 1, port 2	70-72-CF-EA-1B-73
3	Ethernet Port on unit 1, port 3	70-72-CF-EA-1B-74
4	Ethernet Port on unit 1, port 4	70-72-CF-EA-1B-75
5	Ethernet Port on unit 1, port 5	70-72-CF-EA-1B-76

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.
- **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 23, "Chassis ID Subtype," on page 253.)

- **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 25, "Port ID Subtype," on page 254.
- **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 24, "System Capabilities," on page 253.)
- **System Capabilities Enabled** – The primary function(s) of the system which are currently enabled. (See Table 24, "System Capabilities," on page 253.)
- **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 (why not shown?)

- **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 26: 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
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 Capability[5]

- **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.

[5] These fields are only displayed for end-node devices advertising LLDP-MED TLVs.

- **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.

Port Details – Network Policy[5]

- **Application Type** – The primary application(s) 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 Identification[5]

- **Location Data Format** – Any of these location ID data formats:
  - Coordinate-based LCI[6] – Defined in RFC 3825, includes latitude resolution, latitude, longitude resolution, longitude, altitude type, altitude resolution, altitude, and datum.
  - Civic Address LCI[6] – 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 the other items and described under "Configuring LLDP Interface Civic-Address."
  - 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 – Inventory[5]

- **Hardware Revision** – The hardware revision of the end-point device.
- **Software Revision** – The software revision of the end-point device.

~~[6] Location Configuration Information~~

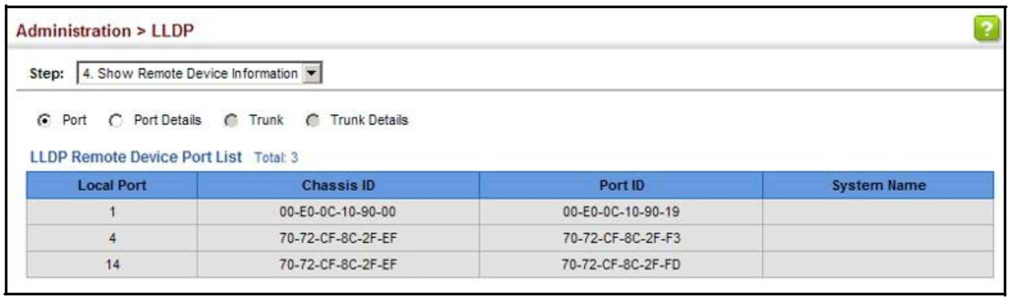
- **Manufacture Name** – The manufacturer of the end-point device.
- **Asset ID** – The asset identifier of the end-point device. End-point devices are typically assigned asset identifiers to facilitate inventory management and assets tracking.
- **Firmware Revision** – The firmware revision of the end-point 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 161: Displaying Remote Device Information for LLDP (Port)

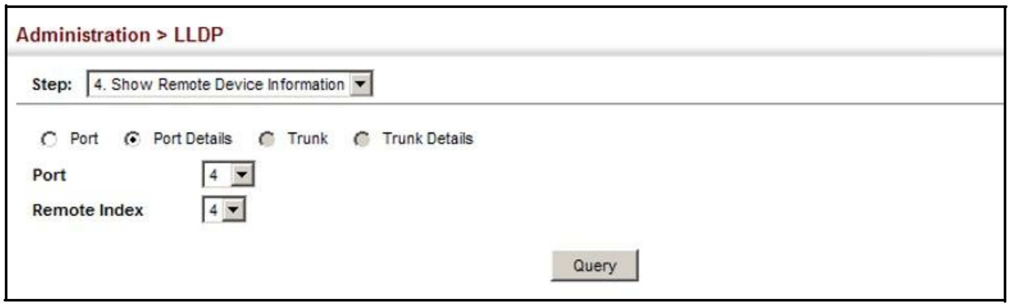


Step: 4. Show Remote Device Information

● Port ○ Port Details ○ Trunk ○ Trunk Details

LLDP Remote Device Port List Total: 3

Local Port	Chassis ID	Port ID	System Name
1	00-E0-0C-10-90-00	00-E0-0C-10-90-19	
4	70-72-CF-8C-2F-EF	70-72-CF-8C-2F-F3	
14	70-72-CF-8C-2F-EF	70-72-CF-8C-2F-FD	



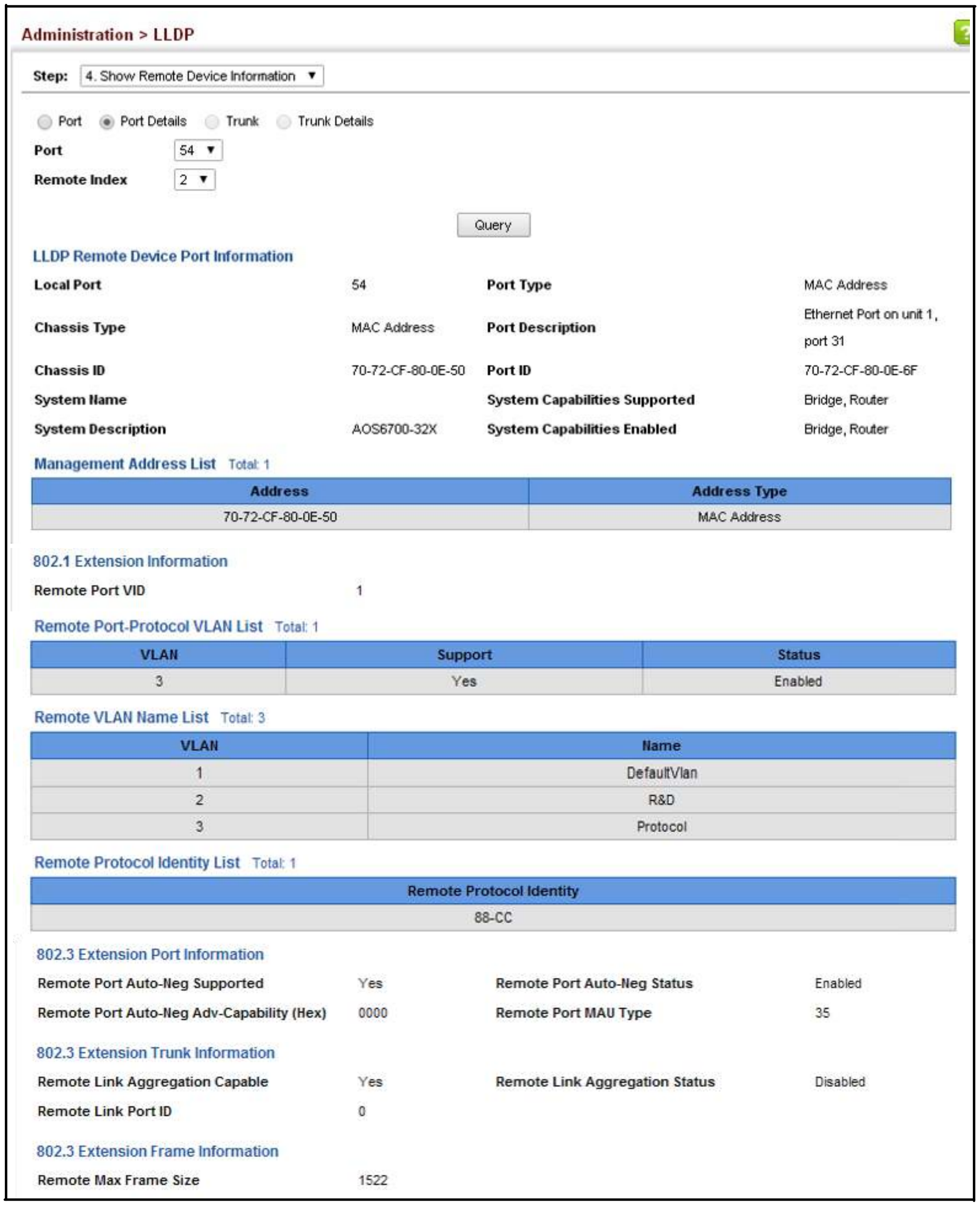
Step: 4. Show Remote Device Information

○ Port ● Port Details ○ Trunk ○ Trunk Details

Port 4

Remote Index 4

Figure 162: Displaying Remote Device Information for LLDP (Port Details)



Administration > LLDP

Step: 4. Show Remote Device Information ▼

○ Port ● Port Details ○ Trunk ○ Trunk Details

Port: 54 ▼

Remote Index: 2 ▼

LLDP Remote Device Port Information

Local Port	54	Port Type	MAC Address
Chassis Type	MAC Address	Port Description	Ethernet Port on unit 1, port 31
Chassis ID	70-72-CF-80-0E-50	Port ID	70-72-CF-80-0E-6F
System Name		System Capabilities Supported	Bridge, Router
System Description	AOS6700-32X	System Capabilities Enabled	Bridge, Router

Management Address List Total: 1

Address	Address Type
70-72-CF-80-0E-50	MAC Address

802.1 Extension Information

Remote Port VID: 1

Remote Port-Protocol VLAN List Total: 1

VLAN	Support	Status
3	Yes	Enabled

Remote VLAN Name List Total: 3

VLAN	Name
1	DefaultVlan
2	R&D
3	Protocol

Remote Protocol Identity List Total: 1

Remote Protocol Identity
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 (Hex)	0000	Remote Port MAU Type	35

802.3 Extension Trunk Information

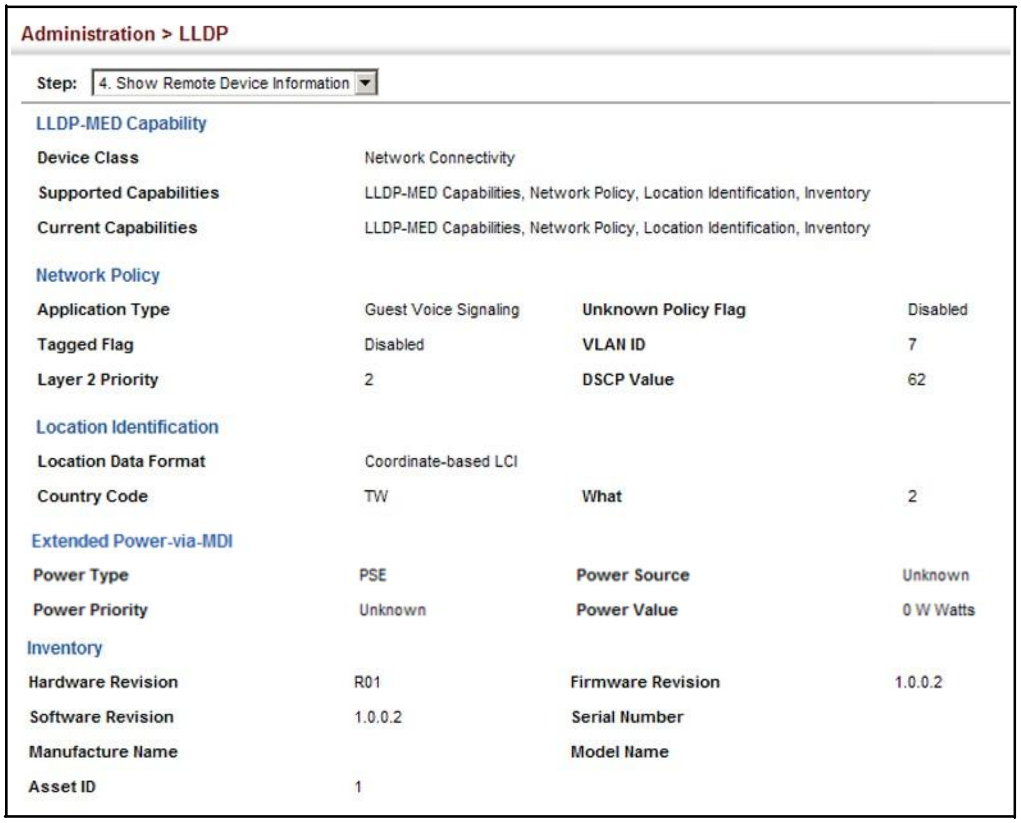
Remote Link Aggregation Capable	Yes	Remote Link Aggregation Status	Disabled
Remote Link Port ID	0		

802.3 Extension Frame Information

Remote Max Frame Size: 1522

Additional information displayed by an end-point device which advertises LLDP-MED TLVs is shown in the following figure.

Figure 163: 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

Extended Power-via-MDI

Power Type	PSE	Power Source	Unknown
Power Priority	Unknown	Power Value	0 W Watts

Inventory

Hardware Revision	R01	Firmware Revision	1.0.0.2
Software Revision	1.0.0.2	Serial Number	
Manufacture Name		Model Name	
Asset ID	1		

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

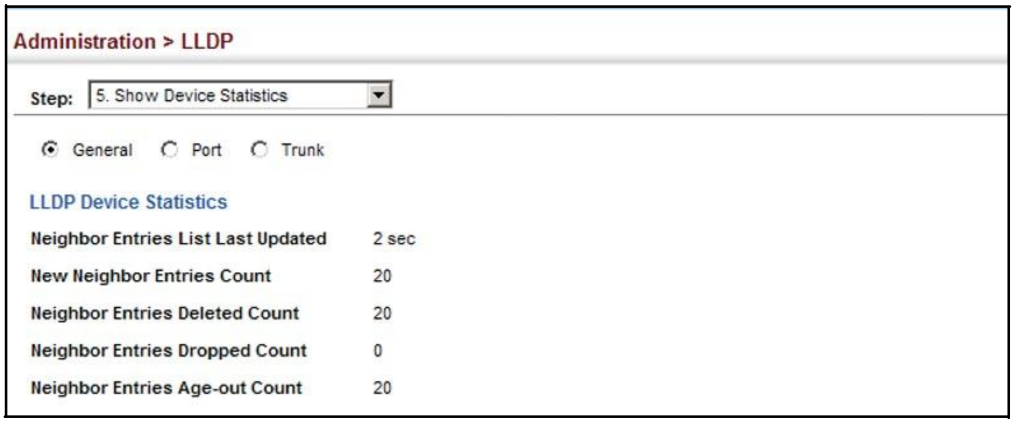
- **Frames Discarded** – Number of frames discarded because they did not conform to the general validation rules as well as any specific usage rules defined for the particular TLV.
- **Frames Invalid** – A count of all LLDPDUs received with one or more detectable errors.
- **Frames Received** – Number 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 164: Displaying LLDP Device Statistics (General)



Administration > LLDP

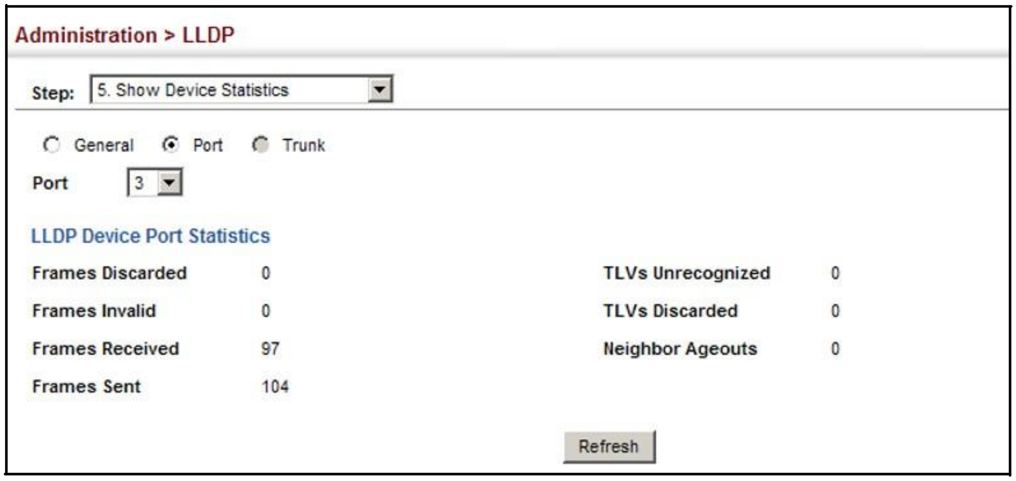
Step: 5. Show Device Statistics

● General ○ Port ○ Trunk

LLDP Device Statistics

Neighbor Entries List Last Updated	2 sec
New Neighbor Entries Count	20
Neighbor Entries Deleted Count	20
Neighbor Entries Dropped Count	0
Neighbor Entries Age-out Count	20

Figure 165: Displaying LLDP Device Statistics (Port)



Administration > LLDP

Step: 5. Show Device Statistics

○ General ● Port ○ Trunk

Port 3

LLDP Device Port Statistics

Frames Discarded	0	TLVs Unrecognized	0
Frames Invalid	0	TLVs Discarded	0
Frames Received	97	Neighbor Ageouts	0
Frames Sent	104		

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 it’s 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	*user defined*	*user defined*	*user defined*	*user defined*	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	*user defined*	*user defined*	*user defined*	*user defined*	Community string only
v3	noAuthNoPriv	*user defined*	*user defined*	*user defined*	*user defined*	A user name match only
v3	AuthNoPriv	*user defined*	*user defined*	*user defined*	*user defined*	Provides user authentication via MD5 or SHA algorithms
v3	AuthPriv	*user defined*	*user defined*	*user defined*	*user defined*	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**[7] – 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.

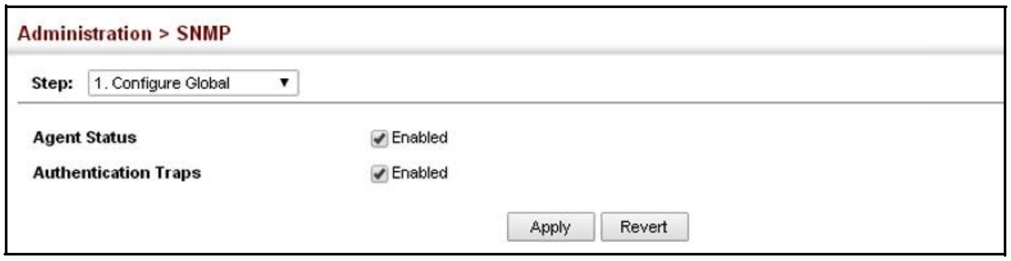
2. Select Configure Global from the Step list.

3. Enable SNMP and the required trap types.

4. Click Apply

[7] 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 271).

Figure 166: Configuring Global Settings for SNMP



Administration > SNMP

Step: 1. Configure Global

Agent Status ☑ Enabled

Authentication Traps ☑ Enabled

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 EngineID was last configured.

Web Interface

To configure the local SNMP engine ID:

1. Click Administration, SNMP.

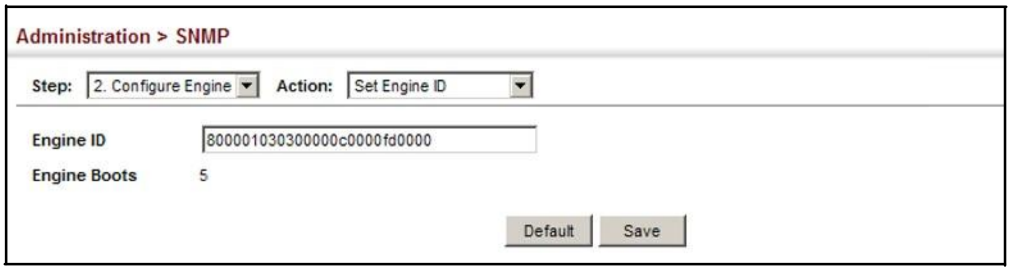
2. Select Configure Engine from the Step list.

3. Select Set Engine ID from the Action list.

4. Enter an ID of a least 9 hexadecimal characters.

5. Click Apply

Figure 167: Configuring the Local Engine ID for SNMP



Administration > SNMP

Step: 2. Configure Engine   Action: Set Engine ID

Engine ID 800001030300000c0000fd0000

Engine Boots 5

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 281.)

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".

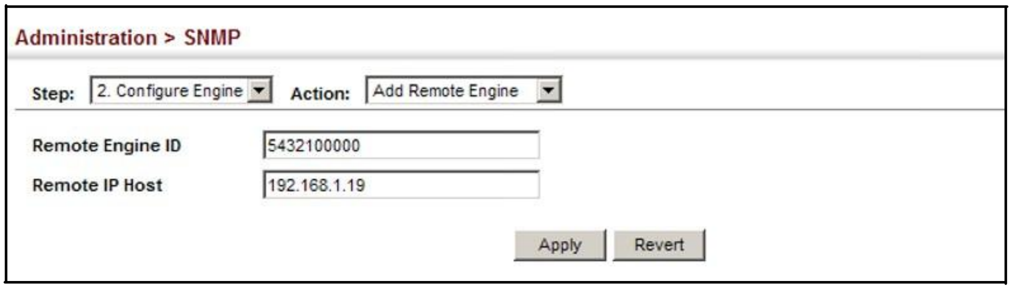
- **Remote IP Host** – The IP address of a remote management station which is using the specified engine ID.

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 168: Configuring a Remote Engine ID for SNMP



Administration > SNMP

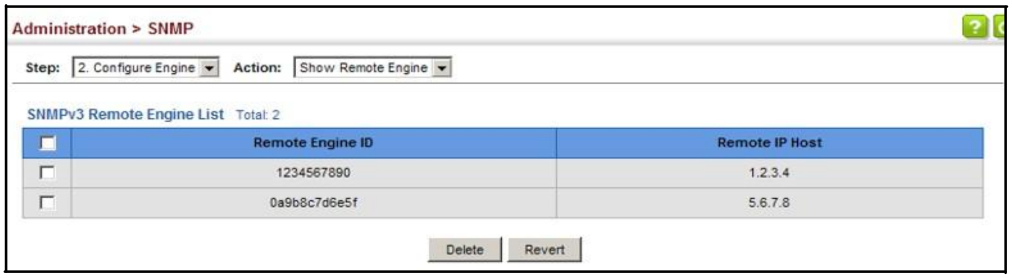
Step: 2. Configure Engine
Action: Add Remote Engine

Remote Engine ID: 5432100000
Remote IP Host: 192.168.1.19

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 169: Showing Remote Engine IDs for SNMP



Administration > SNMP

Step: 2. Configure Engine
Action: Show Remote Engine

SNMPv3 Remote Engine List Total: 2

□	Remote Engine ID	Remote IP Host
□	1234567890	1.2.3.4
□	0a9b8c7d6e5f	5.6.7.8

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: 1-64 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.
- **Type** – Indicates if the object identifier of a branch within the MIB tree is included or excluded from the SNMP view.

Add OIDSubtree

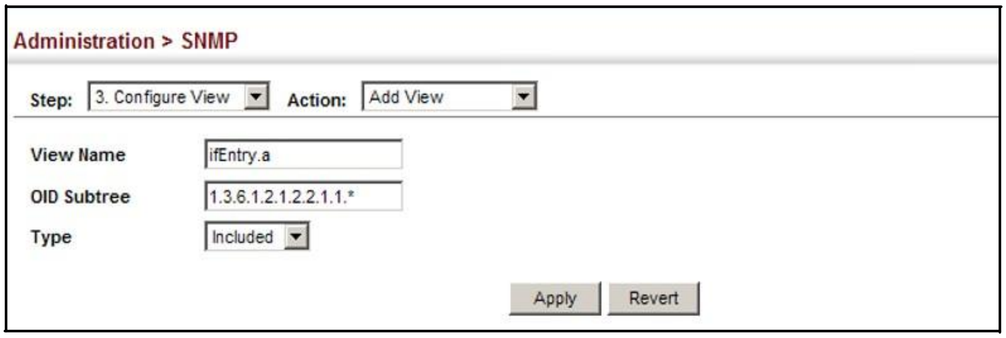
- **View Name** – Lists the SNMP views configured in the Add View page.
- **OID Subtree** – Adds an additional object identifier of a branch within the MIB tree to the selected View. Wild cards can be used to mask a specific portion of the OID string.
- **Type** – Indicates if the object identifier of 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 170: Creating an SNMP View



Administration > SNMP

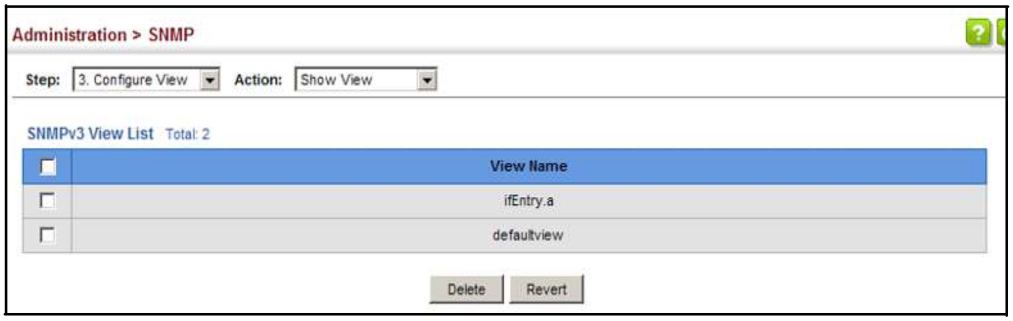
Step: 3. Configure View Action: Add View

View Name: ifEntry.a
OID Subtree: 1.3.6.1.2.1.2.2.1.1.*
Type: Included

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 171: Showing SNMP Views



Step: 3. Configure View Action: Show View

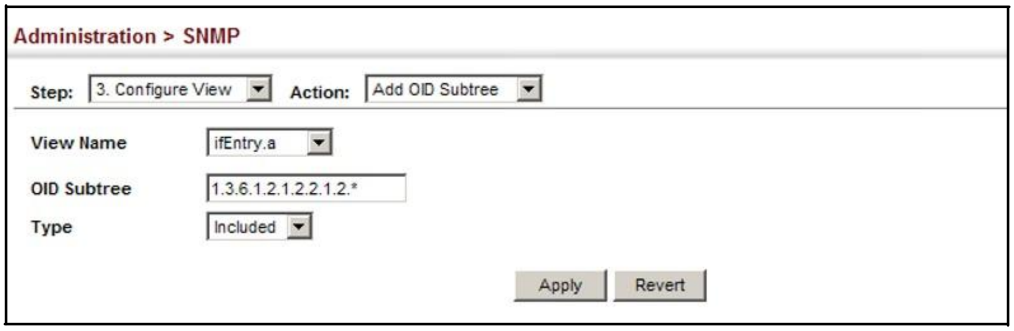
SNMPv3 View List Total: 2

□	View Name
□	ifEntry.a
□	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 172: Adding an OID Subtree to an SNMP View



Step: 3. Configure View Action: Add OID Subtree

View Name: ifEntry.a

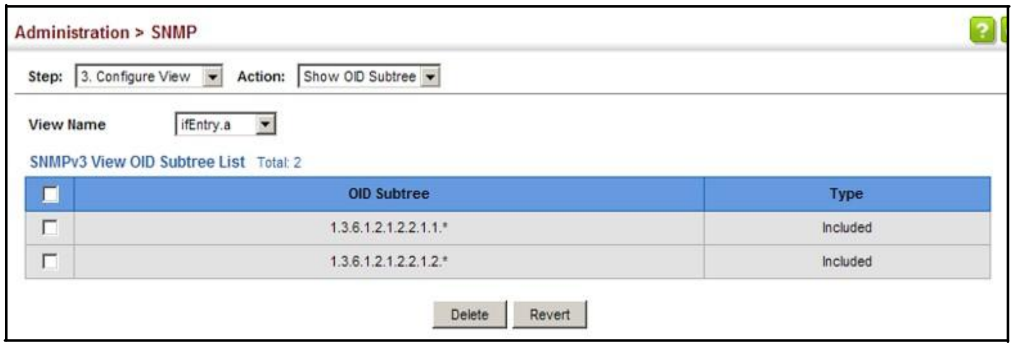
OID Subtree: 1.3.6.1.2.1.2.2.1.2.*

Type: Included

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 173: Showing the OID Subtree Configured for SNMP Views



Step: 3. Configure View Action: Show OID Subtree

View Name ifEntry.a

SNMPv3 View OID Subtree List Total: 2

□	OID Subtree	Type
□	1.3.6.1.2.1.2.2.1.1.*	Included
□	1.3.6.1.2.1.2.2.1.2.*	Included

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
RFC 1493 Traps		
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.
SNMPv2 Traps		
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.
RMON Events (V2)		
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.
Private Traps (waiting for mib from sc_juang)		
swPowerStatus ChangeTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.1	This trap is sent when the power state changes.
swFanFailureTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.17	This trap is sent when the fan fails.
swFanRecoverTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.18	This trap is sent when fan failure has recovered.
swThermalRisingNotification	1.3.6.1.4.1.259.12.1.2.2.1.0.58	This trap is sent when the temperature is over the switchThermalActionRisingThreshold.

Table 28: Supported Notification Messages (Continued)

Model	Level	Group
swThermalFallingNotification	1.3.6.1.4.1.259.12.1.2.2.1.0.59	This trap is sent when the temperature is below the switchThermalActionFallingThreshold.
autoUpgradeTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.104	This trap is sent when auto upgrade is executed.
swCpuUtiRisingNotification	1.3.6.1.4.1.259.12.1.2.2.1.0.107	This notification indicates that the CPU utilization has risen from cpuUtiFallingThreshold to cpuUtiRisingThreshold.
swCpuUtiFallingNotification	1.3.6.1.4.1.259.12.1.2.2.1.0.108	This notification indicates that the CPU utilization has fallen from cpuUtiRisingThreshold to cpuUtiFallingThreshold.
swMemoryUtiRisingThreshold Notification	1.3.6.1.4.1.259.12.1.2.2.1.0.109	This notification indicates that the memory utilization has risen from memoryUtiFallingThreshold to memoryUtiRisingThreshold.
swMemoryUtiFallingThreshold Notification	1.3.6.1.4.1.259.12.1.2.2.1.0.110	This notification indicates that the memory utilization has fallen from memoryUtiRisingThreshold to memoryUtiFallingThreshold.
dhcpRougeServerAttackTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.114	This trap is sent when receiving a DHCP packet from a rouge server.
macNotificationTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.138	This trap is sent when there are changes of the dynamic MAC addresses on the switch.
sfpThresholdAlarmWarnTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.189	This trap is sent when the SFP's A/D quantity is not within alarm/warning thresholds.
udldPortShutdownTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.192	This trap is sent when the port is shut down by UDLD.
userAuthenticationFailureTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.199	This trap will be triggered if authentication is fail.
userAuthenticationSuccessTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.200	This trap will be triggered if authentication is successful.
loginTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.201	This trap is sent when user login.
logoutTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.202	This trap is sent when user logout.
fileCopyTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.208	This trap is sent when file copy is executed.
userauthCreateUserTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.209	This trap is sent when create user account.
userauthDeleteUserTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.210	This trap is sent when delete user account.
userauthModifyUserPrivilegeTrap	1.3.6.1.4.1.259.12.1.2.2.1.0.211	This trap is sent when modify user privilege.

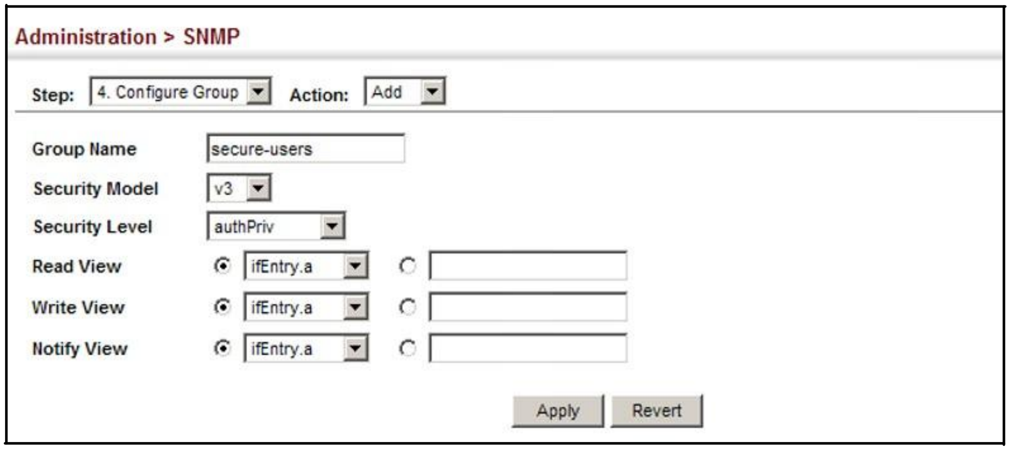
* These are legacy notifications and therefore must be enabled in conjunction with the corresponding traps on the SNMP Configuration menu.

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 174: Creating an SNMP Group



Administration > SNMP

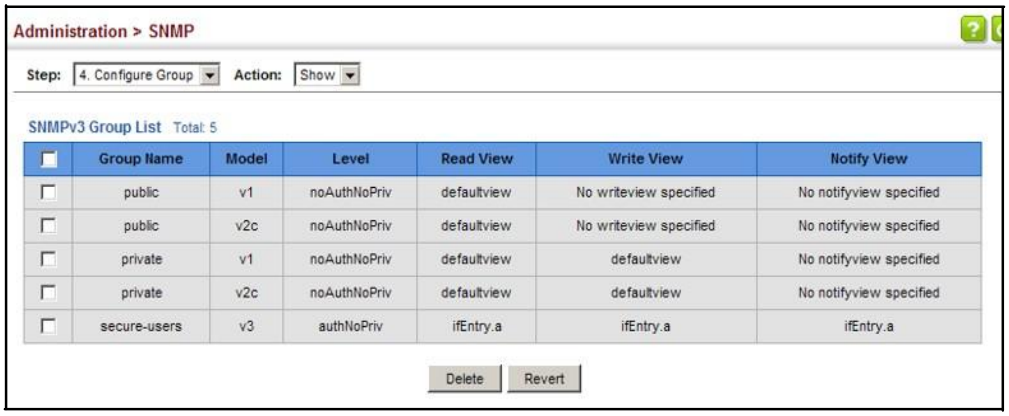
Step: 4. Configure Group Action: Add

Group Name	secure-users	
Security Model	v3	
Security Level	authPriv	
Read View	● ifEntry.a	○
Write View	● ifEntry.a	○
Notify View	● ifEntry.a	○

To show SNMP groups:

1. Click Administration, SNMP.
2. Select Configure Group from the Step list.
3. Select Show from the Action list.

Figure 175: Showing SNMP Groups



Administration > SNMP

Step: 4. Configure Group Action: Show

SNMPv3 Group List Total: 5

□	Group Name	Model	Level	Read View	Write View	Notify View
□	public	v1	noAuthNoPriv	defaultview	No writeview specified	No notifyview specified
□	public	v2c	noAuthNoPriv	defaultview	No writeview specified	No notifyview specified
□	private	v1	noAuthNoPriv	defaultview	defaultview	No notifyview specified
□	private	v2c	noAuthNoPriv	defaultview	defaultview	No notifyview specified
□	secure-users	v3	authNoPriv	ifEntry.a	ifEntry.a	ifEntry.a

Setting Community Access Strings

Use the Administration > SNMP (Configure User - Add Community) 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)

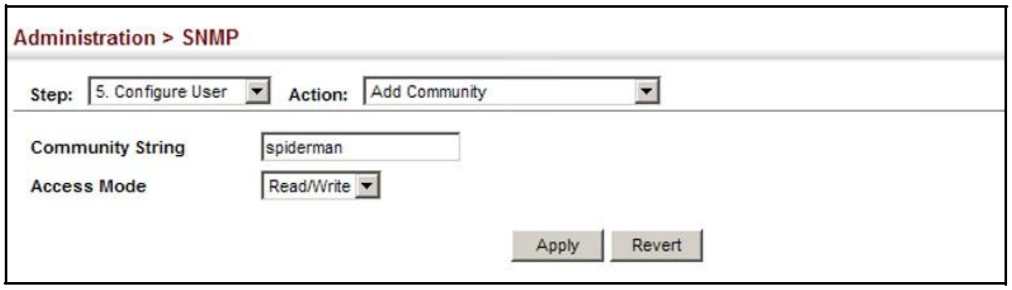
- **Access Mode** – Specifies the access rights for the community string:
  - **Read-Only** – Authorized management stations are only able to retrieve MIB objects.
  - **Read/Write** – Authorized management stations are able to both retrieve and modify MIB objects.

Web Interface

To set a community access string:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.
3. Select Add Community 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 176: Setting Community Access Strings



Administration > SNMP

Step: 5. Configure User
Action: Add Community

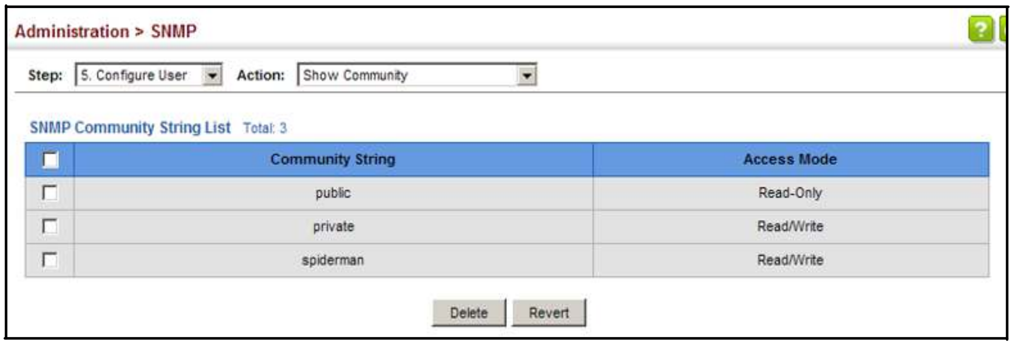
Community String: spiderman
Access Mode: Read/Write

To show the community access strings:

1. Click Administration, SNMP.
2. Select Configure User from the Step list.

3. Select Show Community from the Action list.

Figure 177: Showing Community Access Strings



Step: 5. Configure User Action: Show Community

SNMP Community String List Total: 3

□	Community String	Access Mode
□	public	Read-Only
□	private	Read/Write
□	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.

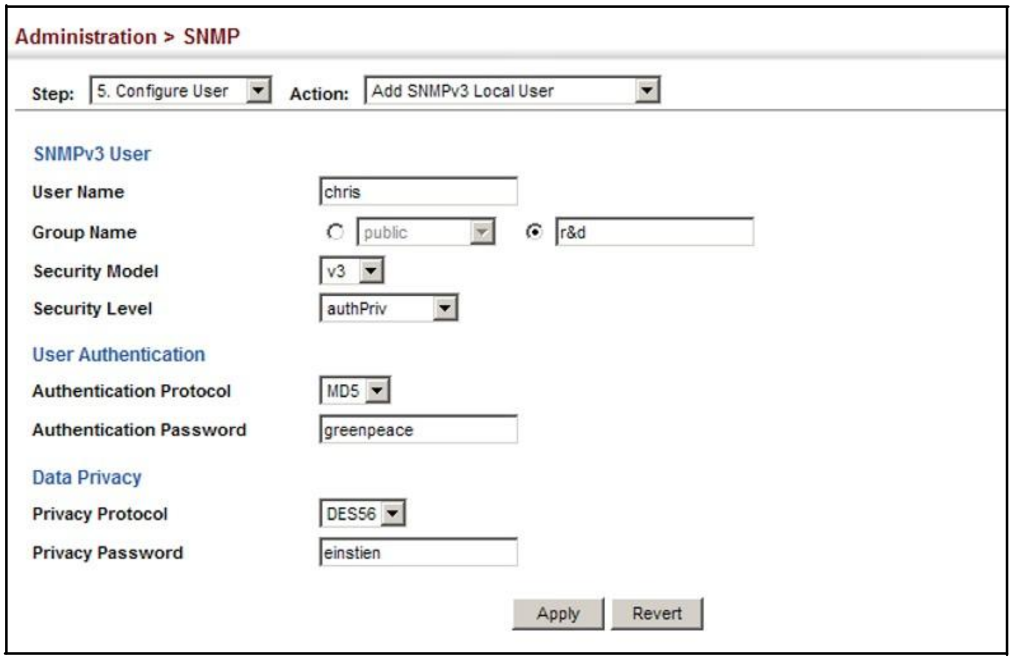
- **Privacy Protocol** – The encryption algorithm used for data privacy:
  - **3DES** - Uses SNMPv3 with privacy with 3DES (168-bit) encryption.
  - **AES128** - Uses SNMPv3 with privacy with AES128 encryption.
  - **AES192** - Uses SNMPv3 with privacy with AES192 encryption.
  - **AES256** - Uses SNMPv3 with privacy with AES256 encryption.
  - **DES56** - Uses SNMPv3 with privacy with DES56 encryption.
- **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 178: 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

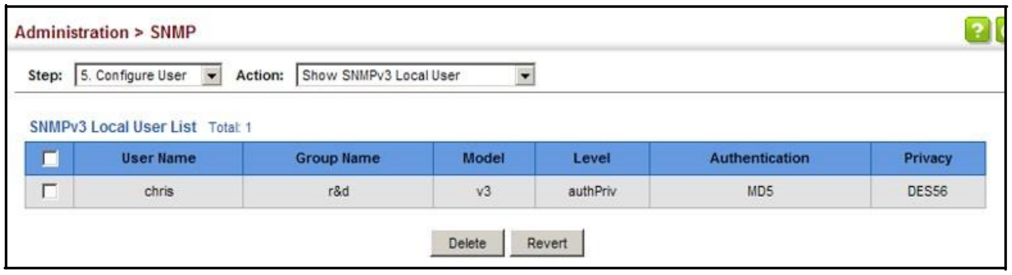
Data Privacy

Privacy Protocol: DES56
Privacy Password: einstien

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 179: Showing Local SNMPv3 Users



SNMPv3 Local User List Total: 1

□	User Name	Group Name	Model	Level	Authentication	Privacy
□	chris	r&d	v3	authPriv	MD5	DES56

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 284 and "Specifying a Remote Engine ID" on page 270.)

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** – The Internet address of the remote device where the user resides.
- **Security Model** – The user security model; SNMP v1, v2c or v3. (Default: v3)

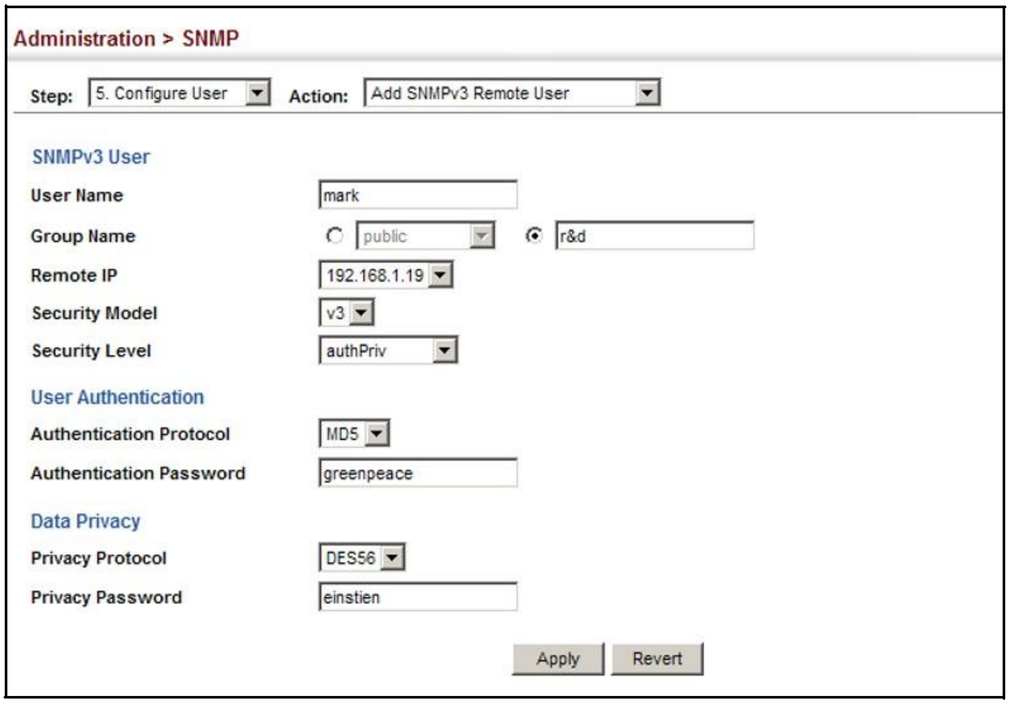
- **Security Level** – The following security levels are only used for the groups assigned to the SNMP security model:
  - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications. (This is the default security level.)
  - **AuthNoPriv** – SNMP communications use authentication, 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 used for data privacy:
  - **3DES** - Uses SNMPv3 with privacy with 3DES (168-bit) encryption.
  - **AES128** - Uses SNMPv3 with privacy with AES128 encryption.
  - **AES192** - Uses SNMPv3 with privacy with AES192 encryption.
  - **AES256** - Uses SNMPv3 with privacy with AES256 encryption.
  - **DES56** - Uses SNMPv3 with privacy with DES56 encryption.
- **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 180: Configuring Remote SNMPv3 Users



Administration > SNMP

Step: 5. Configure User Action: Add SNMPv3 Remote User

SNMPv3 User

User Name: mark

Group Name: ○ public ● r&d

Remote IP: 192.168.1.19

Security Model: v3

Security Level: authPriv

User Authentication

Authentication Protocol: MD5

Authentication Password: greenpeace

Data Privacy

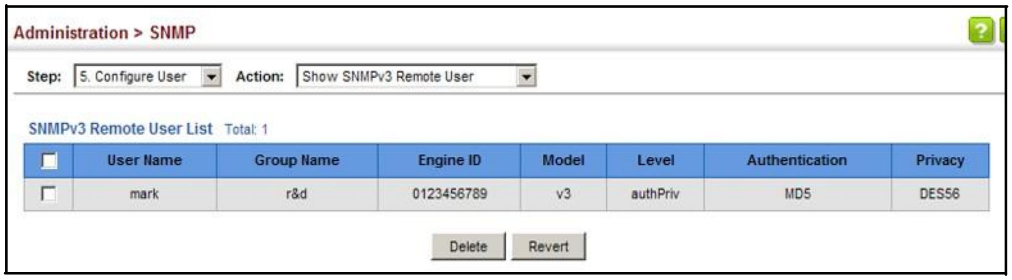
Privacy Protocol: DES56

Privacy Password: einstien

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 181: Showing Remote SNMPv3 Users



Administration > SNMP

Step: 5. Configure User Action: Show SNMPv3 Remote User

SNMPv3 Remote User List Total: 1

□	User Name	Group Name	Engine ID	Model	Level	Authentication	Privacy
□	mark	r&d	0123456789	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 268).
  2. Create a view with the required notification messages (page 271).
  3. Configure the group (matching the community string specified on the Configure Trap - Add page) to include the required notify view (page 274).
  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 268).
  2. Create a local SNMPv3 user to use in the message exchange process (page 279). 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 local user, and default settings for the read, write, and notify view.
  3. Create a view with the required notification messages (page 271).
  4. Create a group that includes the required notify view (page 274).
  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 279), 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 281), one will be automatically generated.

- **UDP Port** – Specifies the UDP port number used by the trap manager. (Default: 162)

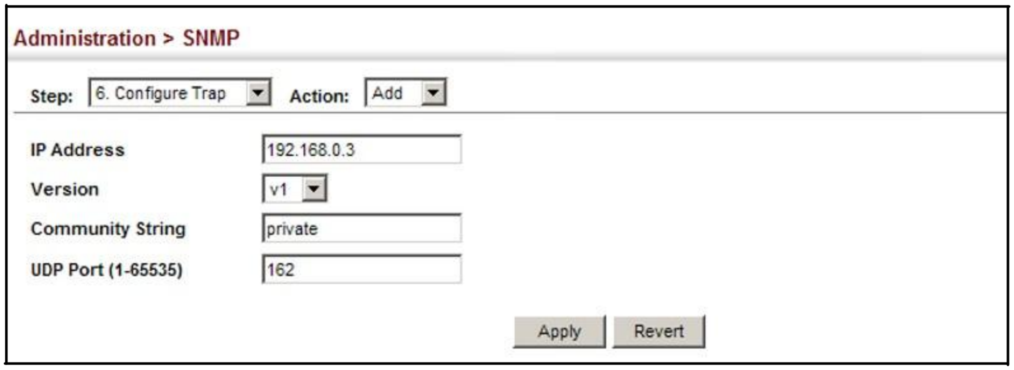
- **Security Level** – When trap version 3 is selected, you must specify one of the following security levels. (Default: noAuthNoPriv)
  - **noAuthNoPriv** – There is no authentication or encryption used in SNMP communications.
  - **AuthNoPriv** – SNMP communications use authentication, but the data 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 182: Configuring Trap Managers (SNMPv1)



Administration > SNMP

Step: 6. Configure Trap Action: Add

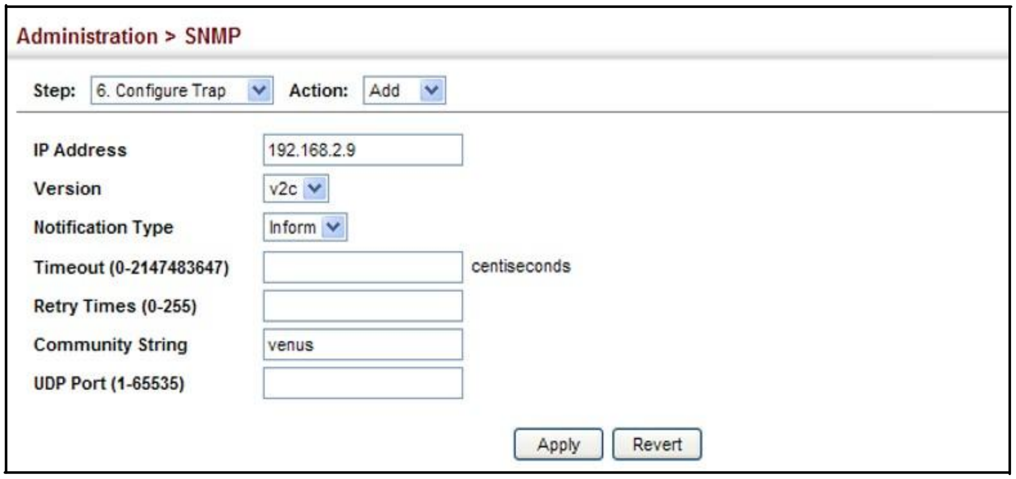
IP Address 192.168.0.3

Version v1

Community String private

UDP Port (1-65535) 162

Figure 183: Configuring Trap Managers (SNMPv2c)



Administration > SNMP

Step: 6. Configure Trap Action: Add

IP Address 192.168.2.9

Version v2c

Notification Type Inform

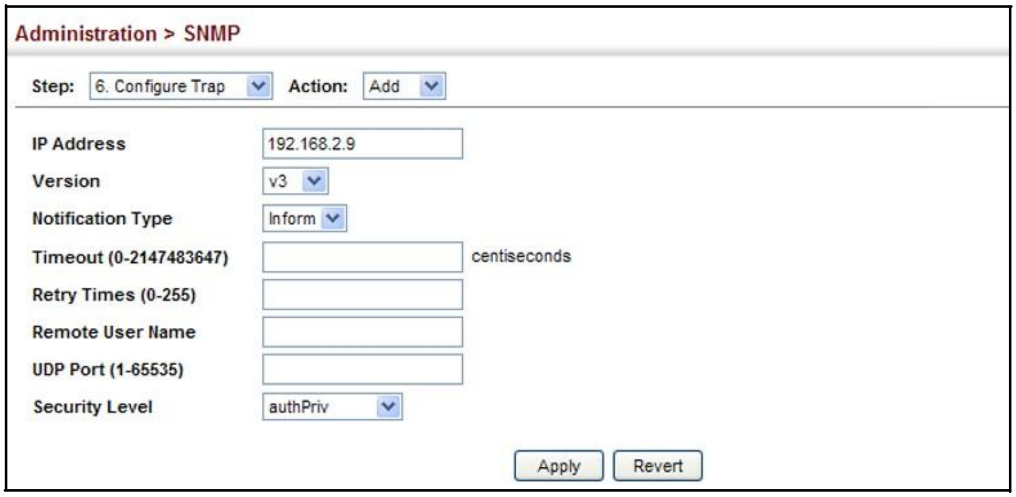
Timeout (0-2147483647) centiseconds

Retry Times (0-255)

Community String venus

UDP Port (1-65535)

Figure 184: Configuring Trap Managers (SNMPv3)



Administration > SNMP

Step: 6. Configure Trap Action: Add

IP Address 192.168.2.9

Version v3

Notification Type Inform

Timeout (0-2147483647) centiseconds

Retry Times (0-255)

Remote User Name

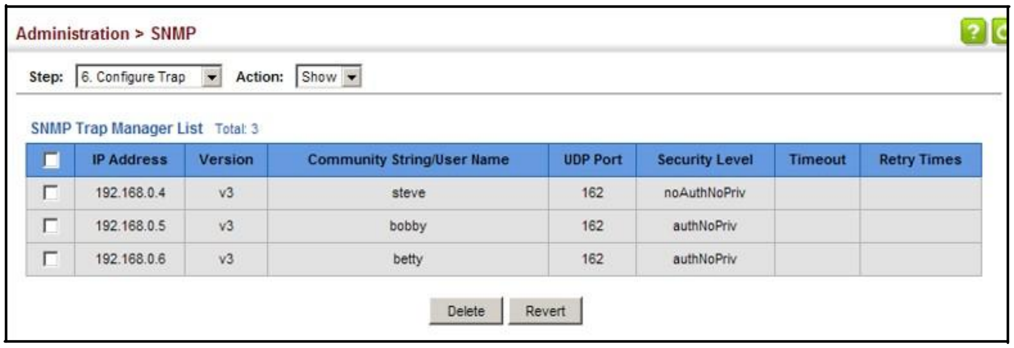
UDP Port (1-65535)

Security Level authPriv

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 185: Showing Trap Managers



Administration > SNMP

Step: 6. Configure Trap Action: Show

SNMP Trap Manager List Total: 3

□	IP Address	Version	Community String/User Name	UDP Port	Security Level	Timeout	Retry Times
□	192.168.0.4	v3	steve	162	noAuthNoPriv		
□	192.168.0.5	v3	bobby	162	authNoPriv		
□	192.168.0.6	v3	betty	162	authNoPriv		

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 62. 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 284, a default notify filter will be created.

Parameters

These parameters are displayed:

- **IP Address** – The Internet 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.

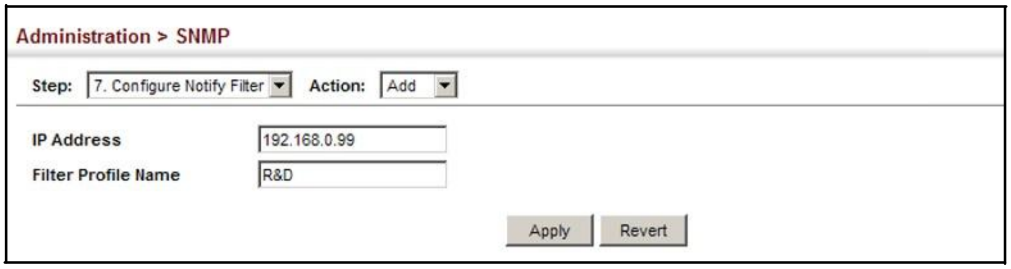
- **Filter Profile Name** – Notification log profile name. (Range: 1-32 characters)

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 186: Creating SNMP Notification Logs



Administration > SNMP

Step: 7. Configure Notify Filter Action: Add

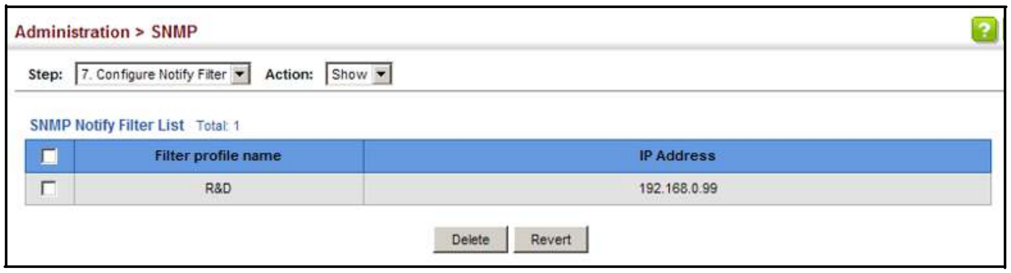
IP Address: 192.168.0.99

Filter Profile Name: R&D

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 187: Showing SNMP Notification Logs



Administration > SNMP

Step: 7. Configure Notify Filter ▼ Action: Show ▼

SNMP Notify Filter List Total: 1

□	Filter profile name	IP Address
□	R&D	192.168.0.99

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.

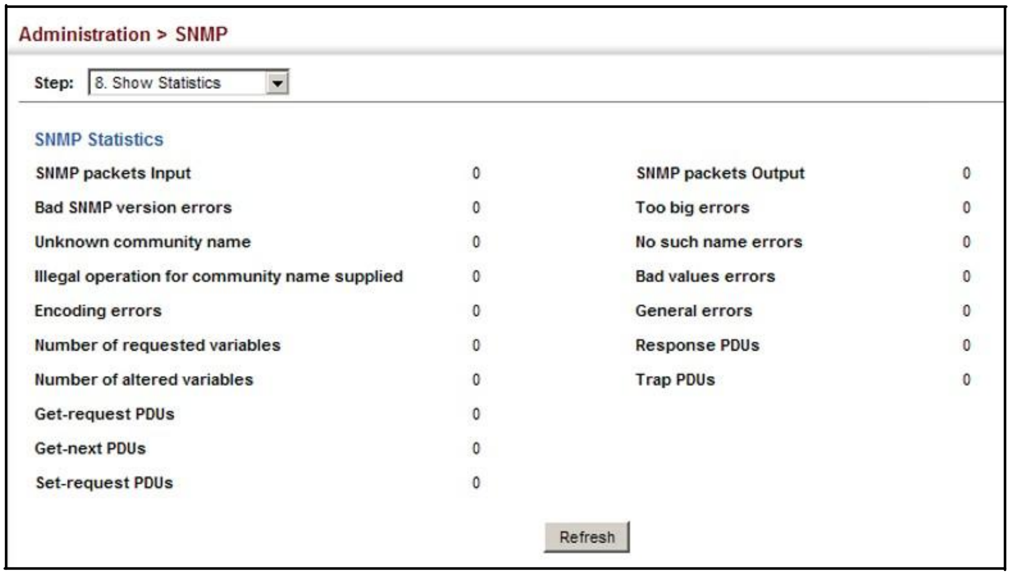
- **Trap PDUs** – The total number of SNMP Trap PDUs which have been accepted and processed by, or generated by, the SNMP protocol entity.

To show SNMP statistics:

1. Click Administration, SNMP.

2. Select Show Statistics from the Step list.

Figure 188: Showing SNMP Statistics



Administration > SNMP

Step: 8. Show Statistics

SNMP Statistics

SNMP packets Input	0	SNMP packets Output	0
Bad SNMP version errors	0	Too big errors	0
Unknown community name	0	No such name errors	0
Illegal operation for community name supplied	0	Bad values errors	0
Encoding errors	0	General errors	0
Number of requested variables	0	Response PDUs	0
Number of altered variables	0	Trap PDUs	0
Get-request PDUs	0		
Get-next PDUs	0		
Set-request PDUs	0		

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)

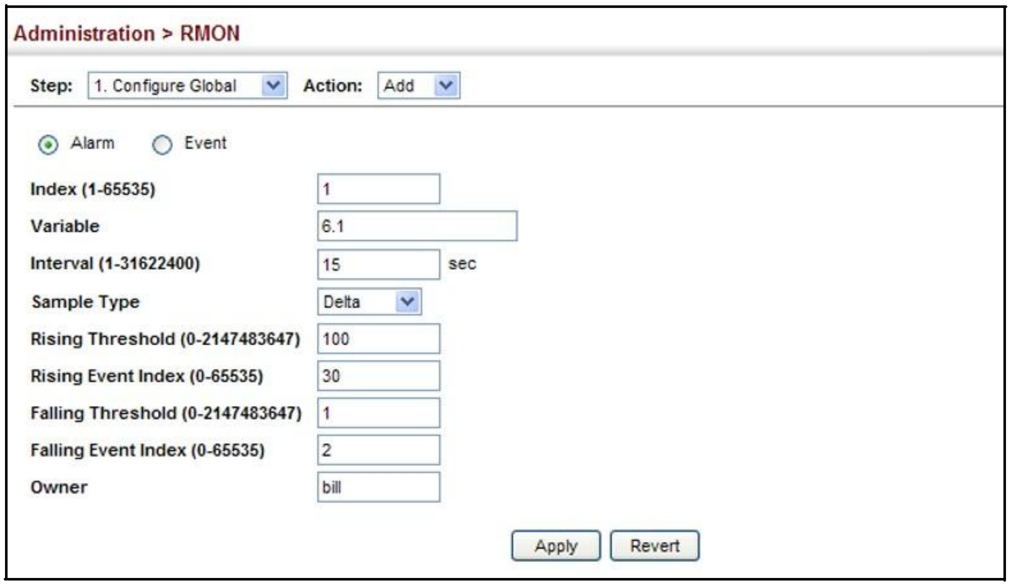
- **Sample Type** – Tests for absolute or relative changes in the specified variable.
  - **Absolute** – The variable is compared directly to the thresholds at the end of the sampling period.
  - **Delta** – The last sample is subtracted from the current value and the difference is then compared to the 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: 1-127 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 189: Configuring an RMON Alarm



Administration > RMON

Step: 1. Configure Global Action: Add

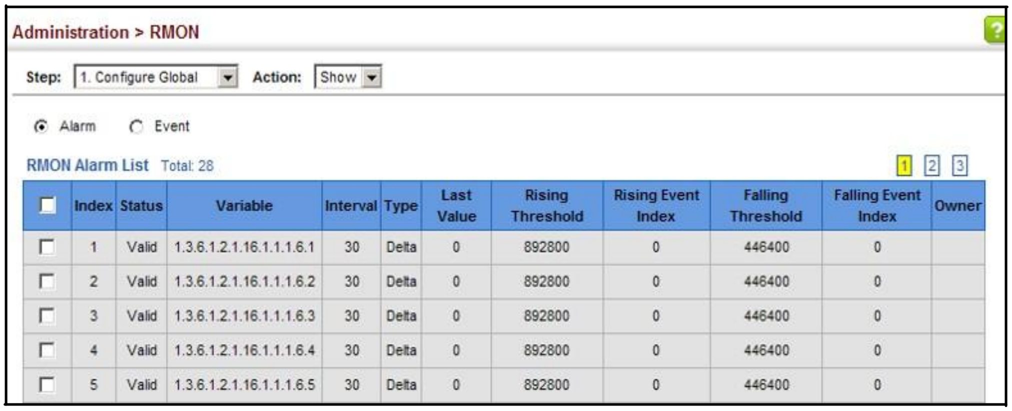
● Alarm ○ Event

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

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 190: Showing Configured RMON Alarms



Administration > RMON

Step: 1. Configure Global Action: Show

● Alarm ○ Event

RMON Alarm List Total: 28

□	Index	Status	Variable	Interval	Type	Last Value	Rising Threshold	Rising Event Index	Falling Threshold	Falling Event Index	Owner
□	1	Valid	1.3.6.1.2.1.16.1.1.1.6.1	30	Delta	0	892800	0	446400	0	
□	2	Valid	1.3.6.1.2.1.16.1.1.1.6.2	30	Delta	0	892800	0	446400	0	
□	3	Valid	1.3.6.1.2.1.16.1.1.1.6.3	30	Delta	0	892800	0	446400	0	
□	4	Valid	1.3.6.1.2.1.16.1.1.1.6.4	30	Delta	0	892800	0	446400	0	
□	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 241).

  - **Trap** – Sends a trap message to all configured trap managers (see "Specifying Trap Managers" on page 284).

  - **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 278) prior to configuring it here. (Range: 1-127 characters)

- **Description** – A comment that describes this event. (Range: 1-127 characters)

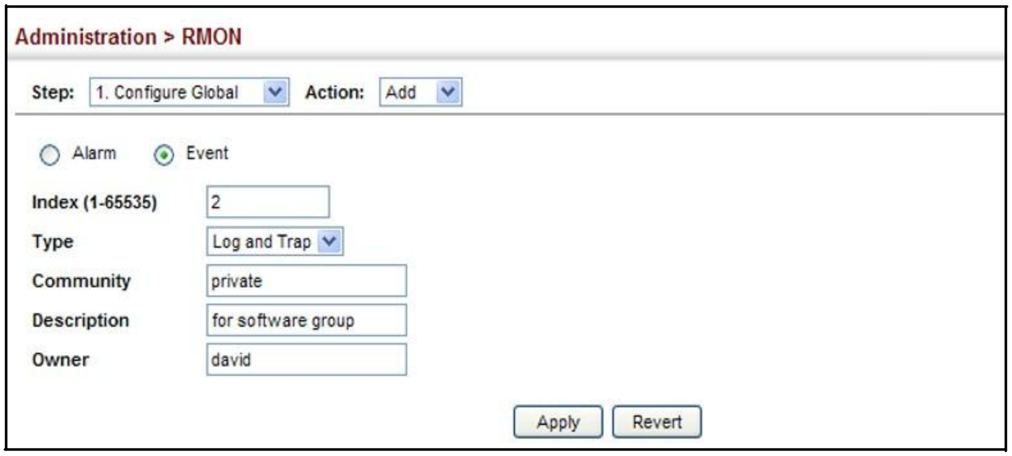
- **Owner** – Name of the person who created this entry. (Range: 1-127 characters)

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 191: Configuring an RMON Event



Administration > RMON

Step: 1. Configure Global   Action: Add

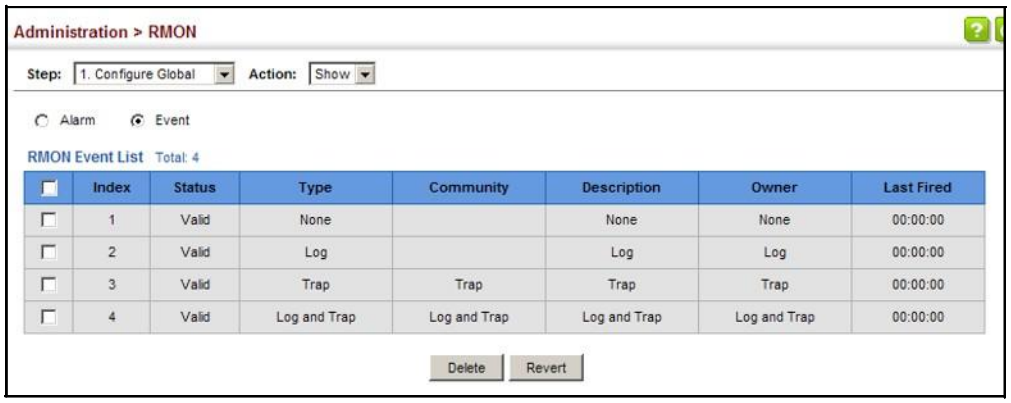
○ Alarm   ● Event

Index (1-65535)	2
Type	Log and Trap
Community	private
Description	for software group
Owner	david

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 192: Showing Configured RMON Events



Administration > RMON

Step: 1. Configure Global Action: Show

○ Alarm ● Event

RMON Event List Total: 4

□	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 92.
- 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.
- **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: 50~~)

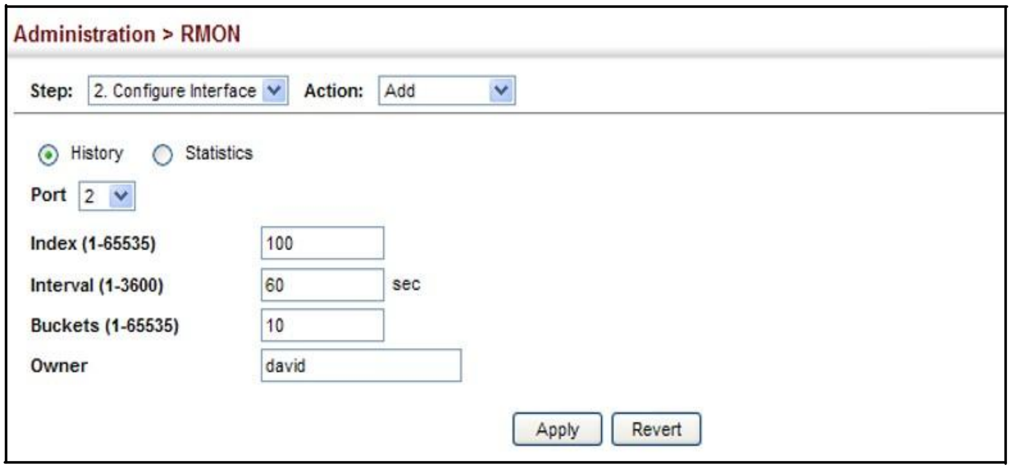
  The number of buckets granted are displayed on the Show page.
- **Owner** - Name of the person who created this entry. (Range: 1-127 characters)

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 193: Configuring an RMON History Sample



Administration > RMON

Step: 2. Configure Interface Action: Add

● History ○ Statistics

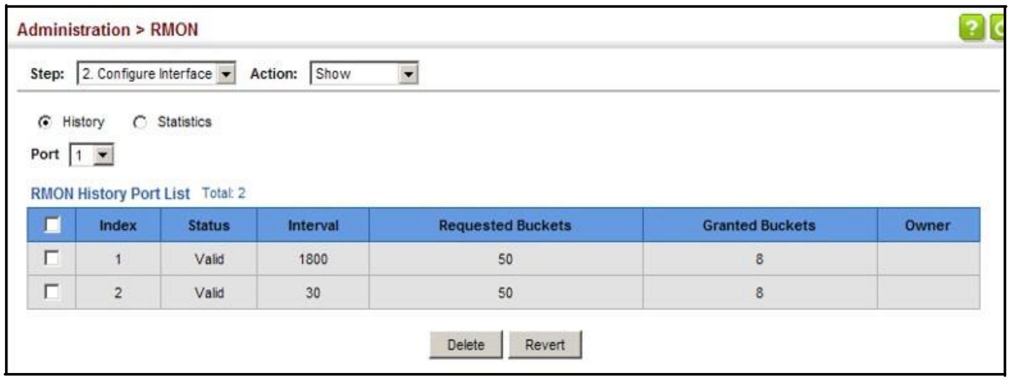
Port 2

Index (1-65535)	100
Interval (1-3600)	60 sec
Buckets (1-65535)	10
Owner	david

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 194: Showing Configured RMON History Samples



Administration > RMON

Step: 2. Configure Interface Action: Show

● History ○ Statistics

Port 1

RMON History Port List Total: 2

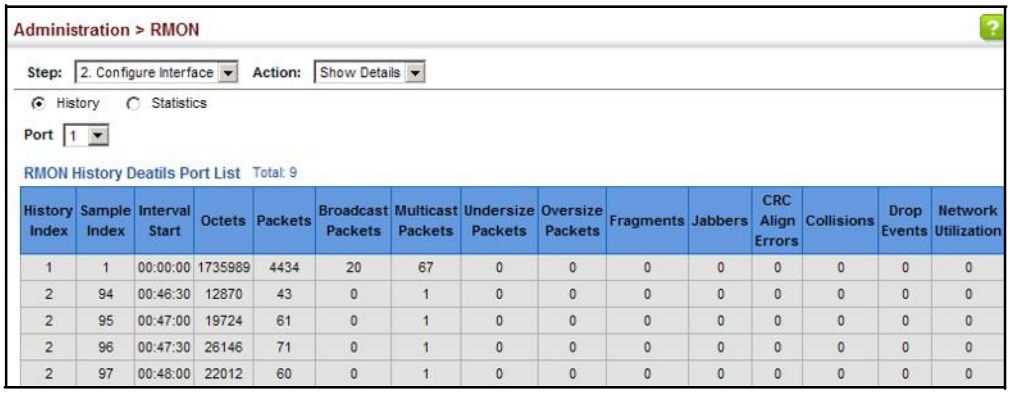
□	Index	Status	Interval	Requested Buckets	Granted Buckets	Owner
□	1	Valid	1800	50	8	
□	2	Valid	30	50	8	

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 195: Showing Collected RMON History Samples



Administration > RMON

Step: 2. Configure Interface ▾ Action: Show Details ▾

● History ○ Statistics

Port 1 ▾

RMON History Deatils Port List Total: 9

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	00:00:00	1735989	4434	20	67	0	0	0	0	0	0	0	0
2	94	00:46:30	12870	43	0	1	0	0	0	0	0	0	0	0
2	95	00:47:00	19724	61	0	1	0	0	0	0	0	0	0	0
2	96	00:47:30	26146	71	0	1	0	0	0	0	0	0	0	0
2	97	00:48:00	22012	60	0	1	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.
- **Index** – Index to this entry. (Range: 1-65535)
- **Owner** – Name of the person who created this entry. (Range: 1-127 characters)

Web Interface

To enable regular sampling of statistics on a port:

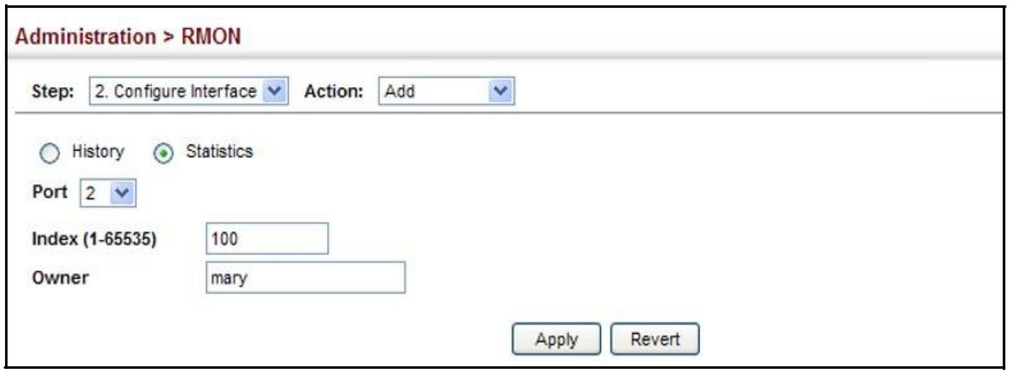
1. Click Administration, RMON.
2. Select Configure Interface from the Step list.
3. Select Add from the Action list.
4. Click Statistics.

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 196: Configuring an RMON Statistical Sample



Step: 2. Configure Interface Action: Add

○ History ● Statistics

Port 2

Index (1-65535) 100

Owner mary

To show configured RMON statistical samples:

1. Click Administration, RMON.

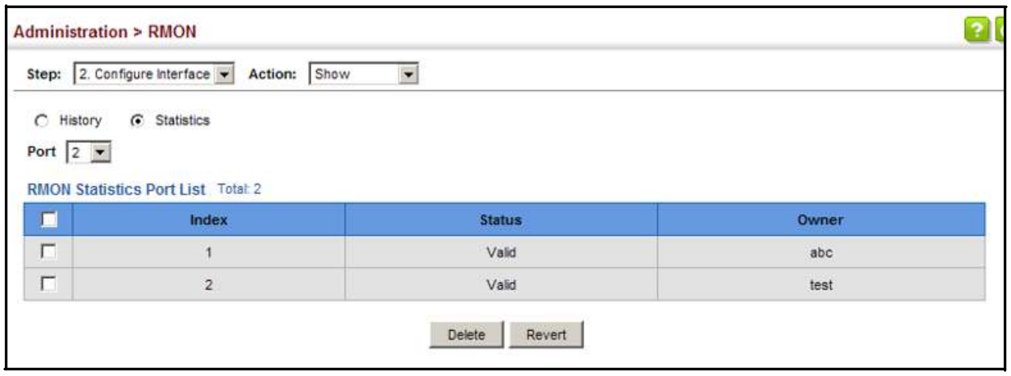
2. Select Configure Interface from the Step list.

3. Select Show from the Action list.

4. Select a port from the list.

5. Click Statistics.

Figure 197: Showing Configured RMON Statistical Samples



Step: 2. Configure Interface Action: Show

○ History ● Statistics

Port 2

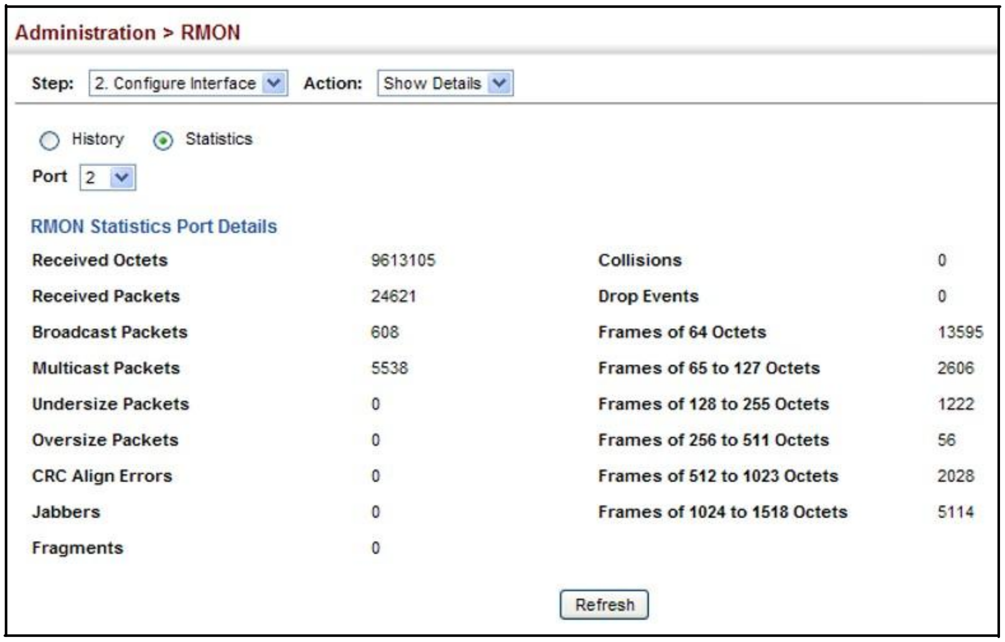
RMON Statistics Port List Total: 2

□	Index	Status	Owner
□	1	Valid	abc
□	2	Valid	test

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 198: Showing Collected RMON Statistical Samples



Administration > RMON

Step: 2. Configure Interface Action: Show Details

○ History ● Statistics

Port 2

RMON Statistics Port Details

Received Octets	9613105	Collisions	0
Received Packets	24621	Drop Events	0
Broadcast Packets	608	Frames of 64 Octets	13595
Multicast Packets	5538	Frames of 65 to 127 Octets	2606
Undersize Packets	0	Frames of 128 to 255 Octets	1222
Oversize Packets	0	Frames of 256 to 511 Octets	56
CRC Align Errors	0	Frames of 512 to 1023 Octets	2028
Jabbers	0	Frames of 1024 to 1518 Octets	5114
Fragments	0		

UDLD 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 a 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 UDLD Protocol Intervals

Use the Administration > UDLD > Configure Global page to configure the UniDirectional Link Detection message probe interval, detection interval, and recovery interval.

Parameters

These parameters are displayed:

- **Message Interval** – Configures the message interval between UDLD probe messages for ports in the advertisement phase and determined to be bidirectional. (Range: 7-90 seconds; Default: 15 seconds)

  UDLD probe messages are sent after linkup or detection phases. During the detection phase, messages are exchanged at the maximum rate of one per second. After that, if the protocol reaches a stable state and determines that the link is bidirectional, the message interval is increased to a configurable value based on a curve known as M1(t), a time-based function described in RFC 5171.

  If the link is deemed anything other than bidirectional at the end of the detection phase, this curve becomes a flat line with a fixed value of Mfast (7 seconds).

  If the link is instead deemed bidirectional, the curve will use Mfast for the first four subsequent message transmissions and then transition to an Mslow value for all other steady-state transmissions. Mslow is the value configured by this command.

- **Detection Interval** – Sets the amount of time the switch remains in detection state after discovering a neighbor. (Range: 5-255 seconds; Default: 5 seconds)

  When a neighbor device is discovered by UDLD, the switch enters “detection state” and remains in this state for specified detection-interval. After the detection-interval expires, the switch tries to decide whether or the link is unidirectional based on the information collected during the “detection state.”

- **Recovery Status** – Configures the switch to automatically recover from UDLD disabled port state after a period specified by the Recovery Interval. (Default: Disabled)

  When automatic recovery state is changed, any ports shut down by UDLD will be reset.

- **Recovery Interval** – Specifies the period after which to automatically recover from UDLD disabled port state. (Range: 30-86400 seconds; Default: 7 seconds)

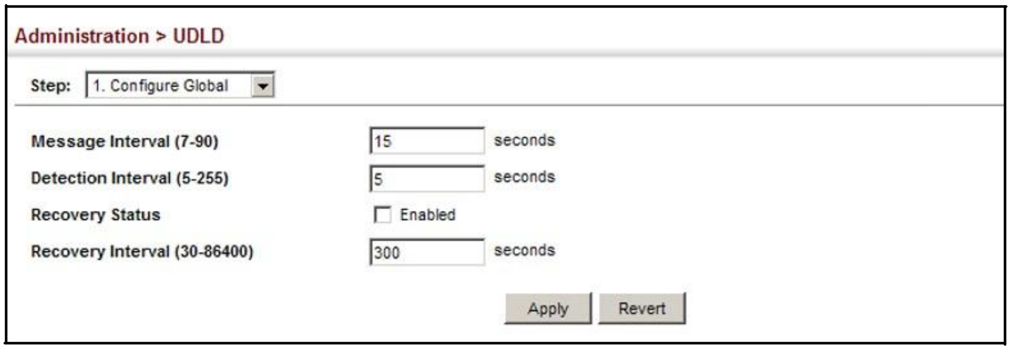
  When the recovery interval is changed, any ports shut down by UDLD will be reset.

Web Interface

To configure the UDLD message probe interval, detection interval, and recovery interval:

1. Click Administration, UDLD, Configure Global.
2. Select Configure Global from the Step list.
3. Configure the message and detection intervals.
4. Enable automatic recovery if required, and set the recovery interval.
5. Click Apply.

Figure 199: Configuring UDLD Protocol Intervals



Administration > UDLD

Step: 1. Configure Global

Message Interval (7-90): 15 seconds

Detection Interval (5-255): 5 seconds

Recovery Status: □ Enabled

Recovery Interval (30-86400): 300 seconds

Configuring UDLD Interface Settings

Use the Administration > UDLD (Configure Interface) page to enable UDLD and aggressive mode which reduces the shut-down delay after loss of bidirectional connectivity is detected.

Parameters

These parameters are displayed:

- **Port** – Port identifier. (Range: 1-28/52)
- **UDLD** – Enables UDLD on a port. (Default: Disabled)
  - UDLD requires that all the devices connected to the same LAN segment be running the protocol in order for a potential mis-configuration to be detected and for prompt corrective action to be taken.
  - Whenever a UDLD device learns about a new neighbor or receives a resynchronization request from an out-of-synch neighbor, it (re)starts the

detection process on its side of the connection and sends N echo messages in reply. (This mechanism implicitly assumes that N packets are sufficient to get through a link and reach the other end, even though some of them might get dropped during the transmission.)

Since this behavior must be the same on all the neighbors, the sender of the echoes expects to receive an echo in reply. If the detection process ends without the proper echo information being received, the link is considered to be unidirectional.

- **Aggressive Mode** – Reduces the shut-down delay after loss of bidirectional connectivity is detected. (Default: Disabled)

  UDLD can function in two modes: normal mode and aggressive mode.

  - In normal mode, determination of link status at the end of the detection process is always based on information received in UDLD messages: whether that's information about the exchange of proper neighbor identification or the absence of such. Hence, albeit bound by a timer, normal mode determinations are always based on gleaned information, and as such are "event-based." If no such information can be obtained (e.g., because of a bidirectional loss of connectivity), UDLD follows a conservative approach to minimize false positives during the detection process and deems a port to be in "undetermined" state. In other words, normal mode will shut down a port only if it can explicitly determine that the associated link is faulty for an extended period of time.
  - In aggressive mode, UDLD will also shut down a port if it loses bidirectional connectivity with the neighbor for the same extended period of time (as that mentioned above for normal mode) and subsequently fails repeated last-resort attempts to re-establish communication with the other end of the link. This mode of operation assumes that loss of communication with the neighbor is a meaningful network event in itself, and a symptom of a serious connectivity problem. Because this type of detection can be event-less, and lack of information cannot always be associated to an actual malfunction of the link, this mode is recommended only in certain scenarios (typically only on point-to-point links where no communication failure between two neighbors is admissible).

- **Operation State** – Shows the UDLD operational state (Disabled, Link down, Link up, Advertisement, Detection, Disabled port, Advertisement - Single neighbor, Advertisement - Multiple neighbors)

- **Port State** – Shows the UDLD port state (Unknown, Bidirectional, Unidirectional, Transmit-to-receive loop, Mismatch with neighbor state reported, Neighbor's echo is empty)

  The state is Unknown if the link is down or not connected to a UDLD-capable device. The state is Bidirectional if the link has a normal two-way connection to a UDLD-capable device. All other states indicate mis-wiring.

- **Message Interval** – The interval between UDLD probe messages used for the indicated operational state.

- **Detection Interval** – The period the switch remains in detection state after discovering a neighbor.

Web Interface

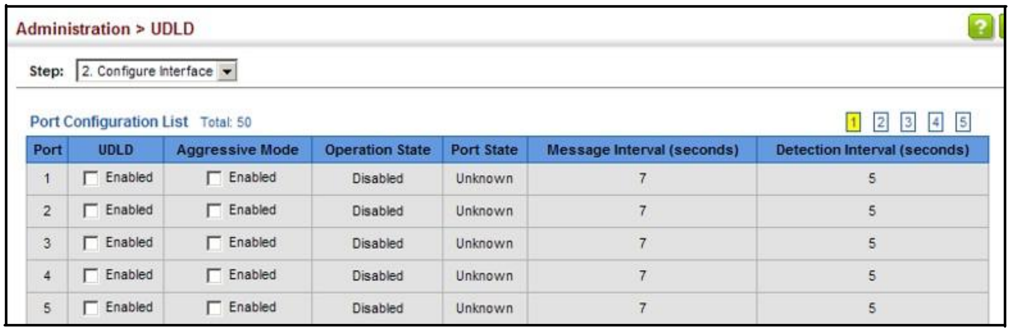
To enable UDLD and aggressive mode:

1. Click Administration, UDLD, Configure Interface.

2. Enable UDLD and aggressive mode on the required ports.

3. Click Apply.

Figure 200: Configuring UDLD Interface Settings



Administration > UDLD

Step: 2. Configure Interface

Port Configuration List Total: 50

Port	UDLD	Aggressive Mode	Operation State	Port State	Message Interval (seconds)	Detection Interval (seconds)
1	□ Enabled	□ Enabled	Disabled	Unknown	7	5
2	□ Enabled	□ Enabled	Disabled	Unknown	7	5
3	□ Enabled	□ Enabled	Disabled	Unknown	7	5
4	□ Enabled	□ Enabled	Disabled	Unknown	7	5
5	□ Enabled	□ Enabled	Disabled	Unknown	7	5

Displaying UDLD Neighbor Information

Use the Administration > UDLD (Show Information) page to show UDLD neighbor information, including neighbor state, expiration time, and protocol intervals.

Parameters

These parameters are displayed:

- **Port** – Port identifier. (Range: 1-32/54)

- **Entry** – Table entry number uniquely identifying the neighbor device discovered by UDLD on a port interface.

- **Device ID** – Device identifier of neighbor sending the UDLD packet.

- **Port ID** – The physical port the UDLD packet is sent from.

- **Device Name** – The device name of this neighbor.

- **Neighbor State** – Link status of neighbor device (Values: unknown, neighborsEchoIsEmpty, bidirectional, mismatchWithneighborStateReported, unidirectional).

- **Expire** – The amount of time remaining before this entry will expire.

- **Message Interval** – The interval between UDLD probe messages for ports in advertisement phase.

- **Detection Interval** – The period the switch remains in detection state after discovering a neighbor.

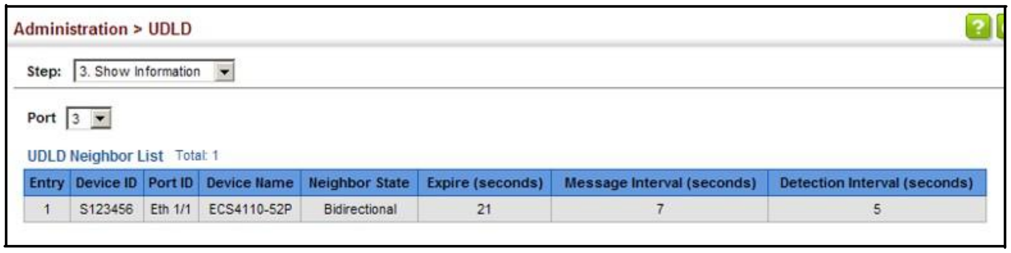
Web Interface

To display UDLD neighbor information:

1. Click Administration, UDLD, Show Information.

2. Select an interface from the Port list.

Figure 201: Displaying UDLD Neighbor Information



Administration > UDLD

Step: 3. Show Information

Port 3

UDLD Neighbor List Total: 1

Entry	Device ID	Port ID	Device Name	Neighbor State	Expire (seconds)	Message Interval (seconds)	Detection Interval (seconds)
1	S123456	Eth 1/1	ECS4110-52P	Bidirectional	21	7	5

13 Multicast Filtering

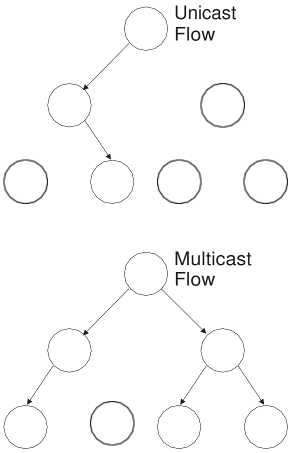
This chapter describes how to configure the following multicast services:

- IGMP Snooping – Configures snooping and query parameters for IPv4.
- Filtering and Throttling – Filters specified multicast service, or throttling the maximum of multicast groups allowed on an interface for IPv4.

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 202: 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 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.

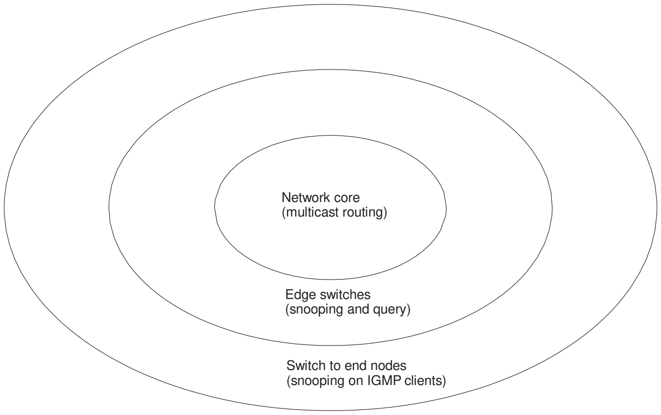
The purpose of IP multicast filtering is to optimize a switched network's performance, so multicast packets will only be forwarded to those ports containing multicast group hosts or multicast routers/switches, instead of flooding traffic to all ports in the subnet (VLAN).

This switch not only supports IP multicast filtering by passively monitoring IGMP query, report messages and multicast routing probe messages to register end-stations as multicast group members, but also supports the Protocol Independent Multicasting (PIM) routing protocol required to forward multicast traffic to other subnets (page 651 and 667).

IGMP Protocol

The Internet Group Management Protocol (IGMP) runs between hosts and their immediately adjacent multicast router/switch. IGMP is a multicast host registration protocol that allows any host to inform its local router that it wants to receive transmissions addressed to a specific multicast group. 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” (at Layer 3) and assumes the role of querying the LAN for group members. It then propagates the service requests on to any adjacent multicast switch/router to ensure that it will continue to receive the multicast service. Based on the group membership information learned from IGMP, a router/switch can determine which (if any) multicast traffic needs to be forwarded to each of its ports. At Layer 3, multicast routers use this information, along with a multicast routing protocol such as Protocol Independent Multicasting (PIM), to support IP multicasting across the Internet. Note that IGMP neither alters nor routes IP multicast packets. A multicast routing protocol must be used to deliver IP multicast packets across different subnetworks. Therefore, when PIM routing is enabled for a subnet on the switch, IGMP is automatically enabled.

Figure 203: IGMP Protocol



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 313) 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 accomplished in one of two ways. A static router port can be manually configured (see "Specifying Static Interfaces for an IPv4 Multicast Router" on page 316). 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 1024 multicast entries can be maintained for IGMP snooping and 255 entries for Multicast Routing when both of these features are enabled. 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 313).

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 316). 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 319).

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 report suppression, and 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 Flood” 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 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 320).

  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)

  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: 1-65535 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.

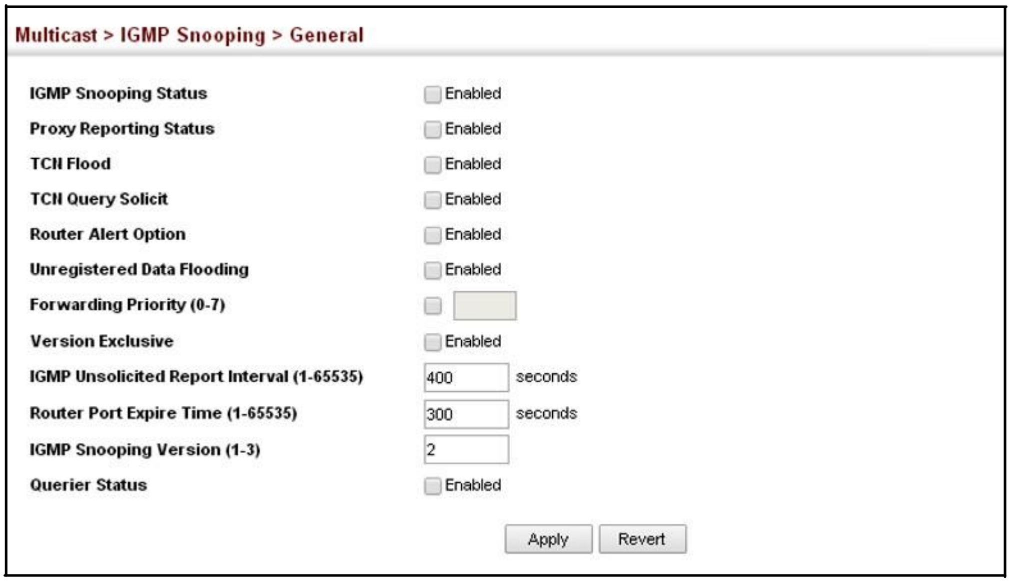
- **Querier Status** – When enabled, the switch can serve as the Querier, which is responsible for asking hosts if they want to receive multicast traffic. This feature is not supported for IGMPv3 snooping. (Default: Disabled)

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 204: Configuring General Settings for IGMP Snooping



Multicast > IGMP Snooping > General

IGMP Snooping Status	☐ Enabled
Proxy Reporting Status	☐ Enabled
TCN Flood	☐ Enabled
TCN Query Solicit	☐ Enabled
Router Alert Option	☐ Enabled
Unregistered Data Flooding	☐ Enabled
Forwarding Priority (0-7)	☐
Version Exclusive	☐ Enabled
IGMP Unsolicited Report Interval (1-65535)	400 seconds
Router Port Expire Time (1-65535)	300 seconds
IGMP Snooping Version (1-3)	2
Querier Status	☐ Enabled

Specifying Static Interfaces for an IPv4 Multicast Router

Use the Multicast > IGMP Snooping > Multicast Router (Add Static Multicast Router) page to statically attach an IPv4 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 313) 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

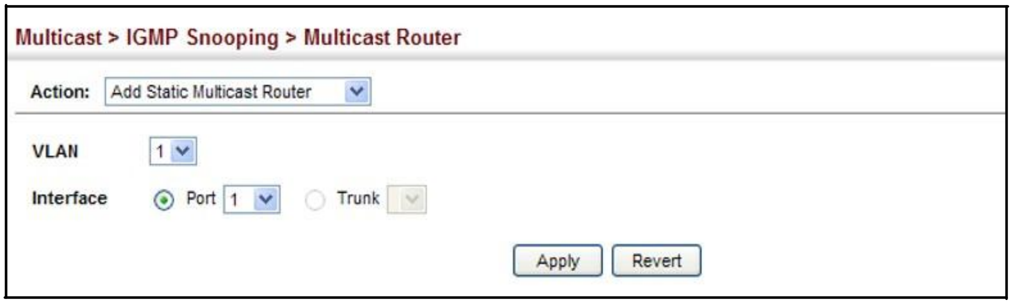
- **VLAN** – Selects the VLAN for which to display any currently active multicast routers.
- **Interface** – Shows the interface to which an active multicast router is attached.
- **Type** – Shows if this entry is static or dynamic.
- **Expire** – Time until this dynamic entry expires.

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 205: Configuring a Static Interface for an IPv4 Multicast Router



Multicast > IGMP Snooping > Multicast Router

Action: Add Static Multicast Router

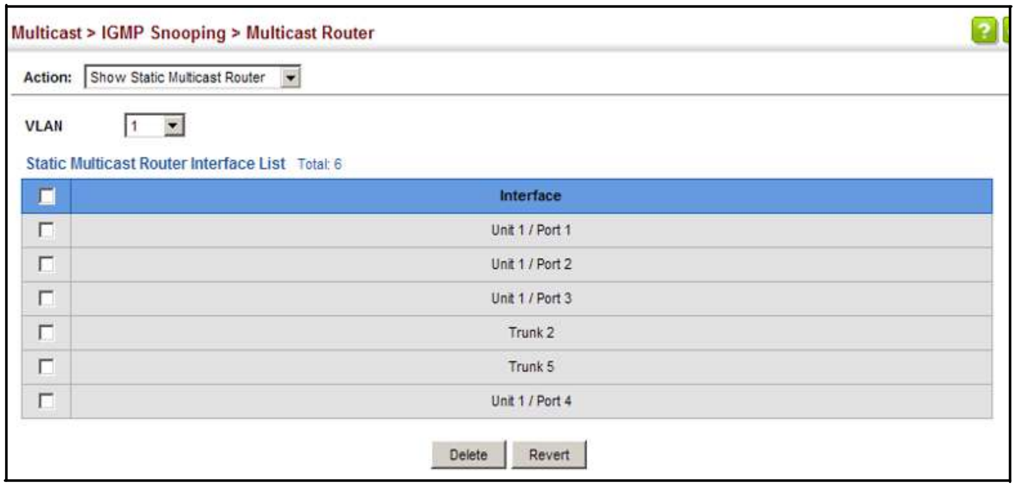
VLAN: 1

Interface: ● Port 1 ○ Trunk

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 206: Showing Static Interfaces Attached an IPv4 Multicast Router



Multicast > IGMP Snooping > Multicast Router

Action: Show Static Multicast Router

VLAN: 1

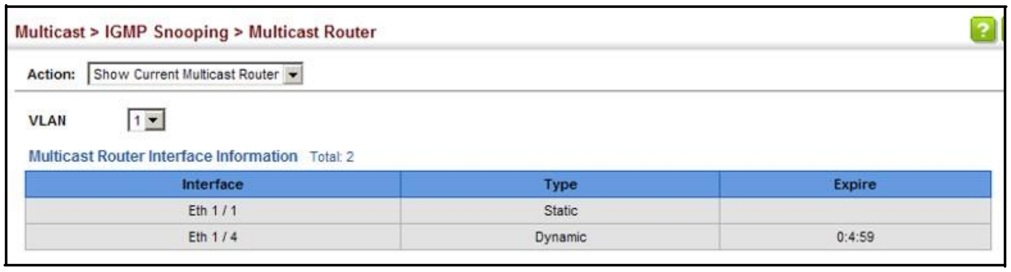
Static Multicast Router Interface List Total: 6

□	Interface
□	Unit 1 / Port 1
□	Unit 1 / Port 2
□	Unit 1 / Port 3
□	Trunk 2
□	Trunk 5
□	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 all the interfaces attached to a multicast router:

1. Click Multicast, IGMP Snooping, Multicast Router.
2. Select Show 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 207: Showing Current Interfaces Attached an IPv4 Multicast Router


Multicast > IGMP Snooping > Multicast Router
Action:
Show Current Multicast Router
VLAN
1
Multicast Router Interface Information Total: 2

Interface	Type	Expire
Eth 1 / 1	Static	
Eth 1 / 4	Dynamic	0:4:59

Assigning Interfaces to IPv4 Multicast Services

Use the Multicast > IGMP Snooping > IGMP Member (Add Static Member) page to statically assign an IPv46 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 313). 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.

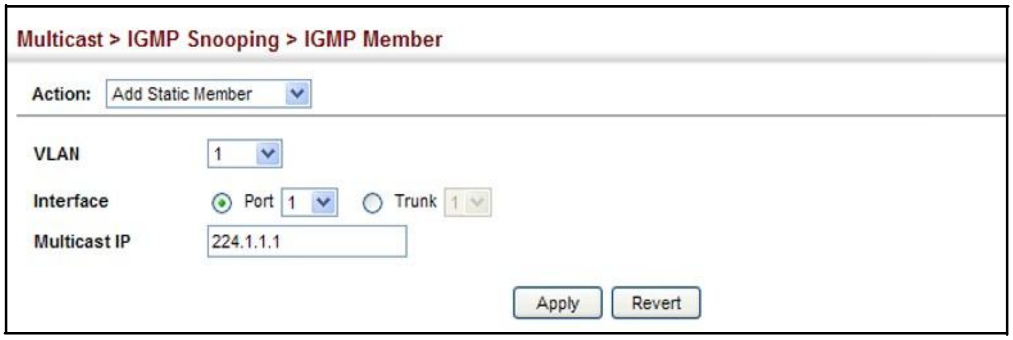
Web Interface

To statically assign an interface to an IPv4 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 208: Assigning an Interface to an IPv4 Multicast Service



Multicast > IGMP Snooping > IGMP Member

Action: Add Static Member

VLAN: 1

Interface: ● Port 1 ○ Trunk 1

Multicast IP: 224.1.1.1

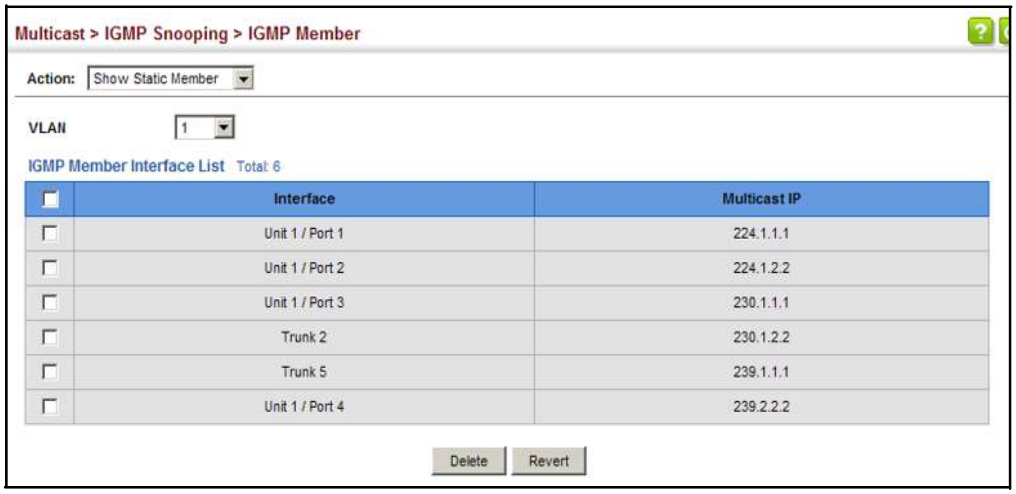
To show the static interfaces assigned to an IPv4 multicast service:

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 209: Showing Static Interfaces Assigned to an IPv4 Multicast Service



Multicast > IGMP Snooping > IGMP Member

Action: Show Static Member

VLAN: 1

IGMP Member Interface List Total: 6

□	Interface	Multicast IP
□	Unit 1 / Port 1	224.1.1.1
□	Unit 1 / Port 2	224.1.2.2
□	Unit 1 / Port 3	230.1.1.1
□	Trunk 2	230.1.2.2
□	Trunk 5	239.1.1.1
□	Unit 1 / Port 4	239.2.2.2

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 313.

Command Usage

Multicast Router Discovery

There have been many mechanisms used in the past to identify multicast routers. This has lead 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 313), 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).

  This attribute is only effective if IGMP snooping is enabled, and IGMPv2 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 proxy 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 313), or as a proxy host when IGMP snooping proxy reporting is enabled (page 313).

- **Query Response Interval** – The maximum time the system waits for a response to proxy general queries. (Range: 10-31740 tenths of a second; Default: 10 seconds)

  This attribute applies when the switch is serving as the querier (page 313), or as a proxy host when IGMP snooping proxy reporting is enabled (page 313).

- **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 (see page 313).

- **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.

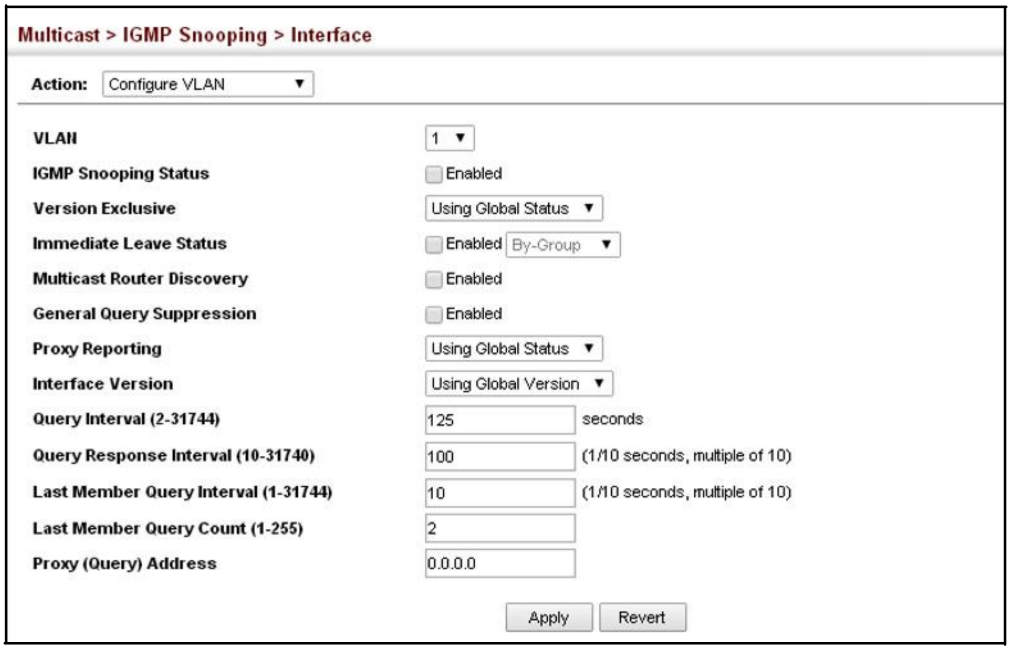
To resolve this problem, the source address in proxied IGMP query messages can be replaced with any valid unicast address (other than the router's own address).

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 210: Configuring IGMP Snooping on a VLAN



Multicast > IGMP Snooping > Interface

Action: Configure VLAN ▼

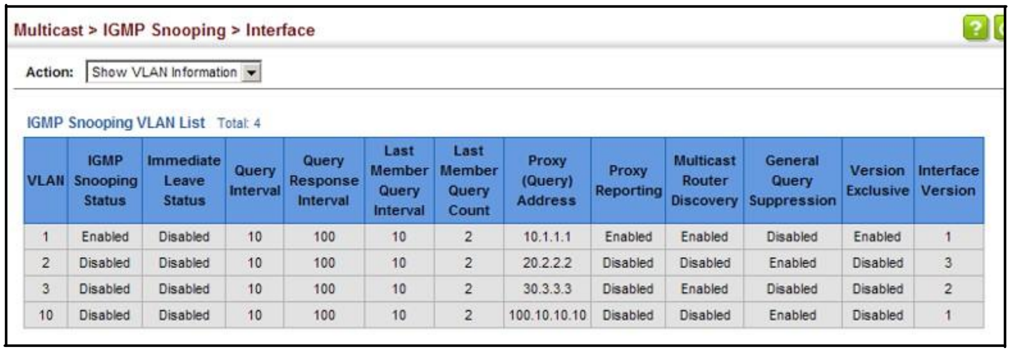
VLAN	1 ▼
IGMP Snooping Status	□ Enabled
Version Exclusive	Using Global Status ▼
Immediate Leave Status	□ Enabled By-Group ▼
Multicast Router Discovery	□ Enabled
General Query Suppression	□ Enabled
Proxy Reporting	Using Global Status ▼
Interface Version	Using Global Version ▼
Query Interval (2-31744)	125 seconds
Query Response Interval (10-31740)	100 (1/10 seconds, multiple of 10)
Last Member Query Interval (1-31744)	10 (1/10 seconds, multiple of 10)
Last Member Query Count (1-255)	2
Proxy (Query) Address	0.0.0.0

To show the interface settings for IGMP snooping:

1. Click Multicast, IGMP Snooping, Interface.

2. Select Show VLAN Information from the Action list.

Figure 211: Showing Interface Settings for IGMP Snooping



Multicast > IGMP Snooping > Interface

Action: Show VLAN Information

IGMP Snooping VLAN List Total: 4

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

Use the Multicast > IGMP Snooping > Interface (Configure Interface) page to configure an interface to drop IGMP query 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.

Web Interface

To drop IGMP query packets or multicast data packets:

1. Click Multicast, IGMP Snooping, Interface.

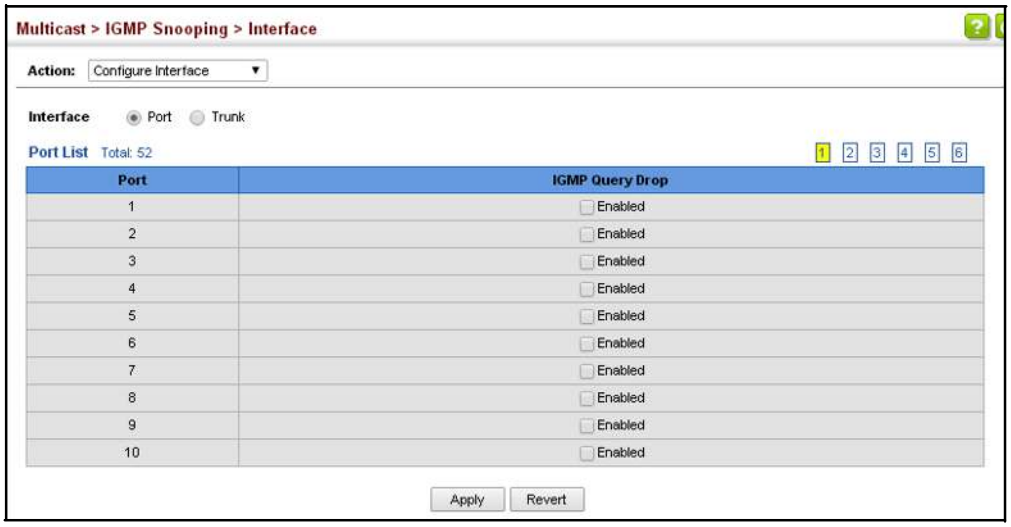
2. Select Configure Interface from the Action List.

3. Click Port or Trunk to display the required interface type.

4. Enable the required drop functions for any interface.

5. Click Apply.

Figure 212: Dropping IGMP Query Packets



Multicast > IGMP Snooping > Interface

Action: Configure Interface ▼

Interface ● Port ○ Trunk

Port List Total: 52 — 1 2 3 4 5 6

Port	IGMP Query Drop
1	☐ Enabled
2	☐ Enabled
3	☐ Enabled
4	☐ Enabled
5	☐ Enabled
6	☐ Enabled
7	☐ Enabled
8	☐ Enabled
9	☐ Enabled
10	☐ Enabled

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 313).

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.
- **Source Address** – The address of one of the multicast servers transmitting traffic to the specified group.
- **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** – The time until this entry expires.
- **Count** – The number of times this address has been learned by IGMP snooping.

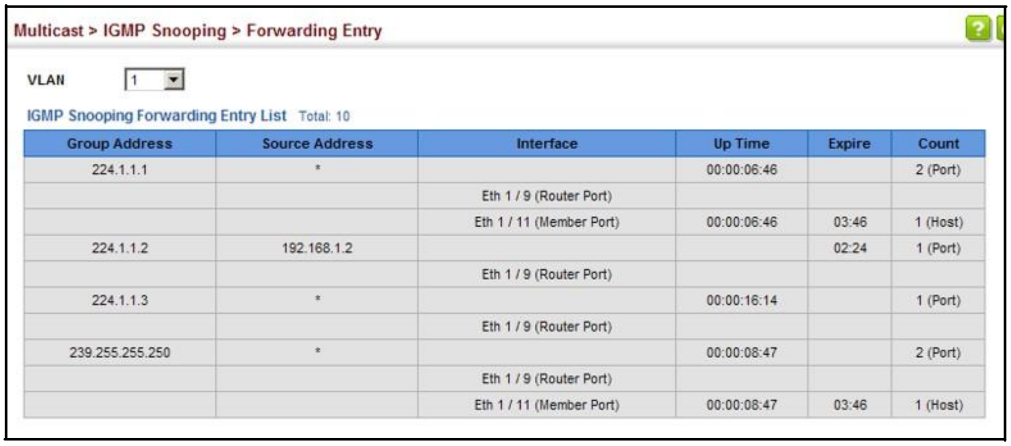
Web Interface

To show multicast groups learned through IGMP snooping:

1. Click Multicast, IGMP Snooping, Forwarding Entry.

2. Select the VLAN for which to display this information.

Figure 213: Showing Multicast Groups Learned by IGMP Snooping



Multicast > IGMP Snooping > Forwarding Entry

VLAN 1

IGMP Snooping Forwarding Entry List Total: 10

Group Address	Source Address	Interface	Up Time	Expire	Count
224.1.1.1	*		00:00:06:46		2 (Port)
		Eth 1 / 9 (Router Port)			
		Eth 1 / 11 (Member Port)	00:00:06:46	03:46	1 (Host)
224.1.1.2	192.168.1.2			02:24	1 (Port)
		Eth 1 / 9 (Router Port)			
224.1.1.3	*		00:00:16:14		1 (Port)
		Eth 1 / 9 (Router Port)			
239.255.255.250	*		00:00:08:47		2 (Port)
		Eth 1 / 9 (Router Port)			
		Eth 1 / 11 (Member Port)	00:00:08:47	03:46	1 (Host)

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: 1-32/54)

- **Trunk** – Trunk identifier. (Range: 1-~~16/~~27)

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.

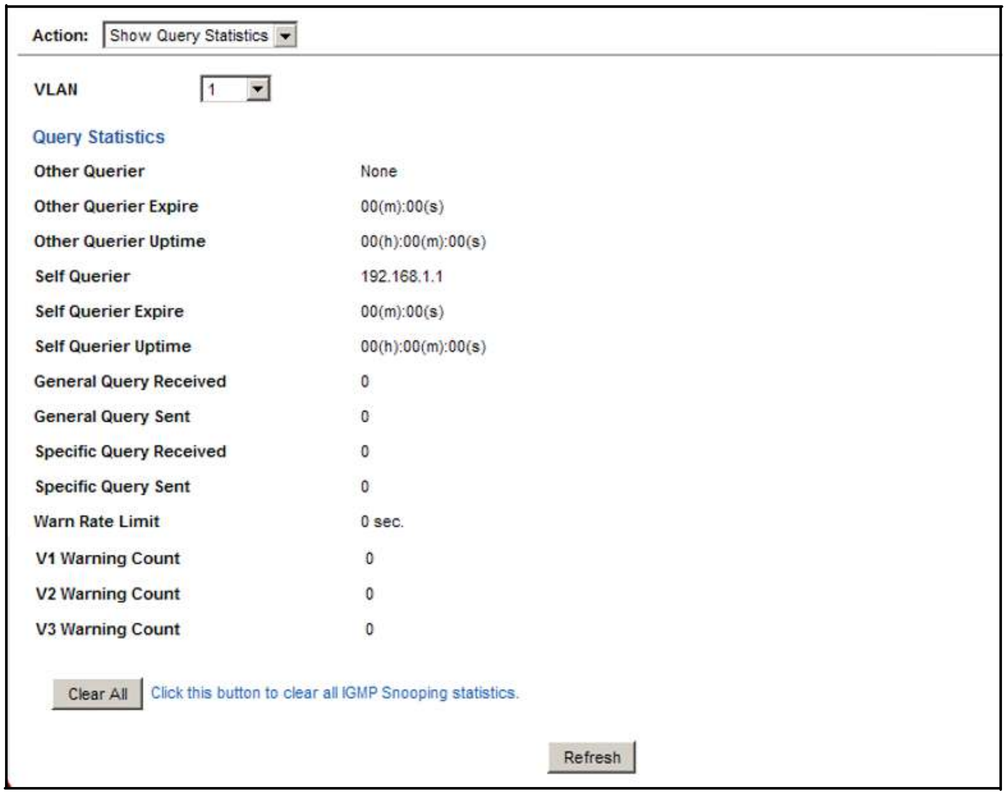
- **G Query** – The number of general query messages sent from this interface.
- **G(-S)-S Query** – The number of group specific or group-and-source specific query messages sent from this interface.

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 214: Displaying IGMP Snooping Statistics – Query



Action: Show Query Statistics

VLAN 1

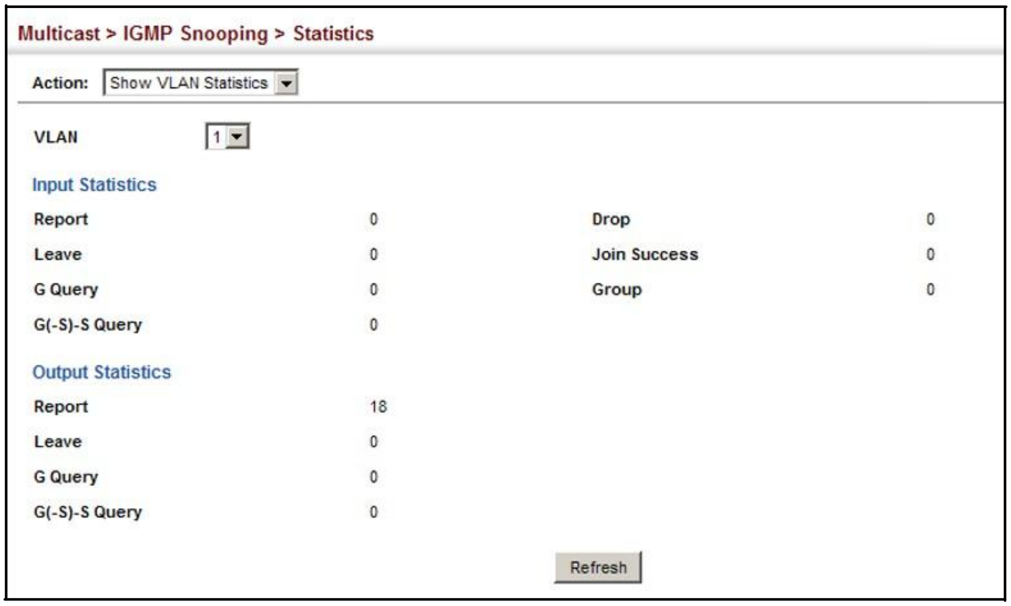
Query Statistics

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

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 215: Displaying IGMP Snooping Statistics – VLAN



Multicast > IGMP Snooping > Statistics

Action: Show VLAN Statistics

VLAN 1

Input Statistics

Report	0	Drop	0
Leave	0	Join Success	0
G Query	0	Group	0
G(-S)-S Query	0		

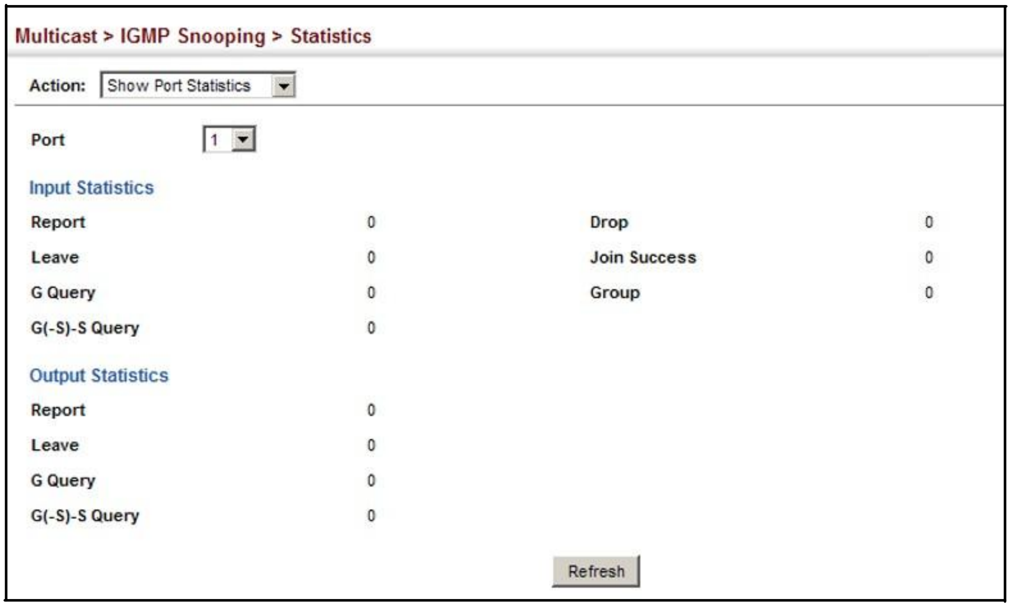
Output Statistics

Report	18
Leave	0
G Query	0
G(-S)-S Query	0

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 216: Displaying IGMP Snooping Statistics – Port



Multicast > IGMP Snooping > Statistics

Action: Show Port Statistics

Port 1

Input Statistics

Report	0	Drop	0
Leave	0	Join Success	0
G Query	0	Group	0
G(-S)-S Query	0		

Output Statistics

Report	0
Leave	0
G Query	0
G(-S)-S Query	0

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:

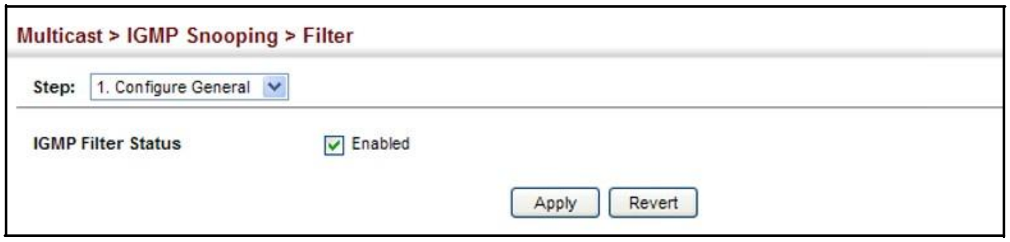
- **IGMP Filter Status** – Enables IGMP filtering and throttling globally for the switch. (Default: Disabled)

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 217: Enabling IGMP Filtering and Throttling


Multicast > IGMP Snooping > Filter

Step: 1. Configure General

IGMP Filter Status ☑ Enabled

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

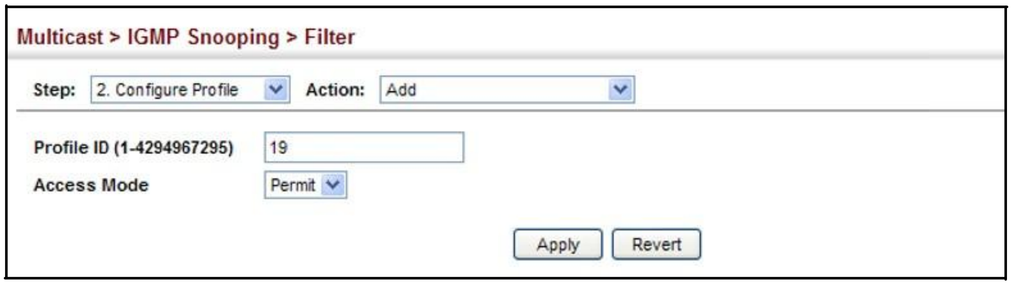
- **Profile ID** – Selects an IGMP profile to configure.
- **Start Multicast IP Address** – Specifies the starting address of a range of multicast groups.
- **End Multicast IP Address** – Specifies the ending address of a range of multicast groups.

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 218: Creating an IGMP Filtering Profile



Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Add

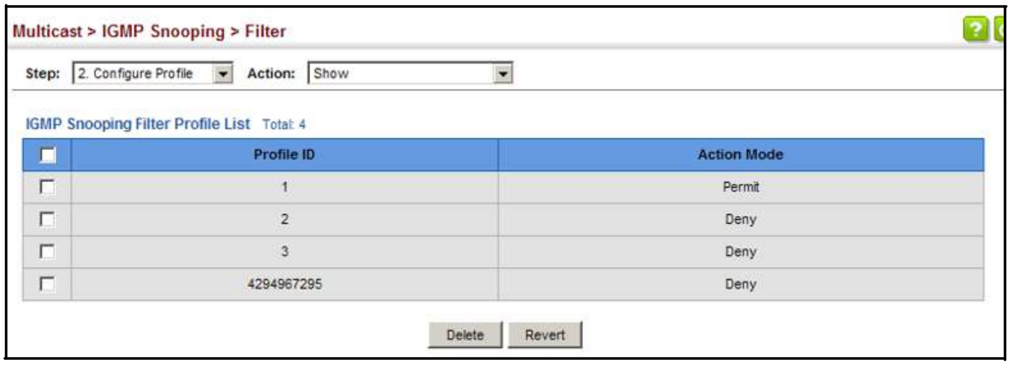
Profile ID (1-4294967295) 19

Access Mode Permit

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 219: Showing the IGMP Filtering Profiles Created



Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Show

IGMP Snooping Filter Profile List Total: 4

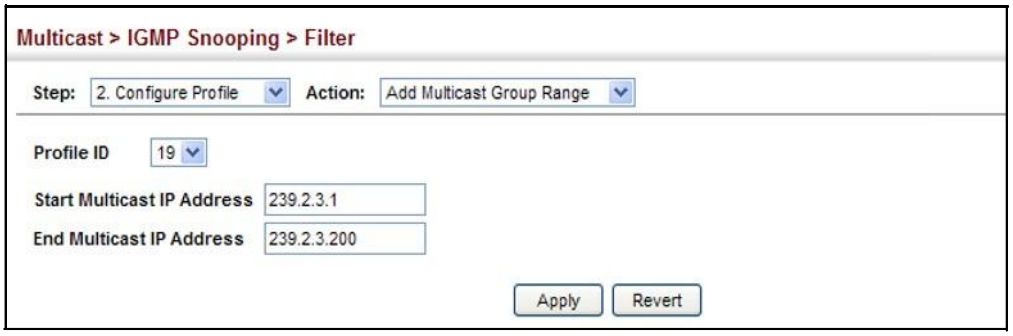
□	Profile ID	Action Mode
□	1	Permit
□	2	Deny
□	3	Deny
□	4294967295	Deny

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 220: Adding Multicast Groups to an IGMP Filtering Profile



Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Add Multicast Group Range

Profile ID: 19

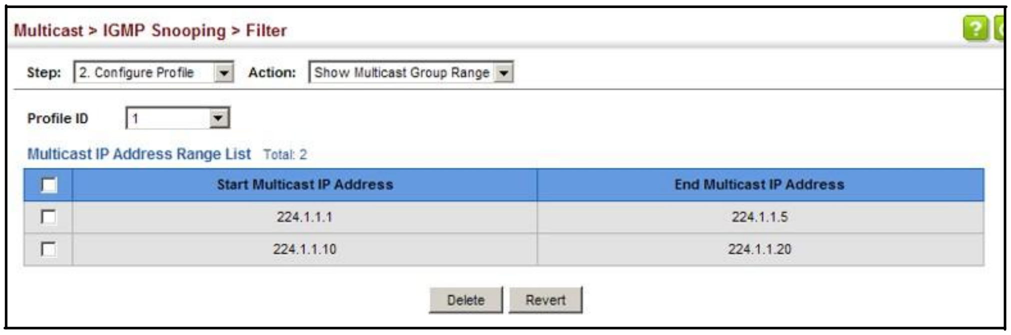
Start Multicast IP Address: 239.2.3.1

End Multicast IP Address: 239.2.3.200

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 221: Showing the Groups Assigned to an IGMP Filtering Profile



Multicast > IGMP Snooping > Filter

Step: 2. Configure Profile Action: Show Multicast Group Range

Profile ID: 1

Multicast IP Address Range List Total: 2

□	Start Multicast IP Address	End Multicast IP Address
□	224.1.1.1	224.1.1.5
□	224.1.1.10	224.1.1.20

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: 1-1024; Default: 1024)

- **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.

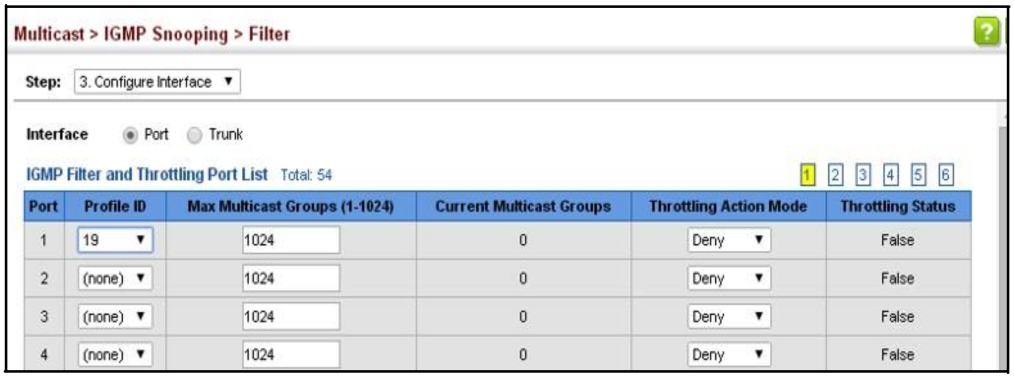
- **Throttling Status** – Indicates if the throttling action has been implemented on the interface. (Options: True or False)

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 222: Configuring IGMP Filtering and Throttling Interface Settings



Multicast > IGMP Snooping > Filter

Step: 3. Configure Interface

Interface ● Port ○ Trunk

IGMP Filter and Throttling Port List Total: 54

Port	Profile ID	Max Multicast Groups (1-1024)	Current Multicast Groups	Throttling Action Mode	Throttling Status
1	19	1024	0	Deny	False
2	(none)	1024	0	Deny	False
3	(none)	1024	0	Deny	False
4	(none)	1024	0	Deny	False

14 IP Configuration

This chapter describes how to configure an initial 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 DHCP server when it is powered on. An IPv6 global unicast or link-local address can be manually configured, or a link-local address can be 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 initial IPv4 interface for management access over the network, or for creating an interface to multiple subnets. 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 6)" on page 343.

Use the IP > General > Routing Interface (Add Address) page to configure an IPv4 address for the switch. An IPv4 address is obtained via DHCP by default for VLAN 1. To configure a static address, you need to change the switch's default settings to values that are compatible with your network. You may also need to a establish a default gateway between the switch and management stations that exist on another network segment (if no routing protocols are enabled).

You can direct the device to obtain an address from a 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.

Command Usage

- This section describes how to configure a single local interface for initial access to the switch. To configure multiple IP interfaces, set up an IP interface for each VLAN.
- Once an IP address has been assigned to an interface, routing between different interfaces on the switch is enabled.

- To enable routing between interfaces defined on this switch and external network interfaces, you must configure static routes (page 376) or use dynamic routing; i.e., OSPFv2 (page 393).

- The precedence for configuring IP interfaces is the IP > General > Routing Interface (Add) menu, static routes (page 376), and then dynamic routing.

Parameters

These parameters are displayed:

- **VLAN** – ID of the configured VLAN (1-4094). 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.

- **IP Address Mode** – Specifies whether IP functionality is enabled via manual configuration (Static), or Dynamic Host Configuration Protocol (DHCP). If DHCP 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 responses can include the IP address, subnet mask, and default gateway. (Default: DHCP)

- **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: None)

Note: You can manage the switch through any configured IP interface.

- **Subnet Mask** – This mask identifies the host address bits used for routing to specific subnets. (Default: None)

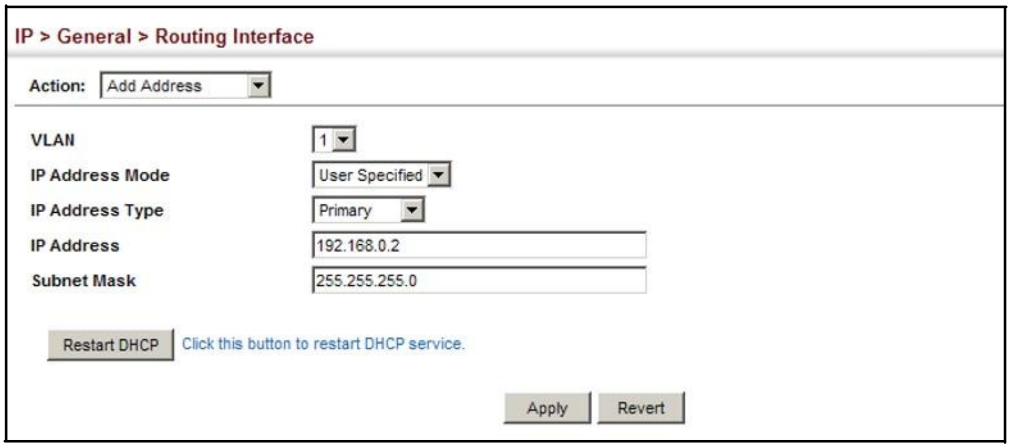
- **Restart DHCP** – Requests a new IP address from the DHCP server.

Web Interface

To set a static IPv4 address for the switch:

1. Click IP, General, Routing Interface.
2. Select Add from the Action list.
3. 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.
4. Click Apply.

Figure 223: Configuring a Static IPv4 Address



IP > General > Routing Interface

Action: Add Address

VLAN	1
IP Address Mode	User Specified
IP Address Type	Primary
IP Address	192.168.0.2
Subnet Mask	255.255.255.0

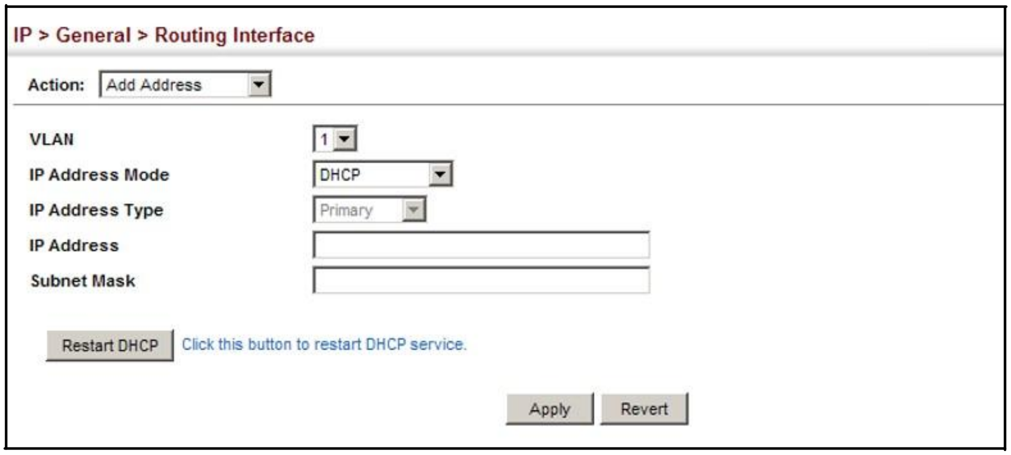
Click this button to restart DHCP service.

To obtain an dynamic IPv4 address through DHCP for the switch:

1. Click IP, General, Routing Interface.
2. Select Add Address from the Action list.
3. Select any configured VLAN, and set IP Address Mode to “DHCP.”
4. Click Apply to save your changes.
5. Then click Restart DHCP to immediately request a new address.

IP will be enabled but will not function until a DHCP reply is received. Requests are broadcast every few minutes using exponential backoff until IP configuration information is obtained from a DHCP server.

Figure 224: Configuring a Dynamic IPv4 Address



IP > General > Routing Interface

Action: Add Address

VLAN: 1
IP Address Mode: DHCP
IP Address Type: Primary
IP Address:
Subnet Mask:

Click this button to restart DHCP service.

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.

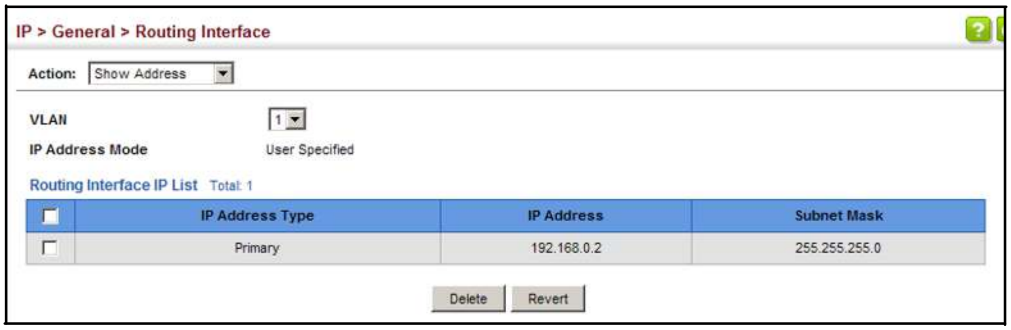
Renewing DCHP – DHCP may lease addresses to clients indefinitely or for a specific period of time. If the address expires or the switch is moved to another network segment, you will lose management access to the switch. In this case, you can reboot the switch or submit a client request to restart DHCP 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 IP, General, Routing Interface.
2. Select Show Address from the Action list.
3. Select an entry from the VLAN list.

Figure 225: Showing the IPv4 Address Configured for an Interface



IP > General > Routing Interface

Action: Show Address

VLAN: 1

IP Address Mode: User Specified

Routing Interface IP List Total: 1

□	IP Address Type	IP Address	Subnet Mask
□	Primary	192.168.0.2	255.255.255.0

Setting the Switch's IP Address (IP Version 6)

This section describes how to configure an initial IPv6 interface for management access over the network, or for creating an interface to multiple subnets. 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 339.

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. A link-local address can be dynamically assigned (using the Configure Interface page) or manually configured (using the Add IPv6 Address page). A global unicast address can only be 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 IP > 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.
  - If no routing protocol is enabled or static route defined, you must define a gateway if the target device is located in a different subnet.

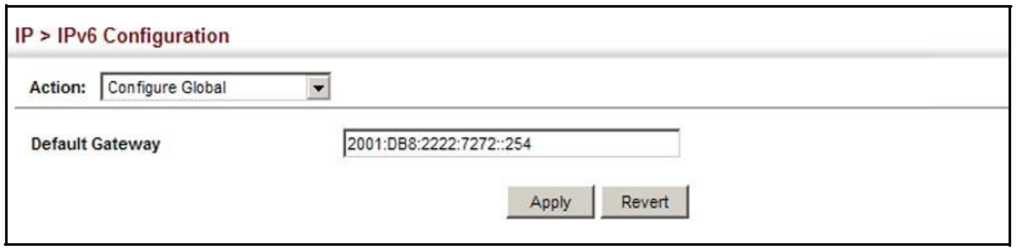
- If a routing protocol is enabled (page 393), you can still define a static route (page 376) to ensure that traffic to the designated address or subnet passes through a preferred gateway.
- An IPv6 default gateway can only be successfully set when a network interface that directly connects to the gateway 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 IP, IPv6 Configuration.
2. Select Configure Global from the Action list.
3. Enter the IPv6 default gateway.
4. Click Apply.

Figure 226: Configuring the IPv6 Default Gateway



IP > IPv6 Configuration

Action: Configure Global

Default Gateway 2001:DB8:2222:7272::254

Configuring IPv6 Interface Settings

Use the IP > IPv6 Configuration (Configure Interface) page to configure general IPv6 settings for the selected VLAN, including 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 option to explicitly enable IPv6 creates a link-local address, but will not generate a global IPv6 address. The global unicast address must be manually configured (see "Configuring an IPv6 Address" on page 348).
- 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 which is to be used for management access, or as a standard interface for a subnet. 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. 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 for lower layer packets, 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: 2)

- 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 125). 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.

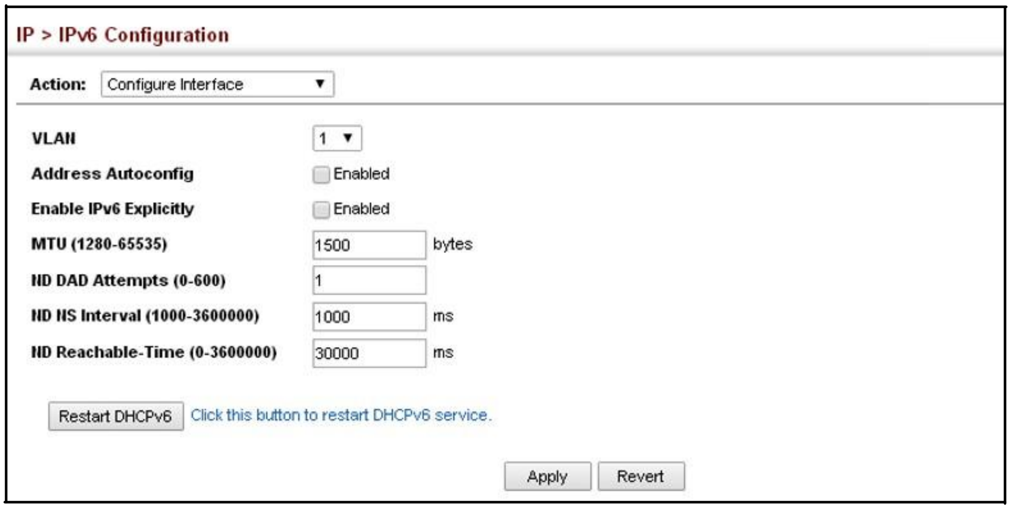
  - The time limit configured by this parameter allows the router to detect unavailable neighbors.
  - This time limit is included in all router advertisements sent out through an interface, ensuring that nodes on the same link use the same time value.
  - Setting the time limit to 0 means that the configured time is unspecified by this router.

Web Interface

To general IPv6 settings for the switch:

1. Click IP, IPv6 Configuration.
2. Select Configure Interface from the Action list.
3. Specify the VLAN to configure.
4. Specify the VLAN to configure, 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 227: Configuring General Settings for an IPv6 Interface



IP > IPv6 Configuration

Action: Configure Interface

VLAN	1
Address Autoconfig	□ Enabled
Enable IPv6 Explicitly	□ Enabled
MTU (1280-65535)	1500 bytes
ND DAD Attempts (0-600)	1
ND NS Interval (1000-3600000)	1000 ms
ND Reachable-Time (0-3600000)	30000 ms

Restart DHCPv6 Click this button to restart DHCPv6 service.

Configuring an IPv6 Address

Use the IP > IPv6 Configuration (Add IPv6 Address) page to configure an initial IPv6 interface for management access over the network, or for creating an interface to multiple subnets.

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 explicitly enabling IPv6 (see “Configuring IPv6 Interface Settings” on page 344) or manually assigning a global unicast address 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:

  - 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, or for creating an interface to multiple subnets. 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.

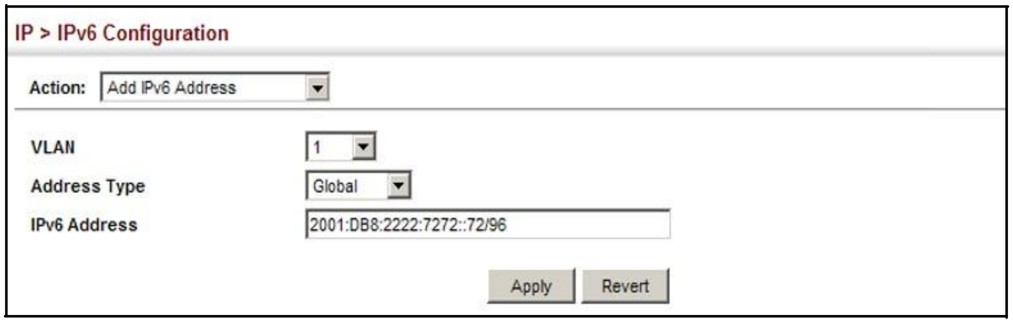
- ♦ **IPv6 Address** – IPv6 address assigned to this interface.

Web Interface

To configure an IPv6 address:

1. Click IP, 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 228: Configuring an IPv6 Address



IP > IPv6 Configuration

Action: Add IPv6 Address

VLAN: 1
Address Type: Global
IPv6 Address: 2001:DB8:2222:7272::72/96

Showing IPv6 Addresses

Use the IP > 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)
- **IP 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 host 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.

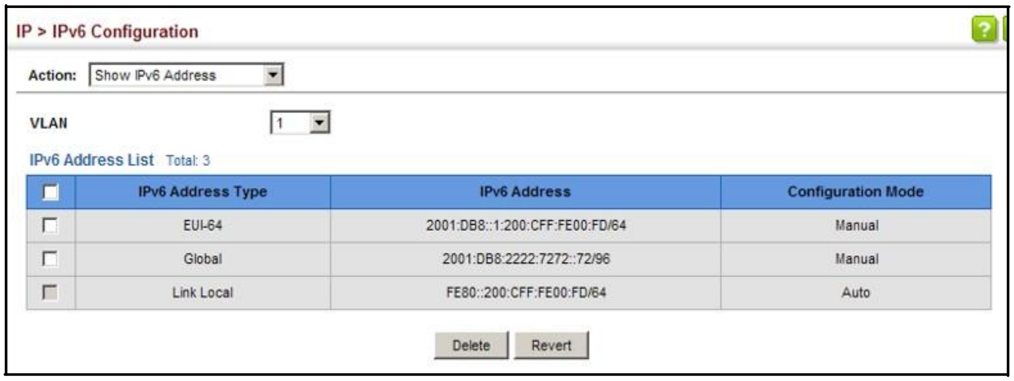
  These additional addresses are displayed by the CLI (see the "show ip interface" command in the *CLI Reference Guide*).
- **Configuration Mode** – Indicates if this address was automatically generated for manually configured.

Web Interface

To show the configured IPv6 addresses:

1. Click IP, IPv6 Configuration.
2. Select Show IPv6 Address from the Action list.
3. Select a VLAN from the list.

Figure 229: Showing Configured IPv6 Addresses



IP > IPv6 Configuration

Action: Show IPv6 Address

VLAN 1

IPv6 Address List Total: 3

□	IPv6 Address Type	IPv6 Address	Configuration Mode
□	EUI-64	2001:DB8::1:200:CFF:FE00:FD/64	Manual
□	Global	2001:DB8:2222:7272::72/96	Manual
□	Link Local	FE80::200:CFF:FE00:FD/64	Auto

Showing the IPv6 Neighbor Cache

Use the IP > IPv6 Configuration (Show IPv6 Neighbor Cache) page to display the IPv6 addresses detected for neighbor devices.

Parameters

These parameters are displayed:

Table 29: 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 Addr	Physical layer MAC address.
State	The following states are used for dynamic entries: ◆ 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 REACH 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.

Table 29: Show IPv6 Neighbors - display description (Continued)

Field	Description
	◆ 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 resending neighbor solicitation messages every RetransTimer interval until confirmation of reachability is received. ◆ Unknown - Unknown state. The following states are used for static entries: ◆ Incomplete -The interface for this entry is down. ◆ 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.

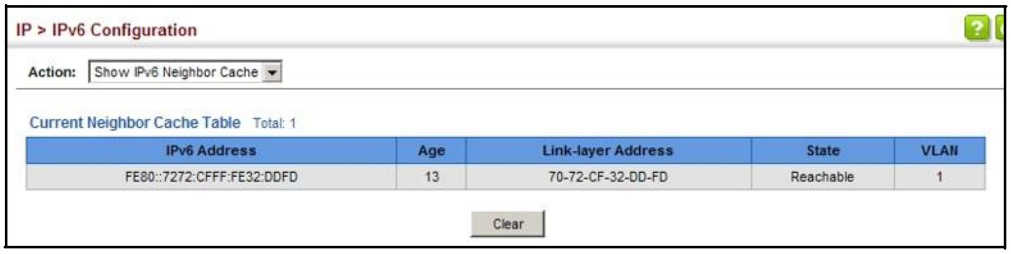
Web Interface

To show neighboring IPv6 devices:

1. Click IP, IPv6 Configuration.

2. Select Show IPv6 Neighbors from the Action list.

Figure 230: Showing IPv6 Neighbors



IP > IPv6 Configuration

Action: Show IPv6 Neighbor Cache

Current Neighbor Cache Table Total: 1

IPv6 Address	Age	Link-layer Address	State	VLAN
FE80::7272:CFFF:FE32:DDFD	13	70-72-CF-32-DD-FD	Reachable	1

Showing IPv6 Statistics

Use the IP > 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 30: Show IPv6 Statistics - display description

Field	Description
IPv6 Statistics	
IPv6 Received	
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.

Table 30: Show IPv6 Statistics - display description (Continued)

Field	Description
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 increment ed at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.
Reassembly 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.
Reassembly 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.
IPv6 Transmitted	
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 ipv6IfStatsOutForwDatagrams.
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 ipv6IfStatsOutForwDatagrams 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	
ICMPv6 received	
Input	The total number of ICMP messages received by the interface which includes all those counted by ipv6IfIcmpInErrors. 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 check sums, bad length, etc.).

Table 30: Show IPv6 Statistics - display description (Continued)

Field	Description
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.
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.
ICMPv6 Transmitted	
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.
Parameter Problem Message	The number of ICMP Parameter Problem 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.

Table 30: Show IPv6 Statistics - display description (Continued)

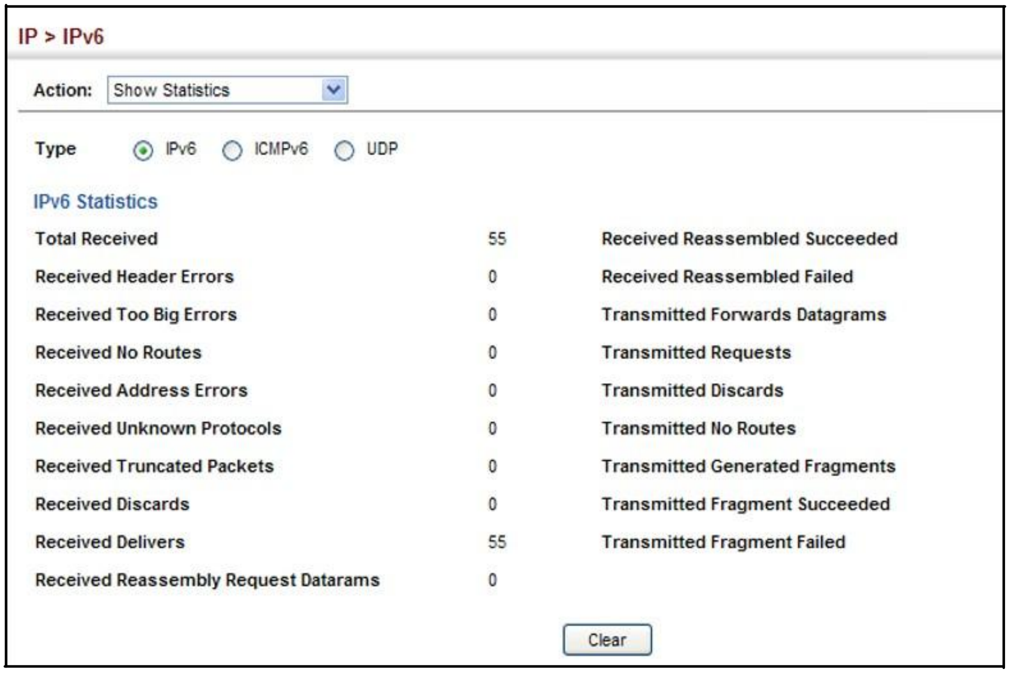
Field	Description
Neighbor Advertisement Messages	The number of ICMP Router Advertisement messages sent by the interface.
Redirect Messages	The number of Redirect messages sent. For a host, this object will always be zero, since hosts do not send redirects.
Group Membership Query Messages	The number of ICMPv6 Group Membership Query messages sent by the interface.
Group Membership Response Messages	The number of ICMPv6 Group Membership Response messages sent.
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 IP, IPv6 Configuration.
2. Select Show Statistics from the Action list.
3. Click IPv6, ICMPv6 or UDP.

Figure 231: Showing IPv6 Statistics (IPv6)



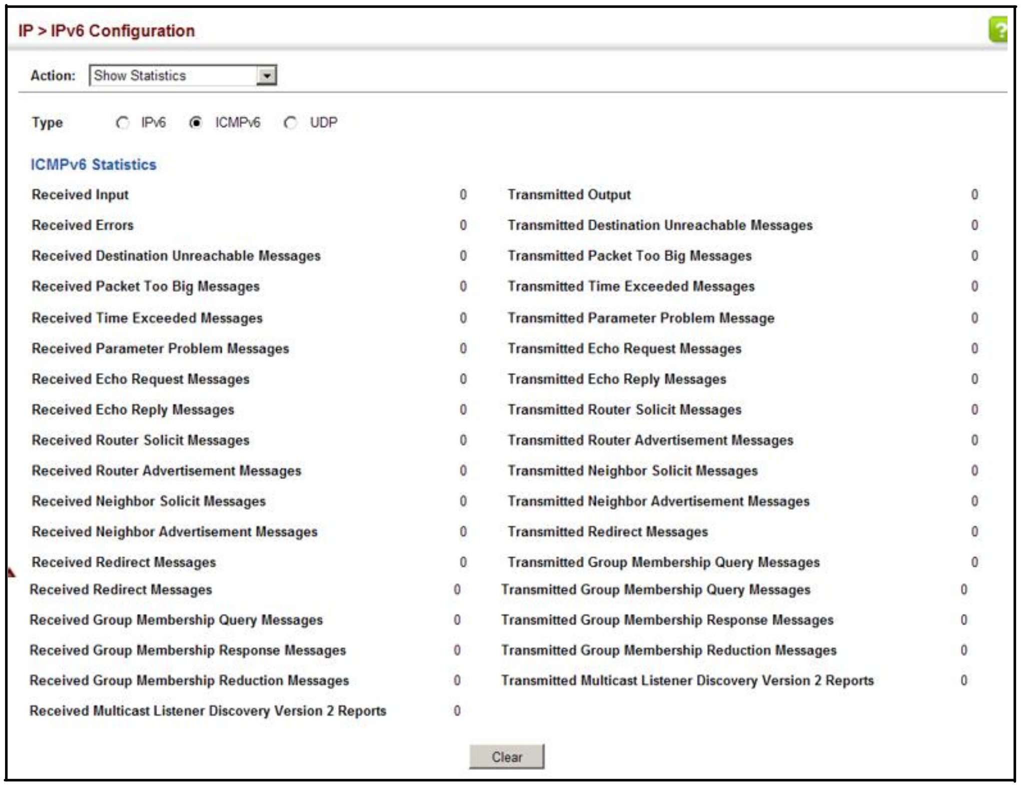
Action: Show Statistics

Type ● IPv6 ○ ICMPv6 ○ UDP

IPv6 Statistics

Total Received	55	Received Reassembled Succeeded
Received Header Errors	0	Received Reassembled Failed
Received Too Big Errors	0	Transmitted Forwards Datagrams
Received No Routes	0	Transmitted Requests
Received Address Errors	0	Transmitted Discards
Received Unknown Protocols	0	Transmitted No Routes
Received Truncated Packets	0	Transmitted Generated Fragments
Received Discards	0	Transmitted Fragment Succeeded
Received Delivers	55	Transmitted Fragment Failed
Received Reassembly Request Datarams	0	

Figure 232: Showing IPv6 Statistics (ICMPv6)



IP > IPv6 Configuration

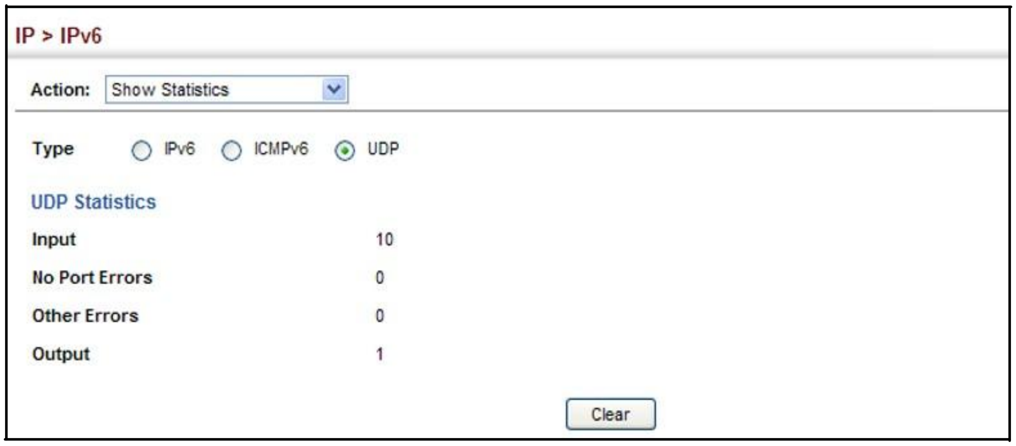
Action: Show Statistics

Type ○ IPv6 ● ICMPv6 ○ UDP

ICMPv6 Statistics

Received Input	0	Transmitted Output	0
Received Errors	0	Transmitted Destination Unreachable Messages	0
Received Destination Unreachable Messages	0	Transmitted Packet Too Big Messages	0
Received Packet Too Big Messages	0	Transmitted Time Exceeded Messages	0
Received Time Exceeded Messages	0	Transmitted Parameter Problem Message	0
Received Parameter Problem Messages	0	Transmitted Echo Request Messages	0
Received Echo Request Messages	0	Transmitted Echo Reply Messages	0
Received Echo Reply Messages	0	Transmitted Router Solicit Messages	0
Received Router Solicit Messages	0	Transmitted Router Advertisement Messages	0
Received Router Advertisement Messages	0	Transmitted Neighbor Solicit Messages	0
Received Neighbor Solicit Messages	0	Transmitted Neighbor Advertisement Messages	0
Received Neighbor Advertisement Messages	0	Transmitted Redirect Messages	0
Received Redirect Messages	0	Transmitted Group Membership Query Messages	0
Received Redirect Messages	0	Transmitted Group Membership Query Messages	0
Received Group Membership Query Messages	0	Transmitted Group Membership Response Messages	0
Received Group Membership Response Messages	0	Transmitted Group Membership Reduction Messages	0
Received Group Membership Reduction Messages	0	Transmitted Multicast Listener Discovery Version 2 Reports	0
Received Multicast Listener Discovery Version 2 Reports	0		

Figure 233: Showing IPv6 Statistics (UDP)



IP > IPv6

Action: Show Statistics

Type ○ IPv6 ○ ICMPv6 ● UDP

UDP Statistics

Input	10
No Port Errors	0
Other Errors	0
Output	1

Showing the MTU for Responding Destinations

Use the IP > 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 31: 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.

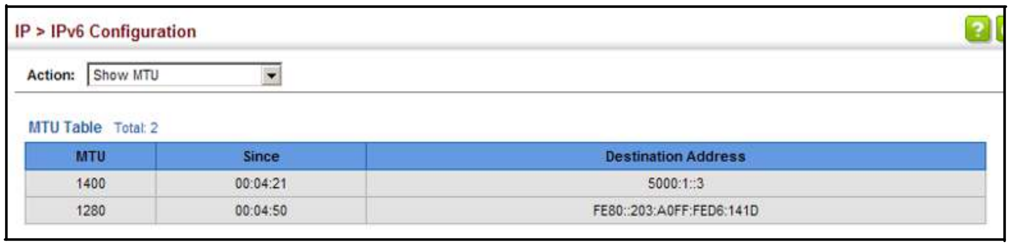
Web Interface

To show the MTU reported from other devices:

1. Click IP, IPv6 Configuration.

2. Select Show MTU from the Action list.

Figure 234: Showing Reported MTU Values



IP > 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

15 IP Services

This chapter describes the following IP services:

- DHCP Client – Specifies the DHCP client identifier for an interface.
- DHCP Relay – Enables DHCP relay service, and defines the servers to which client requests are forwarded.

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 DHCP server, you can relay DHCP client requests to a DHCP server on another subnet.

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 32: 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 33: 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:

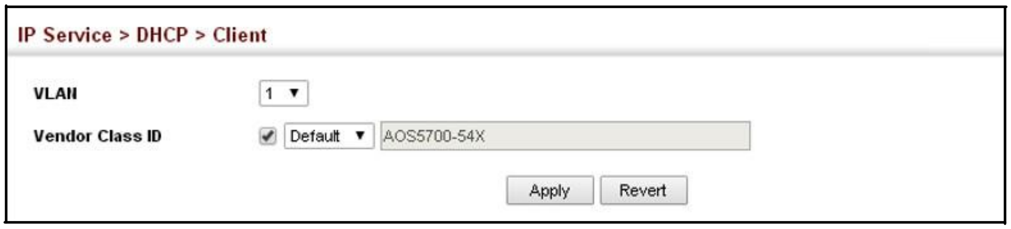
- **VLAN** – ID of configured VLAN.
- **Vendor Class ID** – The following options are supported when the check box is marked to enable this feature:
  - **Default** – The default string is the unit name.
  - **Text** – A text string. (Range: 1-32 characters)
  - **Hex** – A hexadecimal value.

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 235: Specifying A DHCP Client Identifier



IP Service > DHCP > Client

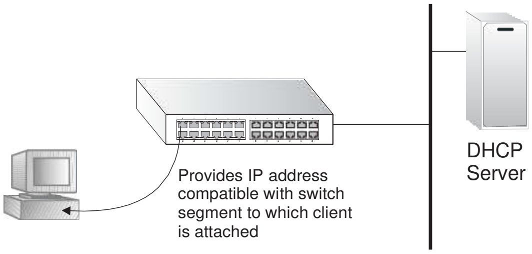
VLAN: 1

Vendor Class ID: ☑ Default AOS5700-54X

Configuring DHCP Relay Service

Use the IP Service > DHCP > Relay page to configure DHCP relay service for attached host devices. 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 broadcasts the DHCP response received from the server to the client.

Figure 236: Layer 3 DHCP Relay Service


Provides IP address compatible with switch segment to which client is attached
DHCP Server

Command Usage

- You must specify the IP address for at least one DHCP server. Otherwise, the switch's DHCP relay agent will not forward client requests to a DHCP server.

- DHCP relay configuration will be disabled if an active DHCP server is detected on the same network segment.

Parameters

These parameters are displayed:

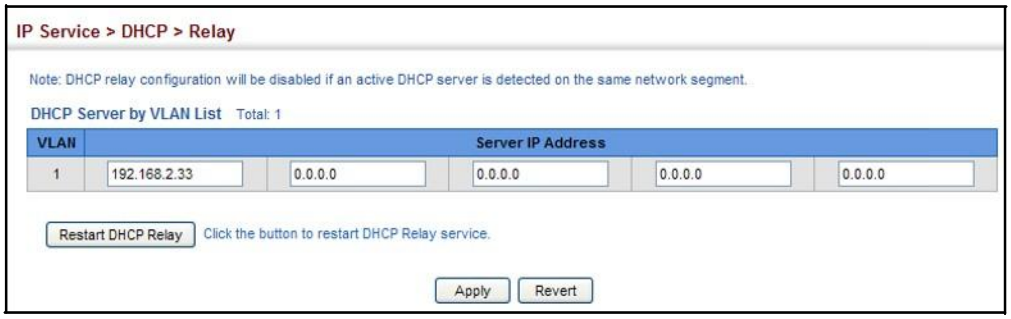
- **VLAN ID** – ID of configured VLAN.
- **Server IP Address** – Addresses of DHCP servers to be used by the switch's DHCP relay agent in order of preference.
- **Restart DHCP Relay** – Use this button to re-initialize DHCP relay service.

Web Interface

To configure DHCP relay service:

1. Click IP Service, DHCP, Relay.
2. Enter up to five IP addresses for any VLAN.
3. Click Apply.

Figure 237: Configuring DHCP Relay Service



IP Service > DHCP > Relay

Note: DHCP relay configuration will be disabled if an active DHCP server is detected on the same network segment.

DHCP Server by VLAN List Total: 1

VLAN	Server IP Address				
1	192.168.2.33	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0

Click the button to restart DHCP Relay service.

16

General IP Routing

This chapter provides information on network functions including:

- Ping – Sends ping message to another node on the network.
- Trace – 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.
- Static Routes – Configures static routes to other network segments.
- Routing Table – Displays routing entries learned through dynamic routing and statically configured entries.
- Equal-cost Multipath Routing – Configures the maximum number of equal-cost paths that can transmit traffic to the same destination

Overview

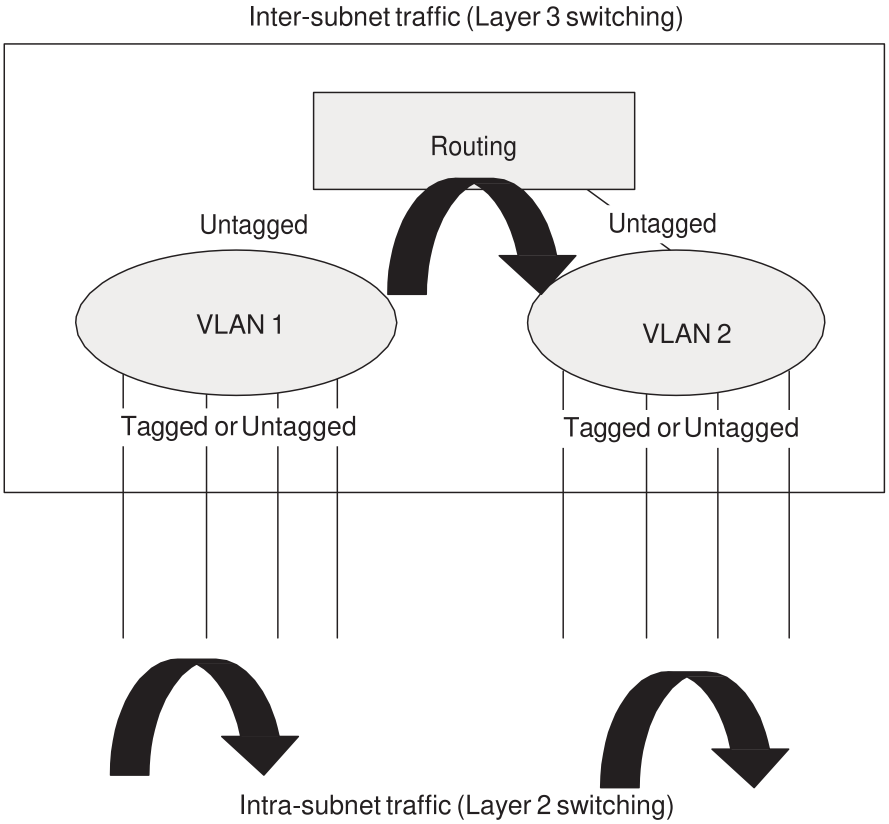
This switch supports IP routing and routing path management via static routing definitions (page 376) and dynamic routing protocols such as OSPF (page 393). When IP routing is functioning, this switch acts as a wire-speed router, passing traffic between VLANs with different IP interfaces, and routing traffic to external IP networks. However, when the switch is first booted, default routing can only forward traffic between local IP interfaces. As with all traditional routers, static and dynamic routing functions must first be configured to work.

Initial Configuration

By default, all ports belong to the same VLAN and the switch provides only Layer 2 functionality. To segment the attached network, first create VLANs for each unique user group or application traffic (page 125), assign all ports that belong to the same group to these VLANs (page 128), and then assign an IP interface to each VLAN (page 368). By separating the network into different VLANs, it can be partitioned into subnetworks that are disconnected at Layer 2. Network traffic within the same subnet is still switched using Layer 2 switching. And the VLANs can now be interconnected (as required) with Layer 3 switching.

Each VLAN represents a virtual interface to Layer 3. You just need to provide the network address for each virtual interface, and the traffic between different subnetworks will be routed by Layer 3 switching.

Figure 238: Virtual Interfaces and Layer 3 Routing


Inter-subnet traffic (Layer 3 switching)
Routing
Untagged
Untagged
VLAN 1
VLAN 2
Tagged or Untagged
Tagged or Untagged
Intra-subnet traffic (Layer 2 switching)

IP Routing and Switching

IP Switching (or packet forwarding) encompasses tasks required to forward packets for both Layer 2 and Layer 3, as well as traditional routing. These functions include:

- Layer 2 forwarding (switching) based on the Layer 2 destination MAC address
- Layer 3 forwarding (routing):
  - Based on the Layer 3 destination address
  - Replacing destination/source MAC addresses for each hop
  - Incrementing the hop count
  - Decrementing the time-to-live
  - Verifying and recalculating the Layer 3 checksum

If the destination node is on the same subnetwork as the source network, then the packet can be transmitted directly without the help of a router. However, if the MAC address is not yet known to the switch, an Address Resolution Protocol (ARP) packet with the destination IP address is broadcast to get the destination MAC address from the destination node. The IP packet can then be sent directly with the destination MAC address.

If the destination belongs to a different subnet on this switch, the packet can be routed directly to the destination node. However, if the packet belongs to a subnet not included on this switch, then the packet should be sent to the next hop router (with the MAC address of the router itself used as the destination MAC address, and the destination IP address of the destination node). The router will then forward the packet to the destination node through the correct path. The router can also use the ARP protocol to find out the MAC address of the destination node of the next router as necessary.

Note: In order to perform IP switching, the switch should be recognized by other network nodes as an IP router, either by setting it as the default gateway or by redirection from another router via the ICMP process.

When the switch receives an IP packet addressed to its own MAC address, the packet follows the Layer 3 routing process. The destination IP address is checked against the Layer 3 address table. If the address is not already there, the switch broadcasts an ARP packet to all the ports on the destination VLAN to find out the destination MAC address. After the MAC address is discovered, the packet is reformatted and sent out to the destination. The reformat process includes decreasing the Time-To-Live (TTL) field of the IP header, recalculating the IP header checksum, and replacing the destination MAC address with either the MAC address of the destination node or that of the next hop router.

When another packet destined to the same node arrives, the destination MAC can be retrieved directly from the Layer 3 address table; the packet is then reformatted and sent out the destination port. IP switching can be done at wire-speed when the destination address entry is already in the Layer 3 address table.

If the switch determines that a frame must be routed, the route is calculated only during setup. Once the route has been determined, all packets in the current flow are simply switched or forwarded across the chosen path. This takes advantage of the high throughput and low latency of switching by enabling the traffic to bypass the routing engine once the path calculation has been performed.

Routing Path Management

Routing Path Management involves the determination and updating of all the routing information required for packet forwarding, including:

- Handling routing protocols
- Updating the routing table
- Updating the Layer 3 switching database

Routing Protocols

The switch supports both static and dynamic routing.

- Static routing requires routing information to be stored in the switch either manually or when a connection is set up by an application outside the switch.
- Dynamic routing uses a routing protocol to exchange routing information, calculate routing tables, and respond to changes in the status or loading of the network.

Configuring IP Routing Interfaces

Configuring Local and Remote Interfaces

Use the IP > General > Routing Interface page to configure routing interfaces for directly connected IPv4 subnets (see "Setting the Switch's IP Address (IP Version 4)" on page 339. Or use the IP > IPv6 Configuration pages to configure routing interfaces for directly connected IPv6 subnets (see "Setting the Switch's IP Address (IP Version 6)" on page 343).

If this router is directly connected to end node devices (or connected to end nodes through shared media) that will be assigned to a specific subnet, then you must create a router interface for each VLAN that will support routing. The router interface consists of an IP address and subnet mask. This interface address defines both the network prefix number to which the router interface is attached and the router's host number on that network. In other words, a router interface address defines the network segment that is connected to that interface, and allows you to send IP packets to or from the router.

You can specify the IP subnets connected directly to this router by manually assigning an IP address to each VLAN or using DHCP to dynamically assign an address. To specify IP subnets not directly connected to this router, you can either configure static routes (see page 376), or use theOSPF dynamic routing protocol (see page 393) to identify routes that lead to other interfaces by exchanging protocol messages with other routers on the network.

Once IP interfaces have been configured, the switch functions as a multilayer routing switch, operating at either Layer 2 or 3 as required. All IP packets are routed directly between local interfaces, or indirectly to remote interfaces using either static or dynamic routing. All other packets for non-IP protocols (for example, NetBuei, NetWare or AppleTalk) are switched based on MAC addresses).

To route traffic between remote IP interfaces, the switch should be recognized by other network nodes as an IP router, either by setting it to advertise itself as the default gateway or by redirection from another router via the ICMP process used by various routing protocols.

If the switch is configured to advertise itself as the default gateway, a routing protocol must still be used to determine the next hop router for any unknown destinations, i.e., packets that do not match any routing table entry. If another router is designated as the default gateway, then the switch will pass packets to this router for any unknown hosts or subnets.

To configure a default gateway for IPv4, use the static routing table as described on page 376, enter 0.0.0.0 for the IP address and subnet mask, and then specify this switch itself or another router as the gateway. To configure a gateway for IPv6, see "Configuring the IPv6 Default Gateway" on page 343.

Using the Ping Function

Use the IP > General > Ping page to send ICMP echo request packets to another node on the network.

Parameters

These parameters are displayed:

- **~~Host Name/~~IP Address** – IPv4/IPv6 address or alias 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

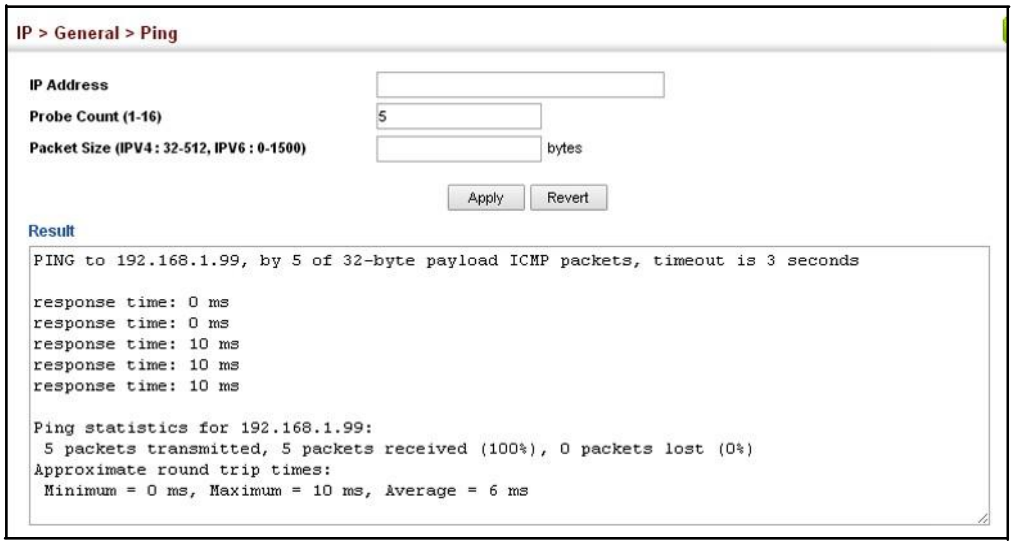
- Use the ping command to see if another site on the network can be reached.
- The following are some results of the **ping** command:
  - *Normal response* - The normal response occurs in one to ten seconds, depending on network traffic.
  - *Destination does not respond* - If the host does not respond, 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 IP, General, Ping.
2. Specify the target device and ping parameters.
3. Click Apply.

Figure 239: Pinging a Network Device



IP Address
Probe Count (1-16): 5
Packet Size (IPV4 : 32-512, IPV6 : 0-1500): bytes

```
PING to 192.168.1.99, by 5 of 32-byte payload ICMP packets, timeout is 3 seconds

response time: 0 ms
response time: 0 ms
response time: 10 ms
response time: 10 ms
response time: 10 ms

Ping statistics for 192.168.1.99:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
 Minimum = 0 ms, Maximum = 10 ms, Average = 6 ms
```

Using the Trace Route Function

Use the IP > General > Trace Route page to show the route packets take to the specified destination.

Parameters

These parameters are displayed:

- **Destination IP Address** – 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.

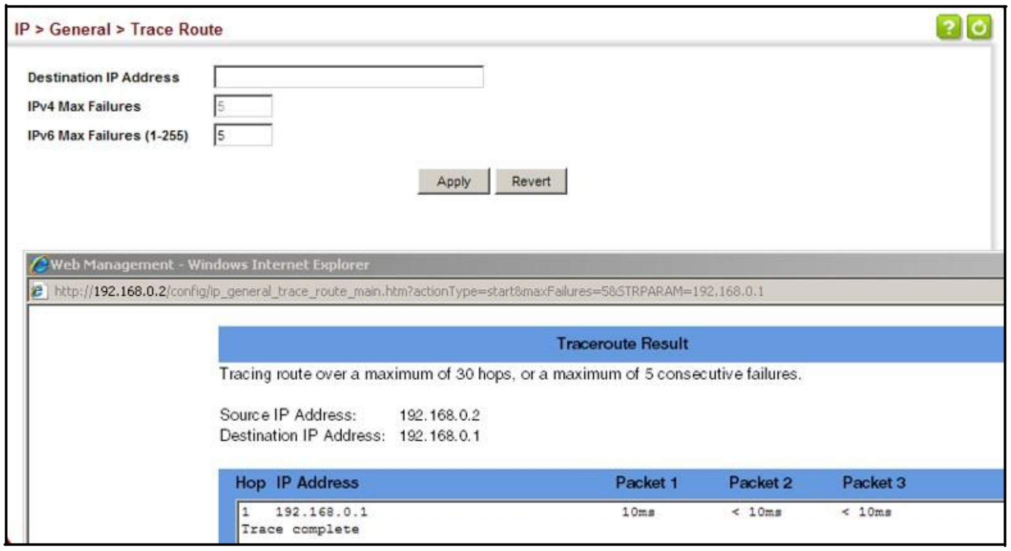
- The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface. Note that the zone-id for the craft interface is 4097.

Web Interface

To trace the route to another device on the network:

1. Click IP, General, Trace Route.
2. Specify the target device.
3. Click Apply.

Figure 240: Tracing the Route to a Network Device



IP > General > Trace Route

Destination IP Address	
IPv4 Max Failures	5
IPv6 Max Failures (1-255)	5

http://192.168.0.2/config/ip_general_trace_route_main.htm?actionType=start&maxFailures=5&STRPARAM=192.168.0.1

Traceroute Result

Tracing route over a maximum of 30 hops, or a maximum of 5 consecutive failures.

Source IP Address: 192.168.0.2
Destination IP Address: 192.168.0.1

```
Hop  IP Address                           Packet 1     Packet 2     Packet 3
1    192.168.0.1                          10ms         < 10ms       < 10ms
Trace complete
```

Address Resolution Protocol

If IP routing is enabled (page 393), 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 34: 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.

ARP Timeout Configuration

Use the IP > ARP (Configure General) page to specify the timeout for ARP cache entries.

Parameters

These parameters are displayed:

- **Timeout** – Sets the aging time for dynamic entries in the ARP cache. (Range: 300 - 86400 seconds; Default: 1200 seconds or 20 minutes)

  The ARP aging timeout can be set for any configured VLAN.

The aging time determines how long dynamic entries remain in the cache. If the timeout is too short, the router may tie up resources by repeating ARP requests for addresses recently flushed from the table.

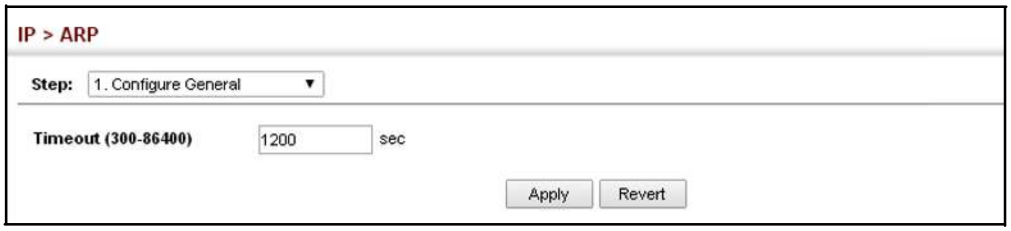
When a ARP entry expires, it is deleted from the cache and an ARP request packet is sent to re-establish the MAC address.

Web Interface

To configure the timeout for the ARP cache:

1. Click IP, ARP.
2. Select Configure General from the Step List.
3. Set the timeout to a suitable value for the ARP cache.
4. Click Apply.

Figure 241: Configuring ARP Timeout



IP > ARP

Step: 1. Configure General

Timeout (300-86400) 1200 sec

Configuring Static ARP Addresses

For devices that do not respond to ARP requests or do not respond in a timely manner, traffic will be dropped because the IP address cannot be mapped to a physical address. If this occurs, use the IP > ARP (Configure Static Address – Add) page to manually map an IP address to the corresponding physical address in the ARP cache.

Command Usage

- The ARP cache is used to map 32-bit IP addresses into 48-bit hardware (that is, Media Access Control) addresses. This cache includes entries for hosts and other routers on local network interfaces defined on this router.
- You can define up to 128 static entries in the ARP cache.
- A static entry may need to be used if there is no response to an ARP broadcast message. For example, some applications may not respond to ARP requests or the response arrives too late, causing network operations to time out.
- Static entries will not be aged out or deleted when power is reset. You can only remove a static entry via the configuration interface.

- Static entries are only displayed on the Show page for VLANs that are up. In other words, static entries are only displayed when configured for the IP subnet of a existing VLAN, and that VLAN is linked up.

Parameters

These parameters are displayed:

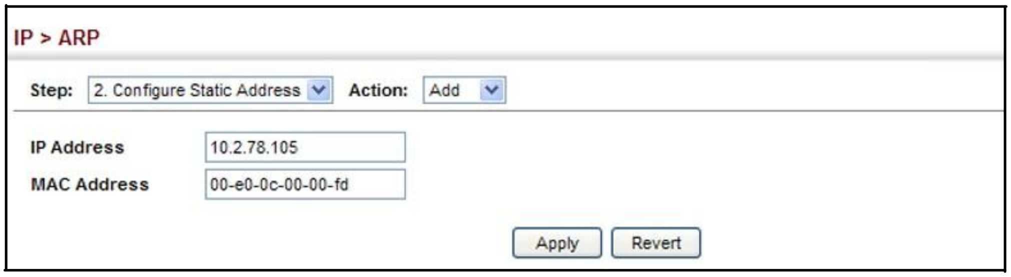
- **IP Address** – IP address statically mapped to a physical MAC address. (Valid IP addresses consist of four numbers, 0 to 255, separated by periods.)
- **MAC Address** – MAC address statically mapped to the corresponding IP address. (Valid MAC addresses are hexadecimal numbers in the format: xx-xx-xx-xx-xx-xx)

Web Interface

To map an IP address to the corresponding physical address in the ARP cache using the web interface:

1. Click IP, ARP.
2. Select Configure Static Address from the Step List.
3. Select Add from the Action List.
4. Enter the IP address and the corresponding MAC address.
5. Click Apply.

Figure 242: Configuring Static ARP Entries



IP > ARP

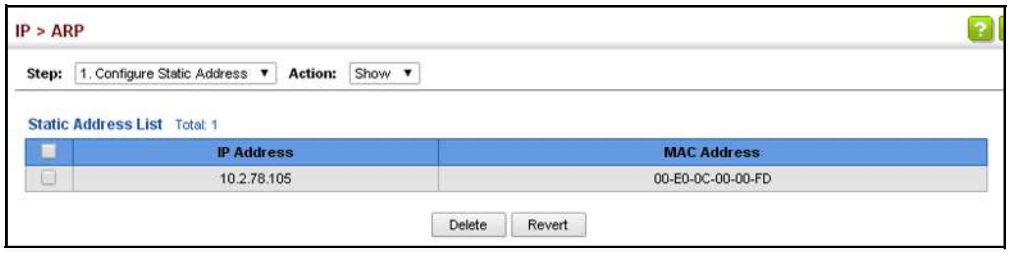
Step: 2. Configure Static Address   Action: Add

IP Address: 10.2.78.105
MAC Address: 00-e0-0c-00-00-fd

To display static entries in the ARP cache:

1. Click IP, ARP.
2. Select Configure Static Address from the Step List.
3. Select Show from the Action List.

Figure 243: Displaying Static ARP Entries


IP > ARP
Step: 1. Configure Static Address ▼ Action: Show ▼
Static Address List Total: 1

□	IP Address	MAC Address
□	10.2.78.105	00-E0-0C-00-00-FD

Displaying Dynamic or Local ARP Entries

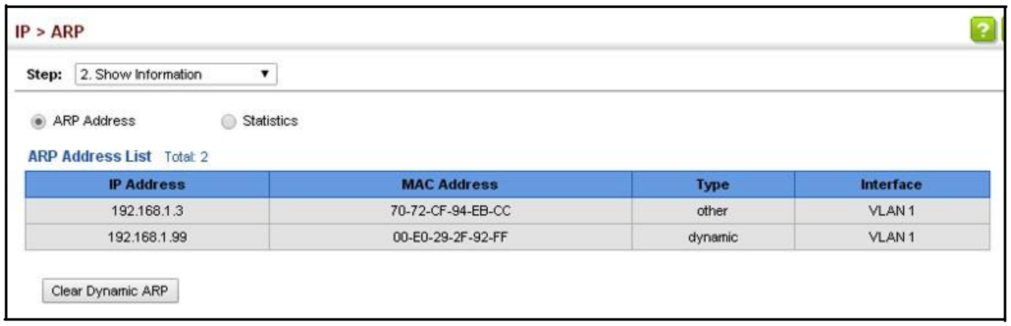
The ARP cache contains static entries, and entries for local interfaces, including subnet, host, and broadcast addresses. However, most entries will be dynamically learned through replies to broadcast messages. Use the IP > ARP (Show Information) page to display dynamic or local entries in the ARP cache.

Web Interface

To display all entries in the ARP cache:

1. Click IP, ARP.
2. Select Show Information from the Step List.
3. Click ARP Address.

Figure 244: Displaying ARP Entries


IP > ARP
Step: 2. Show Information ▼
● ARP Address ○ Statistics
ARP Address List Total: 2

IP Address	MAC Address	Type	Interface
192.168.1.3	70-72-CF-94-EB-CC	other	VLAN 1
192.168.1.99	00-E0-29-2F-92-FF	dynamic	VLAN 1

Displaying ARP Statistics

Use the IP > ARP (Show Information) page to display statistics for ARP messages crossing all interfaces on this router.

Parameters

These parameters are displayed:

Table 35: ARP Statistics

Parameter	Description
Received Request	Number of ARP Request packets received by the router.
Received Reply	Number of ARP Reply packets received by the router.

Table 35: ARP Statistics (Continued)

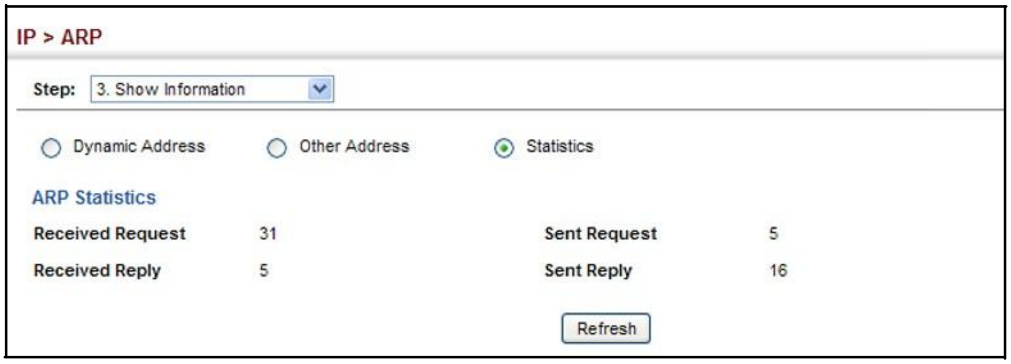
Parameter	Description
Sent Request	Number of ARP Request packets sent by the router.
Sent Reply	Number of ARP Reply packets sent by the router.

Web Interface

To display ARP statistics:

1. Click IP, ARP.
2. Select Show Information from the Step List.
3. Click Statistics.

Figure 245: Displaying ARP Statistics



IP > ARP

Step: 3. Show Information

○ Dynamic Address ○ Other Address ● Statistics

ARP Statistics

Received Request	31	Sent Request	5
Received Reply	5	Sent Reply	16

Configuring Static Routes

This router can dynamically configure routes to other network segments using dynamic routing protocols (i.e., OSPF). However, you can also manually enter static routes in the routing table using the IP > Routing > Static Routes (Add) page. Static routes may be required to access network segments where dynamic routing is not supported, or can be set to force the use of a specific route to a subnet, rather than using dynamic routing. Static routes do not automatically change in response to changes in network topology, so you should only configure a small number of stable routes to ensure network accessibility.

Command Usage

- Up to 256 static routes can be configured.
- Up to eight equal-cost multipaths (ECMP) can be configured for static routing (see "Equal-cost Multipath Routing" on page 379).
- If an administrative distance is defined for a static route, and the same destination can be reached through a dynamic route at a lower administration distance, then the dynamic route will be used.

- If both static and dynamic paths have the same lowest cost, the first route stored in the routing table, either statically configured or dynamically learned via a routing protocol, will be used.

- Static routes are included in OSPF updates periodically sent by the router if this feature is enabled by OSPF (see page 412).

Parameters

These parameters are displayed:

- **Destination IP Address** – IP address of the destination network, subnetwork, or host.

- **Netmask** – Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.

- **Next Hop** – IP address of the next router hop used for this route.

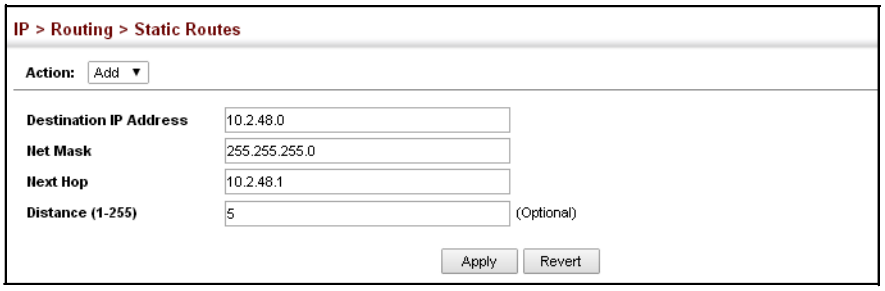
- **Distance** – An administrative distance indicating that this route can be overridden by dynamic routing information if the distance of the dynamic route is less than that configured for the static route. Note that the default administrative distances used by the dynamic unicast routing protocols is 110 for OSPF. (Range: 1-255, Default: 1)

Web Interface

To configure static routes:

1. Click IP, Routing, Static Routes.
2. Select Add from the Action List.
3. Enter the destination address, subnet mask, and next hop router.
4. Click Apply.

Figure 246: Configuring Static Routes



IP > Routing > Static Routes

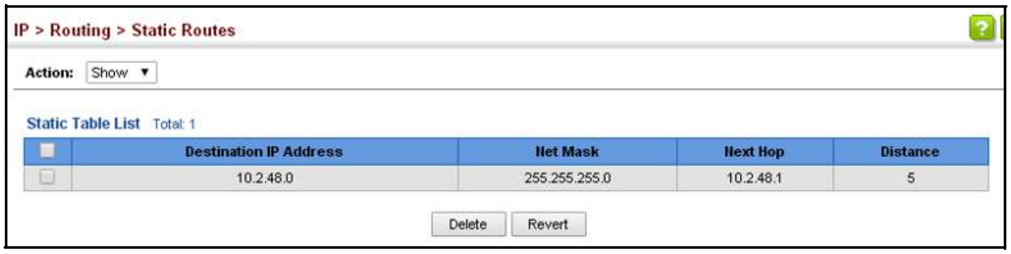
Action: Add

Destination IP Address	10.2.48.0
Net Mask	255.255.255.0
Next Hop	10.2.48.1
Distance (1-255)	5 (Optional)

To display static routes:

1. Click IP, Routing, Static Routes.
2. Select Show from the Action List.

Figure 247: Displaying Static Routes



IP > Routing > Static Routes

Action: Show

Static Table List Total: 1

□	Destination IP Address	Net Mask	Next Hop	Distance
□	10.2.48.0	255.255.255.0	10.2.48.1	5

Displaying the Routing Table

Use the IP > Routing > Routing Table page to display all routes that can be accessed via local network interfaces, through static routes, or through a dynamically learned route. If route information is available through more than one of these methods, the priority for route selection is local, static, and then dynamic (except when the distance parameter of a dynamic route is set to a value that makes its priority exceed that of a static route). Also note that the route for a local interface is not enabled (i.e., listed in the routing table) unless there is at least one active link connected to that interface.

Command Usage

- The Forwarding Information Base (FIB) contains information required to forward IP traffic. It contains the interface identifier and next hop information for each reachable destination network prefix based on the IP routing table. When routing or topology changes occur in the network, the routing table is updated, and those changes are immediately reflected in the FIB.

  The FIB is distinct from the routing table (or, Routing Information Base – RIB), which holds all routing information received from routing peers. The FIB contains unique paths only. It does not contain any secondary paths. A FIB entry consists of the minimum amount of information necessary to make a forwarding decision on a particular packet. The typical components within a FIB entry are a network prefix, a router (i.e., VLAN) interface, and next hop information.

- The Routing Table only displays routes which are currently accessible for forwarding. The router must be able to directly reach the next hop, so the VLAN interface associated with any dynamic or static route entry must be up. Note that routes currently not accessible for forwarding, may still be displayed by using the “show ip route database” command (see the *CLI Reference Guide*.

Parameters

These parameters are displayed:

- **VLAN** – VLAN identifier (i.e., configure as a valid IP subnet).

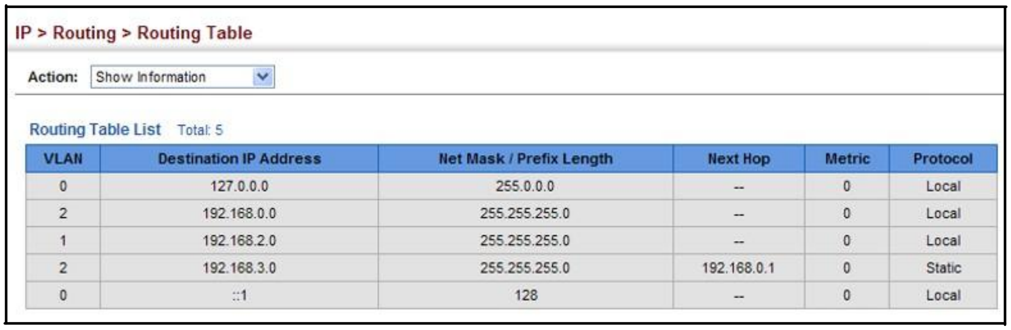
- **Destination IP Address** – IP address of the destination network, subnetwork, or host. Note that the address 0.0.0.0 indicates the default gateway for this router.
- **Net Mask ~~/ Prefix Length~~** – Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.
- **Next Hop** – The IP address of the next hop (or gateway) in this route.
- **Metric** – Cost for this interface.
- **Protocol** – The protocol which generated this route information. (Options: Local, Static, OSPF, Others)

Web Interface

To display the routing table:

1. Click IP, Routing, Routing Table.
2. Select Show Information from the Action List.

Figure 248: Displaying the Routing Table



IP > Routing > Routing Table

Action: Show Information

Routing Table List Total: 5

VLAN	Destination IP Address	Net Mask / Prefix Length	Next Hop	Metric	Protocol
0	127.0.0.0	255.0.0.0	--	0	Local
2	192.168.0.0	255.255.255.0	--	0	Local
1	192.168.2.0	255.255.255.0	--	0	Local
2	192.168.3.0	255.255.255.0	192.168.0.1	0	Static
0	::1	128	--	0	Local

Equal-cost Multipath Routing

Use the IP > Routing > Routing Table (Configure ECMP Number) page to configure the maximum number of equal-cost paths that can transmit traffic to the same destination. The Equal-cost Multipath routing algorithm is a technique that supports load sharing over multiple equal-cost paths for data passing to the same destination. Whenever multiple paths with equal path cost to the same destination are found in the routing table, the ECMP algorithm first checks if the cost is lower than that of any other entries in the routing table. If the cost is the lowest in the table, the switch will use up to eight of the paths with equal lowest cost to balance the traffic forwarded to the destination. ECMP uses either equal-cost multipaths manually configured in the static routing table, or equal-cost multipaths dynamically generated by the Open Shortest Path Algorithm (OSPF). In other words, it uses either static or OSPF entries, not both. Normal unicast routing simply selects the path to the destination that has the lowest cost. Multipath routing still selects the path with the lowest cost, but can forward traffic over multiple paths if they all have the same lowest cost. ECMP is enabled by default on the switch. If there is only one lowest cost path toward the destination, this path will be used to forward all traffic. If there is more than one lowest-cost path configured in the static routing table (see "Configuring Static Routes" on page 376), or dynamically generated by OSPFv2 (see "Configuring the Open Shortest Path First Protocol (Version 2)" on page 393), then up to 8 paths with the same lowest cost can be used to forward traffic to the destination.

Command Usage

- ECMP only selects paths of the same protocol type. It cannot be applied to both static paths and dynamic paths at the same time for the same destination. If both static and dynamic paths have the same lowest cost, the static paths have precedence over dynamic paths.

- Each path toward the same destination with equal-cost takes up one entry in the routing table to record routing information. In other words, a route with 8 paths will take up 8 entries.

- The routing table can only have up to 8 equal-cost multipaths for static routing and 8 for dynamic routing for a common destination. However, the system supports up to 256 total ECMP entries in ASIC for fast switching, with any additional entries handled by software routing.

- When there are multiple paths toward the same destination with equal-cost, the system chooses one of these paths to forward each packet toward the destination by applying a load-splitting algorithm.

  A hash value is calculated based upon the source and destination IP fields of each packet as an indirect index to one of the multiple paths. Because the hash algorithm is calculated based upon the packet header information which can identify specific traffic flows, this technique minimizes the number of times a path is changed for individual flows. In general, path changes for individual flows will only occur when a path is added or removed from the multipath group.

Parameters

These parameters are displayed:

- **ECMP Number** – Sets the maximum number of equal-cost paths to the same destination that can be installed in the routing table. (Range: 1-8; Default: 8)

Web Interface

To configure the maximum ECMP number:

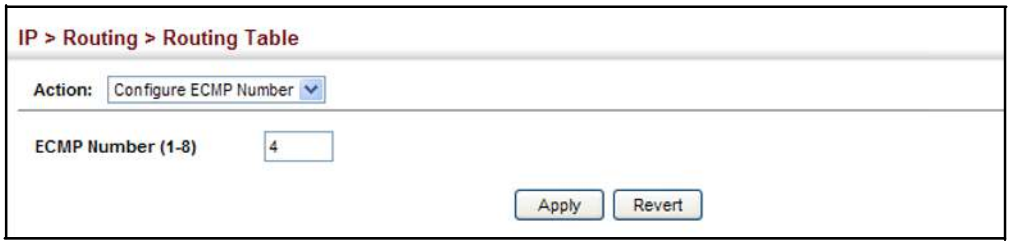
1. Click IP, Routing, Routing Table.

2. Select Configure ECMP Number from the Action List.

3. Enter the maximum number of equal-cost paths used to route traffic to the same destination that are permitted on the switch.

4. Click Apply

Figure 249: Setting the Maximum ECMP Number



IP > Routing > Routing Table

Action: Configure ECMP Number

ECMP Number (1-8): 4

17

Configuring Router Redundancy

Router redundancy protocols use a virtual IP address to support a primary router and multiple backup routers. The backup routers can be configured to take over the workload if the master router fails, or can also be configured to share the traffic load. The primary goal of router redundancy is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

This switch supports the Virtual Router Redundancy Protocol (VRRP). VRRP allows you to specify the interface of one of the routers participating in the virtual group as the address for the master virtual router, or to configure an arbitrary address for the virtual master router. VRRP then selects the backup routers based on the specified virtual router priority.

Router redundancy can be set up in any of the following configurations. These examples use the address of one of the participating routers as the master router. When the virtual router IP address is not a real address, the master router is selected based on priority. When the priority is the same on several competing routers, then the router with the highest IP address is selected as the master.

Figure 250: Master Virtual Router with Backup Routers

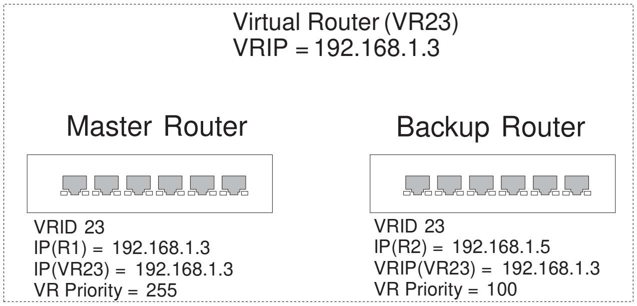


Figure 251: Several Virtual Master Routers Using Backup Routers

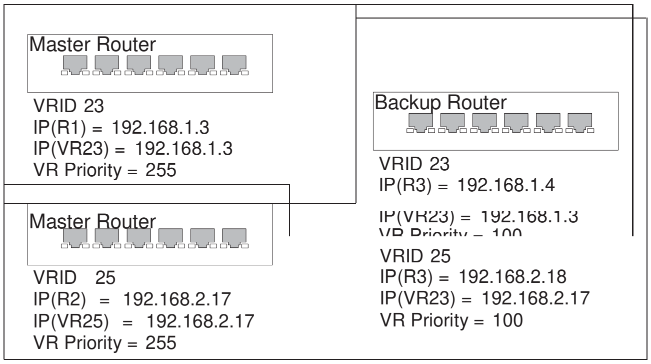
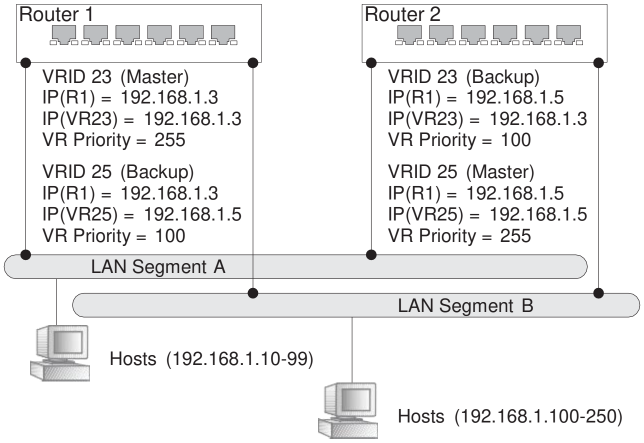


Figure 252: Several Virtual Master Routers Configured for Mutual Backup and Load Sharing



Note: Load sharing can be accomplished by assigning a subset of addresses to different host address pools using a DHCP server.

Configuring VRRP Groups

Use the IP > VRRP pages to configure VRRP. To configure VRRP groups, select an interface on each router in the group that will participate in the protocol as the master router or a backup router. To select a specific device as the master router, set the address of this interface as the virtual router address for the group. Now set the same virtual address and a priority on the backup routers, and configure an authentication string. You can also enable the preempt feature which allows a router to take over as the master router when it comes on line if it has a higher priority than the currently active master router.

Command Usage

Address Assignment –

- To designate a specific router as the VRRP master, the IP address assigned to the virtual router must already be configured on the router that will become the Owner of the group address. In other words, the IP address for the virtual router exists on one, and only one, router in the virtual router group, and the network mask for the virtual router address is derived from the Owner. The Owner will also assume the role of the Master virtual router in the group.

- If a virtual address is assigned to the group which does not exist on any of the group members, then the master router is selected based on priority. In cases where the configured priority is the same on several group members, then the master router with the highest IP address is selected from this group.

- If you have multiple secondary addresses configured on the current VLAN interface, you can add any of these addresses to the virtual router group.

- The interfaces of all routers participating in a virtual router group must be within the same IP subnet.

- VRRP creates a virtual MAC address for the master router based on a standard prefix, with the last octet equal to the group ID. When a backup router takes over as the master, it continues to forward traffic addressed to this virtual MAC address. However, the backup router cannot reply to ICMP pings sent to addresses associated with the virtual group because the IP address owner is off line.

Virtual Router Priority –

- The Owner of the virtual IP address is automatically assigned the highest possible virtual router priority of 255. The backup router with the highest priority will become the master router if the current master fails. However, because the priority of the virtual IP address Owner is the highest, the original master router will always become the active master router when it recovers.

- If two or more routers are configured with the same VRRP priority, the router with the higher IP address is elected as the new master router if the current master fails.

Preempting the Acting Master –

- The virtual IP Owner has the highest priority, so no other router can preempt it, and it will always resume control as the master virtual router when it comes back on line. The preempt function only allows a backup router to take over from a master router if no router in the group is the virtual IP owner, or from another backup router that is temporarily acting as the group master. If preemption is enabled and this router has a higher priority than the current acting master when it comes on line, it will take over as the acting group master.

- You can add a delay to the preempt function to give additional time to receive an advertisement message from the current master before taking control. If the router attempting to become the master has just come on line, this delay also gives it time to gather information for its routing table before actually preempting the currently active master router.

Parameters

These parameters are displayed:

Adding a VRRP Group

- **VRID** – VRRP group identifier. (Range: 1-255)
- **VLAN** – ID of a VLAN configured with an IP interface. (Range: 1-4094; Default: 1)

Adding a Virtual IP Address

- **VLAN ID** – ID of a VLAN configured with an IP interface. (Range: 1-4094)
- **VRID** – VRRP group identifier. (Range: 1-255)
- **IP Address** – Virtual IP address for this group.

  Use the IP address of a real interface on this router to make it the master virtual router for the group. Otherwise, use the virtual address for an existing group to make it a backup router, or to compete as the master based on configured priority if no other members are set as the owner of the group address.

Configuring Detailed Settings

- **VLAN ID** – VLAN configured with an IP interface. (Range: 1-4094)
- **VRID** – VRRP group identifier. (Range: 1-255)
- **Advertisement Interval** – Interval at which the master virtual router sends advertisements communicating its state as the master. (Range: 1-255 seconds; Default: 1 second)

  VRRP advertisements from the current master virtual router include information about its priority and current state as the master.

  VRRP advertisements are sent to the multicast address 224.0.0.8. Using a multicast address reduces the amount of traffic that has to be processed by network devices that are not part of the designated VRRP group.

  If the master router stops sending advertisements, backup routers will bid to become the master router based on priority. The dead interval before attempting to take over as the master is three times the hello interval plus half a second.

- **Priority** – The priority of this router in a VRRP group. (Range: 1-254; Default: 100)
  - The priority for the VRRP group address owner is automatically set to 255.
  - The priority for backup routers is used to determine which router will take over as the acting master router if the current master fails.
- **Preempt Mode** – Allows a backup router to take over as the master virtual router if it has a higher priority than the acting master virtual router (i.e., a master router that is not the group's address owner, or another backup router that has taken over from the previous master). (Default: Enabled)
- **Preempt Delay Time** – Time to wait before issuing a claim to become the master. (Range: 0-120 seconds; 0 seconds)
- **Authentication Mode** – Authentication mode used to verify VRRP packets received from other routers. (Options: None, Simple Text; Default: None)

  If simple text authentication is selected, then you must also enter an authentication string.

  All routers in the same VRRP group must be set to the same authentication mode, and be configured with the same authentication string.

  Plain text authentication does not provide any real security. It is supported only to prevent a misconfigured router from participating in VRRP.
- **Authentication String** – Key used to authenticate VRRP packets received from other routers. (Range: 1-8 alphanumeric characters)

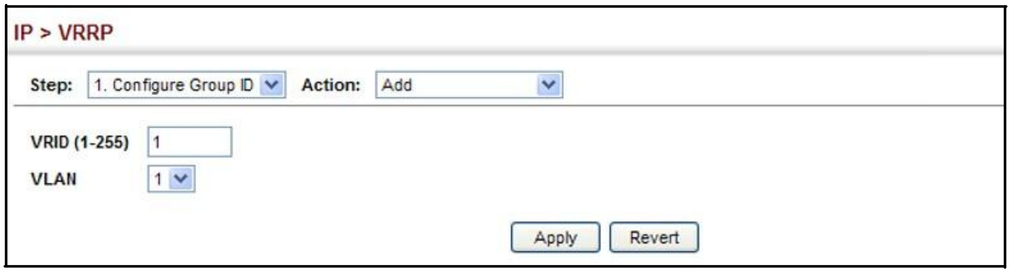
  When a VRRP packet is received from another router in the group, its authentication string is compared to the string configured on this router. If the strings match, the message is accepted. Otherwise, the packet is discarded.
- **State** – VRRP router role. (Values: Master, Backup)
- **Virtual MAC Address** – Virtual MAC address for this group.
- **Master Router** – The primary router servicing this group.
- **Master Priority** – The priority of the master router.
- **Master Advertisement Interval** – The interval at which the master router sends messages advertising itself as the group master.
- **Master Down Interval** – If no advertisement message is received from the master router after this interval, backup routers will assume that the master is dead, and will start bidding to become the group master.

Web Interface

To configure VRRP:

1. Click IP, VRRP.
2. Select Configure Group ID from the Step List.
3. Select Add from the Action List.
4. Enter the VRID group number, and select the VLAN (i.e., IP subnet) which is to be serviced by this group.
5. Click Apply.

Figure 253: Configuring the VRRP Group ID



IP > VRRP

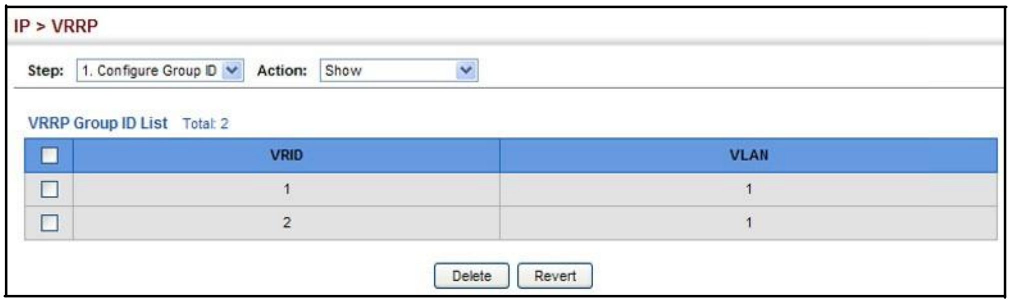
Step: 1. Configure Group ID Action: Add

VRID (1-255): 1
VLAN: 1

To show the configured VRRP groups:

1. Click IP, VRRP.
2. Select Configure Group ID from the Step List.
3. Select Show from the Action List.

Figure 254: Showing Configured VRRP Groups



IP > VRRP

Step: 1. Configure Group ID Action: Show

VRRP Group ID List Total: 2

□	VRID	VLAN
□	1	1
□	2	1

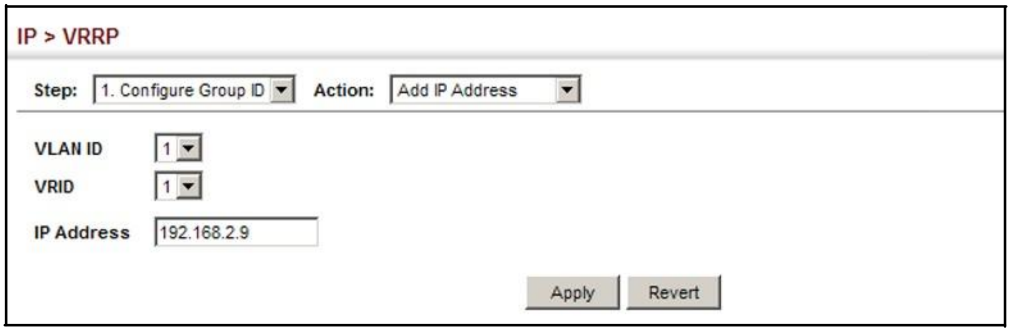
To configure the virtual router address for a VRRP group:

1. Click IP, VRRP.
2. Select Configure Group ID from the Step List.
3. Select Add IP Address from the Action List.

4. Select a VLAN, a VRRP group identifier, and enter the IP address for the virtual router.

5. Click Apply.

Figure 255: Setting the Virtual Router Address for a VRRP Group



Step: 1. Configure Group ID
Action: Add IP Address
VLAN ID 1
VRID 1
IP Address 192.168.2.9

To show the virtual IP address assigned to a VRRP group:

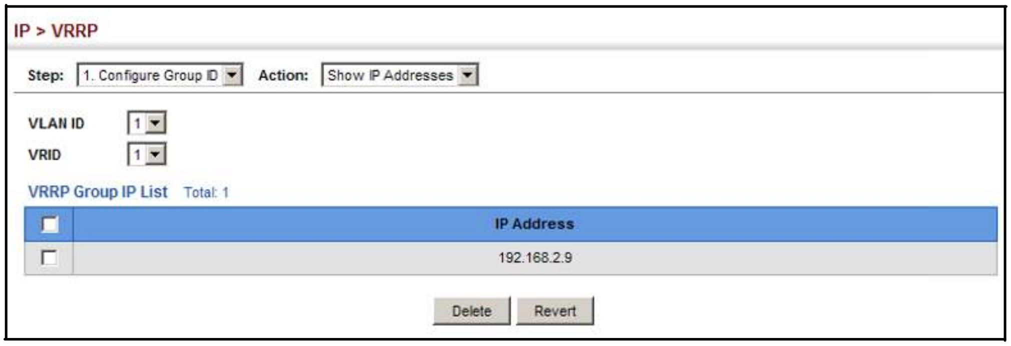
1. Click IP, VRRP.

2. Select Configure Group ID from the Step List.

3. Select Show IP Addresses from the Action List.

4. Select a VLAN, and a VRRP group identifier.

Figure 256: Showing the Virtual Addresses Assigned to VRRP Groups



Step: 1. Configure Group ID
Action: Show IP Addresses
VLAN ID 1
VRID 1

VRRP Group IP List Total: 1

□	IP Address
□	192.168.2.9

To configure detailed settings for a VRRP group:

1. Click IP, VRRP.

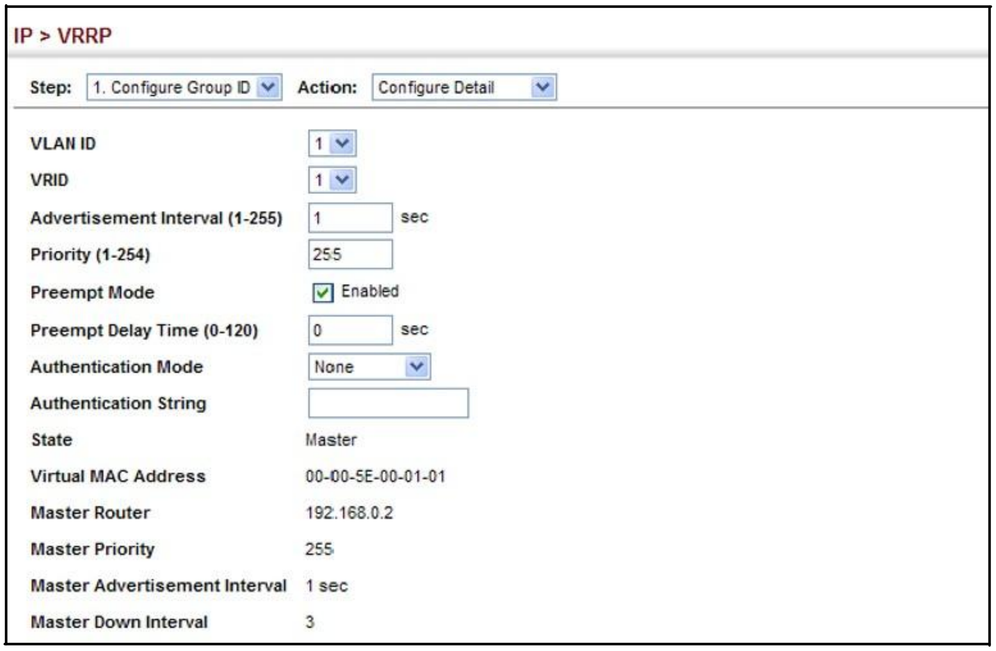
2. Select Configure Group ID from the Step List.

3. Select Configure Detail from the Action List.

4. Select a VRRP group identifier, and set any of the VRRP protocol parameters as required.

5. Click Apply.

Figure 257: Configuring Detailed Settings for a VRRP Group



IP > VRRP

Step: 1. Configure Group ID Action: Configure Detail

VLAN ID 1
VRID 1
Advertisement Interval (1-255) 1 sec
Priority (1-254) 255
Preempt Mode ☑ Enabled
Preempt Delay Time (0-120) 0 sec
Authentication Mode None
Authentication String
State Master
Virtual MAC Address 00-00-5E-00-01-01
Master Router 192.168.0.2
Master Priority 255
Master Advertisement Interval 1 sec
Master Down Interval 3

Displaying VRRP Global Statistics

Use the IP > VRRP (Show Statistics – Global Statistics) page to display counters for errors found in VRRP protocol packets.

Parameters

These parameters are displayed:

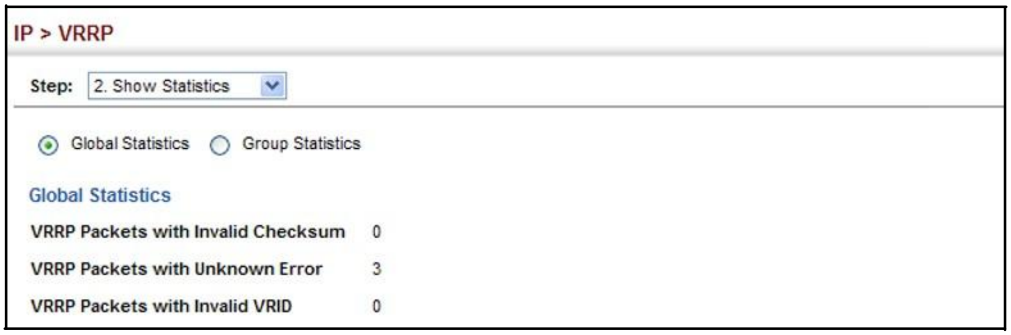
- **VRRP Packets with Invalid Checksum** – The total number of VRRP packets received with an invalid VRRP checksum value.
- **VRRP Packets with Unknown Error** – The total number of VRRP packets received with an unknown or unsupported version number.
- **VRRP Packets with Invalid VRID** – The total number of VRRP packets received with an invalid VRID for this virtual router.

Web Interface

To show counters for errors found in VRRP protocol packets:

1. Click IP, VRRP.
2. Select Show Statistics from the Step List.
3. Click Global Statistics.

Figure 258: Showing Counters for Errors Found in VRRP Packets



Step: 2. Show Statistics

● Global Statistics ○ Group Statistics

Global Statistics

VRRP Packets with Invalid Checksum	0
VRRP Packets with Unknown Error	3
VRRP Packets with Invalid VRID	0

Displaying VRRP Group Statistics

Use the IP > VRRP (Show Statistics – Group Statistics) page to display counters for VRRP protocol events and errors that have occurred on a specific VRRP interface.

Parameters

These parameters are displayed:

- **VLAN ID** – VLAN configured with an IP interface. (Range: 1-4094)
- **VRID** – VRRP group identifier. (Range: 1-255)

The following statistics are displayed:

Table 36: VRRP Group Statistics

Parameter	Description
Times Transitioned to Master	Number of times this router has transitioned to master.
Received Advertisement Packets	Number of VRRP advertisements received by this router.
Received Error Advertisement Interval Packets	Number of VRRP advertisements received for which the advertisement interval is different from the one configured for the local virtual router.
Received Authentication Failure Packets	Number of VRRP packets received that do not pass the authentication check.
Received Error IP TTL VRRP Packets	Number of VRRP packets received by the virtual router with IP TTL (Time-To-Live) not equal to 255.
Received Priority 0 VRRP Packets	Number of VRRP packets received by the virtual router with priority set to 0.
Sent Priority 0 VRRP Packets	Number of VRRP packets sent by the virtual router with priority set to 0. A priority value of zero indicates that the group master has stopped participating in VRRP, and is used to quickly transition a backup unit to master mode without having to wait for the master to time out.
Received Invalid Type VRRP Packets	Number of VRRP packets received by the virtual router with an invalid value in the "type" field.

Table 36: VRRP Group Statistics (Continued)

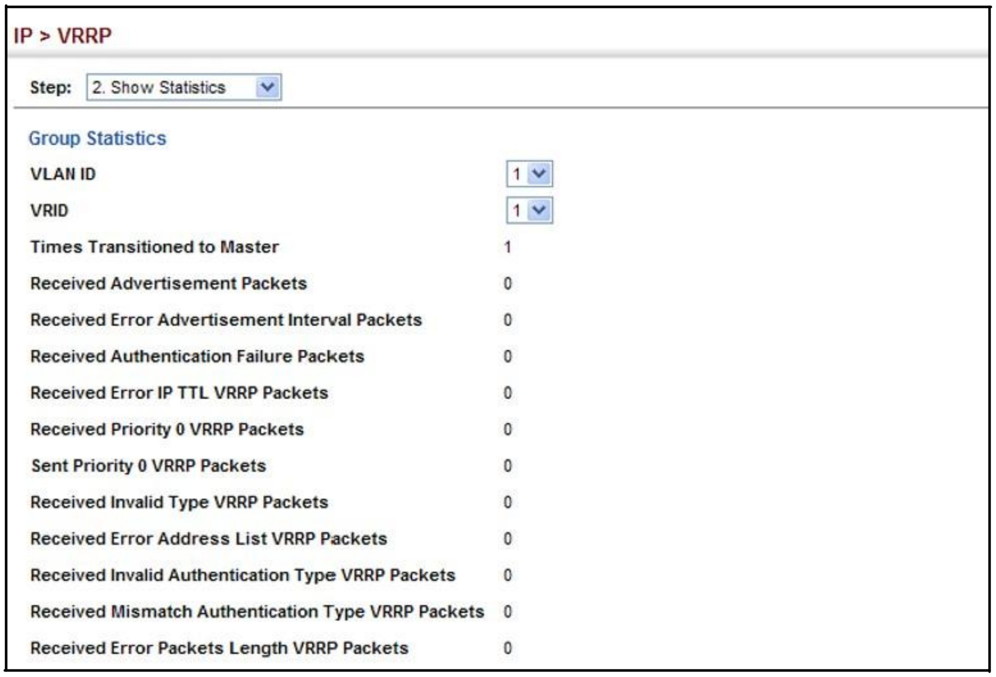
Parameter	Description
Received Error Address List VRRP Packets	Number of packets received for which the address list does not match the locally configured list for the virtual router.
Received Invalid Authentication Type VRRP Packets	Number of packets received with an unknown authentication type.
Received Mismatch Authentication Type VRRP Packets	Number of packets received with "Auth Type" not equal to the locally configured authentication method.
Received Error Packets Length VRRP Packets	Number of packets received with a packet length less than the length of the VRRP header.

Web Interface

To show counters for VRRP protocol events and errors that occurred on a specific VRRP interface:

1. Click IP, VRRP.
2. Select Show Statistics from the Step List.
3. Click Group Statistics.

Figure 259: Showing Counters for Errors Found in a VRRP Group



IP > VRRP

Step: 2. Show Statistics

Group Statistics

VLAN ID	1
VRID	1
Times Transitioned to Master	1
Received Advertisement Packets	0
Received Error Advertisement Interval Packets	0
Received Authentication Failure Packets	0
Received Error IP TTL VRRP Packets	0
Received Priority 0 VRRP Packets	0
Sent Priority 0 VRRP Packets	0
Received Invalid Type VRRP Packets	0
Received Error Address List VRRP Packets	0
Received Invalid Authentication Type VRRP Packets	0
Received Mismatch Authentication Type VRRP Packets	0
Received Error Packets Length VRRP Packets	0

18 Unicast Routing

This chapter describes how to configure the following unicast routing protocols:

OSPFv2 – Configures Open Shortest Path First (Version 2) for IPv4.

Overview

This switch can route unicast traffic to different subnetworks using the Open Shortest Path First (OSPF) protocol. It supports OSPFv2 and OSPFv3 dynamic routing. These protocols exchange routing information, calculate routing tables, and can respond to changes in the status or loading of the network.

OSPFv2 Dynamic Routing Protocols

OSPF overcomes all the problems of RIP. It uses a link state routing protocol to generate a shortest-path tree, then builds up its routing table based on this tree. OSPF produces a more stable network because the participating routers act on network changes predictably and simultaneously, converging on the best route more quickly than RIP. Moreover, when several equal-cost routes to a destination exist, traffic can be distributed equally among them.

Non-IP Protocol Routing

The switch supports IP routing only. Non-IP protocols such as IPX and Appletalk cannot be routed by this switch, and will be confined within their local VLAN group unless bridged by an external router.

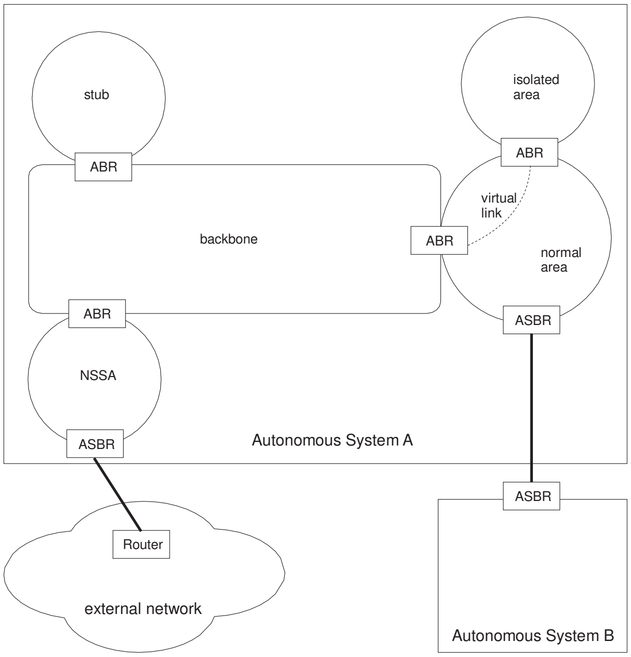
To coexist with a network built on multilayer switches, the subnetworks for non-IP protocols must follow the same logical boundary as that of the IP subnetworks. A separate multi-protocol router can then be used to link the subnetworks by connecting to one port from each available VLAN on the network.

Configuring the Open Shortest Path First Protocol (Version 2)

Open Shortest Path First (OSPF) is more suited for large area networks which experience frequent changes in the links. It also handles subnets much better than RIP. OSPF protocol actively tests the status of each link to its neighbors to generate a shortest path tree, and builds a routing table based on this information. OSPF then utilizes IP multicast to propagate routing information. A separate routing area scheme is also used to further reduce the amount of routing traffic.

Note: The OSPF protocol implemented in this device is based on RFC 2328 (Version 2). It also supports RFC 1583 (early Version 2) compatibility mode to ensure that the same method is used to calculate summary route costs throughout the network when older OSPF routers exist; as well as the not-so-stubby area option (RFC 3101).

Figure 260: Configuring OSPF



Command Usage

- OSPF looks at more than just the simple hop count. When adding the shortest path to any node into the tree, the optimal path is chosen on the basis of delay, throughput and connectivity. OSPF utilizes IP multicast to reduce the amount of routing traffic required when sending or receiving routing path updates. The separate routing area scheme used by OSPF further reduces the amount of routing traffic, and thus inherently provides another level of routing protection. In addition, all routing protocol exchanges can be authenticated. Finally, the OSPF algorithms have been tailored for efficient operation in TCP/IP Internets.

- OSPFv2 is a compatible upgrade to OSPF. It involves enhancements to protocol message authentication, and the addition of a point-to-multipoint interface which allows OSPF to run over non-broadcast networks, as well as support for overlapping area ranges.

- When using OSPF, you must organize your network (i.e., autonomous system) into normal, stub, or not-so-stubby areas; configure the ranges of subnet addresses that can be aggregated by link state advertisements; and configure virtual links for areas that do not have direct physical access to the OSFP backbone.

- To implement OSPF for a large network, you must first organize the network into logical areas to limit the number of OSPF routers that actively exchange Link State Advertisements (LSAs). You can then define an OSPF interface by assigning an IP interface configured on this router to one of these areas. This OSPF interface will send and receive OSPF traffic to neighboring OSPF routers.

- You can further optimize the exchange of OSPF traffic by specifying an area range that covers a large number of subnetwork addresses. This is an important technique for limiting the amount of traffic exchanged between Area Border Routers (ABRs).

- And finally, you must specify a virtual link to any OSPF area that is not physically attached to the OSPF backbone. Virtual links can also be used to provide a redundant link between contiguous areas to prevent areas from being partitioned, or to merge backbone areas. (Note that virtual links are not supported for stubs or NSSAs.)

Defining Network Areas Based on Addresses

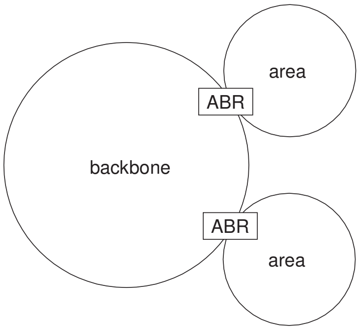
OSPF protocol broadcast messages (i.e., Link State Advertisements or LSAs) are restricted by area to limit their impact on network performance. A large network should be split up into separate OSPF areas to increase network stability, and to reduce protocol traffic by summarizing routing information into more compact messages. Each router in an area shares the same view of the network topology, including area links, route summaries for directly connected areas, and external links to other areas.

Use the Routing Protocol > OSPF > Network Area (Add) page to define an OSPF area and the interfaces that operate within this area. An autonomous system must be configured with a backbone area, designated by the area identifier 0.0.0.0. By default, all other areas are created as normal transit areas.

Routers in a normal area may import or export routing information about individual nodes. To reduce the amount of routing traffic flooded onto the network, an area can be configured to export a single summarized route that covers a broad range of network addresses within the area (page 410). To further reduce the amount of routes passed between areas, an area can be configured as a stub (page 403, page 407) or a not-so-stubby area (page 403, page 404).

Normal Area – A large OSPF domain should be broken up into several areas to increase network stability and reduce the amount of routing traffic required through the use of route summaries that aggregate a range of addresses into a single route. The backbone or any normal area can pass traffic between other areas, and are therefore known as transit areas. Each router in an area has identical routing tables. These tables may include area links, summarized links, or external links that depict the topology of the autonomous system.

Figure 261: OSPF Areas



CLI References

Command Usage

- Specify an Area ID and the corresponding network address range for each OSPF broadcast area. Each area identifies a logical group of OSPF routers that actively exchange Link State Advertisements (LSAs) to ensure that they share an identical view of the network topology.

- Each area must be connected to a backbone area. This area passes routing information between other areas in the autonomous system. All routers must be connected to the backbone, either directly, or through a virtual link if a direct physical connection is not possible.

- All areas are created as normal transit areas using the Network Area (Add) page. A normal area (or transit area) can send and receive external LSAs. If necessary, an area can be configured as a not-so-stubby area (NSSA) that can import external route information into its area, or as a stubby area that cannot send or receive external LSAs.

- An area must be assigned a range of subnetwork addresses. This area and the corresponding address range forms a routing interface, and can be configured to aggregate LSAs from all of its subnetwork addresses and exchange this information with other routers in the network as described under "Configuring Area Ranges (Route Summarization for ABRs)" on page 410.

- If an address range overlaps other network areas, the router will use the network area with the address range that most closely matches the interface address. Also, note that if a more specific address range is removed from an area, the interface belonging to that range may still remain active if a less specific address range covering that area has been specified.

Parameters

These parameters are displayed:

- **Process ID** – Protocol identifier used to distinguish between multiple routing instances. (Range: 1-65535)

- **IP Address** – Address of the interfaces to add to the area.

- **Netmask** – Network mask of the address range to add to the area.

- **Area ID** – Area to which the specified address or range is assigned. An OSPF area identifies a group of routers that share common routing information. The area ID can be in the form of an IPv4 address, or as a four octet unsigned integer ranging from 0-4294967295.

  Set the area ID to the same value for all routers on a network segment using the network mask to add one or more interfaces to an area.

Web Interface

To define an OSPF area and the interfaces that operate within this area:

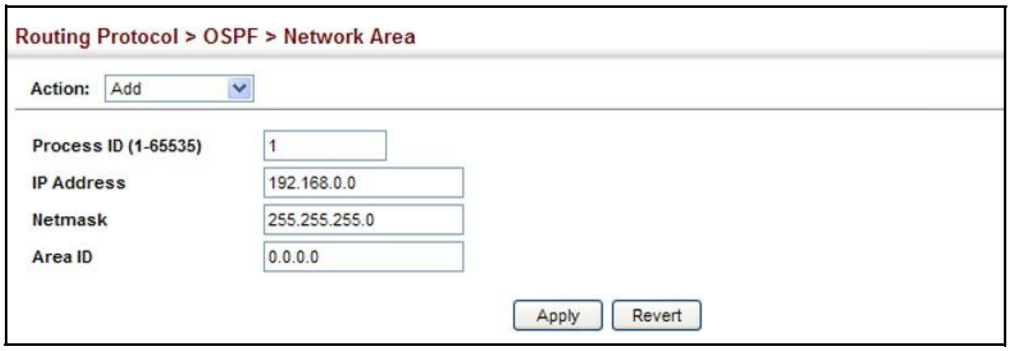
1. Click Routing Protocol, OSPF, Network Area.

2. Select Add from the Action list.

3. Configure a backbone area that is contiguous with all the other areas in the network, and configure an area for all of the other OSPF interfaces.

4. Click Apply

Figure 262: Defining OSPF Network Areas Based on Addresses



Routing Protocol > OSPF > Network Area

Action: Add

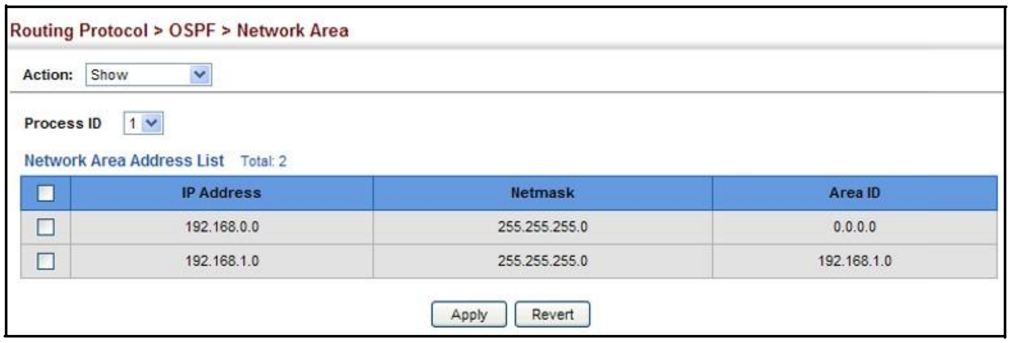
Process ID (1-65535)	1
IP Address	192.168.0.0
Netmask	255.255.255.0
Area ID	0.0.0.0

To to show the OSPF areas and the assigned interfaces:

1. Click Routing Protocol, OSPF, Network Area.

2. Select Show from the Action list.

Figure 263: Showing OSPF Network Areas



Routing Protocol > OSPF > Network Area

Action: Show

Process ID 1

Network Area Address List Total: 2

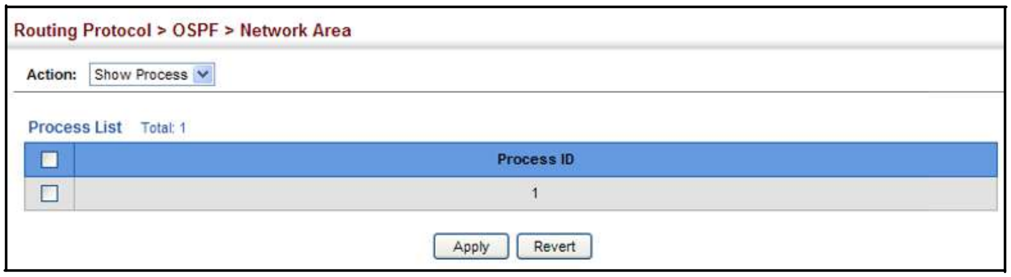
□	IP Address	Netmask	Area ID
□	192.168.0.0	255.255.255.0	0.0.0.0
□	192.168.1.0	255.255.255.0	192.168.1.0

To to show the OSPF process identifiers:

1. Click Routing Protocol, OSPF, Network Area.

2. Select Show Process from the Action list.

Figure 264: Showing OSPF Process Identifiers



Routing Protocol > OSPF > Network Area

Action: Show Process

Process List Total: 1

□	Process ID
□	1

Configuring General Protocol Settings

To implement dynamic OSPF routing, first assign VLAN groups to each IP subnet to which this router will be attached (as described in the preceding section), then use the Routing Protocol > OSPF > System (Configure) page to assign an Router ID to this device, and set the other basic protocol parameters.

Parameters

These parameters are displayed:

- **Process ID** – Protocol identifier as configured on the Routing Protocol > OSPF > Network Area (Add) page. (Range: 1-65535)

General Information

- **RFC1583 Compatible** – If one or more routers in a routing domain are using early Version 2 of OSPF, this router should use RFC 1583 (early OSPFv2) compatibility mode to ensure that all routers are using the same RFC for calculating summary route costs. Enable this field to force the router to calculate summary route costs using RFC 1583. (Default: Disabled)

When RFC 1583 compatibility is enabled, only cost is used when choosing among multiple AS-external LSAs advertising the same destination. When disabled, preference is based on type of path, using cost only to break ties (see RFC 2328).

If there any OSPF routers in an area exchanging summary information (specifically, ABRs) which have not been upgraded to OSPFv2 (RFC 2328), RFC 1583 should be used on the newly upgraded OSPFv2 routers to ensure compatibility with routers still running older OSPFv2 code.

- **OSPF Router ID** – Assigns a unique router ID for this device within the autonomous system for the current OSPF process.

  The router ID must be unique for every router in the autonomous system. Note that the router ID cannot be set to 0.0.0.0.

  If this router already has registered neighbors, the new router ID will be used when the router is rebooted.

- **Auto Cost** – Calculates the cost for an interface by dividing the reference bandwidth by the interface bandwidth. The reference bandwidth is defined in Mbits per second. (Range: 1-4294967)

  By default, the cost is 0.1 for Gigabit ports, and 0.01 for 10 Gigabit ports. A higher reference bandwidth can be used for aggregate links to indicate preferred use as a lower cost interface.

- **SPF Hold Time** – The hold time between making two consecutive shortest path first (SPF) calculations. (Range: 0-65535 seconds; Default: 10 seconds)

  Setting the SPF holdtime to 0 means that there is no delay between consecutive calculations.

- **SPF Delay Time** – The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-65535 seconds; Default: 5 seconds)

  Using a low value for the delay and hold time allows the router to switch to a new path faster, but uses more CPU processing time.

- **Default Metric** – The default metric for external routes imported from other protocols. (Range: 0-16777214; Default: 20)

  A default metric must be used to resolve the problem of redistributing external routes from other protocols that use incompatible metrics.

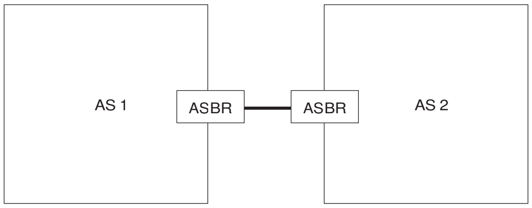
  This default metric does not override the metric value set on the Redistribute configuration screen (see page 412). When a metric value has not been configured on the Redistribute page, the default metric configured on the System configuration page sets the metric value to be used for all imported external routes.

Default Information

- **Originate Default Route** – Generates a default external route into an autonomous system. Note that the **Advertise Default Route** field must also be properly configured. (Default: Disabled)

  When this feature is used to redistribute routes into a routing domain (that is, an Autonomous System), this router automatically becomes an Autonomous System Boundary Router (ASBR). This allows the router to exchange routing information with boundary routers in other autonomous systems to which it may be attached. If a router is functioning as an ASBR, then every other router in the autonomous system can learn about external routes from this device.

  Figure 265: AS Boundary Router



- **Advertise Default Route** – The router can advertise a default external route into the autonomous system (AS). (Options: Not Always, Always; Default: Not Always)

  - **Always** – The router will advertise itself as a default external route for the local AS, even if a default external route does not actually exist. (To define a default route, see "Configuring Static Routes" on page 376.)

  - **NotAlways** – It can only advertise a default external route into the AS if it has been configured to import external routes through static routes, and such a route is known. (See "Redistributing External Routes" on page 412.)

- **External Metric Type** – The external link type used to advertise the default route. Type 1 route advertisements add the internal cost to the external route metric. Type 2 routes do not add the internal cost metric. When comparing Type 2 routes, the internal cost is only used as a tie-breaker if several Type 2 routes have the same cost. (Default: Type 2)

- **Default External Metric** – Metric assigned to the default route. (Range: 0-16777215; Default: 20)

  The metric for the default external route is used to calculate the path cost for traffic passed from other routers within the AS out through the ASBR.

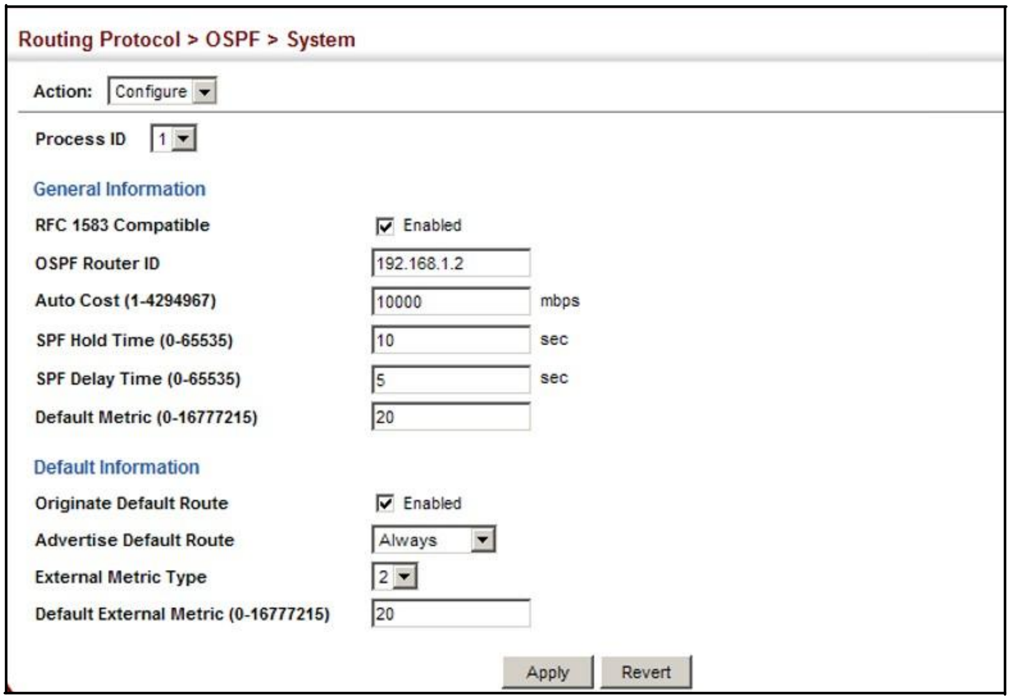
  Redistribution of routing information from other protocols is controlled by the Redistribute function (see page 412).

Web Interface

To configure general settings for OSPF:

1. Click Routing Protocol, OSPF, System.
2. Select Configure from the Action list.
3. Select a Process ID, and then specify the Router ID and other global attributes as required. For example, by setting the Auto Cost to 10000, the cost of using an interface is set to 10 for Gigabit ports, and 1 for 10 Gigabit ports.
4. Click Apply

Figure 266: Configure General Settings for OSPF



Routing Protocol > OSPF > System

Action: Configure

Process ID: 1

General Information

RFC 1583 Compatible: ☑ Enabled

OSPF Router ID: 192.168.1.2

Auto Cost (1-4294967): 10000 mbps

SPF Hold Time (0-65535): 10 sec

SPF Delay Time (0-65535): 5 sec

Default Metric (0-16777215): 20

Default Information

Originate Default Route: ☑ Enabled

Advertise Default Route: Always

External Metric Type: 2

Default External Metric (0-16777215): 20

Displaying Administrative Settings and Statistics

Use the Routing Protocol > OSPF > System (Show) page to display general administrative settings and statistics for OSPF.

Parameters

These parameters are displayed:

Table 37: OSPF System Information

Parameter	Description
Router ID Type	Indicates if the router ID was manually configured or automatically generated by the system.
Rx LSAs	The number of link-state advertisements that have been received.

Table 37: OSPF System Information (Continued)

Parameter	Description
Originate LSAs	The number of new link-state advertisements that have been originated.
AS LSA Count	The number of autonomous system LSAs in the link-state database.
External LSA Count	The number of external link-state advertisements in the link-state database.
External LSA Checksum	Checksum of the external link-state advertisement database.
Admin Status	Indicates if there are one or more configured OSPF areas with an active interface (that is, a Layer 3 interface that is enabled and up).
ABR Status (Area Border Router)	Indicates if this router connects directly to networks in two or more areas. An area border router runs a separate copy of the Shortest Path First algorithm, maintaining a separate routing database for each area.
ASBR Status (Autonomous System Boundary Router)	Indicates if this router exchanges routing information with boundary routers in other autonomous systems to which it may be attached. If a router is enabled as an ASBR, then every other router in the autonomous system can learn about external routes from this device.
Restart Status	Indicates if the OSPF process is in graceful-restart state.
Area Number	The number of configured areas attached to this router.
Version Number	The OSPF version number. The OSPF protocol implemented in this device is based on RFC 2328 (Version 2). It also supports RFC 1583 (early Version 2) compatibility mode.

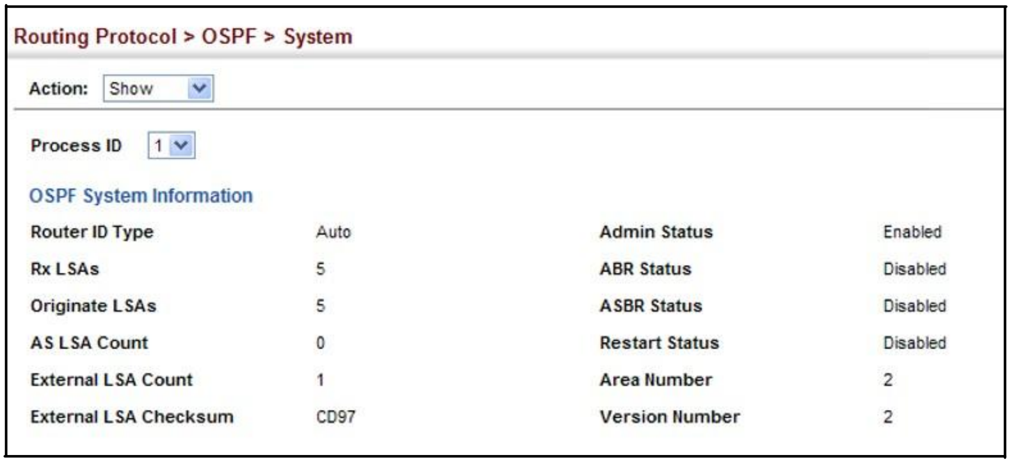
Web Interface

To show administrative settings and statistics for OSPF:

To display general settings for OSPF:

1. Click Routing Protocol, OSPF, System.
2. Select Show from the Action list.
3. Select a Process ID.

Figure 267: Showing General Settings for OSPF



Routing Protocol > OSPF > System

Action: Show

Process ID 1

OSPF System Information

Router ID Type	Auto	Admin Status	Enabled
Rx LSAs	5	ABR Status	Disabled
Originate LSAs	5	ASBR Status	Disabled
AS LSA Count	0	Restart Status	Disabled
External LSA Count	1	Area Number	2
External LSA Checksum	CD97	Version Number	2

Adding an NSSA or Stub

Use the Routing Protocol > OSPF > Area (Configure Area – Add Area) page to add a not-so-stubby area (NSSA) or a stubby area (Stub).

Command Usage

- This router supports up to 5 stubs or NSSAs.

Parameters

These parameters are displayed:

- **Process ID** – Protocol identifier as configured on the Routing Protocol > OSPF > Network Area (Add) page. (Range: 1-65535)
- **Area ID** – Identifier for a not-so-stubby area (NSSA) or stub. The area ID can be in the form of an IPv4 address, or as a four octet unsigned integer ranging from 0-4294967295.

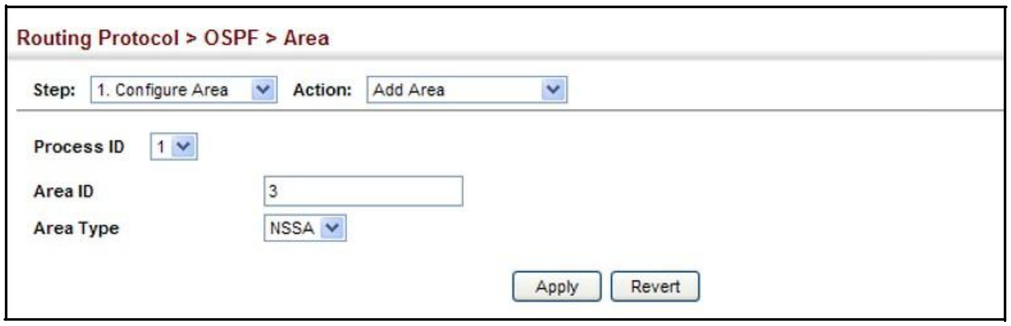
  Set the area ID to the same value for all routers on a network segment using the network mask to add one or more interfaces to an area.
- **Area Type** – Specifies an NSSA or stub.

Web Interface

To add an NSSA or stub to the OSPF administrative domain:

1. Click Routing Protocol, OSPF, Area.
2. Select Configure Area from the Step list.
3. Select Add Area from the Action list.
4. Select a Process ID, enter the area identifier, and set the area type to NSSA or Stub.
5. Click Apply

Figure 268: Adding an NSSA or Stub



Routing Protocol > OSPF > Area

Step: 1. Configure Area Action: Add Area

Process ID: 1

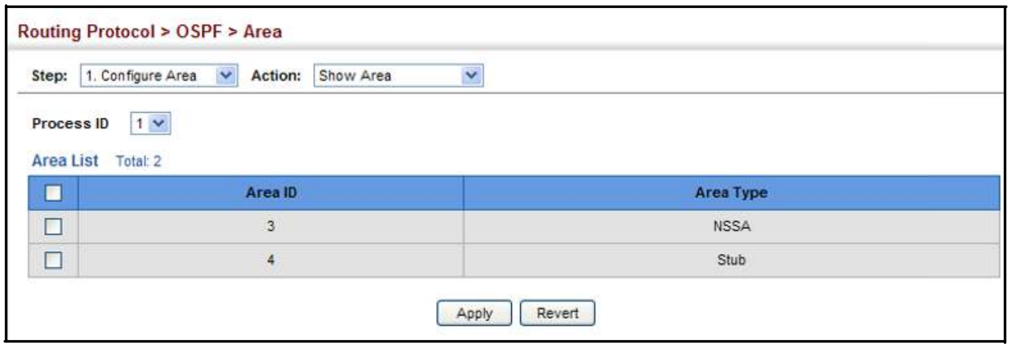
Area ID: 3

Area Type: NSSA

To show the NSSA or stubs added to the specified OSPF domain:

1. Click Routing Protocol, OSPF, Area.
2. Select Configure Area from the Step list.
3. Select Show Area from the Action list.
4. Select a Process ID.

Figure 269: Showing NSSAs or Stubs



Routing Protocol > OSPF > Area

Step: 1. Configure Area Action: Show Area

Process ID 1

Area List Total: 2

□	Area ID	Area Type
□	3	NSSA
□	4	Stub

Configuring NSSA Settings

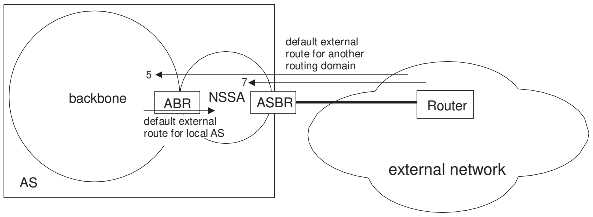
Use the Routing Protocol > OSPF > Area (Configure Area – Configure NSSA Area) page to configure protocol settings for a not-so-stubby area (NSSA).

An NSSA can be configured to control the use of default routes for Area Border Routers (ABRs) and Autonomous System Boundary Routers (ASBRs), or external routes learned from other routing domains and imported through an ABR.

An NSSA is similar to a stub. It blocks most external routing information, and can be configured to advertise a single default route for traffic passing between the NSSA and other areas within the autonomous system (AS) when the router is an ABR.

An NSSA can also import external routes from one or more small routing domains that are not part of the AS, such as another OSPF domain or locally configured static routes. This external AS routing information is generated by the NSSA's ASBR and advertised only within the NSSA. By default, these routes are not flooded onto the backbone or into any other area by ABRs. However, the NSSA's ABRs will convert NSSA external LSAs (Type 7) into external LSAs (Type-5) which are propagated into other areas within the AS.

Figure 270: OSPF NSSA



Command Usage

- Before creating an NSSA, first specify the address range for the area (see "Defining Network Areas Based on Addresses" on page 395). Then create an NSSA as described under "Adding an NSSA or Stub" on page 403.
- NSSAs cannot be used as a transit area, and should therefore be placed at the edge of the routing domain.
- An NSSA can have multiple ABRs or exit points. However, all of the exit points and local routers must contain the same external routing data so that the exit point does not need to be determined for each external destination.
- There are no external routes in an OSPF stub area, so routes cannot be redistributed from another protocol into a stub area. On the other hand, an NSSA allows external routes from another protocol to be redistributed into its own area, and then leaked to adjacent areas.
- Routes that can be advertised with NSSA external LSAs include network destinations outside the AS learned through OSPF, the default route, static routes, or directly connected networks that are not running OSPF.
- An NSSA can be used to simplify administration when connecting a central site using OSPF to a remote site that is using a different routing protocol. OSPF can be easily extended to cover the remote connection by defining the area between the central router and the remote router as an NSSA.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Area ID** – Identifier for a not-so-stubby area (NSSA).
- **Translator Role** – Indicates NSSA-ABR translator role for converting Type 7 external LSAs into Type 5 external LSAs. These roles include:
  - **Never** – A router that never translates NSSA LSAs to Type-5 external LSAs.
  - **Always** – A router that always translates NSSA LSA to Type-5 external LSA.
  - **Candidate** – A router translates NSSA LSAs to Type-5 external LSAs if elected.
- **Redistribute** – Disable this option when the router is an NSSA Area Border Router (ABR) and routes only need to be imported into normal areas (see "Redistributing External Routes" on page 412), but not into the NSSA. In other words, redistribution should be disabled to prevent the NSSA ABR from advertising external routing information (learned through routers in other areas) into the NSSA. (Default: Enabled)

- **Originate Default Information** – When the router is an NSSA Area Border Router (ABR) or an NSSA Autonomous System Boundary Router (ASBR), this option causes it to generate a Type-7 default LSA into the NSSA. This default provides a route to other areas within the AS for an NSSA ABR, or to areas outside the AS for an NSSA ASBR. (Default: Disabled)

  An NSSA is similar to a stub, because when the router is an ABR, it can send a default route for other areas in the AS into the NSSA using the Originate Default Information option. However, an NSSA is different from a stub, because when the router is an ASBR, it can import a default external AS route (for routing protocol domains adjacent to the NSSA but not within the OSPF AS) into the NSSA using this option.

- **Metric Type** – Type 1 or Type 2 external routes. When using Type 2, routers do not add internal cost to the external route metric. (Default: Type 2)

- **Metric** – Metric assigned to Type-7 default LSAs. (Range: 0-16777214; Default: 1)

- **Default Cost** – Cost for the default summary route sent into an NSSA from an area border router (ABR). (Range: 0-16777215; Default: 0)

  Note that when the default cost is set to “0,” the router will not advertise a default route into the attached NSSA.

- **Summary** – Controls the use of summary routes. (Default: Summary)

  - **Summary** – Unlike stub areas, all Type-3 summary LSAs will be imported into NSSAs to ensure that internal routes are always chosen over Type-7 NSSA external routes.

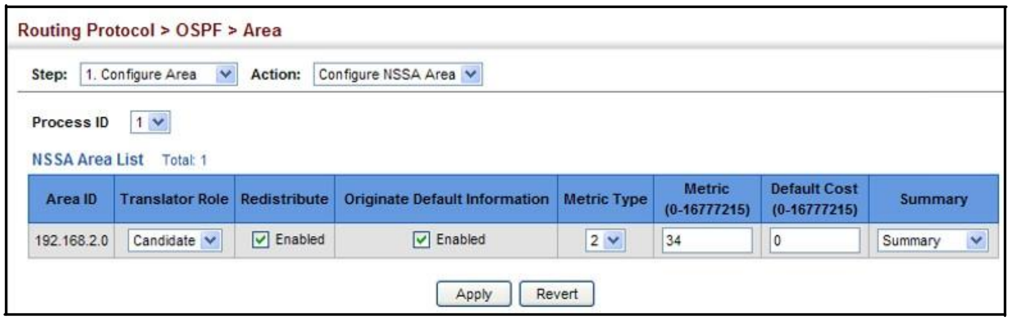
  - **No Summary** – Allows an area to retain standard NSSA features, but does not inject inter-area routes (Type-3 and Type-4 summary routes) into this area. Instead, it advertises a default route as a Type-3 LSA.

Web Interface

To configure protocol settings for an NSSA:

1. Click Routing Protocol, OSPF, Area.
2. Select Configure Area from the Step list.
3. Select Configure NSSA Area from the Action list.
4. Select a Process ID, and modify the routing behavior for an NSSA.
5. Click Apply

Figure 271: Configuring Protocol Settings for an NSSA



Routing Protocol > OSPF > Area

Step: 1. Configure Area   Action: Configure NSSA Area

Process ID 1

NSSA Area List Total: 1

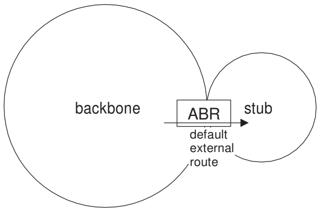
Area ID	Translator Role	Redistribute	Originate Default Information	Metric Type	Metric (0-16777215)	Default Cost (0-16777215)	Summary
192.168.2.0	Candidate	☑ Enabled	☑ Enabled	2	34	0	Summary

Configuring Stub Settings

Use the Routing Protocol > OSPF > Area (Configure Area – Configure Stub Area) page to configure protocol settings for a stub.

A stub does not accept external routing information. Instead, an area border router adjacent to a stub can be configured to send a default external route into the stub for all destinations outside the local area or the autonomous system. This route will also be advertised as a single entry point for traffic entering the stub. Using a stub can significantly reduce the amount of topology data that has to be exchanged over the network.

Figure 272: OSPF Stub Area



By default, a stub can only pass traffic to other areas in the autonomous system through the default external route. However, an area border router can also be configured to send Type 3 summary link advertisements into the stub about subnetworks located elsewhere in the autonomous system.

Command Usage

- Before creating a stub, first specify the address range for the area (see "Defining Network Areas Based on Addresses" on page 395). Then create a stub as described under "Adding an NSSA or Stub" on page 403.

- Stubs cannot be used as a transit area, and should therefore be placed at the edge of the routing domain.

- A stub can have multiple ABRs or exit points. However, all of the exit points and local routers must contain the same external routing data so that the exit point does not need to be determined for each external destination.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Area ID** – Identifier for a stub.
- **Default Cost** – Cost for the default summary route sent into a stub from an area border router (ABR). (Range: 0-16777215; Default: 0)

  Note that he the default cost is set to "0," the router will not advertise a default route into the attached stub.

- **Summary** – Controls the use of summary routes.
  - **Summary** – Allows an Area Border Router (ABR) to send a summary link advertisement into the stub area.
  - **No Summary** – Stops an ABR from sending a summary link advertisement into a stub area.

    Routing table space is saved in a stub by blocking Type-4 AS summary LSAs and Type 5 external LSAs. This option can be used to completely isolate the stub by also stopping an ABR from sending Type-3 summary LSAs that advertise the default route for destinations external to the local area or the autonomous system.

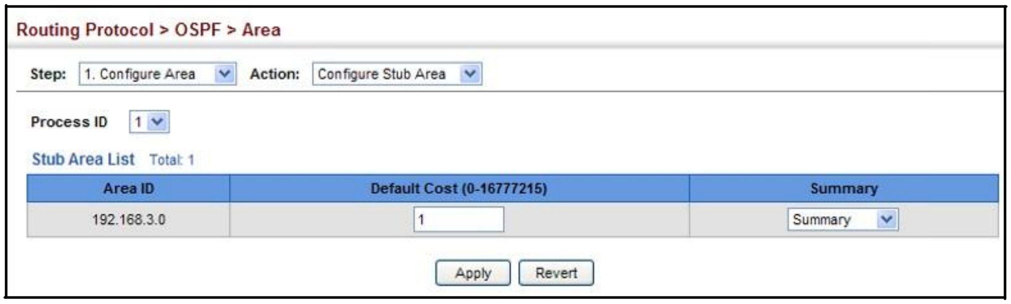
    Define an area as a totally stubby area only if routers in the area do not require summary LSAs from other areas.

Web Interface

To configure protocol settings for a stub:

1. Click Routing Protocol, OSPF, Area.
2. Select Configure Area from the Step list.
3. Select Configure Stub Area from the Action list.
4. Select a Process ID, and modify the routing behavior for a stub.
5. Click Apply

Figure 273: Configuring Protocol Settings for a Stub



Area ID	Default Cost (0-16777215)	Summary
192.168.3.0	1	Summary

Displaying Information on NSSA and Stub Areas

Use the Routing Protocol > OSPF > Area (Show Information) page to protocol information on NSSA and Stub areas.

Parameters

These parameters are displayed:

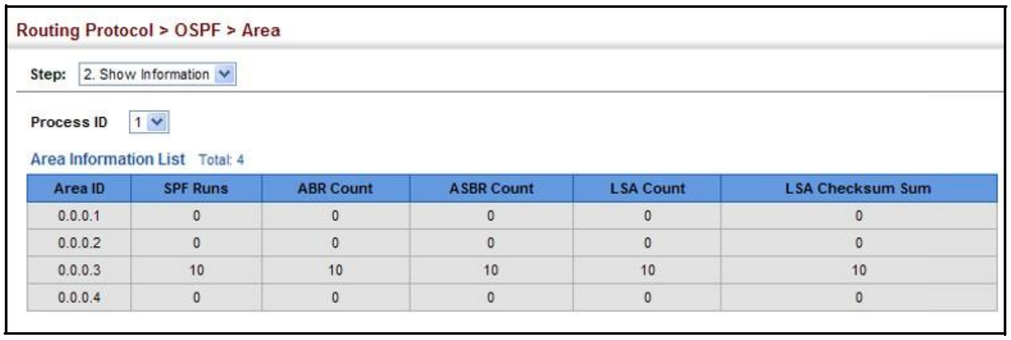
- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Area ID** – Identifier for a not-so-stubby area (NSSA) or stub.
- **SPF Runs** – The number of times the Shortest Path First algorithm has been run for this area.
- **ABR Count** – The number of Area Border Routers attached to this area.
- **ASBR Count** – The number of Autonomous System Boundary Routers attached to this area.
- **LSA Count** – The number of new link-state advertisements that have been originated.
- **LSA Checksum Sum** – The sum of the link-state advertisements' LS checksums contained in this area's link-state database.

Web Interface

To display information on NSSA and stub areas:

1. Click Routing Protocol, OSPF, Area.
2. Select Show Information from the Action list.
3. Select a Process ID.

Figure 274: Displaying Information on NSSA and Stub Areas



Routing Protocol > OSPF > Area

Step: 2. Show Information

Process ID 1

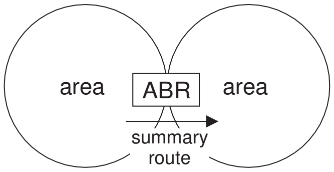
Area Information List Total: 4

Area ID	SPF Runs	ABR Count	ASBR Count	LSA Count	LSA Checksum Sum
0.0.0.1	0	0	0	0	0
0.0.0.2	0	0	0	0	0
0.0.0.3	10	10	10	10	10
0.0.0.4	0	0	0	0	0

Configuring Area Ranges (Route Summarization for ABRs)

An OSPF area can include a large number of nodes. If the Area Border Router (ABR) has to advertise route information for each of these nodes, this wastes a lot of bandwidth and processor time. Instead, you can use the Routing Protocol > OSPF > Area Range (Add) page to configure an ABR to advertise a single summary route that covers all the individual networks within its area. When using route summaries, local changes do not have to be propagated to other area routers. This allows OSPF to be easily scaled for larger networks, and provides a more stable network topology.

Figure 275: Route Summarization for ABRs



Command Usage

- Use the Area Range configuration page to summarize intra-area routes, and advertise this information to other areas through Area Border Routers (ABRs). The summary route for an area is defined by an IP address and network mask. You therefore need to structure each area with a contiguous set of addresses so that all routes in the area fall within an easily specified range. If it is not possible to use one contiguous set of addresses, then the routes can be summarized for several area ranges.This router also supports Variable Length Subnet Masks (VLSMs), so you can summarize an address range on any bit boundary in a network address.

- To summarize the external LSAs imported into your autonomous system (i.e., local routing domain), use the Summary Address configuration screen (page 410).

- This router supports up five summary routes for area ranges.

Parameters

These parameters are displayed:

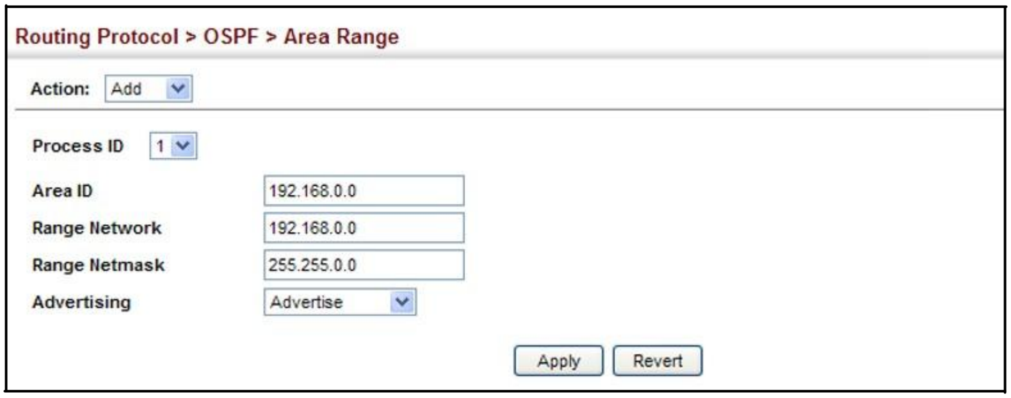
- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Area ID** – Identifies an area for which the routes are summarized. The area ID can be in the form of an IPv4 address, or also as a four octet unsigned integer ranging from 0-4294967295.
- **Range Network** – Base address for the routes to summarize.
- **Range Netmask** – Network mask for the summary route.
- **Advertising** – Indicates whether or not to advertise the summary route. If the routes are set to be advertised, the router will issue a Type 3 summary LSA for each specified address range. If the summary is not advertised, the specified routes remain hidden from the rest of the network. (Default: Advertise)

Web Interface

To configure a route summary for an area range:

1. Click Routing Protocol, OSPF, Area Range.
2. Select Add from the Action list.
3. Specify the process ID, area identifier, the base address and network mask, and select whether or not to advertise the summary route to other areas.
4. Click Apply

Figure 276: Configuring Route Summaries for an Area Range



Routing Protocol > OSPF > Area Range

Action: Add

Process ID: 1

Area ID: 192.168.0.0

Range Network: 192.168.0.0

Range Netmask: 255.255.0.0

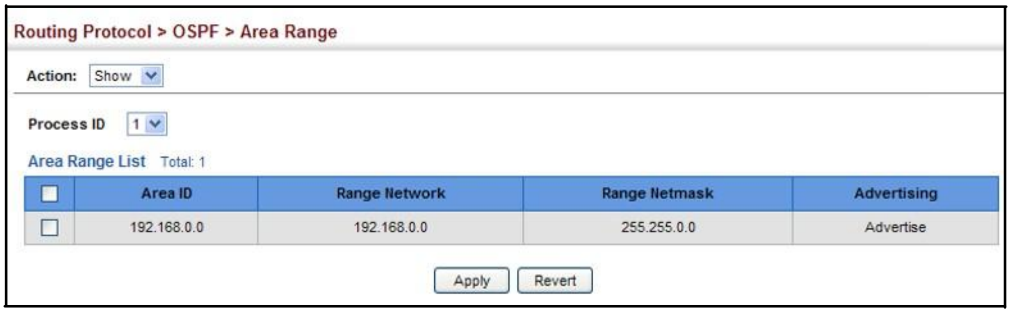
Advertising: Advertise

To show the configured route summaries:

1. Click Routing Protocol, OSPF, Area Range.
2. Select Show from the Action list.

3. Select the process ID.

Figure 277: Showing Configured Route Summaries



Routing Protocol > OSPF > Area Range

Action: Show

Process ID 1

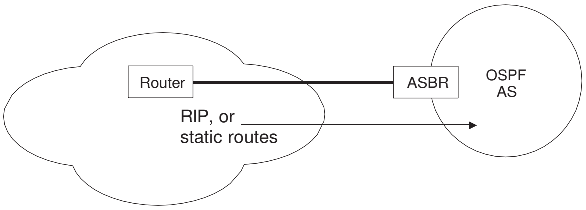
Area Range List Total: 1

□	Area ID	Range Network	Range Netmask	Advertising
□	192.168.0.0	192.168.0.0	255.255.0.0	Advertise

Redistributing External Routes

Use the Routing Protocol > OSPF > Redistribute (Add) page to import external routing information from other routing protocols, static routes, or directly connected routes into the autonomous system, and to generate AS-external-LSAs.

Figure 278: Redistributing External Routes



Command Usage

- This router supports redistribution for all currently connected routes, ~~or entries learned through~~ and static routes.
- When you redistribute external routes into an OSPF autonomous system (AS), the router automatically becomes an autonomous system boundary router (ASBR).
- However, if the router has been configured as an ASBR via the General Configuration screen, but redistribution is not enabled, the router will only generate a “default” external route into the AS if it has been configured to “always” advertise a default route even if an external route does not actually exist (page 398).

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Protocol Type** – Specifies the external routing protocol type for which routing information is to be redistributed into the local routing domain. (Options: Static, Connected, BGP; Default: BGP)

- **Metric Type** – Indicates the method used to calculate external route costs. (Options: Type 1, Type 2; Default: Type 1)

  Metric type specifies the way to advertise routes to destinations outside the autonomous system (AS) through External LSAs. Specify Type 1 to add the internal cost metric to the external route metric. In other words, the cost of the route from any router within the AS is equal to the cost associated with reaching the advertising ASBR, plus the cost of the external route. Specify Type 2 to only advertise the external route metric.

- **Metric** – Metric assigned to all external routes for the specified protocol. (Range: 0-16777214)

  The metric value specified for redistributed routes supersedes the Default External Metric specified in the Routing Protocol > OSPF > System screen (page 398).

- **Tag** – A tag placed in the AS-external LSA to identify a specific external routing domain, or to pass additional information between routers.
  (Range: 0-4294967295)

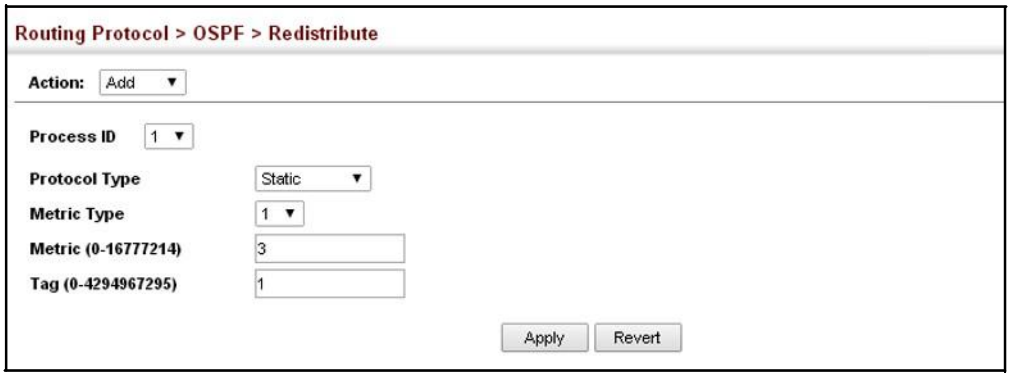
  A tag can be used to distinguish between routes learned from different external autonomous systems (other routing protocols). For example, if there are two ASBRs in a routing domain: A and B. ASBR A can be configured to redistribute routes learned from domain 1 (identified by tag 1) and ASBR B can redistribute routes learned from domain 2 (identified by tag 2).

Web Interface

To configure the router to import external routing information:

1. Click Routing Protocol, OSPF, Redistribute.
2. Select Add from the Action list.
3. Specify the process ID, the protocol type to import, the metric type, path cost, and optional tag.
4. Click Apply.

Figure 279: Importing External Routes



Routing Protocol > OSPF > Redistribute

Action: Add

Process ID: 1

Protocol Type: Static

Metric Type: 1

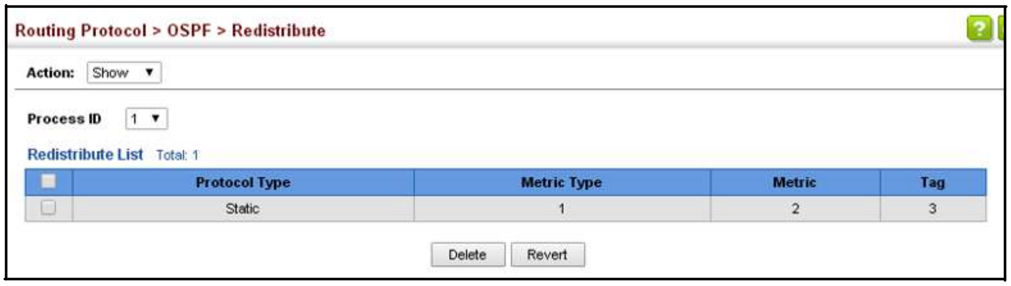
Metric (0-16777214): 3

Tag (0-4294967295): 1

To show the imported external route types:

1. Click Routing Protocol, OSPF, Redistribute.
2. Select Show from the Action list.
3. Select the process ID.

Figure 280: Showing Imported External Route Types



Routing Protocol > OSPF > Redistribute

Action: Show ▼

Process ID 1 ▼

Redistribute List Total: 1

□	Protocol Type	Metric Type	Metric	Tag
□	Static	1	2	3

Configuring Summary Addresses (for External AS Routes)

Redistributing routes from other protocols into OSPF normally requires the router to advertise each route individually in an external LSA as described in the preceding section. The reduce the number of protocol messages required to redistribute these external routes, an Autonomous System Boundary Router (ASBR) can instead be configured to redistribute routes learned from other protocols into all attached autonomous systems.

To reduce the amount of external LSAs sent to other autonomous systems, you can use the Routing Protocol > OSPF > Summary Address (Add) page to configure the router to advertise an aggregate route that consolidates a broad range of external addresses. This helps both to decrease the number of external LSAs advertised and the size of the OSPF link state database.

Command Usage

- If you are not sure what address ranges to consolidate, first enable external route redistribution via the Redistribute configuration screen, view the routes imported into the routing table, and then configure one or more summary addresses to reduce the size of the routing table and consolidate these external routes for advertising into the local domain.
- To summarize routes sent between OSPF areas, use the Area Range Configuration screen (page 410).
- This router supports up 20 Type-5 summary routes.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).

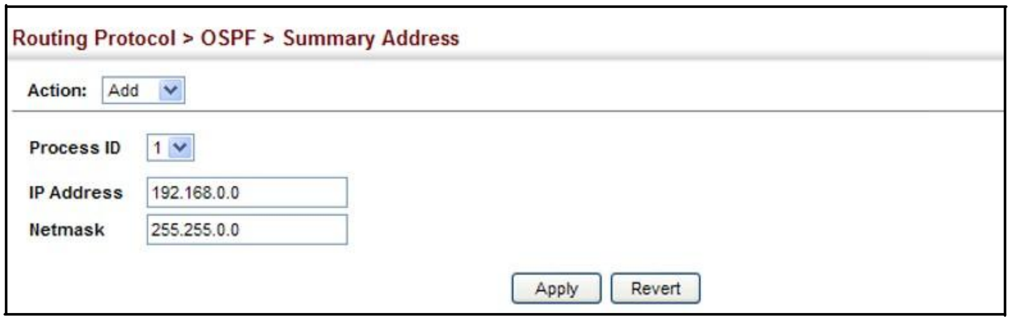
- **IP Address** – Summary address covering a range of addresses.
- **Netmask** – Network mask for the summary route.

Web Interface

To configure the router to summarize external routing information:

1. Click Routing Protocol, OSPF, Summary Address.
2. Select Add from the Action list.
3. Specify the process ID, the base address and network mask.
4. Click Apply.

Figure 281: Summarizing External Routes



Routing Protocol > OSPF > Summary Address

Action: Add

Process ID: 1

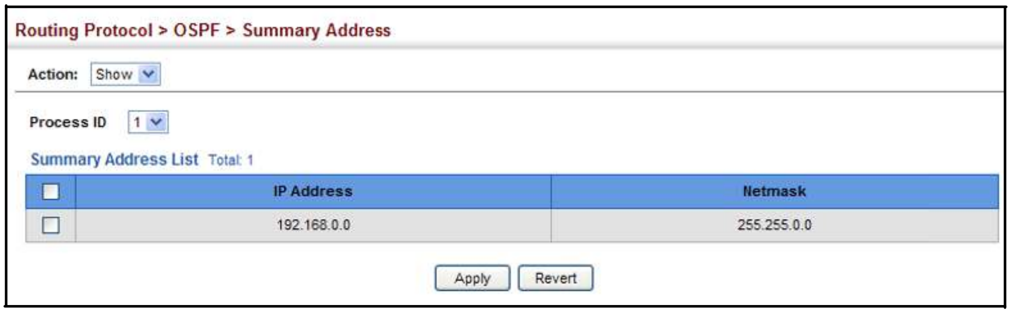
IP Address: 192.168.0.0

Netmask: 255.255.0.0

To show the summary addresses for external routes:

1. Click Routing Protocol, OSPF, Summary Address.
2. Select Show from the Action list.
3. Select the process ID.

Figure 282: Showing Summary Addresses for External Routes



Routing Protocol > OSPF > Summary Address

Action: Show

Process ID: 1

Summary Address List Total: 1

□	IP Address	Netmask
□	192.168.0.0	255.255.0.0

Configuring OSPF Interfaces

You should specify a routing interface for any local subnet that needs to communicate with other network segments located on this router or elsewhere in the network. First configure a VLAN for each subnet that will be directly connected to this router, assign IP interfaces to each VLAN (i.e., one primary interface and one or more secondary interfaces), and then use the Network Area configuration page to assign an interface address range to an OSPF area.

After assigning a routing interface to an OSPF area, use the Routing Protocol > OSPF > Interface (Configure by VLAN) or (Configure by Address) page to configure the interface-specific parameters used by OSPF to set the cost used to select preferred paths, select the designated router, control the timing of link state advertisements, and specify the method used to authenticate routing messages.

Command Usage

- The Configure by VLAN page is used to set the OSPF interface settings for the all areas assigned to a VLAN on the Network Area (Add) page (see page 395).

- The Configure by Address page is used to set the OSPF interface settings for a specific area assigned to a VLAN on the Network Area (Add) page (see page 395).

Parameters

These parameters are displayed:

- **VLAN ID** – A VLAN to which an IP interface has been assigned.

- **IP Address** – Address of the interfaces assigned to a VLAN on the Network Area (Add) page.

  This parameter only applies to the Configure by Address page.

- **Cost** – Sets the cost of sending a protocol packet on an interface, where higher values indicate slower ports. (Range: 1-65535; Default: 1)

  The interface cost indicates the overhead required to send packets across a certain interface. This is advertised as the link cost in router link state advertisements.

  Routes are assigned a metric equal to the sum of all metrics for each interface link in the route.

  This router uses a default cost of 1 for all ports. Therefore, if you install a 10 Gigabit module, you need to reset the cost for all of the 1 Gbps ports to a value greater than 1 to reflect the actual interface bandwidth.

- **Router Priority** – Sets the interface priority for this router. (Range: 0-255; Default: 1)

  This priority determines the designated router (DR) and backup designated router (BDR) for each OSPF area. The DR forms an active adjacency to all other routers in the area to exchange routing topology information. If for any reason the DR fails, the BDR takes over this role.

Set the priority to zero to prevent a router from being elected as a DR or BDR. If set to any value other than zero, the router with the highest priority becomes the DR and the router with the next highest priority becomes the BDR. If two or more routers are set to the same highest priority, the router with the higher ID will be elected.

If a DR already exists for an area when this interface comes up, the new router will accept the current DR regardless of its own priority. The DR will not change until the next time the election process is initiated.

Configure router priority for multi-access networks only and not for point-to-point networks.

- **Hello Interval** – Sets the interval between sending hello packets on an interface. This interval must be set to the same value for all routers on the network. (Range: 1-65535 seconds; Default: 10)

  Hello packets are used to inform other routers that the sending router is still active. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase routing traffic.

- **Dead Interval** – Sets the interval at which hello packets are not seen before neighbors declare the router down. This interval must be set to the same value for all routers on the network. (Range: 1-65535 seconds; Default: 40, or 4 times the Hello Interval)

  The dead-interval is advertised in the router's hello packets. It must be a multiple of hello-interval and be the same for all routers on a specific network.

- **Transmit Delay** – Sets the estimated time to send a link-state update packet over an interface. (Range: 1-65535 seconds; Default: 1 second)

  LSAs have their age incremented by this delay before transmission. You should consider both the transmission and propagation delays for an interface when estimating this delay. Set the transmit delay according to link speed, using larger values for lower-speed links.

  If this delay is not added, the time required to transmit an LSA over the link is not taken into consideration by the routing process. On slow links, the router may send packets more quickly than devices can receive them. To avoid this problem, you can use the transmit delay to force the router to wait a specified interval between transmissions.

- **Retransmit Interval** – Sets the time between resending link-state advertisements. (Range: 1-65535 seconds; Default: 5 seconds)

  A router will resend an LSA to a neighbor if it receives no acknowledgment after the specified retransmit interval. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. Note that this value should be larger for virtual links.

  Set this interval to a value that is greater than the round-trip delay between any two routers on the attached network to avoid unnecessary retransmissions.

- **Authentication Type** – Specifies the authentication type used for an interface. (Options: None, Simple, MD5; Default: None)

  Use authentication to prevent routers from inadvertently joining an unauthorized area. Configure routers in the same area with the same password (or key). All neighboring routers on the same network with the same password will exchange routing data.

  When using simple password authentication, a password is included in the packet. If it does not match the password configured on the receiving router, the packet is discarded. This method provides very little security as it is possible to learn the authentication key by snooping on routing protocol packets.

  When using Message-Digest 5 (MD5) authentication, the router uses the MD5 algorithm to verify data integrity by creating a 128-bit message digest from the authentication key. Without the proper key and key-id, it is nearly impossible to produce any message that matches the prespecified target message digest.

  The Message Digest Key ID and Authentication Key and must be used consistently throughout the autonomous system.

- **Authentication Key** – Assign a plain-text password used by neighboring routers to verify the authenticity of routing protocol messages. (Range: 1-8 characters for simple password or 1-16 characters for MD5 authentication; Default: no key)

  When plain-text or Message-Digest 5 (MD5) authentication is enabled as described in the preceding item, this password (key) is inserted into the OSPF header when routing protocol packets are originated by this device.

  A different password can be assigned to each network interface, but the password must be used consistently on all neighboring routers throughout a network (that is, autonomous system). All neighboring routers in the same network with the same password will exchange routing data.

- **Message Digest Key ID** – Assigns a key identifier used in conjunction with the authentication key to verify the authenticity of routing protocol messages sent to neighboring routers. (Range: 1-255; Default: none)

  Normally, only one key is used per interface to generate authentication information for outbound packets and to authenticate incoming packets. Neighbor routers must use the same key identifier and key value.

  When changing to a new key, the router will send multiple copies of all protocol messages, one with the old key and another with the new key. Once all the neighboring routers start sending protocol messages back to this router with the new key, the router will stop using the old key. This rollover process gives the network administrator time to update all of the routers on the network without affecting the network connectivity. Once all the network routers have been updated with the new key, the old key should be removed for security reasons.

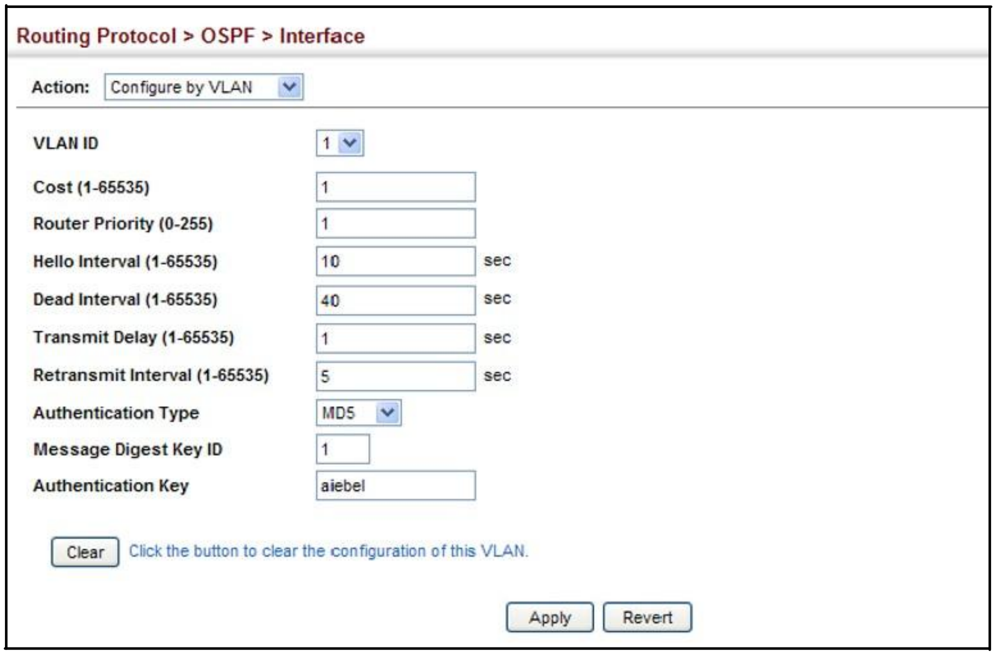
  Before setting a new key identifier, the current key must first be deleted on the Show MD5 Key page.

Web Interface

To configure OSPF interface for all areas assigned to a VLAN:

1. Click Routing Protocol, OSPF, Interface.
2. Select Configure by VLAN from the Action list.
3. Specify the VLAN ID, and configure the required interface settings.
4. Click Apply.

Figure 283: Configuring Settings for All Interfaces Assigned to a VLAN



Routing Protocol > OSPF > Interface

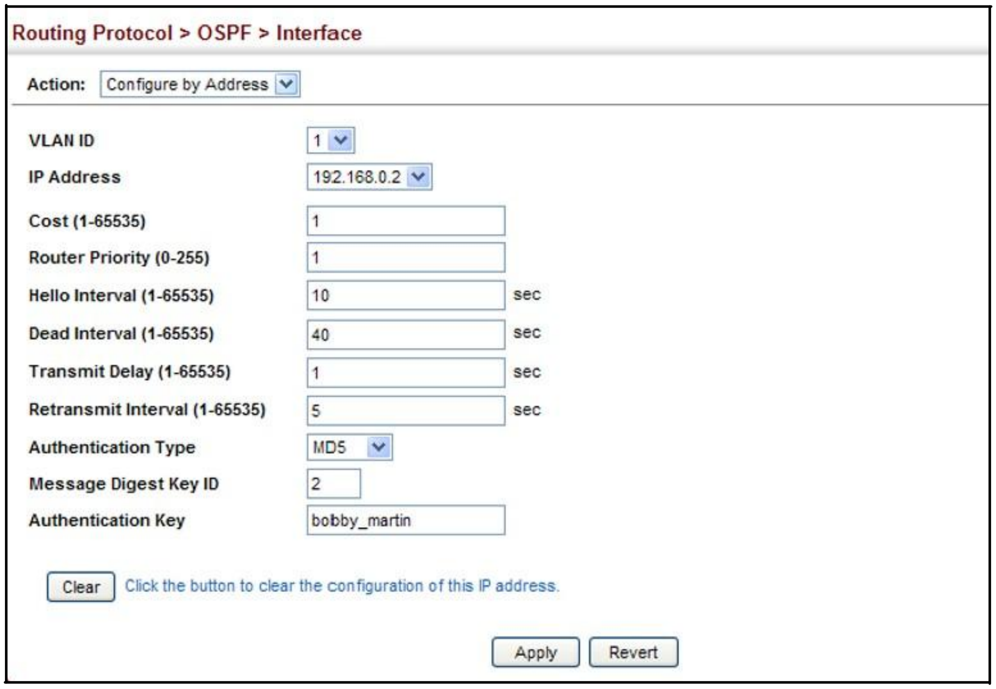
Action: Configure by VLAN

VLAN ID	1	
Cost (1-65535)	1	
Router Priority (0-255)	1	
Hello Interval (1-65535)	10	sec
Dead Interval (1-65535)	40	sec
Transmit Delay (1-65535)	1	sec
Retransmit Interval (1-65535)	5	sec
Authentication Type	MD5	
Message Digest Key ID	1	
Authentication Key	aiebel	

To configure interface settings for a specific area assigned to a VLAN:

1. Click Routing Protocol, OSPF, Interface.
2. Select Configure by Address from the Action list.
3. Specify the VLAN ID, enter the address assigned to an area, and configure the required interface settings.
4. Click Apply.

Figure 284: Configuring Settings for a Specific Area Assigned to a VLAN



Routing Protocol > OSPF > Interface

Action: Configure by Address

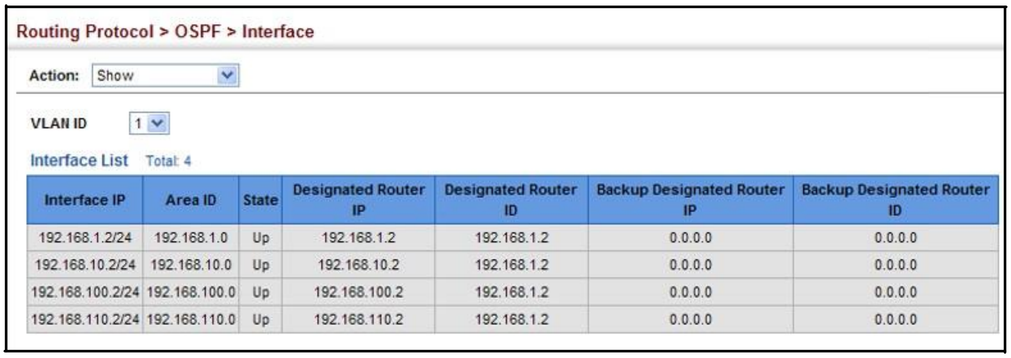
VLAN ID: 1
IP Address: 192.168.0.2
Cost (1-65535): 1
Router Priority (0-255): 1
Hello Interval (1-65535): 10 sec
Dead Interval (1-65535): 40 sec
Transmit Delay (1-65535): 1 sec
Retransmit Interval (1-65535): 5 sec
Authentication Type: MD5
Message Digest Key ID: 2
Authentication Key: bobby_martin

Clear — Click the button to clear the configuration of this IP address.

To show the configuration settings for OSPF interfaces:

1. Click Routing Protocol, OSPF, Interface.
2. Select Show from the Action list.
3. Select the VLAN ID.

Figure 285: Showing OSPF Interfaces



Routing Protocol > OSPF > Interface

Action: Show

VLAN ID: 1

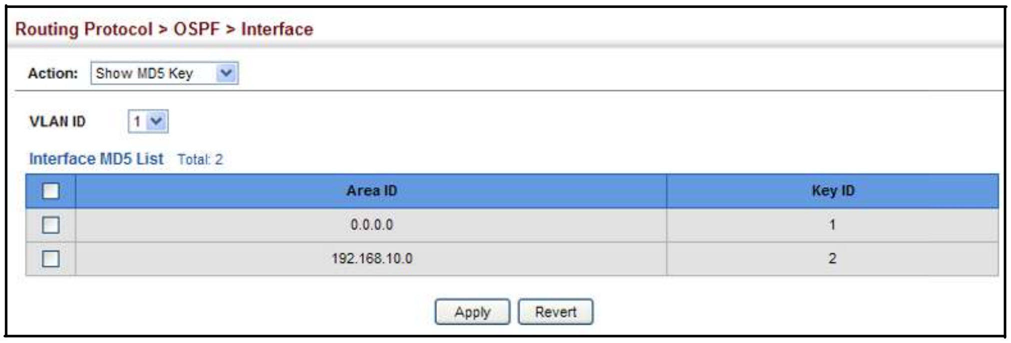
Interface List Total: 4

Interface IP	Area ID	State	Designated Router IP	Designated Router ID	Backup Designated Router IP	Backup Designated Router ID
192.168.1.2/24	192.168.1.0	Up	192.168.1.2	192.168.1.2	0.0.0.0	0.0.0.0
192.168.10.2/24	192.168.10.0	Up	192.168.10.2	192.168.1.2	0.0.0.0	0.0.0.0
192.168.100.2/24	192.168.100.0	Up	192.168.100.2	192.168.1.2	0.0.0.0	0.0.0.0
192.168.110.2/24	192.168.110.0	Up	192.168.110.2	192.168.1.2	0.0.0.0	0.0.0.0

To show the MD5 authentication keys configured for an interface:

1. Click Routing Protocol, OSPF, Interface.
2. Select Show MD5 Key from the Action list.
3. Select the VLAN ID.

Figure 286: Showing MD5 Authentication Keys



Routing Protocol > OSPF > Interface

Action: Show MD5 Key

VLAN ID 1

Interface MD5 List Total: 2

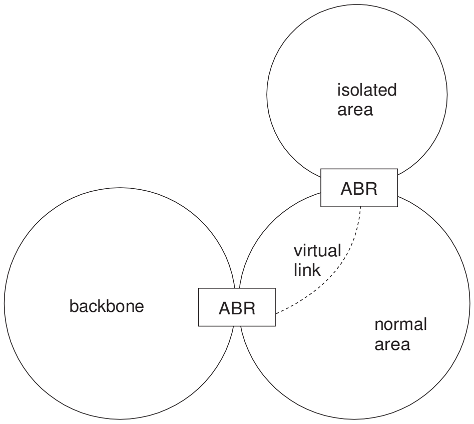
□	Area ID	Key ID
□	0.0.0.0	1
□	192.168.10.0	2

Configuring Virtual Links

Use the Routing Protocol > OSPF > Virtual Link (Add) and (Configure Detailed Settings) pages to configure a virtual link from an area that does not have a direct physical connection to the OSPF backbone.

All OSPF areas must connect to the backbone. If an area does not have a direct physical connection to the backbone, you can configure a virtual link that provides a logical path to the backbone. To connect an isolated area to the backbone, the logical path can cross a single non-backbone area (i.e., transit area) to reach the backbone. To define this path, you must configure an ABR that serves as an endpoint connecting the isolated area to the common transit area, and specify a neighboring ABR at the other endpoint connecting the common transit area to the backbone itself. (Note that you cannot configure a virtual link that runs through a stub or NSSA.)

Figure 287: OSPF Virtual Link



Virtual links can also be used to create a redundant link between any area and the backbone to help prevent partitioning, or to connect two existing backbone areas into a common backbone.

Any area disconnected from the backbone must include the transit area ID and the router ID for a virtual link neighbor that is adjacent to the backbone.

This router supports up five virtual links.

Command Usage

- Use the Add page to create a virtual link, and then use the Configure Detailed Settings page to set the protocol timers and authentication settings for the link. The parameters to be configured on the Configure Detailed Settings page are described under "Configuring OSPF Interfaces" on page 416.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).

- **Transit Area ID** – Identifies the transit area for the virtual link. The area ID must be in the form of an IPv4 address, or also as a four octet unsigned integer ranging from 0-4294967295.

- **Neighbor ID** – Router ID of the virtual link neighbor. This specifies the Area Border Router (ABR) at the other end of the virtual link. To create a virtual link, it must be configured for an ABR at both ends of the link. One of the ABRs must be next to the isolated area and the transit area at one end of the link, while the other ABR must be next to the transit area and backbone at the other end of the link.

Web Interface

To create a virtual link:

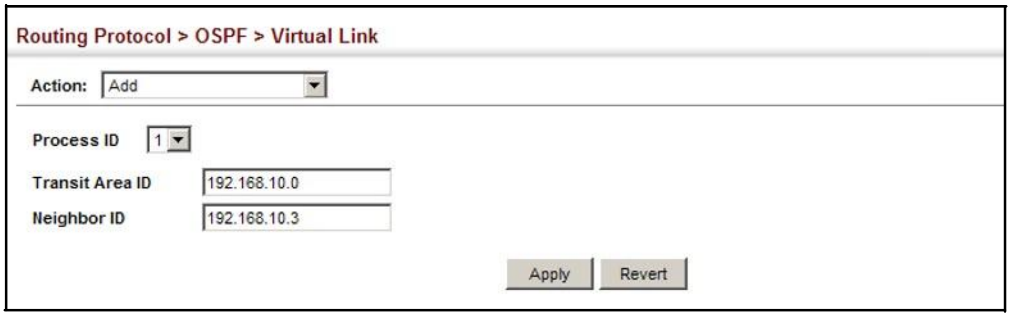
1. Click Routing Protocol, OSPF, Virtual Link.

2. Select Add from the Action list.

3. Specify the process ID, the Area ID, and Neighbor router ID.

4. Click Apply.

Figure 288: Adding a Virtual Link



Routing Protocol > OSPF > Virtual Link

Action: Add

Process ID 1

Transit Area ID 192.168.10.0

Neighbor ID 192.168.10.3

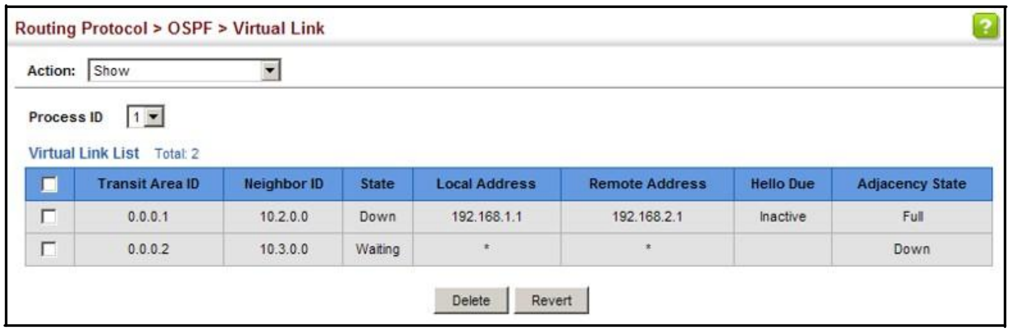
To show virtual links:

1. Click Routing Protocol, OSPF, Virtual Link.

2. Select Show from the Action list.

3. Select the process ID.

Figure 289: Showing Virtual Links



Routing Protocol > OSPF > Virtual Link

Action: Show

Process ID 1

Virtual Link List Total: 2

□	Transit Area ID	Neighbor ID	State	Local Address	Remote Address	Hello Due	Adjacency State
□	0.0.0.1	10.2.0.0	Down	192.168.1.1	192.168.2.1	Inactive	Full
□	0.0.0.2	10.3.0.0	Waiting	*	*		Down

To configure detailed settings for a virtual link:

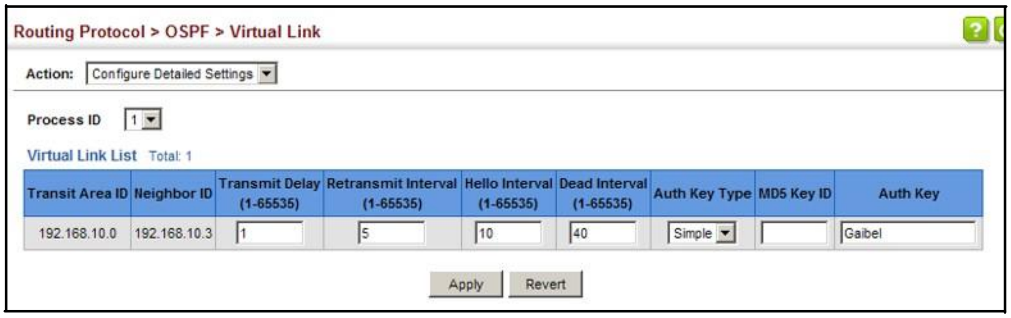
1. Click Routing Protocol, OSPF, Virtual Link.

2. Select Configure Detailed Settings from the Action list.

3. Specify the process ID, then modify the protocol timers and authentication settings as required.

4. Click Apply.

Figure 290: Configuring Detailed Settings for a Virtual Link



Routing Protocol > OSPF > Virtual Link

Action: Configure Detailed Settings

Process ID 1

Virtual Link List Total: 1

Transit Area ID	Neighbor ID	Transmit Delay (1-65535)	Retransmit Interval (1-65535)	Hello Interval (1-65535)	Dead Interval (1-65535)	Auth Key Type	MD5 Key ID	Auth Key
192.168.10.0	192.168.10.3	1	5	10	40	Simple		Gaibel

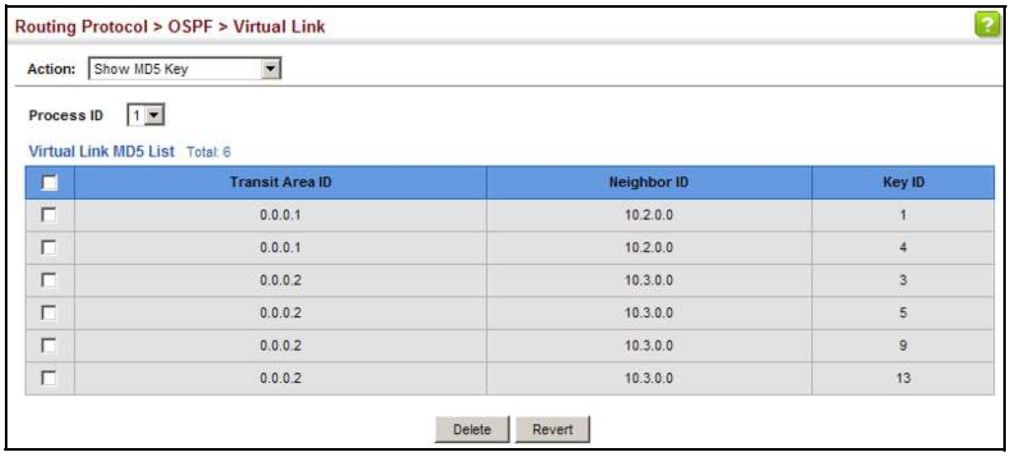
To show the MD5 authentication keys configured for a virtual link:

1. Click Routing Protocol, OSPF, Interface.

2. Select Show MD5 Key from the Action list.

3. Select the VLAN ID.

Figure 291: Showing MD5 Authentication Keys



Action: Show MD5 Key

Process ID 1

Virtual Link MD5 List Total: 6

□	Transit Area ID	Neighbor ID	Key ID
□	0.0.0.1	10.2.0.0	1
□	0.0.0.1	10.2.0.0	4
□	0.0.0.2	10.3.0.0	3
□	0.0.0.2	10.3.0.0	5
□	0.0.0.2	10.3.0.0	9
□	0.0.0.2	10.3.0.0	13

Displaying Link State Database Information

Use the Routing Protocol > OSPF > Information (LSDB) page to show the Link State Advertisements (LSAs) sent by OSPF routers advertising routes. The full collection of LSAs collected by a router interface from the attached area is known as a link state database. Routers that are connected to multiple interfaces will have a separate database for each area. Each router in the same area should have an identical database describing the topology for that area, and the shortest path to external destinations.

The full database is exchanged between neighboring routers as soon as a new router is discovered. Afterwards, any changes that occur in the routing tables are synchronized with neighboring routers through a process called reliable flooding. You can show information about different LSAs stored in this router’s database, which may include any of the following types:

- Router (Type 1) – All routers in an OSPF area originate Router LSAs that describe the state and cost of its active interfaces and neighbors.
- Network (Type 2) – The designated router for each area originates a Network LSA that describes all the routers that are attached to this network segment.
- Summary (Type 3) – Area border routers can generate Summary LSAs that give the cost to a subnetwork located outside the area.
- AS Summary (Type 4) – Area border routers can generate AS Summary LSAs that give the cost to an autonomous system boundary router (ASBR).
- AS External (Type 5) – An ASBR can generate an AS External LSA for each known network destination outside the AS.
- NSSA External (Type 7) – An ASBR within an NSSA generates an NSSA external link state advertisement for each known network destination outside the AS.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **Query by** – The LSA database can be searched using the following criteria:
  - Self-Originate – LSAs generated by this router.
  - Link ID – LSAs advertising a specific link.
  - Adv Router – LSAs advertised by a specific router.
- **Link State Type** – The information returned by a query can be displayed for all LSA types or for a specific type. (Default: All)

Information displayed for each LSA entry includes:

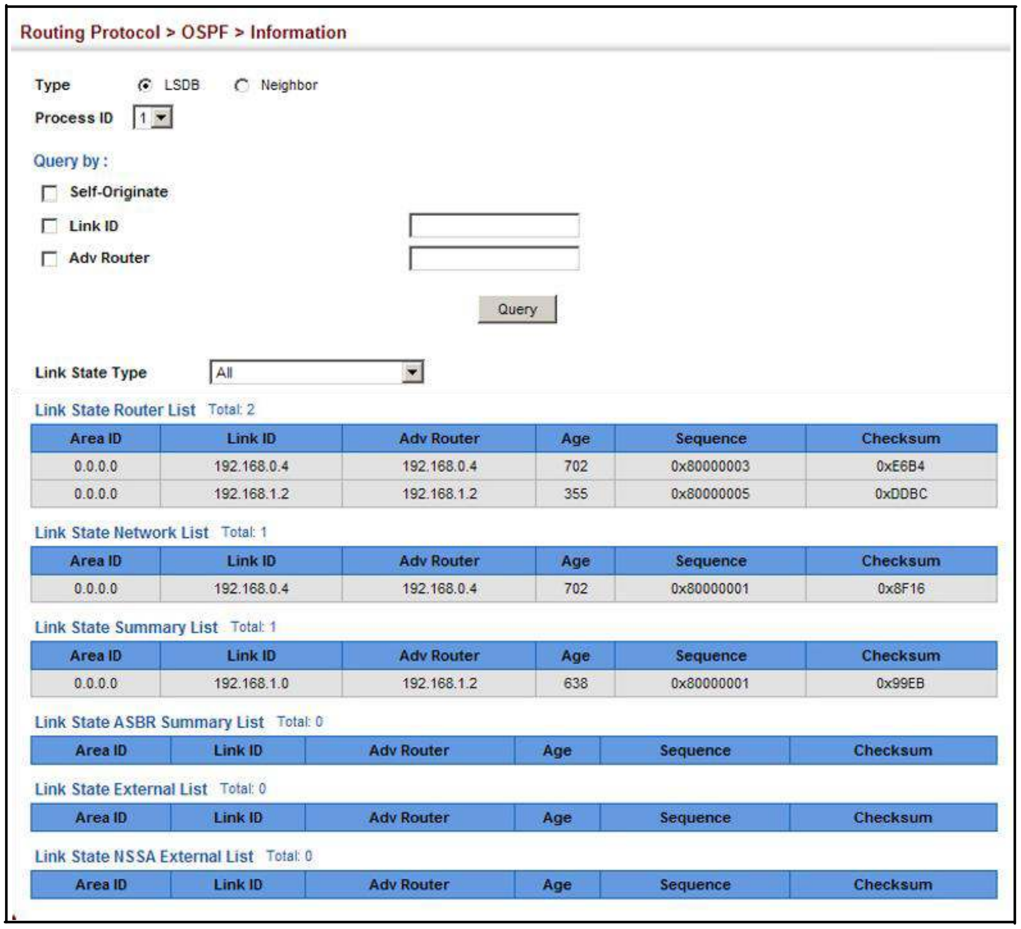
- **Area ID** – Area defined for which LSA information is to be displayed.
- **Link ID** – Network portion described by an LSA. The Link ID is either:
  - An IP network number for Type 3 Summary and Type 5 AS External LSAs. (When an Type 5 AS External LSA is describing a default route, its Link ID is set to the default destination 0.0.0.0.)
  - A Router ID for Router, Network, and Type 4 AS Summary LSAs.
- **Adv Router** – IP address of the advertising router.
- **Age** – Age of LSA (in seconds).
- **Sequence** – Sequence number of LSA (used to detect older duplicate LSAs).
- **Checksum** – Checksum of the complete contents of the LSA.

Web Interface

To display information in the link state database:

1. Click Routing Protocol, OSPF, Information.
2. Click LSDB.
3. Select the process identifier.
4. Specify required search criteria, such as self-originated LSAs, LSAs with a specific link ID, or LSAs advertised by a specific router.
5. Then select the database entries to display based on LSA type.

Figure 292: Displaying Information in the Link State Database



Routing Protocol > OSPF > Information

Type ● LSDB ○ Neighbor

Process ID 1

Query by :

☐ Self-Originate

☐ Link ID

☐ Adv Router

Query

Link State Type All

Link State Router List Total: 2

Area ID	Link ID	Adv Router	Age	Sequence	Checksum
0.0.0.0	192.168.0.4	192.168.0.4	702	0x80000003	0xE6B4
0.0.0.0	192.168.1.2	192.168.1.2	355	0x80000005	0xDDBC

Link State Network List Total: 1

Area ID	Link ID	Adv Router	Age	Sequence	Checksum
0.0.0.0	192.168.0.4	192.168.0.4	702	0x80000001	0x8F16

Link State Summary List Total: 1

Area ID	Link ID	Adv Router	Age	Sequence	Checksum
0.0.0.0	192.168.1.0	192.168.1.2	638	0x80000001	0x99EB

Link State ASBR Summary List Total: 0

Area ID	Link ID	Adv Router	Age	Sequence	Checksum

Link State External List Total: 0

Area ID	Link ID	Adv Router	Age	Sequence	Checksum

Link State NSSA External List Total: 0

Area ID	Link ID	Adv Router	Age	Sequence	Checksum

Displaying Information on Neighboring Routers

Use the Routing Protocol > OSPF > Information (Neighbor) page to display information about neighboring routers on each interface.

Parameters

These parameters are displayed:

- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **ID** – Neighbor's router ID.
- **Priority** – Neighbor's router priority.
- **State** – OSPF state and identification flag.

  States include:

  - Down – Connection down
  - Attempt – Connection down, but attempting contact (non-broadcast networks)

- Init – Have received Hello packet, but communications not yet established
- Two-way – Bidirectional communications established
- ExStart – Initializing adjacency between neighbors
- Exchange – Database descriptions being exchanged
- Loading – LSA databases being exchanged
- Full – Neighboring routers now fully adjacent

Identification flags include:

- D – Dynamic neighbor
- S – Static neighbor
- DR – Designated router
- BDR – Backup designated router

◆ **Address** – IP address of this interface.

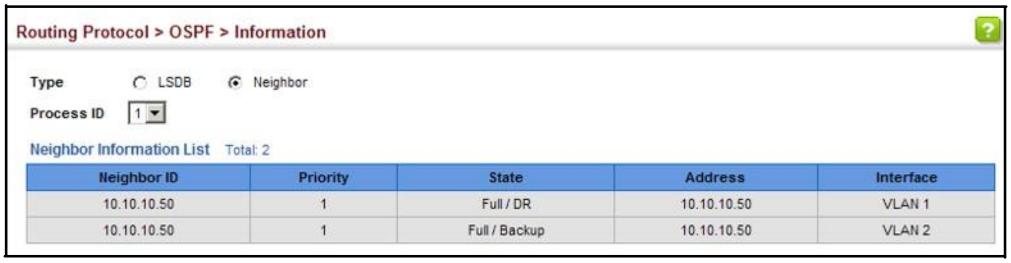
◆ **Interface** – A Layer 3 interface on which OSPF has been enabled.

Web Interface

To display information about neighboring routers stored in the link state database:

1. Click Routing Protocol, OSPF, Information.
2. Click Neighbor.
3. Select the process identifier.

Figure 293: Displaying Neighbor Routers Stored in the Link State Database



Routing Protocol > OSPF > Information

Type ○ LSDB ● Neighbor

Process ID 1

Neighbor Information List Total: 2

Neighbor ID	Priority	State	Address	Interface
10.10.10.50	1	Full / DR	10.10.10.50	VLAN 1
10.10.10.50	1	Full / Backup	10.10.10.50	VLAN 2

Configuring Passive Interfaces

Use the Routing Protocol > OSPF > Passive Interface pages to configure or display information about interfaces on which OSPF routing traffic is suppressed.

Command Usage

◆ You can configure an OSPF interface as passive to prevent OSPF routing traffic from exiting or entering that interface. No OSPF adjacency can be formed if one of the interfaces involved is set to passive mode. The specified interface will appear as a stub in the OSPF domain. Also, if you configure an OSPF interface as passive where an adjacency already exists, the adjacency will drop almost immediately.

- Use this command in conjunction with the information provided under "Displaying Information on Neighboring Routers" on page 426 to control the routing updates sent to specific neighbors.

Parameters

These parameters are displayed:

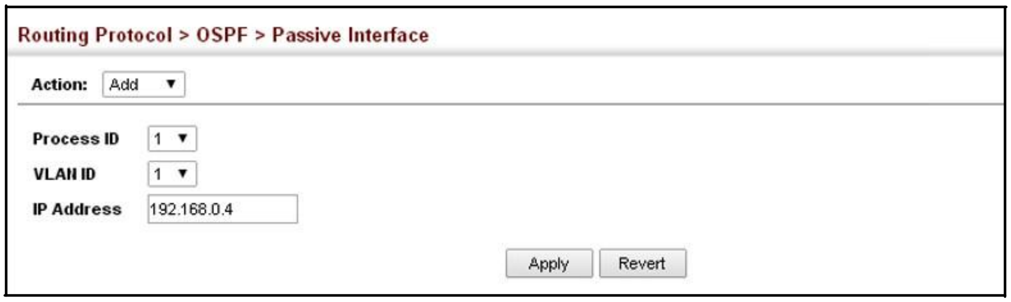
- **Process ID** – Process ID as configured in the Network Area configuration screen (see page 395).
- **VLAN ID** – VLAN ID. (Range: 1-4094)
- **IP Address** – An IPv4 address configured on this interface.

Web Interface

To configure a passive interface:

1. Click Routing Protocol, OSPF, Passive Interface.
2. Select Add from the Action list.
3. Select the process identifier, VLAN ID, and an IPv4 address.

Figure 294: Configuring an OSPF Passive Interface



Routing Protocol > OSPF > Passive Interface

Action: Add

Process ID 1

VLAN ID 1

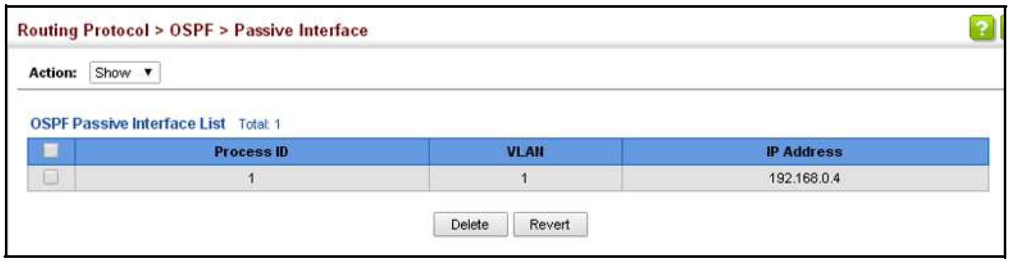
IP Address 192.168.0.4

To display information about passive interfaces

1. Click Routing Protocol, OSPF, Passive Interface.

2. Select Show from the Action list.

Figure 295: Showing OSPF Passive Interfaces



Routing Protocol > OSPF > Passive Interface

Action: Show

OSPF Passive Interface List Total: 1

□	Process ID	VLAN	IP Address
□	1	1	192.168.0.4

Section III

Appendices

This section provides additional information and includes these items:

A

Software Specifications

Software Features

Management Authentication Local, RADIUS, TACACS+, Port Authentication (802.1X), HTTPS, SSH, Port Security, IP Filter

Client Access Control Access Control Lists (2048 rules), Port Authentication (802.1X), MAC Authentication, Port Security, DHCP Snooping, IP Source Guard

Port Configuration 1000BASE-SX/LX - 1000 Mbps full duplex (SFP)
10GBASE-CR/SR/LR/LRM - 10 Gbps full duplex (SFP+)
40GBASET-CR4 - 40 Gbps full duplex (QSFP+)

Flow Control Full Duplex: IEEE 802.3-2005
Half Duplex: Back pressure

Storm Control Broadcast, multicast, or unicast traffic throttled above a critical threshold

Port Mirroring 2 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)
Class of Service	Supports eight levels of priority Strict, Weighted Round Robin (WRR), or combination of strict and weighted queueing Layer 3/4 priority mapping: IP Port, IP Precedence, IP DSCP
Quality of Service	DiffServ supports class maps, policy maps, and service policies
Multicast Filtering	IGMP Snooping (Layer 2 IPv4) MLD Snooping (Layer 2 IPv6) IGMP (Layer 3) Multicast VLAN Registration (IPv4/IPv6)
IP Routing	ARP, Proxy ARP Static routes CIDR (Classless Inter-Domain Routing) RIP, RIPv2, OSPFv2, OSPFv3 unicast routing PIM-SM, PIM-DM, PIMv6 multicast routing VRRP (Virtual Router Redundancy Protocol)
Additional Features	Connectivity Fault Management DHCP Client, Relay, Option 82, Server DNS Client, Proxy 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, FTP 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)

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

IEEE 802.1ag Connectivity Fault Management (Amendment 5, D7.1)

ARP (RFC 826)

DHCP Client (RFC 2131)

DHCP Relay (RFC 951, 2132, 3046)

DHCP Server (RFC 2131, 2132)

HTTPS

ICMP (RFC 792)

IGMP (RFC 1112)

IGMPv2 (RFC 2236)

IGMPv3 (RFC 3376) - partial support

IGMP Proxy (RFC 4541)

IPv4 IGMP (RFC 3228)

MLD Snooping (RFC 4541)

NTP (RFC 1305)

OSPF (RFC 2328, 2178, 1587)

OSPFv3 (RFC 2740)

PIM-SM (RFC 4601)

PIM-DM (RFC 3973)

RADIUS+ (RFC 2618)

RIPv1 (RFC 1058)

RIPv2 (RFC 2453)

RIPv2, extension (RFC 1724)

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)

VRRP (RFC 3768)

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)

OSPF MIB (RFC 1850)

OSPFv3 MIB (draft-ietf-ospf-ospfv3-mib-15.txt)

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)

QinQ Tunneling (IEEE 802.1ad Provider Bridges)

Quality of Service MIB

RADIUS Accounting Server MIB (RFC 2621)

RADIUS Authentication Client MIB (RFC 2619)

RIP1 MIB (RFC 1058)

RIP2 MIB (RFC 2453)

RIP2 Extension (RFC1724)

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)

VRRP MIB (RFC 2787)

B Troubleshooting

Problems Accessing the Management Interface

Table 38: Troubleshooting Chart

Symptom	Action
Cannot connect using a web browser	◆ 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.
Cannot access the on-board configuration program via a serial port connection	◆ Refer to the *CLI Reference Guide* for information on troubleshooting a connection to the serial port
Forgot or lost the password	◆ 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

:
```

C

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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.

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 an 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 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.

MVR Multicast VLAN Registration is a method of using a single network-wide multicast VLAN to transmit common services, such as such as television channels or video-on-demand, across a service-provider's network. MVR simplifies the configuration of multicast services by using a common VLAN for distribution, while still preserving security and data isolation for subscribers residing in both the MVR VLAN and other standard VLAN groups.

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.

OSPF Open Shortest Path First is a link-state routing protocol that functions better over a larger network such as the Internet, as opposed to distance-vector routing protocols such as RIP. It includes features such as unlimited hop count, authentication of routing updates, and Variable Length Subnet Masks (VLSM).

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.

QinQ QinQ tunneling is designed for service providers carrying traffic for multiple customers across their networks. It is used to maintain customer-specific VLAN and Layer 2 protocol configurations even when different customers use the same internal VLAN IDs.

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.

RIP Routing Information Protocol seeks to find the shortest route to another device by minimizing the distance-vector, or hop count, which serves as a rough estimate of transmission cost. RIP-2 is a compatible upgrade to RIP. It adds useful capabilities for subnet routing, authentication, and multicast transmissions.

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.

VRRP Virtual Router Redundancy Protocol uses a virtual IP address to support a primary router and multiple backup routers. The backups can be configured to take over the workload if the master fails or to load share the traffic. The primary goal of VRRP is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

XModem A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

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