ADMINISTRATION GUIDE

Cisco Small Business 300 Series Managed Switch Administration Guide

10/100 Switches	SF 300-08, SF 302-08, SF 302-08MP, SF 302-08P, SF 300-24, SF 300-24P, SF 300-48, SF 300-48P
Gigabit Switches	SG 300-10, SG 300-10MP, SG 300-10P, SG 300-20, SG 300-28, SG 300-28P, SG 300-52

Contents

1

Getting Started

This chapter provides an introduction to the user interface, and includes the following topics:

- **Starting the Web-based Switch Configuration Utility**
- **Quick Start Switch Configuration**
- **Window Navigation**

Starting the Web-based Switch Configuration Utility

This section describes how to navigate the web-based switch configuration utility.

Browsers have the following restrictions:

- If you are using Internet Explorer 6, you cannot directly use an IPv6 address to access the switch. You can, however, use the DNS (Domain Name System) server to create a domain name that contains the IPv6 address, and then use that domain name in the address bar in place of the IPv6 address.
- If you have multiple IPv6 interfaces on your management station, use the IPv6 global address instead of IPv6 link local address to access the switch from your browser.

Launching the Configuration Utility

To open the user interface:

STEP 1 Open a Web browser.

STEP 2 Enter the IP address of the switch you are configuring in the address bar on the browser, and then press **Enter**. The *Login Page* opens.

NOTE When the switch is using the factory default IP address, its power LED flashes continuously. When the switch is using a DHCP assigned IP address or an administrator configured static IP address, the power LED is on solid.

Logging In

The default username is **cisco** and the default password is **cisco**. The first time that you log in with the default username and password, you are required to enter a new password.

To log in to the device configuration utility:

STEP 1 Enter the username/password. The factory default username/password is **cisco/ cisco**. The password can contain up to 32 ASCII characters. Password-complexity rules are described in the **Setting Password Complexity Rules** section of the **Configuring Security** chapter.

STEP 2 If you are not using English, select the desired language from the *Language* drop-down menu. To add a new language to the switch or update a current one, refer to the *Upgrade/Backup Firmware/Language* section.

STEP 3 If this is the first time that you logged on with the default user ID (**cisco**) and the default password (**cisco**) or your password has expired, the Change Password Page opens. See *Password Expiration* for additional information.

STEP 4 Enter the new username/password and click **Apply**.

When the login attempt is successful, the *Getting Started Page* opens.

If you entered an incorrect username or password, an error message is displayed and the *Login Page* remains displayed on the window.

Select **Don’t show this page on startup** to prevent the Getting Started Page page from being displayed each time that you logon to the system. If you select this option, the *System Summary Page* is opened instead of the *Getting Started Page*.

Password Expiration

The *New Password Page* is displayed:

- The first time you access the switch with the default username **cisco** and password **cisco**. This page forces you to replace the factory default password.
- When the password expires, this page forces you to select a new password.

Logging Out

By default, the application logs out after ten minutes of inactivity. You can change this default value as described in the **Defining Idle Session Timeout** section in the **General Administrative Information and Operations** chapter.

⚠ CAUTION Unless the Running Configuration is copied to the Startup Configuration, all changes made since the last time the file was saved are lost if the switch is rebooted. We recommend that you save the Running Configuration to the Startup Configuration before logging off to preserve any changes you made during this session.

A red X icon displayed to the left of the **Save** application link indicates that Running Configuration changes have been made that have not yet been saved to the Startup Configuration file.

When you click **Save**, the *Copy/Save Configuration Page* is displayed. Save the Running Configuration file by copying it to the Startup Configuration file. After this save, the red X icon and the Save application link are no longer displayed.

To logout, click **Logout** in the top right corner of any page. The system logs out of the switch.

When a timeout occurs or you intentionally log out of the system, a message is displayed and the *Login Page* opens, with a message indicating the logged-out state. After you log in, the application returns to the initial page.

The initial page displayed depends on the “Do not show this page on startup” option in the *Getting Started Page.* If you did not select this option, the initial page is the *Getting Started Page.* If you did select this option, the initial page is the *System Summary Page*.

Quick Start Switch Configuration

To simplify switch configuration through quick navigation, the *Getting Started Page* provides links to the most commonly used pages.

Links on the Getting Started Page

Category	Link Name (on the Page)	Linked Page
Initial Setup	Change Device IP Address	*IPv4 Interface Page*
	Create VLAN	*Create VLAN Page*
	Configure Port Settings	*Port Settings Page*
Switch Status	System Summary	*System Summary Page*
	Port Statistics	*Interface Page*
	RMON Statistics	*Statistics Page*
	View Log	*RAM Memory Page*
Quick Access	Change Device Password	*User Accounts Page*
	Upgrade Device Software	*Upgrade/Backup Firmware/ Language*
	Backup Device Configuration	*Download/Backup Configuration/Log Page*
	Create MAC Based ACL	*MAC Based ACL Page*
	Create IP Based ACL	*IPv4 Based ACL Page*
	Configure QoS	*QoS Properties Page*
	Configure Port Mirroring	*Port and VLAN Mirroring Page*

Window Navigation

This section describes the features of the web-based switch configuration utility.

Application Header

The Application Header is displayed on every page. It provides the following application links:

Application Links

Application Link Name	Description
	A red X icon displayed to the left of the **Save** application link indicates that Running Configuration changes have been made that have not yet been saved to the Startup Configuration file. Click **Save** to display the *Copy/Save Configuration Page*. Save the Running Configuration file type by copying it to the Startup Configuration file type on the switch. After this save, the red X icon and the Save application link are no longer displayed. When the switch is rebooted, it copies the Startup Configuration file type to the Running Configuration and sets the switch parameters according to the data in the Running Configuration.
User	Click to display the name of the user logged on to the switch. The default username is **cisco**. (The default password is **cisco**.)
Logout	Click to logout of the web-based switch configuration utility.
About	Click to display the switch name and switch version number.
Help	Click to display the online help.

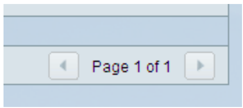
Application Links (Continued)

Application Link Name	Description
Language Menu	Select a language or load a new language file into the switch. If the language required is displayed in the menu, select it. If it is not displayed, select **Add new language**. For more information about adding a new language, refer to the *Upgrade/Backup Firmware/Language*.
Alert	The Syslog Alert Status icon is displayed when a SYSLOG message, above the *critical* severity level, is logged. Click the icon to open the *RAM Memory Page*. After you access this page, the Syslog Alert Status icon is no longer displayed. To display the page when there is not an active SYSLOG message, follow the **Status and Statistics** > **View Log** > **RAM Memory Page** path.

Management Buttons

The following table describes the commonly-used buttons that appear on various pages in the system.

Management Buttons

Button Name	Description
	Navigate the table by using the right and left arrow icons when there are more than 50 entries in a table.
*	Indicates a mandatory field.
Add	Click to display the related *Add* page and add an entry to a table. Enter the information and click **Apply** to save it to the Running Configuration. Click **Close** to return to the main page. Click **Save** to display the *Copy/Save Configuration Page* and save the Running Configuration to the Startup Configuration file type on the switch.

Management Buttons (Continued)

Button Name	Description
Apply	Click to apply changes to the Running Configuration on the switch. If the swtich is rebooted, the Running Configuration is lost, unless it is saved to the Startup Configuration file type or another file type. Click **Save** to display the *Copy/ Save Configuration Page* and save the Running Configuration to the Startup Configuration file type on the switch.
Cancel	Click to reset changes made on the page.
Clear All Interfaces Counters	Click to clear the statistic counters for all interfaces.
Clear Interface Counters	Click to clear the statistic counters for the selected interface.
Clear Logs	Clears log files.
Clear Table	Clears table entries.
Close	Returns to main page. If there are changes that were not applied to the Running Configuration, a message is displayed.
Copy Settings	A table typically contains one or more entries containing configuration settings. Instead of modifying each entry individually, it is possible to modify one entry and then copy it to multiple entries, as described below: 1. Select the entry to be copied. Click **Copy Settings** to display the popup. 2. Enter the destination entry numbers in the **to** field. 3. Click **Apply** to save the changes and click **Close** to return to the main page.
Delete	Select the entry in the table to be deleted and click **Delete** to remove entries from a table. The entry is deleted.
Details	Click to display the details associated with the entry selected on the main page.

Management Buttons (Continued)

Button Name	Description
Edit	Select the entry and click **Edit** to open the entries for editing. The *Edit* page opens, and the entry can be modified. 1. Click **Apply** to save the changes to the Running Configuration. 2. Click **Close** to return to the main page.
Go	Enter the query filtering criteria and click **Go**. The results are displayed on the page.
Test	Click **Test** to perform the related tests.

2

Viewing Statistics

This chapter describes how to view switch statistics.

It contains the following sections:

- **Viewing Ethernet Interface**
- **Viewing Etherlike Statistics**
- **Viewing GVRP Statistics**
- **Viewing 802.1X EAP Statistics**
- **Viewing TCAM Utilization**
- **Managing RMON Statistics**

Viewing Ethernet Interface

The *Interface Page* displays traffic statistics per port. The refresh rate of the information can be selected.

This page is useful for analyzing the amount of traffic that is both sent and received and its dispersion (Unicast, Multicast, and Broadcast).

To display Ethernet statistics:

STEP 1 Click **Status and Statistics** > **Interface**. The *Interface Page* opens.

STEP 2 Enter the parameters.

- **Interface**—Select the type of interface and specific interface for which Ethernet statistics are to be displayed.
- **Refresh Rate**—Select the time period that passes before the interface Ethernet statistics are refreshed. The available options are:
  - *No Refresh*—Statistics are not refreshed.
  - *15 Sec*—Statistics are refreshed every 15 seconds.
  - *30 Sec*—Statistics are refreshed every 30 seconds.
  - *60 Sec*—Statistics are refreshed every 60 seconds.

The Receive Statistics area displays information about incoming packets.

- **Total Bytes (Octets)**—Octets received, including bad packets and FCS octets, but excluding framing bits.
- **Unicast Packets**—Good Unicast packets received.
- **Multicast Packets**—Good Multicast packets received.
- **Broadcast Packets**—Good Broadcast packets received.
- **Packets with Errors**—Packets with errors received.

The Transmit Statistics area displays information about outgoing packets.

- **Total Bytes (Octets)**—Octets transmitted, including bad packets and FCS octets, but excluding framing bits.
- **Unicast Packets**—Good Unicast packets transmitted.
- **Multicast Packets**—Good Multicast packets transmitted.
- **Broadcast Packets**—Good Broadcast packets transmitted.

To clear statistics counters:

- Click **Clear Interface Counters** to clear counters for the interface displayed.
- Click **Clear All Interface Counters** to clear counters for all interfaces.

Viewing Etherlike Statistics

The *Etherlike Page* displays statistics per port according to the Etherlike MIB standard definition. The refresh rate of the information can be selected. This page provides more detailed information regarding errors in the physical layer (Layer 1), which might disrupt traffic.

To view Etherlike Statistics:

STEP 1 Click **Status and Statistics** > **Etherlike**. The *Etherlike Page* opens.

STEP 2 Enter the parameters.

- **Interface—**Select the type of interface and specific interface for which Ethernet statistics are to be displayed.
- **Refresh Rate—**Select the amount of time that passes before the Etherlike statistics are refreshed.

The fields are displayed for the selected interface.

- **Frame Check Sequence (FCS) Errors—**Received frames that failed the CRC (cyclic redundancy checks).
- **Single Collision Frames—**The number of frames involved in a single collision, but were successfully transmitted.
- **Late Collisions—**Collisions that have been detected after the first 512 bits of data.
- **Excessive Collisions—**Number of transmissions due to excessive collisions.
- **Oversize Packets—**Packets greater than 1518 octets received.
- **Internal MAC Receive Errors—**Frames rejected because of receiver errors.
- **Received Pause Frames—**Received flow control pause frames.
- **Transmitted Pause Frames—**Flow control pause frames transmitted from the selected interface.

To clear statistics counters:

- Click **Clear Interface Counters** to clear the selected interface's Etherlike statistics counters.
- Click **Clear All Interface Counters** to clear the Etherlike statistics counters of all interfaces.

Viewing GVRP Statistics

The *GVRP Page* displays information regarding GARP VLAN Registration Protocol (GVRP, also known as MVRP (Multiple VLAN Registration Protocol)) frames that were sent or received from a port. GVRP is a standards-based Layer 2 network protocol, for automatic configuration of VLAN information on switches. It was defined in the 802.1ak amendment to 802.1Q-2005.

GVRP statistics for a port are only displayed if GVRP is enabled globally and on the port. This is done in the *GVRP Page*.

To view GVRP statistics:

STEP 1 Click **Status and Statistics** > **GVRP**. The *GVRP Page* opens.

STEP 2 Enter the parameters.

- **Interface**—Select the interface and specific interface for which GVRP statistics are to be displayed.
- **Refresh Rate—**Select the time period that passes before the GVRP statistics page is refreshed.

The Attribute Counter block displays the counters for various types of packets per interface.

- **Join Empty—**Number of GVRP Join Empty packets received/transmitted.
- **Empty—**Number of GVRP empty packets received/transmitted.
- **Leave Empty—**Number of GVRP Leave Empty packets received/transmitted.
- **Join In—**Number of GVRP Join In packets received/transmitted.
- **Leave In—**Number of GVRP Leave In packets received/transmitted.

- **Leave All—**Number of GVRP Leave All packets received/transmitted.

The GVRP Error Statistics section displays the GVRP error counters.

- **Invalid Protocol ID—**Invalid protocol ID errors.
- **Invalid Attribute Type—**Invalid attribute ID errors.
- **Invalid Attribute Value—**Invalid attribute value errors.
- **Invalid Attribute Length—**Invalid attribute length errors.
- **Invalid Event—**Invalid events.

To clear the counters, click **Clear Interface Counters**. The GVRP statistics counters are cleared.

Viewing 802.1X EAP Statistics

The *802.1x EAP Page* displays detailed information regarding the EAP (Extensible Authentication Protocol) frames that were sent or received. To configure the 802.1X feature, see the *802.1X Properties Page*.

To view the EAP Statistics:

STEP 1 Click **Status and Statistics** > **802.1X EAP**. The *802.1x EAP Page* opens.

STEP 2 Select the **Port** that is polled for statistics.

STEP 3 Select the time period (**Refresh Rate**) that passes before the EAP statistics are refreshed.

The values are displayed for the selected interface.

- **EAPOL Frames Received—**Valid EAPOL frames received on the port.
- **EAPOL Frames Transmitted—**Valid EAPOL frames transmitted by the port.
- **EAPOL Start Frames Received—**EAPOL Start frames received on the port.
- **EAPOL Logoff Frames Received—**EAPOL Logoff frames received on the port.
- **EAP Response/ID Frames Received—**EAP Resp/ID frames received on the port.

- **EAP Response Frames Received—**EAP Response frames received by the port (other than Resp/ID frames).
- **EAP Request/ID Frames Transmitted—**EAP Req/ID frames transmitted by the port.
- **EAP Request Frames Transmitted—**EAP Request frames transmitted by the port.
- **Invalid EAPOL Frames Received—**Unrecognized EAPOL frames received on this port.
- **EAP Length Error Frames Received—**EAPOL frames with an invalid Packet Body Length received on this port.
- **Last EAPOL Frame Version—**Protocol version number attached to the most recently received EAPOL frame.
- **Last EAPOL Frame Source—**Source MAC address attached to the most recently received EAPOL frame.

Viewing TCAM Utilization

The switch architecture uses a TCAM (Ternary Content Addressable Memory) to support an extensive data search in a short period of time.

TCAM holds the rules produced by other processes, such as ACLs (Access Control Lists) or QoS. The maximum number of TCAM rules that can be allocated by all processes is 512.

Some processes allocate rules upon their initiation. Additionally, processes that initialize during system boot use some of their rules during the startup process.

To view TCAM utilization, click **Status and Statistics** > **TCAM Utilization**. The *TCAM Utilization Page* opens, displaying the percentage of TCAM utilization in the system.

This page displays **TCAM Utilization**, the percentage of TCAM resources used.

The TCAM Rules Per Process table lists all processes that can allocate TCAM rules. Each process has its specific allocation policy.

TCAM Rules Per Process

Process	Per Port/ Per Switch	Allocation on Activation	Process Upper Limit	TCAM Rules Used Up Per User Entry	Comments
QoS Advanced Mode Rules	Port	6/device	No limit	1 or 2 TCAM entries per rule.	
Access Control Rules	Port	6/device	No limit	1 or 2 TCAM entries per rule.	
Protocol Based VLAN	Port	0	No limit	1 or 2	Rules are duplicated for MAC-based VLANs.
MAC Based VLAN	Port	0	No limit	No limit	Rules are duplicated for MAC-based VLANs.
DHCP Snooping	Switch	2/device	No limit	8 TCAM entries per DHCP Snooping rule	
IP Source Guard	Port	0	No limit	1 TCAM entry per IP Source Guard entry	
ARP Inspection	Switch	2/device	128	4 TCAM entries per ARP Inspection rule	
VLAN Rate Limiting	Both	0	255	1 Global rule per VLAN Rate Limit.	An additional rule is created for each Permit rule on the interface.

Managing RMON Statistics

RMON (Remote Networking Monitoring) is an SNMP specification that enables an SNMP agent in the switch to proactively monitor traffic statistics over a given period and send traps to an SNMP manager. The local SNMP agent compares actual, real-time counters against predefined thresholds and generates alarms, without the need for polling by a central SNMP management platform. This is an effective mechanism for proactive management, provided that you have right thresholds set relative to your network's base line.

RMON decreases the traffic between the manager and the switch because the SNMP manager does not have to frequently poll the switch for information, and enables the manager to get timely status reports because the switch reports events as they occur.

With this feature, you can perform the following actions:

- View statistics (counter values) as they are currently, meaning since the last time they were cleared. You can also collect the values of these counters over a period of time, and then view the table of collected data, where each collected set is a single line of the *History* tab.
- Define interesting changes in counter values, such as "reached a certain number of late collisions" (defines the alarm), and then define what action to perform when this event occurs (log, trap, or log and trap).

Viewing RMON Statistics

The *Statistics Page* displays detailed information regarding packet sizes and some information regarding physical layer errors. The information shown is according to the RMON standard.

To view the RMON statistics:

STEP 1 Click **RMON** > **Statistics**. The *Statistics Page* opens.

STEP 2 Select the **Interface** for which Ethernet statistics are to be displayed.

STEP 3 Select the **Refresh Rate**, the time period that passes before the interface statistics are refreshed.

The statistics are displayed for the selected interface.

- **Bytes Received (Octets)**—Number of octets received, including bad packets and FCS octets, but excluding framing bits.
- **Drop Events**—Number of packets that were dropped.
- **Packets Received**—Number of packets received, including bad packets, Multicast, and Broadcast packets.
- **Broadcast Packets Received**—Number of good Broadcast packets received. This number does not include Multicast packets.
- **Multicast Packets Received**—Number of good Multicast packets received.
- **CRC & Align Errors**—Number of CRC and Align errors that have occurred.
- **Undersize Packets**—Number of undersized packets (less than 64 octets) received.
- **Oversize Packets**—Number of oversized packets (over 1518 octets) received.
- **Fragments**—Number of fragments (packets with less than 64 octets, excluding framing bits, but including FCS octets) received.
- **Jabbers**—Total number of received packets that were longer than 1632 octets. This number excludes frame bits, but includes FCS octets that had either a bad FCS (Frame Check Sequence) with an integral number of octets (FCS Error) or a bad FCS with a non-integral octet (Alignment Error) number.
- **Collisions**—Number of collisions received. If Jumbo Frames are enabled, the threshold of Jabber Frames is raised to the maximum size of Jumbo Frames.
- **Frames of 64 Bytes**—Number of frames, containing 64 bytes that were received.
- **Frames of 65 to 127 Bytes**—Number of frames, containing 65-127 bytes that were received.
- **Frames of 128 to 255 Bytes**—Number of frames, containing 128-255 bytes that were received.
- **Frames of 256 to 511 Bytes**—Number of frames, containing 256-511 bytes that were received.

- **Frames of 512 to 1023 Bytes**—Number of frames, containing 512-1023 bytes that were received.
- **Frames of 1024 to 1632 Bytes**—Number of frames, containing 1024-1632 bytes that were received.

STEP 4 Select another interface in the Interface field. The RMON statistics are displayed.

Configuring RMON History

The *History Control Table Page* provides the ability to collect a log of statistics on a port.

You can configure the sampling frequency, amount of samples to store and the port from where to gather the data. After the data is sampled and stored, it is displayed in the *History Table Page* that can be viewed by clicking **History Table**.

To view RMON control history information:

STEP 1 Click **Status and Statistics** > **RMON** > **History**. The *History Table Page* opens.

This page displays the following fields:

- **History Entry No.**—Number of the history table entry.
- **Source Interface**—ID of the interface from which the history samples were captured.
- **Max. No. of Samples to Keep**—Maximum number of samples to be stored in this portion of the History table.
- **Sampling Interval**—Time period in seconds that samples were collected from the ports. The field range is 1-3600.
- **Owner**—RMON station or user that requested the RMON information. The field range is 0-20 characters.
- **Current Number of Samples**—RMON is allowed by standard to not grant all requested samples, but rather to limit the number of samples per request. Therefore, this field represents the sample number actually granted to the request that is equal or less than the requested value.

STEP 2 Click **Add**. The *Add RMON History Page* opens.

STEP 3 Enter the parameters.

- **New History Entry—**Displays the number of the new table entry.
- **Source Interface—**Select the type of interface from where the history samples are to be taken.
- **Max No. of Samples to Keep—**Enter the number of samples to store.
- **Sampling Interval**—Enter the time in seconds that samples were collected from the ports. The field range is 1-3600.
- **Owner—**Enter the RMON station or user that requested the RMON information. The field range is 0-20 characters.

STEP 4 Click **Apply**. The entry is added to the *History Control Table Page,* and the switch is updated.

Viewing the RMON History Table

The *History Table Page* displays interface specific statistical network samplings. Each table entry represents all counter values compiled during a single sample.

To view RMON history:

STEP 1 Click **RMON** > **History**. The *History Control Table Page* opens.

STEP 2 Click **History Control Table**. The *History Table Page* opens.

STEP 3 From the **History Entry No.** list, select the entry number to display the samples associated with that history entry.

The fields are displayed for the selected sample.

- **Owner—**History table entry owner.
- **Sample No.**—Statistics were taken from this sample.
- **Drop Events**—Dropped packets due to lack of network resources during the sampling interval. This may not represent the exact number of dropped packets, but rather the number of times dropped packets were detected.
- **Bytes Received**—Octets received that including bad packets and FCS octets, but excluding framing bits.

- **Packets Received—**Packets received, including bad packets, Multicast, and Broadcast packets.
- **Broadcast Packets—**Good Broadcast packets received. This number does not include Multicast packets.
- **Multicast Packets—**Good Multicast packets received.
- **CRC Align Errors—**CRC and Align errors that have occurred.
- **Undersize Packets—**Undersized packets (less than 64 octets) received.
- **Oversize Packets—**Oversized packets (over 1518 octets) received.
- **Fragments—**Fragments (packets with less than 64 octets) received, excluding framing bits, but including FCS octets).
- **Jabbers—**Total number of received packets that were longer than 1632 octets. This number excludes frame bits, but includes FCS octets that had either a bad FCS (Frame Check Sequence) with an integral number of octets (FCS Error) or a bad FCS with a non-integral octet (Alignment Error) number.
- **Collisions—**Collisions received.
- **Utilization—**Percentage of current interface traffic compared to maximum traffic that the interface can handle.

Defining RMON Events Control

The *Events Page* provides the ability to configure events that are *actions* performed when an alarm is generated (alarms are defined in the *Alarms Page*). An event can be any combination of logs and traps. If the action includes logging of the events, they are displayed in the *Event Log Table Page*.

To view RMON events:

STEP 1 Click **RMON** > **Events**. The *Events Page* opens.

This page displays previously-defined events.

STEP 2 Click **Add.** The *Add RMON Events Page* opens.

STEP 3 Enter the parameters.

- **Event Entry**—Displays the event entry index number for the new entry.
- **Community**—Enter the SNMP community string to be included when traps are sent (optional).
- **Description**—Enter a name for the event. This name is used in the *Add RMON Alarm Page* to attach an alarm to an event.
- **Type**—Select the type of action that results from this event. Values are:
    - *None*—No action occurs when the alarm goes off.
    - *Log*—Add a log entry when the alarm goes off.
    - *Trap*—Send a trap when the alarm goes off.
    - *Log and Trap*—Add a log entry and send a trap when the alarm goes off.
- **Owner**—Enter the device or user that defined the event.

STEP 4 Click **Apply**. The RMON event is added and the switch is updated.

Viewing the RMON Events Logs

The *Event Log Table Page* displays the log of events (actions) that occurred. An event can be logged when the type of the event is *Log* or *Log and Trap*. The action in the event is performed when the event is bound to an alarm (see the *Alarms Page*) and the conditions of the alarm have occurred.

STEP 1 Click **RMON** > **Events.** The *Events Page* opens.

STEP 2 Click **Event Log Table.** The *Event Log Table Page* opens.

This page displays the following fields:

- **Event**—Events log entry number.
- **Log No.**—Log number.
- **Log Time**—Time that the log entry was entered.
- **Description**—Log entry description.

Defining RMON Alarms

RMON alarms provide a mechanism for setting thresholds and sampling intervals to generate exception events on any RMON counters or any other SNMP object counter maintained by the agent. Both the rising and falling thresholds must be configured in the alarm. After a rising threshold is crossed, another rising event is not generated until the companion falling threshold is crossed. After a falling alarm is issued, the next alarm is issued when a rising threshold is crossed.

One or more alarms are bound to an event. The event indicates the action to be taken when the alarm occurs.

The *Alarms Page* provides the ability to configure alarms and to bind them with events. Alarm counters can be monitored by either absolute values or changes (delta) in the counter values.

To enter RMON alarms:

STEP 1 Click **RMON** > **Alarms**. The *Alarms Page* opens.

STEP 2 Click **Add.** The *Add RMON Alarm Page* opens.

STEP 3 Enter the parameters.

- **Alarm Entry**—Displays the alarm entry number.
- **Interface—**Select the type of interface for which RMON statistics are displayed.
- **Counter Name—**Select the MIB variable that indicates the type of occurrence measured.
- **Sample Type**—Select the sampling method to generate an alarm. The options are:
  - *Delta*—Subtracts the last sampled value from the current value. The difference in the values is compared to the threshold. If the threshold was passed, an alarm is generated.
  - *Absolute*—If the threshold is passed, an alarm is generated.
- **Rising Threshold**—Enter the rising counter value that triggers the rising threshold alarm.
- **Rising Event—**Select an event, from those that you defined in the Events table, to be performed when a rising event is triggered.

- **Falling Threshold**—Enter the falling counter value that triggers the falling threshold alarm.
- **Falling Event**—Selects an event, from those defined in the Events table, to be performed when a falling event is triggered.
- **Startup Alarm**—Select the first event from which to start generation of alarms. Rising is defined by crossing the threshold from a low-value threshold to a higher-value threshold.
  - *Rising Alarm*—A rising counter value triggers the rising threshold alarm.
  - *Falling Alarm*—A falling counter value triggers the falling threshold alarm.
  - *Rising and Falling*—Both a rising and falling counter values trigger the alarm.
- **Interval**—Enter the alarm interval time in seconds.
- **Owner**—Enter the name of the user or network management system that receives the alarm.

STEP 4 Click **Apply**. The RMON alarm is added and the switch is updated.

3

Managing System Logs

This chapter describes the System Log feature, which enables the switch to keep several independent logs. Each log is a set of messages recording system events.

The switch generates the following local logs:

- Log written into a cyclical list of logged events in RAM and is erased when the switch reboots.
- Log written to a cyclical log-file saved to Flash memory and persists across reboots.

In addition, you can log messages on remote, log-keeping SYSLOG servers in the form of SNMP traps and SYSLOG messages.

This chapter contains the following sections:

- **Setting System Log Settings**
- **Setting Remote Logging Settings**
- **Viewing Memory Logs**

Setting System Log Settings

You can enable or disable logging on the *Log Settings Page,* and select whether to aggregate log messages.

You can select the events by severity level. Each log message has a severity level marked with the first letter of the severity level concatenated with a dash (-) on each side (except for *Emergency* that is indicated by the letter F). For example, the log message "%INIT-I-InitCompleted: ... " has a severity level of **I**, meaning *Informational*.

The event severity levels are listed from the highest severity to the lowest severity, as follows:

- *Emergency*—System is not usable.
- *Alert*—Action is needed.
- *Critical*—System is in a critical condition.
- *Error*—System is in error condition.
- *Warning*—System warning has occurred.
- *Notice*—System is functioning properly, but a system notice has occurred.
- *Informational*—Device information.
- *Debug*—Provides detailed information about an event.

You can select different severity levels for RAM and Flash logs. These logs can are displayed in the *RAM Memory Page* and *Flash Memory Page*, respectively.

Selecting a severity level to be stored in a log causes all of the higher severity events to be automatically stored in the log. Lower severity events are not stored in the log.

For example, if **Warning** is selected, all severity levels that are **Warning** and higher are stored in the log (Emergency, Alert, Critical, Error, and Warning). No events with severity level below **Warning** are stored (Notice, Informational, and Debug).

To set global log parameters:

STEP 1 Click **Administration** > **System Log** > **Logs Settings**. The *Log Settings Page* opens.

STEP 2 Enter the parameters.

- **Logging**—Select to enable message logging.
- **Syslog Aggregation**—Select to enable the aggregation of SYSLOG messages and traps. If enabled, identical and contiguous SYSLOG messages and traps are aggregated over an interval of time and sent in a single message. The aggregated messages are sent in the order of their arrival. Each message states the number of times it has been aggregated.
- **Max Aggregation Time**—Enter the interval of time that SYSLOG messages are aggregated.

- **RAM Memory Logging—**Select the severity levels of the messages to be logged to RAM.
- **Flash Memory Logging—**Select the severity levels of the messages to be logged to Flash memory.

STEP 3 Click **Apply**. The switch is updated.

Setting Remote Logging Settings

The *Remote Log Servers Page* enables defining remote SYSLOG servers where log messages are sent (using the SYSLOG protocol). For each server, you can configure the severity of the messages that it receives.

To define SYSLOG servers:

STEP 1 Click **Administration** > **System Log** > **Remote Log Servers**. The *Remote Log Servers Page* opens.

This page displays the list of remote log servers.

STEP 2 Click **Add.** The *Add Remote Log Server Page* opens.

STEP 3 Enter the parameters.

- **IP Version—**Select the supported IP format.
- **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are:
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface—**Select the link local interface (if IPv6 Address Type Link Local is selected) from the list.
- **Log Server IP Address—**Enter the address of the server to which logs are sent.

- **UDP Port—**Enter the UDP port to which the log messages are sent.
- **Facility—**Select a facility value from which system logs are sent to the remote server. Only one facility value can be assigned to a server. If a second facility code is assigned, the first facility value is overridden.
- **Description—**Enter a server description.
- **Minimum Severity—**Select the minimum level of system log messages to be sent to the server.

STEP 4 Click **Apply.** The *Add Remote Log Server Page* closes, the SYSLOG server is added, and the switch is updated.

Viewing Memory Logs

The switch can write to the following logs:

- Log in RAM (cleared during reboot).
- Log in Flash memory (cleared only upon user command).

You can configure the messages that are written to each log by severity, and a message can go to more than one log, including logs that reside on external SYSLOG servers.

RAM Memory

The *RAM Memory Page* displays all messages, in chronological order, that were saved in RAM (cache). Entries are stored in the RAM log according to the configuration in the *Log Settings Page*.

To view log entries, click **Status and Statistics** > **View Log** > **RAM Memory**. The *RAM Memory Page* opens.

This page displays the following fields:

- **Log Index—**Log entry number.
- **Log Time—**Time when message was generated.
- **Severity—**Event severity.
- **Description—**Message text describing the event.

To clear the log messages, click **Clear Logs.** The messages are cleared.

Flash Memory

The *Flash Memory Page* displays the messages that were stored in Flash memory, in chronological order. The minimum severity for logging is configured in the *Log Settings Page*. Flash logs remain when the switch is rebooted. You can clear the logs manually.

To view the Flash logs click **Status and Statistics** > **View Log** > **Flash Memory**. The *Flash Memory Page* opens.

This page displays the following fields:

- **Log Index—**Log entry number.
- **Log Time—**Time when message was generated.
- **Severity—**Event severity.
- **Description—**Message text describing the event.

To clear the messages, click **Clear Logs.** The messages are cleared.

4

Managing System Files

You can chose the firmware file from which the switch boots. You can also copy file types internally on the switch, or to or from an external device, such as a PC.

The methods of file transfer are:

- Internal copy.
- HTTP that uses the facilities that the browser provides.
- TFTP client, requiring a TFTP server.

Configuration files on the switch are defined by their *type*, and contain the settings and parameter values for the device. When a configuration is referenced on the switch, it is referenced by its *configuration file type*, as opposed a file name that can be modified by the user. Content can be copied from one file type to another, but the names of the file types cannot be changed by the user. Other files on the device include firmware, boot code, and log files, and are referred to as *operational files*.

The configuration files are text files and can be edited by a user in a text editor, such as Notepad after they are copied to an external device, such as a PC.

Files and File Types

The following types of configuration and operational files are found on the switch:

- **Running Configuration—**Parameters that are currently used by the switch to operate. It is the only file type that is modified by you when the parameter values are changed by using one of the configuration interfaces, and must be manually saved to be preserved.

  If the switch is rebooted, the Running Configuration is lost. When the switch is rebooted, this file type is copied from the Startup Configuration stored in Flash to the Running Configuration stored in RAM.

To preserve any changes made to the switch, you must save the Running Configuration to the Startup Configuration, or another file type if you do not want the switch to reboot with this configuration. If you have saved the Running Configuration to the Startup Configuration, when the switch is rebooted, it recreates a Running Configuration that includes the changes you have made since the last time the Running Configuration was saved to the Startup Configuration.

- **Startup Configuration—**The parameter values that were saved by you by copying another configuration (usually the Running Configuration) to the Startup Configuration.

  The Startup Configuration is retained in Flash and is preserved any time the switch is rebooted. When it is rebooted, the Startup Configuration is copied to RAM and identified as the Running Configuration.

- **Backup Configuration—**A manual copy of the parameter definitions for protection against system shutdown or for the maintenance of a specific operating state. You can copy the Mirror Configuration, Startup Configuration, or Running Configuration to a Backup Configuration file. The Backup Configuration exists in Flash and is preserved if the device is rebooted.

- **Mirror Configuration—**A copy of the Startup Configuration, created by the switch after:

  - The switch has been operating continuously for 24 hours.

  - No configuration changes have been made to the Running Configuration in the previous 24 hours.

  - The Startup Configuration is identical to the Running configuration.

  Only the system can copy the Startup Configuration to the Mirror Configuration. However, you can copy from the Mirror Configuration to other file types or to another device.

  If the switch is rebooted, the Mirror Configuration is reset to the factory default parameters. In all other aspects, the Mirror Configuration behaves the same as a Backup Configuration, providing a copy of the parameter values that is preserved if the switch is rebooted.

- **Firmware—**The operating system. More commonly referred to as the *image*.

- **Boot Code—**Controls the basic system startup and launches the firmware image.

- **Language File—**The dictionary that allows the windows to be displayed in the selected language.
- **Flash Log—**SYSLOG messages stored in Flash memory.

File Actions

The following actions can be performed to manage firmware and configuration files:

- Upgrade the firmware or boot code, or replace a language as described in **Upgrade/Backup Firmware/Language** section.
- View the firmware image currently in use or select the image to be used in the next reboot as described in the **Selecting the Active Image** section.
- Save files on the switch to a location on another device as described in the **Downloading or Backing-up a Configuration or Log** section.
- Clear the Startup Configuration or Backup Configuration file types as described in the **Displaying Configuration File Properties**.
- Copy one configuration file type onto another configuration file type as described in the **Copying or Saving Switch Configuration File Types.**
- Upload a configuration file from a TFTP server to the switch as described in the **Setting DHCP Auto Configuration** section.

⚠ CAUTION Unless the Running Configuration is manually copied to the Startup Configuration, Backup Configuration, or an external file, all changes made since the last time the file was saved are lost when the switch is rebooted. We recommend that you save the Running Configuration to the Startup Configuration before logging off to preserve any changes you made during this session.

A red X icon, displayed to the left of the **Save** application link, indicates that configuration changes have been made and have not yet been saved to the Startup Configuration file.

When you click **Save**, the *Copy/Save Configuration Page* is displayed. Save the Running Configuration file by copying it to the Startup Configuration file. After this save, the red X icon and the link to the *Copy/Save Configuration Page* are hidden.

This chapter describes how configuration and log files are managed.

It includes the following topics:

Upgrade/Backup Firmware/Language

The **Upgrade/Backup Firmware/Language** process can be used to:

- Upgrade or backup the firmware image
- Upgrade or backup the boot code
- Import a new language file or upgrade an existing language file

The following methods for transferring files are supported:

- HTTP that uses the facilities provided by the browser
- TFTP that requires a TFTP server

If a new language file was loaded onto the switch, the new language can be selected from the drop-down menu. (It is not necessary to reboot the switch.)

The **Upgrade/Backup Firmware/Language** page can also be accessed by selecting **Add New Language** in the Language drop down menu on every page.

Uploading a New Firmware or Language File

There are two firmware images, **Image1** and **Image2**, stored on the switch. One of the images is identified as the *active image* and other image is identified as the *inactive image*.

When you upgrade the firmware, the new image is always replaces the image identified as the inactive image.

After uploading new firmware on the switch, the switch continues to boot by using the active image (the old version) until you change the status of the new image to be the active image by using the procedure in the **"Selecting the Active Image"** section. Then boot the switch by using the process described in the **Rebooting the Switch** section.

To download or backup a system or language file:

STEP 1 Click **Administration** > **File Management** > **Upgrade/Backup Firmware/ Language**. The *Upgrade/Backup Firmware/Language* page opens.

STEP 2 Click the Transfer Method. If you selected TFTP, go to **STEP 3**. If you selected HTTP, go to **STEP 4**.

STEP 3 If you selected TFTP, enter the parameters as described in this step. Otherwise, skip to **STEP 4**.

Select the **Save Action**.

If for the **Save Action** you select *Upgrade* to specify that the file type on the switch is to be replaced with a new version of that file type located on a TFTP server, do the following. Otherwise, go to the next procedure in this step.

a. **File Type**—Select the destination file type. Only valid file types are shown. (The file types are described in the **Files and File Types** section.)

b. **IP Version—**Select whether an IPv4 or an IPv6 address is used.

c. **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are:

- *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
- *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.

d. **Link Local Interface—**Select the link local interface (if IPv6 is used) from the list.

e. **TFTP Server—**Enter the IP address of the TFTP server.

f. **Source File Name—**Enter the name of the source file.

If for the **Save Action** you selected *Backup* to specify that a copy of the file type is to be saved to a file on another device, do the following:

a. **File Type—**Select the source file type. Only valid file types can be selected. (The file types are described in the **Files and File Types** section.)

b. **IP Version—**Select whether an IPv4 or an IPv6 address is used.

c. **IPv6 Address Type—**Select the IPv6 address type (if used). The options are:

- *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
- *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.

d. **Link-Local Interface—**Select the link local interface (if IPv6 is used) from the list.

e. **TFTP Server—**Enter the IP address of the TFTP server.

f. **Destination File Name—**Enter the destination file name. File names cannot contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on a TFTP server is 160 characters. (Valid characters: A-Z, a-z, 0-9, “.”, “-”, “_”).

STEP 4 If you selected **HTTP**, enter the parameters as described in this step.

Select the **Save Action—**Only supported actions can be selected.

If for the **Save Action** you selected **Upgrade** to specify that the file type on the switch is to be replaced with a new version of that file type, do the following. Otherwise if you selected **Backup**, go to the next procedure in this step.

a. **File Type—**Select the configuration file type. Only valid file types can be selected. (The file types are described in the **Files and File Types** section.)

b. **File Name—**Click *Browse* to select a file or enter the path and source file name to be used in the transfer.

c. Click **Apply**. The file is upgraded.

If for the **Save Action** you selected **Backup** to specify that a copy of the file type is to be saved to a file on another device, do the following:

a. **Source File Type—**Select the configuration file type. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

b. Click **Apply**. The **File Download** window displays.

c. Click **Save**. The **Save As** window displays.

d. Click **Save**.

STEP 5 Click **Apply** or **Done**. The file is upgraded or backed up.

Selecting the Active Image

There are two firmware images, **Image1** and **Image2**, stored on the switch. One of the images is identified as the *active image* and other image is identified as the *inactive image*. The switch boots from the image you set as the *active image*. You can change the image identified as the *inactive image* to the *active image*. (You can reboot the switch by using the process described in the **Rebooting the Switch** section.)

To select the active image:

STEP 1 Click **Administration** > **File Management** > **Active Image**. The *Active Image Page* opens.

The page displays the following:

Active Image—Displays the image file that is currently active on the switch.

Active Image Version Number—Displays the firmware version of the active image.

STEP 2 Select the image from the **Active Image After Reboot** menu to identify the firmware image that is used as the active image after the switch is rebooted. The **Active Image Version Number After Reboot** displays the firmware version of the active image that is used after the switch is rebooted.

STEP 3 Click **Apply**. The active image selection is updated.

Downloading or Backing-up a Configuration or Log

The *Download/Backup Configuration/Log Page* enables the backup from configuration file types or the flash log on the switch to a file on another device or the restoration of configuration file types from another device to the switch.

When restoring a configuration file to the Running Configuration, the imported file *adds* any configuration commands that did not exist in the old file and *overrides* any parameter values in the existing configuration commands.

When restoring a configuration file to the Startup Configuration or a backup configuration file, the new file *replaces* the previous file.

When restoring to Startup Configuration, the switch must be rebooted for the restored Startup Configuration to be used as the Running Configuration. You can reboot the switch by using the process described in the **Rebooting the Switch** section.

To backup or restore the system configuration file:

STEP 1 Click **Administration** > **File Management** > **Download/Backup Configuration/ Logging**. The *Download/Backup Configuration/Log Page* opens.

STEP 2 Click the Transfer Method.

STEP 3 If you selected TFTP, enter the parameters. Otherwise, skip to **STEP 4**.

Select the **Save Action**.

If the **Save Action** you selected is *Download* to specify that the file on another device will replace a file type on the switch, do the following. Otherwise, go to the next procedure in this step.

a. **IP Version—**Select whether an IPv4 or an IPv6 address is used.

b. **IPv6 Address Type—**Select the IPv6 address type (if used). The options are:

- *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
- *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.

c. **Link-Local Interface—**Select the link local interface from the list.

d. **TFTP Server—**Enter the IP address of the TFTP server.

e. **Source File Name—**Enter the source file name. File names cannot contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 160 characters. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_").

f. **Destination File Type—**Enter the destination configuration file type. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

If for the **Save Action** you selected *Backup* to specify that afile type is to be copied to a file on another device, do the following:

a. **IP Version—**Select whether an IPv4 or an IPv6 address is used.

b. **IPv6 Address Type—**Select the IPv6 address type (if used). The options are:

- *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
- *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.

c. **Link-Local Interface—**Select the link local interface from the list.

d. **TFTP Server—**Enter the IP address of the TFTP server.

e. **Source File Type—**Enter the source configuration file type. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

f. **Destination File Name—**Enter the destination file name. File names cannot contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 160 characters. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_").

STEP 4 If you selected HTTP, enter the parameters as described in this step.

Select the **Save Action**.

If for the **Save Action** you select *Download* to specify that the file type on the switch is to be replaced with a new version of that file type from a file on another device, do the following. Otherwise, go to the next procedure in this step.

a. **Source File Name—**Click *Browse* to select a file or enter the path and source file name to be used in the transfer.

b. **Destination File Type—**Select the configuration file type. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

c. Click **Apply**. The file is transferred from the other device to the switch.

If for the **Save Action** you selected *Backup* to specify that a file type is to be copied to a file on another device, do the following:

a. **Source File Type—**Select the configuration file type. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

b. Click **Apply**. The **File Download** window displays.

c. Click **Save**. The **Save As** window displays.

d. Click **Save**.

STEP 5 Click **Apply** or **Done**. The file is upgraded or backed up on the switch (depending upon the file type).

Displaying Configuration File Properties

This *Configuration Files Properties Page* enables the viewing of system configuration file types and the date and time they were modified. It also enables deleting the Startup Configuration and/or the Backup Configuration. You cannot delete the other configuration file types.

To view configuration file properties, click **Administration** > **File Management** > **Configuration Files Properties**. The *Configuration Files Properties Page* opens.

This page provides the following fields:

- **Configuration File Name—**Displays the type of file.
- **Creation Time—**Displays the date and time that file was modified.

To clear a configuration file, select it and click **Clear Files**.

Copying or Saving Switch Configuration File Types

When you click **Apply** on any window, changes that you made to the switch configuration settings are stored *only* in the Running Configuration. To preserve the parameters in the Running Configuration, the Running Configuration must be copied to another configuration type or saved as a file on another device.

The *Copy/Save Configuration Page* enables copying or saving one configuration file to another for backup purposes.

CAUTION Unless the Running Configuration is copied to the Startup Configuration or another configuration file, all changes made since the last time the file was copied are lost when the switch is rebooted.

The following combinations of copying internal file types are allowed:

- From the Running Configuration to the Startup Configuration or Backup Configuration.
- From the Startup Configuration to the Backup Configuration.
- From the Backup Configuration to the Startup Configuration.
- From the Mirror Configuration to the Startup Configuration or Backup Configuration.

To copy one configuration from one file type to another file type:

STEP 1 Click **Administration** > **File Management** > **Copy/Save Configuration**. The *Copy/Save Configuration Page* opens.

STEP 2 Select the **Source File Name** to be copied. Only valid file types are displayed. (The file types are described in the **Files and File Types** section.)

STEP 3 Select the **Destination File Name** to be overwritten by the source file.

STEP 4 Click **Apply**. The file is copied and switch is updated.

Setting DHCP Auto Configuration

Dynamic Host Configuration Protocol (DHCP) provides a means of passing configuration information (including the IP address of a TFTP server and a configuration file name) to hosts on a TCP/IP network. By default, the switch is enabled as a DHCP client.

When the IP address is allocated or renewed, such as during a reboot or upon an explicit DHCP renewal request and if the switch and the server are configured to do so, the switch transfers a configuration file from the TFTP server identified to the switch by DHCP. This process is known as *auto configuration*.

NOTE If you enable DHCP Auto Configuration on a switch with DHCP disabled, you must enable the DHCP by using the procedure is described in the **IP Addressing** section.

The *DHCP Auto Configuration Page* configures the switch to receive DHCP information pointing to a TFTP server for auto configuration purposes or manual configuration of the TFTP server and configuration file in the event that the information is not provided in a DHCP message.

Note the following limitations regarding the DHCP auto-update process:

- A configuration file that is placed on the TFTP server must match the form and format requirements of a supported configuration file. The form and format of the file are checked, but the validity of the configuration *parameters* is not checked prior to loading it to the Startup Configuration.

- To make sure the configuration of devices functions as intended and due to allocation of different IP addresses with each DHCP renew cycle, IP addresses must be bound to MAC addresses in the DHCP server table. This ensures that each device has its own reserved IP address and other relevant information.

To configure DHCP server auto configuration:

STEP 1 Click **Administration** > **File Management** > **DHCP Auto Configuration**. The *DHCP Auto Configuration Page* opens.

STEP 2 Enter the values.

- **Auto Configuration Via DHCP—**Select this field to enable or disable the automatic transfer of a configuration from a TFTP server to the Startup Configuration on the switch.
- **Backup TFTP Server—**Enter the IP address of the TFTP server to be used if no TFTP server IP address was specified in the DHCP message.
- **Backup Configuration File—**Enter the path and file name of the file to be used when no configuration file name was specified in the DHCP message.

The window displays the following:

- **Last Auto Configuration TFTP Server IP Address—**Displays the IP address of the TFTP server last used to perform auto configuration.
- **Last Auto Configuration File Name—**Displays the last file name used by the switch in auto configuration.

  The Last Auto Configuration TFTP Server IP Address and the Last Auto Configuration File Name are compared with the information received from a DHCP server in conjunction with receiving a configuration IP address for the switch. In the event that these values do not match, the switch transfers the configuration file from the TFTP server identified by the DHCP server into the Startup Configuration file, and initiates a reboot. If the values match, no action is taken.

STEP 3 Click **Apply**. The DHCP Auto Configuration is updated.

General Administrative Information and Operations

This chapter describes how to view system information and configure various options on the switch.

It includes the following topics:

System Information

The *System Summary Page* provides a graphic view of the switch, and displays switch status, hardware information, firmware version information, general Power-over-Ethernet (PoE) status, and so forth.

Displaying the System Summary

To view system information, click **Status and Statistics** > **System Summary**. The *System Summary Page* opens.

The System Summary page displays system and hardware information.

System information:

- **System Description**—A description of the system.
- **System Location**—Physical location of the switch. Click **Edit** to go the *System Settings Page* to enter this value.
- **System Contact**—Name of a contact person. Click **Edit** to go the *System Settings Page* to enter this value.
- **Host Name**—Name of the switch. Click **Edit** to go the *System Settings Page* to enter this value. By default, the switch hostname is composed of the word *switch* concatenated with the three least significant bytes of the switch MAC address (the six furthest right hexadecimal digits).
- **System Object ID**—Unique vendor identification of the network management subsystem contained in the entity (used in SNMP).
- **System Uptime**—Time that has elapsed since the last reboot.
- **Current Time**—Current system time.
- **Base MAC Address**—Switch MAC address.
- **Jumbo Frames**—Jumbo frame support status. This support can be enabled or disabled by using the *Port Settings Page*.

Hardware and firmware version information:

- **Model Description**—Switch model description.
- **Serial Number**—Serial number.
- **PID VID**—Part number and version ID.
- **Firmware Version (Active Image)**—Firmware version number of the active image.
- **Firmware MD5 Checksum (Active Image)**—MD5 checksum of the active image.
- **Firmware Version (Non-active Image)**—Firmware version number of the non-active image. .
- **Firmware MD5 Checksum (Non-active Image)**—MD5 checksum of the non-active image.
- **Boot Version**—Boot version number.
- **Boot MD5 Checksum**—MD5 checksum of the boot version.

- **Locale—**Locale of the first language. (This is always English.)
- **Language Version—**Firmware version of the primary language package.
- **Language MD5 Checksum—**MD5 checksum of the language file.
- **Locale—**Locale of the second language.
- **Language version—**Firmware version of the secondary language package.
- **Language MD5 Checksum—**MD5 checksum of the secondary language file.

General PoE Status on models with PoE capability:

- **Maximum Available Power (W)—**Maximum available power that can be delivered by the PoE.
- **Main Power Consumption (W)—**Current PoE power delivered to connected PoE devices.
- **System Operation Status—**PoE Power mode.

Configuring the System Settings

To enter system settings:

STEP 1 Click **Administration** > **System Settings**. The *System Settings Page* opens.

STEP 2 Modify the system settings.

- **System Description—**Displays a description of the switch.
- **System Location—**Enter the location where the switch is physically located.
- **System Contact—**Enter the name of a contact person.
- **Host Name—**Select the host name:
  - *Use Default*—The default hostname (System Name) of these switches is: *switch123456*, where 123456 represents the last three bytes of the switch MAC address in hex format.
  - *User Defined*—Enter the hostname. Use only letters, digits, and hyphens. Host names cannot begin or end with a hyphen. No other symbols, punctuation characters, or blank spaces are permitted (as specified in RFC1033, 1034, 1035).

STEP 3 Click **Apply** to set the values in the Running Configuration.

Switch Models

All models can be fully managed through the web-based switch configuration utility. Layer 2 is the default mode of operation for all devices. In Layer 2 mode, the switch forwards packets as a VLAN aware bridge. In Layer 3 mode, the switch performs both IPv4 routing and VLAN aware bridging.

Each model can be set to Layer 3 mode by using the console interface, described in the **Console Menu Interface** chapter of the administration guide. When the switch operates in Layer 3 mode, the VLAN Rate Limit, and QoS policers are not operational. Other QoS Advanced mode features are operational.

Managed Switch Models

Model Name	Product ID (PID)	Description	Ports	Power Dedicated to PoE	No. of Ports that Support PoE
SG 300-10	SRW2008-K9	10-port Gigabit.	g1-g10, 8 GE + 2 combo ports (GE/SFP).		
SG 300-10MP	SRW2008MP-K9	10-port Gigabit PoE.	g1-g10, 8 GE + 2 combo ports.	At most 124W	8
SG 300-10P	SRW2008P-K9	10-port Gigabit PoE.	g1-g10, 8 GE + 2 combo ports.	At most 62W	8
SG 300-20	SRW2016-K9	20-port Gigabit.	g1-g20, 16 GE + 4 GE-2 shared SFP slots.		
SG 300-28	SRW2024-K9	28-port Gigabit.	g1-g28. 24 regular ports, and four special-purpose ones - uplinks and combo-ports.		
SG 300-28P	SRW2024P-K9	28-port Gigabit PoE.	g1-g28. 24 regular ports, and four special-purpose ones - uplinks and combo-ports.	At most 180W	24
SG 300-52	SRW2048-K9	52-port Gigabit.	g1-g52. 48 regular ports, and four special-purpose ones - uplinks and combo-ports.		

Managed Switch Models (Continued)

Model Name	Product ID (PID)	Description	Ports	Power Dedicated to PoE	No. of Ports that Support PoE
SF 300-08	SRW208-K9	8-port 10/100.	e1-e8. 8-port 10/100.		
SF 302-08	SRW208G-K9	8-port 10/100.	e1-e8, g1-g2. 8-port 10/1000 plus two 10/100/1000 ports.		
SF 302-08MP	SRW208MP-K9	8-port 10/100 PoE.	e1-e8, g1-g2. 8-port 10/1000 plus two 10/100/1000 ports.	At most 124W	8
SF 302-08P	SRW208P-K9	8-port 10/100 PoE.	e1-e8, g1-g2. 8-port 10/100 plus two 10/100/1000 ports.	At most 62W	8
SF 300-24	SRW224G4-K9	24-port 10/100.	e1-e24, g1-g4. 24 regular 10/100 ports plus four 10/100/1000 special-purpose ports - uplinks and combo-ports.		
SF 300-24P	SRW224G4P-K9	24-port 10/100 PoE.	e1-e24, g1-g4. 24 regular 10/100 ports plus four 10/100/1000 special-purpose ports - uplinks and combo-ports.	At most 180W	24
SF 300-48	SRW248G4-K9	48-port Gigabit.	e1-e48, g1-g4. 48 regular 10/100 ports plus four 10/100/1000 special-purpose ports - uplinks and combo-ports.		
SF 300-48P	SRW248G4P-K9	48-port 10/100 PoE.	e1-e48, g1-g4. 48 regular 10/100 ports plus four 10/100/1000 special-purpose ports - uplinks and combo-ports.	At most 375W	48

Rebooting the Switch

Some configuration changes, such as enabling jumbo frame support, require the system to be rebooted before they take effect. However, rebooting the switch deletes the Running Configuration, so it is critical that the Running Configuration is saved to the Startup Configuration before the switch is rebooted. Clicking **Apply** does not save the configuration to the Startup Configuration. For more information on files and file types, see the **Files and File Types** section in the **Managing System Files** chapter.

You can backup the configuration by using Administration > Save/Copy Configuration or click **Save** at the top of the window. You can also upload the configuration from a remote device see the **"Downloading or Backing-up a Configuration or Log"** section in the **Managing System Files** chapter.

To reboot the switch:

STEP 1 Click **Administration** > **Reboot**. The *Reboot Page* opens.

STEP 2 Click one of the Reboot buttons.

- **Reboot—**Reboots the switch. Since any unsaved information in the Running Configuration s discarded when the switch is rebooted, you must click **Save** in the upper-right corner of any window to preserve current configuration across the boot process. (If the Save option is not displayed, the Running Configuration matches the Startup Configuration and no action is necessary.)
- **Reboot to Factory Defaults—**Reboots the switch by using factory default configuration. This process erases the Startup Configuration file; any settings that are not saved to another file are cleared when this action is selected.

⚠ **CAUTION** DHCP Auto Configuration should be disabled (enabled by default), otherwise a configuration file might be loaded from a TFTP server, instead of the factory default settings.

The switch is rebooted.

Monitoring the Fan Status and Temperature

The *Health Page* displays the switch fan status and temperature on a SF 300-48P. The SG 300-28P, SF 300-24P, and SG 300-52 display only the fan status.

To view the switch health parameters, click **Status and Statistics** > **Health**. The *Health Page* opens.

The Health page displays the following fields:

- **Fan Status—**Fan status.
- **Temperature—**Switch temperature.

Defining Idle Session Timeout

The *Idle Session Timeout* configures the time intervals that the management sessions can remain idle before they timeout and the user must login again to reestablish one of the following sessions:

- **HTTP Session Timeout**
- **HTTPS Session Timeout**
- **Console Session Timeout**
- **Telnet Session Timeout**
- **SSH Session Timeout**

To enter the idle session timeout for various types of sessions:

STEP 1 Click **Administration** > **Idle Session Timeout**. The *Idle Session Timeout* opens.

STEP 2 Select the timeout for each session from the corresponding list. The default timeouts are 10 minutes.

STEP 3 Click **Apply** to set the configuration settings on the switch.

————————————————————

6

System Time

Network time synchronization is critical because every aspect of managing, securing, planning, and debugging a network involves determining when events occur. Time also provides the only frame of reference between all devices on the network. Without synchronized time, accurately correlating log files between these devices is difficult, even impossible.

A few of the specific reasons include, tracking security breaches, network usage. Problems affecting a large number of components can be nearly impossible to track if timestamps in logs are inaccurate.

Time also reduces confusion in shared file systems, as it is important for the modification times to be consistent, regardless of the machine on which the filesystems reside.

For these reasons, it is important that the time configured on the all devices on the network be accurate.

NOTE The switch supports Simple Network Time Protocol (SNTP) and when enabled, the switch dynamically synchronizes the switch time with the SNTP server time. The switch operates only as an SNTP client, and cannot provide time services to other devices.

This chapter describes the options for configuring system time, time zone, and Daylight Savings Time (DST). It includes the following topics:

- **System Time Options**
- **Configuring System Time**
- **Setting SNTP**
- **Defining SNTP Authentication**

System Time Options

System time can be set manually by the user or dynamically by using an SNTP server. If an SNTP server is chosen, the manual time settings are overwritten when communications with the server is established.

As part of the boot process, the switch always configures the time, time-zone, and DST in some way, either from DHCP, from SNTP, from values set manually, or if all else fails from the factory defaults.

Time

The following methods are available for obtaining or setting the time on the switch:

- SNTP that ensures accurate network time synchronization of the switch up to the millisecond by using an SNTP server for the clock source.

  NOTE Without synchronized time, accurately correlating log files between devices is difficult, even impossible. We recommend that you use SNTP for the clock source.

- Manual entry of the system time by the user.

- Entry of the time by the computer that accesses the switch through the device configuration utility. If this feature is enabled, the switch uses the system time from the configuring computer, unless the time has been configured on the switch manually by the user or SNTP server support is not available or enabled.

  NOTE Receiving the time from the computer configuring the switch should be the last resort, such as after a power outage and no other time source is available.

Time Zone and Daylight Savings Time (DST)

The Time Zone and DST can be set on the switch in the following ways:

- Dynamic configuration of the switch through a DHCP server, where:

  - Dynamic DST, when enabled and available, always takes precedence over the manual configuration of DST.

  - If the server supplying the source parameters fails or dynamic configuration is disabled by the user, the manual settings are used.

  - Dynamic configuration of the time zone and DST continues after the IP address lease time has expired.

- Manual configuration of the time zone and DST by the user, where the time zone and DST set manually becomes the Operational time zone and DST, only if the dynamic configuration of the time zone and DST is disabled or fails.

Configuring System Time

Use the *System Time Page* to configure the current time, time zone, DST, and the time source. If the time is determined manually, enter the manual time here.

CAUTION The switch does not have an internal clock that updates this value. If the system time is set manually and the switch is rebooted, the manual time settings must be reentered.

To define system time:

STEP 1 Click **Administration**> **Time Settings** > **System Time**. The *System Time Page* opens.

STEP 2 Enter the parameters.

- **Clock Source—**Select the source used to set the system clock.
  - **Use Local Settings—**The system time is either entered manually or taken from the configuring computer. If this radio button is selected, enter the Local Settings.
  - **Use SNTP Server—**The system time is obtained from an SNTP server. Also, add an SNTP server and enable SNTP broadcast mode by using the *SNTP Settings Page*. Enforce authentication of the SNTP sessions by using the *SNTP Authentication Page*.
- **Alternate Clock Source—**Select to set the date and time from this computer when Use Local Settings is selected.
- **Get time zone from DHCP—**Select to enable dynamic configuration of the time zone and the DST from the DHCP server. Whether one or both of these parameters can be configured depends on the information found in the DHCP packet. If this option is enabled, *you must also enable DHCP client on the switch*. To do this, set the **IP Address Type** to **Dynamic** in the *IPv4 Interface Page*.

Local Settings—The local time is used when there is no alternate source of time, such as an SNTP server:

- **Date**—Enter the system date.
- **Local Time**—Enter the system time.
- **Time Zone Offset**—Select the difference in hours between *Greenwich Mean Time* (GMT) and the local time. For example, the Time Zone Offset for Paris is GMT +1, while the Time Zone Offset for New York is GMT – 5.
- **Daylight Savings**—Select Daylight Savings to enable DST.
- **Time Set Offset**—Enter the number of minutes that Daylight Savings Time causes clocks to adjust.
- **Daylight Savings Type**—Select how DST is defined:
  - **USA**—According to the dates used in the USA
  - **European**—According to the dates used by the European Union and other countries that use this standard.
  - **By Dates**—Manually, typically for a country other than the USA or a European country. Enter the following parameters:
    - **From**—Day and time that DST starts.
    - **To**—Day and time that DST ends.
    - **Recurring**—DST occurs on the same date every year. Enter the following parameters:

    From—Date when DST begins each year.

    Day—Day of the week on which DST begins every year.

    Week—Week within the month from which DST begins every year.

    Month—Month of the year in which DST begins every year.

    Time—The time at which DST begins every year.

    To—Date when DST ends each year. For example, DST ends locally every fourth Friday in October at 5:00 am. The parameters are:

    Day—Day of the week on which DST ends every year.

    Week—Week within the month from which DST ends every year.

    Month—Month of the year in which DST ends every year.

Time—The time at which DST ends every year.

STEP 3 Click **Apply**. The system time values are defined, and the switch is updated.

The time settings are displayed in the *Actual Time Details* block.

Setting SNTP

A switch can be configured to synchronize its system clock with an SNTP server by using the *SNTP Settings Page*.

NOTE This feature requires that the DNS servers be configured on the switch (see the **Defining DNS Servers** section) to work properly.

The switch supports the following modes:

- Broadcast—The SNTP server broadcasts the time, and the switch listens to these broadcasts. When the switch is in this mode, there is no need to define a Unicast SNTP server.
- Unicast SNTP Server Mode—The switch sends Unicast queries to the list of manually-configured SNTP servers, and waits for a response.

The switch supports having both modes active at the same time, choosing the best source of the parameters according to the closest stratum (distance from the reference clock.).

To define SNTP server settings:

STEP 1 Click **Administration** > **Time Settings** > **SNTP Settings**. The *SNTP Settings Page* opens.

STEP 2 (Optional) Select **SNTP Broadcast Reception** > **Enable** to listen to SNTP Broadcast synchronization packets for system time information. If this option is selected, the system does not display the SNTP server from which the time parameters are received.

This page displays the following information for each Unicast SNTP server:

- **SNTP Server**—SNTP server IP address. Up to eight SNTP servers can be defined. The preferred server is chosen according to its stratum level.
- **Poll Interval**—Interval (in seconds) at which the SNTP server is polled for system time information. The poll interval is 1024 seconds.

- **Authentication Key ID—**Key Identification used to communicate between the SNTP server and switch.
- **Preference—**Priority of use for the SNTP server.
  - *Primary*—Server with the lowest stratum level. Stratum level is the distance from the reference clock. Time information is taken from this server.
  - *Secondary*—Server with the next lowest stratum level after the primary server. Serves as a backup to the primary server.
  - *In progress*—SNTP server that is currently sending or receiving SNTP information.
- **Status**—SNTP server status. The possible options are:
  - *Up*—SNTP server is currently operating normally.
  - *Down*—SNTP server is currently not available.
  - *Unknown*—SNTP server is currently being searched for by the switch.
- **Last Response—**Date and time of the last time a response was received from this SNTP server.
- **Offset**—The estimated offset of the server's clock relative to the local clock, in milliseconds. The host determines the value of this offset using the algorithm described in RFC 2030.
- **Delay**—The estimated round-trip delay of the server's clock relative to the local clock over the network path between them, in milliseconds. The host determines the value of this delay using the algorithm described in RFC 2030.

STEP 3 Click **Add** to display the *Add SNTP Server Page*.

STEP 4 Enter the following parameters:

- **Server Definition—**Select if the SNTP server is going to be identified by its IP address or if you are going to chose a well-known SNTP server by name from the list.

  NOTE To specify a well-known SNTP server, the switch must be connected to the Internet and configured with a DNS server or configured so that a DNS server is identified by using DHCP. (See the **Defining DNS Servers** section.)

- **IP Version—**Select the version of the IP address: **Version 6** or **Version 4**.

- **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface—**Select the link local interface (if IPv6 Address Type Link Local is selected) from the list.
- **SNTP Server IP Address—**Enter the SNTP server IP address. The format depends on which address type was selected.
- **SNTP Server—**Select the name of the SNTP server from a list of well-known SNTP servers. If **other** is chosen, enter name of SNTP server in the adjacent field.
- **Poll Interval—**Select to enable polling of the SNTP server for system time information. All SNTP servers that are registered for polling are polled, and the clock is selected from the server with the lowest stratum level (distance from the reference clock.) that is reachable. The server with the lowest stratum is considered to be the primary server. The server with the next lowest stratum is a secondary server, and so forth. If the primary server is down, the switch polls all servers with the polling setting enabled, and selects a new primary server with the lowest stratum.
- **Authentication—**Select the check box to enable authentication.
- **Authentication Key ID—**If authentication is enabled, select the value of the key ID. (Create the authentication keys using the *SNTP Authentication Page*.)

STEP 5 Click **Apply**. The STNP server is added, and you are returned to the main page.

Defining SNTP Authentication

The *SNTP Authentication Page* enables configuration of the authentication keys that are used when communicating with an SNTP server that requires authentication.

After a key has been created, it must be bound to one or more relevant SNTP servers to be authenticated. This authentication key can also be used for authentication when receiving Broadcast synchronization.

SNTP sessions might require authentication. A Unicast SNTP server that requires authentication must be bounded with an authentication key when it is added by using the *Add SNTP Server Page*.

To define SNTP authentication:

STEP 1 Click **Administration** > **Time Settings** > **SNTP Authentication**. The *SNTP Authentication Page* opens.

STEP 2 Select **SNTP Authentication** to require authentication of an SNTP session between the switch and an SNTP server.

STEP 3 Click **Apply** to update the switch.

STEP 4 Click **Add.** The *Add SNTP Authentication Page* opens.

STEP 5 Enter the following parameters:

- **Authentication Key ID—**Enter the number used to identify this SNTP authentication key internally.
- **Authentication Key—**Enter the key used for authentication (up to eight characters). The SNTP server must send this key for the switch to synchronize to it.
- **Trusted Key—**Select the check box to allow the switch to receive broadcast synchronization information only from a SNTP server by using this authentication key.

STEP 6 Click **Apply**. The SNTP Authentication is defined, and the switch is updated.

7

Managing Device Diagnostics

This chapter contains information for configuring port mirroring, running cable tests, and viewing device operational information.

It includes the following topics:

- **Testing Copper Ports**
- **Displaying Optical Module Status**
- **Configuring Port and VLAN Mirroring**
- **Viewing CPU Utilization**

Testing Copper Ports

The *Copper Ports Page* displays the results of integrated cable tests performed on copper cables.

Two types of tests are used:

- Time Domain Reflectometry (TDR) technology tests the quality and characteristics of a copper cable attached to a port. Cables of up to 100 meters long can be tested.
- DSP-based tests are performed on active GE links to measure length.

CAUTION When a port is tested, it is set to the Down state and communications are interrupted. After the test, the port returns to the Up state. It is not recommended that you run the copper port test on a port you are using to run the web-based switch configuration utility, because communications with that device are disrupted.

To test copper cables attached to ports:

STEP 1 Click **Administration** > **Diagnostics** > **Copper Ports**. The *Copper Ports Page* opens.

This page displays the results of previously-conducted basic tests.

STEP 2 To perform a Basic test, select a port from the list of ports, and click **Basic Test**. A message displays indicating that the test causes the link to briefly go down.

STEP 3 Click **OK** to confirm that the link can go down or click **Cancel** to abort the test.

The results are displayed on the page:

- **Test Result**—Cable test results. Possible values are:
  - *OK*—Cable passed the test.
  - *No Cable*—Cable is not connected to the port.
  - *Open Cable*—Cable is connected on only one side.
  - *Short Cable*—Short circuit has occurred in the cable.
  - *Unknown Test Result*—Error has occurred.
- **Distance to Fault**—Distance from the port to the location on the cable where the fault was discovered.
- **Cable Length**—Estimated cable length, available only for 1 GB links, excluding Combo ports. See explanation in the *Cable Length Description* section.

  NOTE The cable length is **Unknown** when the green features are enabled.
- **Last Update**—Time of the last test conducted on the port.

STEP 4 To perform the Advanced test on all GE ports, click **Advanced Test.** The *Copper Cable Extended Feature Page* opens.

NOTE To avoid unknown results in the Advanced Test, perform the Basic Test first.

This page displays the results of the most recent test:

- **Port**—Port identifier.
- **Cable Status**—Cable status.
- **Speed**—Link speed.

- **Link Status**—Current link Up/Down status.
- **Pair**—Cable wire pairs being tested.
- **Distance to Fault**—Distance between the port and the location on the cable where the fault was discovered.
- **Status**—Wire pair status. Red indicates fault and Green indicates status OK.
- **Cable length**—Cable length in meters.

  If the link is down, TDR Technology is used to test the GE and FE ports. Cable length measurements are accurate to within 3 to 4 meters.

  If the link is up, DSP Technology is used to test the GE ports. (FE ports are not tested for length.) The values returned are:

  - 1—Less than 50 meters
  - 2—50 to 80 meters
  - 3—80 to 110 meters
  - 4—110 to 140 meters
  - 5—More than 140 meters
- **Channel**—Cable channel.
- **Polarity**—Indicates if automatic polarity detection and correction has been activated for the wire pair.
- **Pair Skew**—Difference in delay between wire pairs.

STEP 5 Click **Close** to close the window.

Displaying Optical Module Status

The *Optical Module Status Page* displays the operating conditions reported by the SFP (Small Form-factor Pluggable) transceiver. Some information might not be available for SFPs that do not support the digital diagnostic monitoring standard SFF-8472.

MSA-compatible SFPs

The following FE SFP (100Mbps) transceivers are supported:

- MFEBX1: 100BASE-BX-20U SFP transceiver for single-mode fiber, 1310 nm wavelength, supports up to 20 km.
- MFEFX1: 100BASE-FX SFP transceiver, for multimode fiber, 1310 nm wavelength, supports up to 2 km.
- MFELX1: 100BASE-LX SFP transceiver, for single-mode fiber, 1310 nm wavelength, supports up to 10 km.

The following GE SFP (1000Mbps) transceivers are supported:

- MGBBX1: 1000BASE-BX-20U SFP transceiver, for single-mode fiber, 1310 nm wavelength, supports up to 40 km.
- MGBLH1: 1000BASE-LH SFP transceiver, for single-mode fiber, 1310 nm wavelength, supports up to 40 km.
- MGBLX1: 1000BASE-LX SFP transceiver, for single-mode fiber, 1310 nm wavelength, supports up to 10 km.
- MGBSX1:1000BASE-SX SFP transceiver, for multimode fiber, 850 nm wavelength, supports up to 550 m.
- MGBT1: 1000BASE-T SFP transceiver for category 5 copper wire, supports up to 100 m.

To view the results of optical tests. click **Administration** > **Diagnostics** > **Optical Module Status**. The *Optical Module Status Page* opens.

This page displays the following fields:

- **Port**—Port number on which the SFP is connected.
- **Temperature—**Temperature (Celsius) at which the SFP is operating.
- **Voltage—**SFP’s operating voltage.
- **Current—**SFP’s current consumption.

- **Output Power**—Transmitted optical power.
- **Input Power**—Received optical power.
- **Transmitter Fault**—Remote SFP reports signal loss. Values are True, False, and No Signal (N/S).
- **Loss of Signal**—Local SFP reports signal loss. Values are True and False.
- **Data Ready**—SFP is operational. Values are True and False

Configuring Port and VLAN Mirroring

Port Mirroring is used on a network switch to send a copy of network packets seen on one switch port, multiple switch ports, or an entire VLAN to a network monitoring connection on another switch port. This is commonly used for network appliances that require monitoring of network traffic, such as an intrusion-detection system. A network analyzer connected to the monitoring port displays the data packets for diagnosing, debugging, and performance monitoring. Up to eight sources can be mirrored. This can be any combination of eight individual ports and/or VLANs.

A packet that is received on a network port assigned to a VLAN that is subject to mirroring, is mirrored to the analyzer port even if the packet was eventually trapped or discarded. Packets sent by the switch are mirrored when Transmit (Tx) Mirroring is activated.

Mirroring does not guarantee that all traffic from the source port(s) is received on the analyzer (destination) port. If more data is sent to the analyzer port than it can support, some data might be lost.

VLAN mirroring is not active on a VLAN that was not created. For example, if VLAN 23 was created by GVRP and later on removed from the VLAN database for any reason and you manually created VLAN 34, and you create port mirroring that includes VLAN 23, VLAN 34, or both, and later on delete VLAN 34, the status in port mirroring is set to **Not Ready**, because the VLANs are no longer in the database.

Only one instance of mirroring is supported system-wide. The analyzer port (or target port for VLAN mirroring or port mirroring) is the same for all the mirrored VLANs or mirrored ports.

To enable port and VLAN mirroring:

STEP 1 Click **Administration** > **Diagnostics** > **Port and VLAN Mirroring**. The *Port and VLAN Mirroring Page* opens.

This page displays the following fields:

- **Destination Port—**Port to which traffic is to be copied; the analyzer port.
- **Source Interface—**Interface, port, or VLAN, from which traffic is sent to the analyzer port.
- **Type—**Type of monitoring: incoming to the port, outgoing from the port, or both.
- **Status—**Whether the interface is up or down.

STEP 2 Click **Add** to add a port or VLAN to be mirrored. The *Add Port/VLAN Mirroring Page* opens.

STEP 3 Enter the parameters:

- **Destination Port—**Select the analyzer port to where packets are copied. A network analyzer, such as a PC running Wireshark, is connected to this port. A port identified as a analyzer destination port, it remains the analyzer destination port until all the entries are removed.
- **Source Interface—**Select Port or VLAN as the source port or source VLAN from where traffic is to be mirrored.
- **Type—**Select whether incoming, outgoing, or both types of traffic are mirrored to the analyzer port. If **Port** is selected, the options are:
  - *Rx Only*—Port mirroring on incoming packets.
  - *Tx Only*—Port mirroring on outgoing packets.
  - *Tx and Rx*—Port mirroring on both incoming and outgoing packets.

STEP 4 Click **Apply**. Port mirroring is added, and the switch is updated.

Viewing CPU Utilization

The *CPU Utilization Page* displays the switch CPU utilization. You can enable or disable CPU utilization monitoring, and configure the rate at which the graph is updated.

To enable and display CPU utilization:

STEP 1 Click **Administration** > **Diagnostics** > **CPU Utilization**. The *CPU Utilization Page* opens.

STEP 2 Select **CPU Utilization** to enable viewing CPU resource utilization information.

STEP 3 Select the **Refresh Rate** (time period in seconds) that passes before the statistics are refreshed. A new sample is created for each time period.

The window displays a graph of the CPU utilization. The Y axis is percentage of usage, and the X axis is the sample number.

8

Configuring Discovery

This chapter provides information for configuring Discovery.

It includes the following topics:

- **Configuring Bonjour Discovery**
- **Configuring LLDP**

Configuring Bonjour Discovery

As a Bonjour client, the switch periodically broadcasts Bonjour Discovery protocol packets to directly-connected IP subnet(s), advertising its existence and the services that it provides, for example, HTTP, HTTPs, and Telnet. (Use the **Security** > **TCP/UDP Services** page to enable or disable the switch services.) The switch can be *discovered* by a network management system or other third-party applications. By default, Bonjour is enabled runs on the Management VLAN. The Bonjour console automatically detects the device and displays it.

Bonjour for a System in Layer 2 Mode

When the switch is in Layer 2 mode Bonjour Discovery is enabled globally; it cannot be enabled on a per-port or per-VLAN basis. The switch advertises all of the services that have been turned on by the administrator: HTTP, HTTPS, Telnet, and SSH.

When Bonjour Discovery and IGMP are both enabled, the IP Multicast address of Bonjour is displayed on the *IP Multicast Group Address Page*.

When Bonjour Discovery is disabled, the switch stops any service type advertisements and does not respond to any requests for service from network management applications.

To globally enable Bonjour when the switch is in Layer 2 mode:

STEP 1 Click **Administration** > **Discovery - Bonjour**. The *Discovery - Bonjour Page* opens.

STEP 2 Select **Enable** to enable Bonjour Discovery globally on the switch.

STEP 3 Click **Apply**. Bonjour is enabled or disabled on the switch according to the selection.

Bonjour for a System in Layer 3 Mode

In Layer 3 mode, each interface (VLAN, port, or LAG) can be assigned an IP address. When Bonjour is enabled, the switch can send Bonjour Discovery packets on all interfaces that have IP addresses. (Go to **IP Configuration** > **Management and IP Interface** > **IPv4 Interface** to configure an IP address to an interface.) You can enable Bonjour Discovery for individual interfaces.

If a interface, such as a VLAN, is deleted, Goodbye packets are sent to deregister services the switch is advertising from the neighboring cache table within the local network. (See the Bonjour Discovery Interface Control Table on **Administration** > **Discovery** - **Bonjour** page. If the available services are changed, those changes are advertised, deregistering services that are turned off and registering services that are turned on. If an IP address is changed, that change is advertised.

By default, Bonjour is enabled on all interfaces that are members of the Management VLAN.

If Bonjour is disabled, the switch does not send any Bonjour Discovery advertisements and it does not listen for Bonjour Discovery advertisements sent by other devices.

To configure Bonjour when the switch is in Layer 3 mode:

STEP 1 Click > **Administration** > **Discovery - Bonjour**. The *Discovery-Bonjour Page* opens.

STEP 2 Select the interfaces to be enabled or disabled and added to or deleted from the Bonjour Discovery Interface Control table. Bonjour Discover can only enabled on interfaces with an IP address.

STEP 3 Click **Add** to enable an interface and add it to the Bonjour Discovery Interface Control table.

Click **Delete** to disable an interface and remove it to the Bonjour Discovery Interface Control table.

STEP 4 Click **Apply**. A popup is displayed indicating whether Bonjour was successfully enabled or disabled on the interfaces.

STEP 5 Click **Apply**. Bonjour is enabled or disable on the interfaces added.

Configuring LLDP

The Link Layer Discovery Protocol (LLDP) enables network managers to troubleshoot and enhance network management by discovering and maintaining network topologies over multi-vendor environments. LLDP discovers network neighbors by standardizing methods for network devices to advertise themselves to other systems, and to store discovered information.

LLDP enables a device to advertise its identification, configuration, and capabilities to neighboring devices that then store the data in a Management Information Base (MIB). The network management system models the topology of the network by querying these MIB databases.

The LLDP protocol operates in Layer 2 by broadcasting Multicast frames from each port. These are referred to as Protocol Data Units (PDUs or LLDP PDUs), and are processed by devices that are aware of the LLDP protocol. The LLDP PDU contains TLVs (type-length-value tuples), which contain the information broadcast by the device. The types of TLVs to be broadcast can be configured.

The LLDP protocol has an extension called LLDP Media Endpoint Discovery (LLDP-MED), which provides and accepts information from voice or video devices. For further information about LLDP-MED, see the *LLDP MED Protocol* section.

LLDP Configuration Workflow

Following are examples of actions that can be performed with the LLDP feature:

1. Enable LLDP globally (LLDP is enabled by default), and enter LLDP global parameters, such as the time interval for sending LLDP updates using the *LLDP Properties Page*.
2. Configure LLDP per interface by using the *Port Settings Page*.
3. Create LLDP MED network policies by using the *LLDP MED Network Policy Page*.

4. Associate LLDP MED network policies to ports by using the *LLDP MED Port Settings Page*.
5. View LLDP local port status details by using the *LLDP Local Information Page.*
6. View the LLDP information that was discovered from neighbors, such as local port, system name, time to live, system description, system capabilities by using the *LLDP Neighbors Information Page*.
7. View LLDP-related statistical information per interface by using the *LLDP Statistics Page*.
8. Display overloading information by using the *LLDP Overloading Page*.

Setting LLDP Properties

The *LLDP Properties Page* enables entering LLDP general parameters. These include enabling/disabling the feature globally and setting timers.

To enter LLDP properties:

STEP 1 Click **Administration** > **Discovery - LLDP** > **Properties**. The *LLDP Properties Page* opens.

STEP 2 Enter the parameters.

- **LLDP Status—**Select the LLDP global status on the switch.
- **TLV Advertise Interval—**Enter the rate in seconds at which LLDP advertisement updates are sent.
- **Topology Change SNMP Notification Interval—**Enter the minimum time interval between SNMP notifications.
- **Hold Multiplier—**Enter the amount of time that LLDP packets are held before the packets are discarded, measured in multiples of the TLV Advertise Interval. For example, if the TLV Advertise Interval is 30 seconds, and the Hold Multiplier is 4, then the LLDP packets are discarded after 120 seconds.
- **Reinitializing Delay—**Enter the time interval in seconds that passes between disabling and reinitializing LLDP, following an LLDP enable/disable cycle.
- **Transmit Delay—**Enter the amount of time in seconds that passes between successive LLDP frame transmissions due to changes in the LLDP local systems MIB.

For a description of LLDP MED, refer to the *LLDP MED Protocol* section.

STEP 3 In the **Fast Start Repeat Count** field, enter the number of times LLDP packets are sent when the LLDP-MED Fast Start mechanism is initialized. This occurs when a new endpoint device links to the switch.

STEP 4 Click **Apply**. The LLDP properties are defined.

Editing LLDP Port Settings

The *Port Settings Page* enables activating LLDP and SNMP notification per port, and entering the TLVs that are sent in the LLDP PDU.

By setting these properties it is possible to provide various types of information to devices that support the LLDP protocol.

The LLDP-MED TLVs to be advertised can be selected in the *LLDP MED Port Settings Page*.

To define the LLDP port settings:

STEP 1 Click **Administration** > **Discovery - LLDP** > **Port Settings**. The *Port Settings Page* opens.

This page displays the port LLDP information.

STEP 2 Select a port and click **Edit.** The *Edit LLDP Port Settings Page* opens.

This page provides the following fields:

- **Interface**—Select the port to be defined.
- **Administrative Status**—Select the LLDP publishing option for the port. The values are:
  - *Tx Only*—Publishes only but does not discover.
  - *Rx Only*—Discovers but does not publish.
  - *Tx & Rx*—Publishes and discovers.
  - *Disable*—Indicates that LLDP is disabled on the port.

- **SNMP Notification—**Select **Enable** notifications are sent to SNMP notification recipients, for example a SNMP managing system, when there is a topology change.

  The time interval between notifications is entered in the Topology Change SNMP Notification Interval field in the *LLDP Properties Page*. Define SNMP Notification Recipients by using the **SNMP** > **Notification Recipient v1,2** and/or **SNMP** > **Notification Recipient v3**.

- **Available Optional TLVs**—Select the information to be published by the switch by moving the TLV to the **Selected Optional TLVs** list. The available TLVs contain the following information:

  - *Port Description*—Information about the port, including manufacturer, product name and hardware/software version.
  - *System Name*—System's assigned name (in alpha-numeric format). The value equals the sysName object.
  - *System Description*—Description of the network entity (in alpha-numeric format). This includes the system's name and versions of the hardware, operating system, and networking software supported by the switch. The value equals the sysDescr object.
  - *System Capabilities*—Primary functions of the switch, and whether or not these functions are enabled in the switch. The capabilities are indicated by two octets. Bits 0 through 7 indicate Other, Repeater, Bridge, WLAN AP, Router, Telephone, DOCSIS cable device, and station respectively. Bits 8 through 15 are reserved.
  - *802.3 MAC-PHY*—Duplex and bit rate capability and the current duplex and bit rate settings of the sending device. It also indicates whether the current settings are due to auto-negotiation or manual configuration.
  - *802.3 Link Aggregation*—Whether the link (associated with the port on which the LLDP PDU is transmitted) can be aggregated. It also indicates whether the link is currently aggregated, and if so, provides the aggregated port identifier.

- *802.3 Maximum Frame*—Maximum frame size capability of the MAC/PHY implementation.

The following fields relate to the Management Address:

- **Advertisement Mode**—Select one of the following ways to advertise the IP management address of the switch:
  - *Auto Advertise*—Send the current management IP address of the switch, regardless of whether it was acquired via DHCP or manually.
  - *None*—Do not advertise the management IP address.
  - *Manual Advertise*—Select this option and the management IP address to be advertised. We recommended that this option be selected when the switch is in Layer 3 mode and the switch is configured with multiple IP addresses.
- **IP Address**—If Manual Advertise was selected, select the Management IP address from the addresses provided.

STEP 3 Enter the relevant information, and click **Apply**. The port settings are modified, and the switch is updated.

LLDP MED Protocol

LLDP Media Endpoint Discovery (LLDP-MED) is an enhancement of LLDP that provides additional capabilities to support media devices.

LLDP-MED:

- Provides detailed network topology information, including the devices located on the network and their location, for example, which IP phone is connected to which port, which software is running on which switch, and which port is connected to which PC.
- Device location discovery to allow creation of location databases and, in the case of Voice over Internet Protocol (VoIP), Emergency Call Service (E-911) by using IP Phone location information.

- Provides troubleshooting information. LLDP MED sends alerts to network managers:
  - Port speed and duplex mode conflicts
  - QoS policy misconfigurations

NOTE The switch automatically *advertises* the policy according to your configuration; however, you must also manually configure the switch to *use* that policy.

Setting LLDP MED Network Policy

An LLDP-MED network policy is a related set of configuration settings identified by a network policy number. This set is loaded into an LLDP-MED TLV, and sent to devices connected to the switch. This information is used by the connected device to send traffic, as specified in the network policy. For example, a policy can be created for VoIP phones that instructs them to:

- Send voice traffic on VLAN 10
- Tag voice traffic with DSCP=63
- Transmit data-traffic to the switch (from the PC connected to the switch through the VoIP phone) without modification to traffic sent by the PC (typically, Untagged).

Network policies are associated with ports by using the *LLDP MED Port Settings Page*. (An administrator must create the VLANs, and configure memberships in the VLANs based on the specification in the LLDP-MED network policies.)

To define an LLDP MED network policy:

STEP 1 Click **Administration** > **Discovery - LLDP** > **LLDP MED Network Policy.** The *LLDP MED Network Policy Page* opens.

This page displays previously-created network policies.

STEP 2 Click **Add** and the *Add LLDP MED Network Policy Page* opens.

This page enables the definition of new policies.

STEP 3 Enter the values.

- **Network Policy Number—**Select the number of the policy to be created.

- **Application—**Select from the list the type of application (type of traffic) for which the network policy is being defined:
  - **Voice**
  - **Voice Signaling**
  - **Guest Voice**
  - **Guest Voice Signaling**
  - **Softphone Voice**
  - **Video Conferencing**
  - **Streaming Video**
  - **Video Signaling**
- **VLAN ID—**Enter the VLAN ID to which the traffic should be sent.
- **VLAN Tag**—Select whether the traffic is Tagged or Untagged.
- **User Priority—**Select the traffic priority applied to traffic defined by this network policy.
- **DSCP Value**—Select the DSCP value to associate with application data sent by neighbors. This informs them how they should mark the application traffic they send to the switch.

STEP 4 Click **Apply**. The network policy is defined. Associate the network policy with a port by using the *LLDP MED Port Settings Page*.

Configuring LLDP MED Port Settings

The *LLDP MED Port Settings Page* enables selecting the network policies, configured in the *LLDP MED Network Policy Page,* to be advertised on the port, and selecting the LLDP-MED TLVs to be sent inside the LLDP PDU.

To configure LLDP MED on each port:

STEP 1 Click **Administration** > **Discovery - LLDP** > **LLDP MED Port Settings**. The *LLDP MED Port Settings Page* opens.

This page displays LLDP MED settings, including enabled TLVs, for all ports.

STEP 2 Select a port, and click **Edit.** The *Edit LLDP MED Port Settings Page* opens.

This page enables associating LLDP MED policies to ports.

STEP 3 Enter the parameters.

- **Port—**Select a port to configure. After you have configured this port and clicked **Apply**, you can configure another port without returning to the LLDP MED Port Settings Page.
- **LLDP MED Status—**Enable/disable LLDP MED on this port.
- **SNMP Notification—**Select whether SNMP notification is sent on a per-port basis when an end station that supports MED is discovered, for example a SNMP managing system, when there is a topology change.
- **Available Optional TLVs—**Select the TLVs that can be published by the switch, by moving them to the *Selected Optional TLVs* list.
- **Available Network Policies—**Select the LLDP MED policies that will be published by LLDP, by moving them to the Selected Network Policies list. These were created in the *LLDP MED Network Policy Page.*

NOTE The following fields must be entered in hexadecimal characters in the exact data format that is defined in the LLDP-MED standard (ANSI-TIA-1057_final_for_publication.pdf).

- **Location Coordinate—**Enter the coordinate location to be published by LLDP.
- **Location Civic Address—**Enter the civic address to be published by LLDP.
- **Location (ECS) ELIN—**Enter the Emergency Call Service (ECS) ELIN location to be published by LLDP.

STEP 4 Click **Apply.** The LLDP MED port settings are modified, and the switch is updated.

Displaying LLDP Port Status

The *LLDP Port Status Table Page* displays the LLDP global information, as well as the LLDP status for every port.

To view the LLDP port status, click **Administration** > **Discovery - LLDP** > **LLDP Port Status**. The *LLDP Port Status Page* opens.

LLDP Port Status Global Information

- **Chassis ID Subtype—**Type of chassis ID (for example, MAC address).
- **Chassis ID—**Identifier of chassis. Where the chassis ID subtype is a MAC address, the MAC address of the switch is displayed.
- **System Name—**Name of switch.
- **System Description—**Description of the switch (in alpha-numeric format).
- **Supported System Capabilities—**Primary functions of the device, such as Bridge, WLAN AP, or Router.
- **Enabled System Capabilities—**Primary enabled function(s) of the device.
- **Port ID Subtype—**Type of the port identifier that is shown.

LLDP Port Status Table

- **Interface—**Port identifier.
- **LLDP Status—**LLDP publishing option.
- **LLDP MED Status—**Enabled or disabled.
- **Local PoE—**Local PoE information advertised.
- **Remote PoE—**PoE information advertised by the neighbor.
- **# of neighbors—**Number of neighbors discovered.
- **Neighbor Capability of 1st Device—**Displays the primary enabled device functions of the neighbor, for example: Bridge or Router.

Displaying LLDP Local Information

To view the LLDP local port status advertised on a port:

STEP 1 Click **Administration** > **Discovery - LLDP** > **LLDP Local Information**. The *LLDP Local Information Page* opens.

Click **LLDP Local Information Details** to see the details of the LLDP and LLDP-MED TLVs sent to the neighbor.

Click **LLDP Neighbor Information Details** to see the details of the LLDP and LLDP-MED TLVs received from the neighbor.

STEP 2 Select the desired port from the **Port** list.

This page provides the following fields:

Global

- **Chassis ID Subtype—**Type of chassis ID. (For example the MAC address.)
- **Chassis ID—**Identifier of chassis. Where the chassis ID subtype is a MAC address, the MAC address of the switch is displayed.
- **System Name—**Name of switch.
- **System Description—**Description of the switch (in alpha-numeric format).
- **Supported System Capabilities—**Primary functions of the device, such as Bridge, WLAN AP, or Router.
- **Enabled System Capabilities—**Primary enabled function(s) of the device.
- **Port ID Subtype—**Type of the port identifier that is shown.
- **Port ID—**Identifier of port.
- **Port Description—**Information about the port, including manufacturer, product name and hardware/software version.

Management Address

Displays the table of addresses of the local LLDP agent. Other remote managers can use this address to obtain information related to the local device. The address consists of the following elements:

- **Address Subtype—**Type of management IP address that is listed in the Management Address field, for example, IPv4.

- **Address—**Returned address most appropriate for management use, typically a Layer 3 address.
- **Interface Subtype—**Numbering method used for defining the interface number.
- **Interface Number—**Specific interface associated with this management address.

MAC/PHY Details

- **Auto-Negotiation Supported—**Port speed auto-negotiation support status.
- **Auto-Negotiation Enabled—**Port speed auto-negotiation active status.
- **Auto-Negotiation Advertised Capabilities—**Port speed auto-negotiation capabilities, for example, 1000BASE-T half duplex mode, 100BASE-TX full duplex mode.
- **Operational MAU Type—**Medium Attachment Unit (MAU) type. The MAU performs physical layer functions, including digital data conversion from the Ethernet interfaces' collision detection and bit injection into the network, for example, 100BASE-TX full duplex mode.

802.3 Details

- **802.3 Maximum Frame Size—**The maximum supported IEEE 802.3 frame size.

802.3 Link Aggregation

- **Aggregation Capability—**Indicates whether the interface can be aggregated.
- **Aggregation Status—**Indicates whether the interface is aggregated.
- **Aggregation Port ID—**Advertised aggregated interface ID.

MED Details

- **Capabilities Supported—**MED capabilities supported on the port.
- **Current Capabilities—**MED capabilities enabled on the port.
- **Device Class—**LLDP-MED endpoint device class. The possible device classes are:
  - **Endpoint Class 1—**Indicates a generic endpoint class, offering basic LLDP services.

  - **Endpoint Class 2**—Indicates a media endpoint class, offering media streaming capabilities, as well as all Class 1 features.

  - **Endpoint Class 3**—Indicates a communications device class, offering all Class 1 and Class 2 features plus location, 911, Layer 2 switch support, and device information management capabilities.

- **PoE Device Type**—Port PoE type, for example, powered.
- **PoE Power Source**—Port power source.
- **PoE Power Priority**—Port power priority.
- **PoE Power Value**—Port power value.
- **Hardware Revision**—Hardware version.
- **Firmware Revision**—Firmware version.
- **Software Revision**—Software version.
- **Serial Number**—Device serial number.
- **Manufacturer Name**—Device manufacturer name.
- **Model Name**—Device model name.
- **Asset ID**—Asset ID.

Location Information

Enter the following data structures in hexadecimal as described in section 10.2.4 of the ANSI-TIA-1057 standard:

- **Civic**—Street address.
- **Coordinates**—Map coordinates: latitude, longitude, and altitude.
- **ECS ELIN**—Emergency Call Service (ECS) Emergency Location Identification Number (ELIN).

Network Policy Table

- **Application Type**—Network policy application type, for example, Voice.
- **VLAN ID**—VLAN ID for which the network policy is defined.

- **VLAN Type**—VLAN type for which the network policy is defined. The possible field values are:
    - Tagged—Indicates the network policy is defined for tagged VLANs.
    - Untagged—Indicates the network policy is defined for untagged VLANs.
- **User Priority**—Network policy user priority.
- **DSCP**—Network policy DSCP.

Displaying LLDP Neighbors Information

The *LLDP Neighbors Information Page* displays information that was received using the LLDP protocol from neighboring devices.

After timeout (based on the value received from the neighbor Time To Live TLV during which no LLDP PDU was received from a neighbor), the information is deleted.

To view the LLDP neighbors information:

STEP 1 Click **Administration** > **Discovery - LLDP** > **Neighbors Information**. The *LLDP Neighbors Information Page* opens.

This page displays the following fields:

- **Local Port**—Number of the local port to which the neighbor is connected.
- **Chassis ID Subtype**—Type of chassis ID (for example, MAC address).
- **Chassis ID**—Identifier of the 802 LAN neighboring device's chassis.
- **Port ID Subtype**—Type of the port identifier that is shown.
- **Port ID**—Identifier of port.
- **System Name**—Published name of the switch.
- **Time to Live**—Time interval (in seconds) after which the information for this neighbor is deleted.

STEP 2 Select a local port, and click **Details**. The *Neighbors Information Page* opens.

This page displays the following fields:

Port Details

- **Local Port**—Port number.
- **MSAP Entry**—Device Media Service Access Point (MSAP) entry number.

Basic Details

- **Chassis ID Subtype**—Type of chassis ID (for example, MAC address).
- **Chassis ID**—Identifier of the 802 LAN neighboring device chassis.
- **Port ID Subtype**—Type of the port identifier that is shown.
- **Port ID**—Identifier of port.
- **Port Description**—Information about the port, including manufacturer, product name and hardware/software version.
- **System Name**—Name of system that is published.
- **System Description**—Description of the network entity (in alpha-numeric format). This includes the system name and versions of the hardware, operating system, and networking software supported by the device. The value equals the sysDescr object.
- **Supported System Capabilities**—Primary functions of the device. The capabilities are indicated by two octets. Bits 0 through 7 indicate Other, Repeater, Bridge, WLAN AP, Router, Telephone, DOCSIS cable device, and station respectively. Bits 8 through 15 are reserved.
- **Enabled System Capabilities**—Primary enabled function(s) of the device.

Managed Address

- **Address Subtype**—Managed address subtype, for example, MAC or IPv4.
- **Address**—Managed address.
- **Interface Subtype**—Port subtype.
- **Interface Number**—Port number.

MAC/PHY Details

- **Auto-Negotiation Supported**—Port speed auto-negotiation support status. The possible values are True and False.

- **Auto-Negotiation Enabled—**Port speed auto-negotiation active status. The possible values are True and False.
- **Auto-Negotiation Advertised Capabilities—**Port speed auto-negotiation capabilities, for example, 1000BASE-T half duplex mode, 100BASE-TX full duplex mode.
- **Operational MAU Type—**Medium Attachment Unit (MAU) type. The MAU performs physical layer functions, including digital data conversion from the Ethernet interfaces' collision detection and bit injection into the network, for example, 100BASE-TX full duplex mode.

802.3 Power via MDI

- **MDI Power Support Port Class—**Advertised power support port class.
- **PSE MDI Power Support—**Indicates if MDI power is supported on the port.
- **PSE MDI Power State—**Indicates if MDI power is enabled on the port.
- **PSE Power Pair Control Ability—**Indicates if power pair control is supported on the port.
- **PSE Power Pair—**Power pair control type supported on the port.
- **PSE Power Class—**Advertised power class of the port.

802.3 Details

- **802.3 Maximum Frame Size—**Advertised maximum frame size that is supported on the port.

802.3 Link Aggregation

- **Aggregation Capability—**Indicates if the port can be aggregated.
- **Aggregation Status—**Indicates if the port is currently aggregated.
- **Aggregation Port ID—**Advertised aggregated port ID.

MED Details

- **Capabilities Supported—**MED capabilities enabled on the port.
- **Current Capabilities—**MED TLVs advertised by the port.
- **Device Class—**LLDP-MED endpoint device class. The possible device classes are:
  - *Endpoint Class 1*—Indicates a generic endpoint class, offering basic LLDP services.

  - *Endpoint Class 2*—Indicates a media endpoint class, offering media streaming capabilities as well as all Class 1 features.
  - *Endpoint Class 3*—Indicates a communications device class, offering all Class 1 and Class 2 features plus location, 911, Layer 2 switch support and device information management capabilities.

- **PoE Device Type—**Port PoE type, for example, powered.
- **PoE Power Source—**Port's power source.
- **PoE Power Priority—**Port's power priority.
- **PoE Power Value—**Port's power value.
- **Hardware Revision** –Hardware version.
- **Firmware Revision—**Firmware version.
- **Software Revision—**Software version.
- **Serial Number—**Device serial number.
- **Manufacturer Name—**Device manufacturer name.
- **Model Name—**Device model name.
- **Asset ID—**Asset ID.

802.1 VLAN and Protocol

- **PVID—**Advertised port VLAN ID.

PPVID

- **VID—**Protocol VLAN ID.
- **Supported—**Supported Port and Protocol VLAN IDs.
- **Enabled—**Enabled Port and Protocol VLAN IDs.

VLAN IDs

- **VID—**Port and Protocol VLAN ID.
- **VLAN Names—**Advertised VLAN names.

Protocol IDs

- **Protocol ID—**Advertised protocol IDs.

Location Information

Enter the following data structures in hexadecimal as described in section 10.2.4 of the ANSI-TIA-1057 standard:

- **Civic**—Civic or street address.
- **Coordinates**—Location map coordinates—latitude, longitude, and altitude.
- **ECS ELIN**—Device's Emergency Call Service (ECS) Emergency Location Identification Number (ELIN).
- **Unknown**—Unknown location information.

Network Policies

- **Application Type**—Network policy application type, for example, Voice.
- **VLAN ID**—VLAN ID for which the network policy is defined.
- **VLAN Type**—VLAN type, Tagged or Untagged, for which the network policy is defined.
- **User Priority**—Network policy user priority.
- **DSCP**—Network policy DSCP.

Accessing LLDP Statistics

The *LLDP Statistics Page* displays LLDP statistical information per port.

To view the LLDP statistics:

STEP 1 Click **Administration** > **Discovery - LLDP** > **LLDP Statistics**. The *LLDP Statistics Page* opens.

For each port, the fields are displayed:

- **Interface**—Identifier of interface.
- **Tx Frames Total**—Number of transmitted frames.
- **Rx Frames**
  - **Total**—Number of received frames.
  - **Discarded**—Total number of received frames that were discarded.

  - **Errors**—Total number of received frames with errors.

- **Rx TLVs**
  - **Discarded**—Total number of received TLVs that were discarded.
  - **Unrecognized**—Total number of received TLVs that were unrecognized.

- **Neighbor's Information Deletion Count**—Number of neighbor ageouts on the interface.

STEP 2 Click **Refresh** to view the latest statistics.

LLDP Overloading

LLDP adds information to packets, and can create oversized packets. The information that LLDP adds is divided into groups. The switch transmits the maximum number of whole groups possible, meaning that no partial groups are transmitted.

The *LLDP Overloading Page* displays the number of bytes sent and number of bytes remaining to be sent for LLDP TLVs per port, and the port's transmission status.

To view LLDP overloading information:

STEP 1 Click **Administration** > **Discovery - LLDP** > **LLDP Overloading**. The *LLDP Overloading Page* opens.

This page displays the following fields for each port:

- **Interface**—Port identifier.
- **Total (Bytes)**—Total number of bytes in each packet.
- **Left to Send (Bytes)**—Total number of bytes left to add into the packet.
- **Status**—Whether TLVs are being transmitted or if they are overloaded.

STEP 2 To view the overloading details for a port, select it and click **Details**. The *LLDP Overloading Details* opens.

This page displays the following information for each TLV sent on the port:

- **LLDP Mandatory TLVs**

  - *Size (Bytes)*—Total mandatory TLV byte size.
  - *Status*—If the mandatory TLV group is being transmitted, or if the TLV group was overloaded.

- **LLDP MED Capabilities**
  - *Size (Bytes)*—Total LLDP MED capabilities packets byte size.
  - *Status*—If the LLDP MED capabilities packets were sent, or if they were overloaded.
- **LLDP MED Location**
  - *Size (Bytes)*—Total LLDP MED location packets byte size.
  - *Status*—If the LLDP MED locations packets were sent, or if they were overloaded.
- **LLDP MED Network Policy**
  - *Size (Bytes)*—Total LLDP MED network policies packets byte size.
  - *Status*—If the LLDP MED network policies packets were sent, or if they were overloaded.
- **LLDP MED Extended Power via MDI**
  - *Size (Bytes)*—Total LLDP MED extended power via MDI packets byte size.
  - *Status*—If the LLDP MED extended power via MDI packets were sent, or if they were overloaded.
- **802.3 TLVs**
  - *Size (Bytes)*—Total LLDP MED 802.3 TLVs packets byte size.
  - *Status*—If the LLDP MED 802.3 TLVs packets were sent, or if they were overloaded.
- **LLDP Optional TLVs**
  - *Size (Bytes)*—Total LLDP MED optional TLVs packets byte size.
  - *Status*—If the LLDP MED optional TLVs packets were sent, or if they were overloaded.

- **LLDP MED Inventor**
  - *Size (Bytes)*—Total LLDP MED inventory TLVs packets byte size.
  - *Status*—If the LLDP MED inventory packets were sent, or if they were overloaded.
- **Total (Bytes)**—Total number of packets sent (in bytes).
- **Left to Send (Bytes)**—Total number of packet bytes left to transmit.

9

Port Management

This chapter describes port configuration, link aggregation, and the Green Ethernet feature.

It contains the following topics:

- **Setting the Basic Port Configuration**
- **Configuring Link Aggregation**
- **Static and Dynamic LAG Workflow**
- **Defining LAG Management**
- **Configuring LACP**
- **Green Ethernet**

Port Management Workflow

To configure ports, perform the following actions:

1. Configure port by using the *Port Settings Page*.
2. Enable/disable the Link Aggregation Control protocol, and configure the potential member ports to the desired Link Aggregation Groups (LAGs) by using the *LAG Management Page*. By default, all LAGs have no port members.
3. Configure the Ethernet parameters, such as speed and auto negotiation for the Link Aggregation Groups by using the *LAG Settings Page*.
4. Configure the LACP parameters for the ports that are members or candidates of a Link Aggregation Group by using the *LACP Page.*
5. Configure global Green Ethernet settings by using the *Properties Page*.
6. Configure per port Green Ethernet energy mode by using the *Port Settings Page*.

7. If PoE is supported and enabled for the switch, configure the switch as described in **Managing Power-over-Ethernet Devices**.

Setting the Basic Port Configuration

The *Port Settings Page* displays the global and per port setting of all the ports. This page enables you to select and configure the desired ports from the *Edit Port Setting Page*.

NOTE SFP Fiber takes precedence when both ports are being used.

To configure port settings:

STEP 1 Click **Port Management** > **Port Settings**. The *Port Settings Page* opens.

STEP 2 Select (**Jumbo Frames) Enable** to support packets of up to 10 Kb in size. If **Jumbo Frames** is not enabled, the system supports packet size up to 1,632 bytes.

STEP 3 Click **Apply** to update the global setting.

Jumbo frames configuration changes take effect *only* after the Running Configuration is explicitly saved to the Startup Configuration File using the *Copy/ Save Configuration Page*, and the switch is rebooted.

STEP 4 To update the port settings, select the desired port, and click **Edit.** The *Edit Port Setting Page* opens.

STEP 5 Modify the following parameters:

- **Port**—Select the port number.
- **Port Description—**Enter the port user-defined name or comment.
- **Port Type—**Displays the port type. The possible options are:
  - *Copper Ports*—Regular, not combo, support the following values: 10M, 100M, 1000M (type: Copper).
  - *Combo Ports Copper*—Combo port connected with copper CAT5 cable, supports the following values: 10M, 100M, 1000M (type: ComboC).
  - *Combo Fiber—SFP Fiber Gigabit Interface Converter Port* with the following values: 100M and 1000M (type: ComboF)
- **Administrative Status**—Select whether the port should be operational (Up) or non-operational (Down) when the switch is rebooted.

- **Operational Status—**Displays the current port connection status.
- **Reactivate Suspended Port—**Select to reactivate a port that has been suspended. There are numerous ways that a port can be suspended, such as through the locked port security option, Access Control List (ACL) configurations, BPDUGuard, or Root-Guard.
- **Auto-Negotiation—**Select to enable auto-negotiation on the port. Auto-Negotiation enables a port to advertise its transmission rate, duplex mode, and Flow Control abilities to other devices.
- **Operational Auto-Negotiation—**Displays the current auto-negotiation status on the port.
- **Administrative Port Speed—**Select the configured rate for the port. The port type determines the speed setting options are available. You can designate *Administrative Speed* only when port auto-negotiation is disabled.
- **Operational Port Speed—**Displays the current port speed that is the result of negotiation.
- **Administrative Duplex Mode—**Select the port duplex mode. This field is configurable only when auto-negotiation is disabled, and the port speed is set to 10M or 100M. The possible options are:
  - *Full*—The interface supports transmission between the switch and the client in both directions simultaneously.
  - *Half*—The interface supports transmission between the switch and the client in only one direction at a time.
- **Operational Duplex Mode—**Displays the port's current duplex mode that is the result of negotiation.
- **Auto Advertisement—**Select the capabilities to be advertised by the port. The options are:
  - *Max Capability*—All port speeds and duplex mode settings can be accepted.
  - *10 Half*—10 Mbps speed and Half Duplex mode.
  - *10 Full*—10 Mbps speed and Full Duplex mode.
  - *100 Half*—100 Mbps speed and Half Duplex mode.
  - *100 Full*—100 Mbps speed and Full Duplex mode.

- *1000 Full*—1000 Mbps speed and Full Duplex mode.

- **Operation Advertisement**—Displays the capabilities currently published to the port's neighbor to start the negotiation process. The possible options are those specified in the *Administrative Advertisement* field.

- **Back Pressure**—Select the Back Pressure mode on the port (used with Half Duplex mode) to slow down the packet reception rate when the switch is congested. It disables the remote port, preventing it from sending packets by jamming the medium.

- **Flow Control**—Enable or disable 802.3x Flow Control, or enable the auto-negotiation of Flow Control on the port (only when in Full Duplex mode).

- **MDI/MDIX**—the *Media Dependent Interface* (MDI)/*Media Dependent Interface with Crossover* (MDIX) status on the port. The switch ports are wired by following the Telecommunications Industry Association standards.

  The options are:

  - *MDIX*—Select to connect this switch to hubs and switches by using a straight through cable. This switch swaps its transmit and receives pairs, so that this switch can be connected with another switch or a hub by using a straight through cable.

  - *MDI*—Select to connect this switch to a station by using a straight through cable.

  - *Auto*—Select to configure this switch to automatically detect the correct pinouts for the connection to another device. If the other device supports AutoMDX and the parameter is set to Auto, typically the devices negotiate the pinouts, based on the type of cable connecting the devices and the transmit and receive pinout configuration on each port.

- **Operational MDI/MDIX**—Displays the current MDI/MDIX setting.

- **Protected Port**—Select to make this a protected port. (A protected port is also referred as a Private VLAN Edge (PVE).) The features of a protected port are as follows:

  - Protected Ports provide Layer 2 isolation between interfaces (Ethernet ports and Link Aggregation Groups (LAGs)) that share the same Broadcast domain (VLAN).

  - Packets received from protected ports can be forwarded only to unprotected egress ports. Protected port filtering rules are also applied to packets that are forwarded by software, such as snooping applications.

  - Port protection is not subject to VLAN membership. Devices connected to protected ports are not allowed to communicate with each other, even if they are members of the same VLAN.
  - Both ports and LAGs can be defined as protected or unprotected.
- **Member in LAG**—Displays the LAG, if the port is a member of a LAG.

STEP 6 Click **Apply**. *The Port Settings* are modified, and the switch is updated.

Configuring another port by selecting the desired port from the Port field at the top of the *Edit Port Setting Page*.

Configuring Link Aggregation

Link Aggregation Control Protocol (LACP) is part of an IEEE specification (802.3ad) that allows you to bundle several physical ports together to form a single logical channel. Link aggregation optimizes port usage by linking multiple ports together to form a Link Aggregation Group (LAG). LAGs multiply the bandwidth, increase port flexibility, and provide link redundancy between two devices.

Two types of LAGs are supported:

- *Static*—A LAG is static if the LACP (Link Aggregation Control Protocol) is disabled. You configure a static LAG with a group of ports that are always active members of the LAG.
- *Dynamic*—A LAG is dynamic if it is LACP-enabled. You define a group of ports as candidate ports of a dynamic LAG. The LACP determines which candidate ports from the LAG are active member ports. The non-active member ports are *standby* ports ready to replace any failing active member ports.

Load Balancing

Traffic forwarded to a LAG is load-balanced across the active member ports, thus achieving an effective bandwidth close to the aggregate bandwidth of all the active member ports of the LAG.

Traffic load balancing over the active member ports of a LAG is managed by a hash-based distribution function that distributes Unicast traffic based on Layer 2 or Layer 3 packet header information. Multicast packets behave in the same way as Unicast packets.

The switch support two modes of load balancing:

- By MAC Addresses—Based on the destination and source MAC addresses of all packets.
- By IP and MAC Addresses—Based on the destination and source IP addresses for IP packets, and destination and source MAC addresses for non-IP packets.

LAG Management

Active member ports in a LAG are defined statically by explicit user assignment or are dynamically selected by the Link Aggregation Control Protocol (LACP). The LACP selection process selects the active member ports for the LAG after exchanging LACP information between the local and remote devices.

In general, a LAG is treated by the system as a single logical port. In particular, the LAG has port attributes similar to a regular port, such as state and speed.

The switch supports eight LAGs.

Every LAG has the following characteristics:

- All ports in a LAG must be of the same media type.
- To add a port to the LAG, it cannot belong to any VLAN except the default VLAN.
- Ports in a LAG must not be assigned to another LAG.
- No more than eight ports are assigned to a static LAG and no more than 16 ports can be candidates for a dynamic LAG.
- All the *ports* in a LAG must have auto-negotiation disabled, although the *LAG* can have auto-negotiation enabled.
- When a port is added to the original configuration of the LAG, the configuration that existed for the port is no longer applied, and the configuration of the LAG applies to the port. When the port is removed from the LAG, its original configuration is reapplied.
- Protocols, such as Spanning Tree, consider all the ports in the LAG to be one port.
- All the ports in the LAG must have the same 802.1p priority.

Static and Dynamic LAG Workflow

To configure a **static** LAG, perform the following actions:

1. Configure the selected LAG as a static LAG by disabling LACP on the LAG. Assign up to eight active member ports to the static LAG by selecting and moving the ports from the **Port List** to the **LAG Members** list by using the *LAG Management Page*.
2. Configure the LAG speed and flow control by using the *LAG Settings Page*.

To configure a **dynamic** LAG, perform the following actions:

1. Configure the selected LAG as a dynamic LAG by enabling LACP on the LAG. Assign up to 16 candidates ports to the dynamic LAG by selecting and moving the ports from the **Port List** to the **LAG Members** List by using the *LAG Management Page*.
2. Configure the LAG speed and flow control by using the *LAG Settings Page*.
3. Configure the LACP parameters of the ports in the LAG by using the *LACP Page*.

Defining LAG Management

The *LAG Management Page* displays the global and per LAG settings. The page also enables you to configure the global setting and to select and edit the desired LAG on the *Edit LAG Membership Page*.

STEP 1 To configure LAG management, click **Port Management** > **Link Aggregation** > **LAG Management.** The *LAG Management Page* opens.

STEP 2 Select one of the following **Load Balance Algorithms**:

- *MAC Address*—Perform loading balancing by source and destination MAC addresses on all packets.
- *IP/MAC Address*—Perform load balancing by the source and destination IP addresses on IP packets, and by the source and destination MAC addresses on non-IP packets

STEP 3 Click **Apply**. The Load Balance Algorithm is defined, and the switch is updated.

Defining Member Ports in a LAG

The LAG Management Page enables you to define the member ports in a LAG.

STEP 1 Select the LAG to be configured, and click **Edit.** The *Edit LAG Membership Page* opens.

STEP 2 Enter the values for the following fields:

- **LAG—**Select the LAG number.
- **LAG Name—**Enter the LAG name or a comment.
- **LACP—**Select to enable LACP on the selected LAG. This makes it a dynamic LAG.
- **Port List—**Move those ports that are to be assigned to the LAG from the **Port List** to the **LAG Members** list. Up to eight ports per static LAG can be assigned, and 16 ports can be assigned to a dynamic LAG.

STEP 3 Click **Apply**. The LAG membership is defined, and the switch is updated.

You can select another LAG for configuration by changing the LAG field.

Configuring LAG Settings

The *LAG Settings Page* displays a table of current settings for all LAGs. You can configure the settings of selected LAGs, and reactivate suspended LAGs by launching the *Edit LAG Settings Page*.

To configure the LAG:

STEP 1 Click **Port Management** > **LAG Aggregation** > **LAG Settings**. The *LAG Settings Page* opens.

STEP 2 Select a LAG, and click **Edit**. The *Edit LAG Settings Page* opens.

STEP 3 Enter the values for the following fields:

- **LAG—**Select the LAG ID number.
- **Description—**Enter the LAG name or a comment.
- **LAG Type—**Displays the port type that comprises the LAG.

- **Administrative Status**—Set the selected LAG to operational (Up) or non-operational (Down).
- **Operational Status**—Displays whether the LAG is currently operating.
- **Reactivate Suspended LAG**—Select to reactivate a port if the LAG has been disabled through the locked port security option or through the ACL configurations.
- **Administrative Auto-Negotiation**—Enables or disable auto-negotiation on the LAG. Auto-negotiation is a protocol between two link partners that enables a LAG to advertise its transmission rate and flow control to its partner (the Flow Control default is *disabled*). It is recommended to keep auto-negotiation enabled on both sides of an aggregate link, or disabled on both sides, while ensuring that link speeds are identical.
- **Operational Auto-Negotiation**—Displays the auto-negotiation setting.
- **Administrative Speed**—Select the LAG speed.
- **Operational LAG Speed**—Displays the current speed at which the LAG is operating.
- **Administrative Advertisement**—Select the capabilities to be advertised by the LAG. The options are:
  - *Max Capability*—All LAG speeds and both duplex modes are available.
  - *10 Full*—The LAG advertises a 10 Mbps speed and the mode is full duplex.
  - *100 Full*—The LAG advertises a 100 Mbps speed and the mode is full duplex.
  - *1000 Full*—The LAG advertises a 1000 Mbps speed and the mode is full duplex.
- **Operational Advertisement**—Displays the Administrative Advertisement status. The LAG advertises its capabilities to its neighbor LAG to start the negotiation process. The possible values are those specified in the *Administrative Advertisement* field.
- **Neighbor Advertisement**—Displays the neighbor LAG (the LAG to which the selected interface is connected) that advertises its capabilities to the LAG to start the negotiation process. The possible values are the same as those listed in the *Administrative Advertisement* field.

- **Administrative Flow Control**—Enable or disable Flow Control or enable the auto-negotiation of Flow Control on the LAG.
- **Operational Flow Control**—Displays the current Flow Control setting.
- **Protected LAG**—Select to make the LAG a protected port for Layer 2 isolation. The Port Configuration description in the **Port Management Workflow** section for details regarding protected ports and LAGs.

STEP 4 Click **Apply**. The switch is updated.

You can select another LAG for configuration by changing the LAG field.

Configuring LACP

A dynamic LAG is LACP-enabled; the Link Aggregation Control Protocol is run on every candidate port defined in the LAG.

LACP system priority and LACP port priority determine which of the candidate ports become active member ports in a dynamic LAG configured with more than eight candidate ports. The selected candidate ports of the LAG are all connected to the same remote device.

An LACP channel group can have up to 16 Ethernet ports of the same type. Up to eight ports can be active, and up to eight ports can be in standby mode. When there are more than eight ports in an LACP channel-group, the switch on the controlling end of the link uses port priorities to determine which ports are bundled into the channel and which ports are put in hot-standby mode. Port priorities on the other switch (the non-controlling end of the link) are ignored.

The LACP priority is taken either from the local or the remote device according to the following rule: The local LACP System Priority is compared to the remote LACP System Priority device. The lowest priority is used. If both priorities are the same, the local and remote MAC addresses are compared. The priority of the device with the lowest MAC address is used.

The additional rules in selecting the active or standby ports in a dynamic LACP are as follows:

- Any link operating at a different speed from the highest-speed active member or operating at half-duplex is made standby. All the active ports in a dynamic LAG operate at the same baud rate.

- If the port LACP priority of the link is lower than that of the currently-active link members, and the number of active members is already at the maximum number, the link is made inactive, and placed in standby mode.

Setting Port LACP Parameter Settings

The *LACP Page* displays and enables configuration of the LACP System Priority, LACP timeout, and LACP port priority. LACP timeout is a per port parameter, and is the time interval between the sending and receiving of consecutive LACP PDUs. With all factors equal, when the LAG is configured with more candidate ports than the maximum number of active ports allowed, the switch selects ports as active from the dynamic LAG that has the highest priority

NOTE The LACP setting is irrelevant on ports that are not members of a dynamic LAG.

To define the LACP settings:

STEP 1 Click **Port Management** > **Link Aggregation** > **LACP**. The *LACP Page* opens.

STEP 2 Enter the global **LACP System Priority** value that determines which candidate ports will become members of the LAG.

The page displays the LACP settings of every port. You can select and edit the desired port by using the *Edit LACP Page*

STEP 3 Select a port, and click **Edit.** The *Edit LACP Page* opens.

STEP 4 Enter the values for the following fields:

- **Port—**Select the port number to which timeout and priority values are assigned.
- **LACP Port Priority—**Enter the LACP priority value for the port.
- **LACP Timeout—**Select the periodic transmissions of LACP PDUs occur at either a slow or fast transmission rate, depending upon the expressed LACP timeout preference.

STEP 5 Click **Apply**. The switch is updated.

You can continue editing by selecting another port in the Port field.

Green Ethernet

Green Ethernet is a common name for a set of features that are designed to be environmentally friendly, and to reduce the power consumption of a device.

The Green Ethernet feature reduces overall power usage in two ways:

- **Energy-Detect Mode—**On an inactive link, the port moves into inactive mode, saving power while keeping the Administrative status of the port Up. Recovery from this mode to full operational mode is fast, transparent, and no frames are lost. This mode is supported on both GE and FE ports.
- **Short-Reach Mode—**Cable length is analyzed, and the power usage is adjusted for various cable lengths. In this mode, the VCT (Virtual Cable Tester) length test is performed to measure cable length. If the cable is shorter than a predetermined length, the switch uses less power to send frames over the cable, thus saving energy. This mode is only supported on RJ45 GE ports; it does not apply to the GE ports with the Combo Port.

The two Green Ethernet modes: Energy Detect Mode and Short Reach Mode must be enabled globally and configured per port.

Power savings and current power consumption can be monitored. The total amount of saved energy can be viewed as a percentage of the power that would have been consumed by the physical interfaces had they not been running in Green Ethernet mode.

Power savings can be monitored.

The Green Ethernet features are defined per port, regardless of their LAG membership.

Setting Global Green Ethernet Properties

The *Properties Page* displays and enables configuration of the Green Ethernet mode for the switch. It also displays the current power savings.

To define Global Green Ethernet properties:

STEP 1 Click **Port Management** > **Green Ethernet** > **Properties**. The *Properties Page* opens.

STEP 2 Enter the values for the following fields:

- **Energy Detect Mode**—Globally enable or disable Energy Detect mode. If this mode is changed, a message is displayed.

  The Energy mode is changed when you click **OK**.

- **Short Reach Mode**—Globally enable or disable Short Reach mode if there are GE ports on the switch.

  NOTE Disabling or enabling Energy Detect Mode temporarily disconnects the network connections.

- **Power Savings**—Displays the percentage of power saved by running in Green Ethernet mode.

- **Cumulative Energy Saved**—Displays the amount of energy saved from the last switch reboot. This value is updated each time there is an event that affects power saving.

STEP 3 Click **Apply**. *The Port Settings* are modified, and the switch is updated.

Setting per Port Green Ethernet Properties

The *Port Settings Page* displays the current Green Ethernet Energy mode for each port, and enables selecting a port for Green Ethernet Energy configuration by using the *Edit Port Setting Page*. For the Green Ethernet modes to operate on a port, the corresponding modes must be activated globally in the *Properties Page.*

To define per port Green Ethernet settings:

STEP 1 Click **Port Management** > **Green Ethernet**> **Port Settings**. The *Port Settings Page* opens.

The *Port Settings Page* displays the following:

- **Entry number—**The sequential number of the entry in the table.
- **Port—**The port number.
- **Energy Detect—**State of the port regarding Energy Detect mode:
  - *Administrative*—Displays whether Energy Detect mode was enabled.
  - *Operational*—Displays whether Energy Detect mode is currently operating.
  - *Reason*—If Energy Detect mode is not operational, displays the reason.
- **Short Reach—**State of the port regarding Short Reach mode:
  - *Administrative*—Displays whether Short Reach mode was enabled.
  - *Operational*—Displays whether Short Reach mode is currently operating.
  - *Reason*—If Short-Reach mode is not operational, displays the reason.

  NOTE The window displays the Short Reach setting for each port; however, the Short Reach feature is *not enabled* on any port unless the Short Reach feature is also enabled globally by using the *Properties Page*. To enable Short Reach globally, see the **Setting Global Green Ethernet Properties** section.

- **Cable Length—**Displays VCT cable length in meters.

STEP 2 Select a **Port** and click **Edit**. *The Edit Port Setting Page* opens.

STEP 3 Select to enable or disable Energy Detect mode on the port.

STEP 4 Select to enable or disable Short Reach mode on the port.

STEP 5 Click **Apply**. The Green Ethernet port settings are modified, and the switch is updated.

Select another port to display or edit that port.

10

Managing Power-over-Ethernet Devices

The Power over Ethernet (PoE) feature is only available on PoE-based devices. For a list of PoE-based devices, refer to the **Switch Models** section.

This chapter describes how to use the PoE feature.

It includes the following topics:

PoE on the Switch

A PoE switch is PSE (Power Sourcing Equipment) that delivers electrical power to connected PD (Powered Devices) over existing copper cables without interfering with the network traffic, updating the physical network or modifying the network infrastructure.

PoE Features

PoE provides the following features:

- Eliminates the need to run 110/220 V AC power to all devices on a wired LAN.
- Removes the necessity for placing all network devices next to power sources.
- Eliminates the need to deploy double cabling systems in an enterprise significantly decreasing installation costs.

Power over Ethernet can be used in any enterprise network that deploys relatively low-powered devices connected to the Ethernet LAN, such as:

- IP phones
- Wireless access points
- IP gateways
- Audio and video remote monitoring devices

PoE Operation

PoE implements in the following stages:

- Detection—Sends special pulses on the copper cable. When a PoE device is located at the other end, that device responds to these pulses.
- Classification—Negotiation between the Power Sourcing Equipment (PSE) and the Powered Device (PD) commences after the Detection stage. During negotiation, the PD specifies its class, which is the amount of maximum power that the PD consumes.
- Power Consumption—After the classification stage completes, the PSE provides power to the PD. If the PD supports PoE, but without classification, it is assumed to be class 0 (the maximum). If a PD tries to consume more power than permitted by the standard, the PSE stops supplying power to the port.

PoE supports two modes:

- Port Limit—The maximum power the switch agrees to supply is limited to the value the system administrator configures, regardless of the Classification result.
- Class Power Limit—The maximum power the switch agrees to supply is determined by the results of the Classification stage. This means that it is set as per the Client's request.

PoE Configuration Considerations

There are two factors to consider in the PoE feature:

- The amount of power that the PSE can supply
- The amount of power that the PD is actually attempting to consume

You can decide the following:

- Maximum power a PSE is allowed to supply to a PD
- During device operation, to change the mode from Class Power Limit to Port Limit and vice versa. The power values per port that were configured for the Port Limit mode are retained.
- Maximum port limit allowed as a per-port numerical limit in mW (Port Limit mode).
- To generate a trap when a PD tries to consume too much and at what percent of the maximum power this trap is generated.

The PoE-specific hardware automatically detects the PD class and its power limit according to the class of the device connected to each specific port (Class Limit mode).

If at any time during the connectivity an attached PD requires more power from the switch than the configured allocation allows (no matter if the switch is in Class Limit or Port Limit mode), the switch does the following:

- Maintains the up/down status of the PoE port link
- Turns off power delivery to the PoE port
- Logs the reason for turning off power
- Generates an SNMP trap

Configuring PoE Properties

The *PoE Properties Page* enables selecting either the Port Limit or Class Limit PoE mode and specifying the PoE traps to be generated.

These settings are entered in advance. When the PD actually connects and is consuming power, it might consume much less than the maximum power allowed.

Output power is disabled during power-on reboot, initialization, and system configuration to ensure that PDs are not damaged.

To configure PoE on the switch and monitor current power usage:

STEP 1 Click **Port Management** > **PoE** > **Properties**. The *PoE Properties Page* opens.

STEP 2 Enter the values for the following fields:

- **Power Mode**—Select one of the following options:
  - *Port Limit*—The maximum power limit per each port is configured by the user.
  - *Class Limit*—The maximum power limit per port is determined by the class of the device, which results from the Classification stage.
- **Traps**—Enable or disable traps. If traps are enabled, you must also enable SNMP and configure at least one SNMP Notification Recipient.
- **Power Trap Threshold**—Enter the usage threshold that is a percentage of the power limit. An alarm is initiated if the power exceeds this value.

The following counters are displayed:

- **Nominal Power**—The total amount of power the switch can supply to all the connected PDs.
- **Consumed Power**—Amount of power currently being consumed by the PoE ports.
- **Available Power**—Nominal power - the amount of consumed power.

Configuring the PoE Power, Priority, and Class

The *PoE Settings Page* displays system PoE information for enabling PoE on the interfaces and monitoring the current power usage and maximum power limit per port.

This page limits the power per port in two ways depending on the Power Mode:

- Port Limit: Power is limited to a specified wattage. For these settings to be active, the system must be in PoE Port Limit mode. That mode is configured in the *PoE Properties Page*.

  When the power consumed on the port exceeds the port limit, the port power is turned off.

- Class Limit: Power is limited based on the class of the connected PD. For these settings to be active, the system must be in PoE Class Limit mode. That mode is configured in the *PoE Properties Page*.

  When the power consumed on the port exceeds the class limit, the port power is turned off.

In some cases, the switch does not have enough power to supply all ports with their allowed power at once. To resolve this problem, assign both limits and priorities to the ports. For example, 15.4W is allowed on all 48 ports, but only 24 ports can be supplied at one time due to power limits. In this case, the priority determines which ports receive power and which ports do not even though no port is above the limit and they all have PDs connected. These priorities are entered in the *PoE Settings Page*.

To configure PoE port settings:

STEP 1 Click **Port Management** > **PoE** > **Settings**. The *PoE Settings Page* opens.

STEP 2 Select a port and click **Edit.** The *Edit PoE Settings Page* opens.

STEP 3 Enter the value for the following field:

- **Port**—Select the port to configure.
- **PoE Administrative Status**—Enable or disable PoE on the port.
- **Power Priority Level**—Select the port priority: low, high, or critical, for use when the power supply is low. For example, if the power supply is running at 99% usage and port 1 is prioritized as high, but port 3 is prioritized as low, port 1 receives power and port 3 might be denied power.

- **Class**—This field is displayed only if the Power Mode set in the *PoE Properties Page* is Class Limit. The class determines the power level:

Class	Maximum Power Delivered by Switch Port
0	15.4 watt
1	4.0 watt
2	7.0 watt
3	15.4 watt
4	15.4 watt

- **Power Allocation**—This field is displayed only if the Power Mode set in the *PoE Properties Page* is Port Limit. Enter the power in milliwatts allocated to the port. The range is 0 to 15,400.
- **Power Consumption**—Displays the amount of power in milliwatts assigned to the powered device connected to the selected interface.
- **Overload Counter**—Displays the total number of power overload occurrences.
- **Short Counter**—Displays the total number of power shortage occurrences.
- **Denied Counter**—Displays number of times the powered device was denied power.
- **Absent Counter**—Displays the number of times that power was stopped to the powered device, because the powered device was no longer detected.
- **Invalid Signature Counter**—Displays the times an invalid signature was received. Signatures are the means by which the powered device identifies itself to the PSE. Signatures are generated during powered device detection, classification, or maintenance.

STEP 4 Click **Apply**. The PoE settings for the port are defined and the switch is updated.

11

VLAN Management

This chapter contains the following topics:

VLANs

A VLAN is a logical group that enables devices connected to the VLAN to communicate with each other over the Ethernet MAC layer, regardless of the physical LAN segment of the bridged network to which they are connected.

VLAN Description

Each VLAN is configured with a unique VID (VLAN ID) with a value from 1 to 4094. A port on a device in a bridged network is a member of a VLAN if it can send data to and receive data from the VLAN. A port is an untagged member of a VLAN if all packets destined for that port into the VLAN have no VLAN tag. A port is a tagged member of a VLAN if all packets destined for that port into the VLAN have a VLAN tag. A port can be a member of one or more VLANs.

A port in VLAN Access mode can be part of only one VLAN. If it is in General or Trunk mode, the port can be part of one or more VLANs.

VLANs address security and scalability issues. Traffic from a VLAN stays within the VLAN, and terminates at devices in the VLAN. It also eases network configuration by logically connecting devices without physically relocating those devices.

If a frame is VLAN-tagged, a four-byte VLAN tag is added to each Ethernet frame, increasing the maximum frame size from 1518 to 1522. The tag contains a VLAN ID between 1 and 4094, and a VLAN Priority Tag (VPT) between 0 and 7. See *QoS Modes* for details about VPT.

When a frame enters a VLAN-aware device, it is classified as belonging to a VLAN, based on the four-byte VLAN tag in the frame.

If there is no VLAN tag in the frame or the frame is priority-tagged only, the frame is classified to the VLAN based on the PVID (Port VLAN Identifier) configured at the ingress port where the frame is received.

The frame is discarded at the ingress port if Ingress Filtering is enabled and the ingress port is not a member of the VLAN to which the packet belongs. A frame is regarded as priority-tagged only if the VID in its VLAN tag is 0.

Frames belonging to a VLAN remain within the VLAN. This is achieved by sending or forwarding a frame only to egress ports that are members of the target VLAN. An egress port may be a tagged or untagged member of a VLAN.

The egress port:

- Adds a VLAN tag to the frame if the egress port is a tagged member of the target VLAN, and the original frame does not have a VLAN tag.
- Removes the VLAN tag from the frame if the egress port is an untagged member of the target VLAN, and the original frame has a VLAN tag.

VLAN Roles

VLANs function at Layer 2. All VLAN traffic (Unicast/Broadcast/Multicast) remains within that VLAN. Devices attached to different VLANs do not have direct connectivity to each other over the Ethernet MAC layer. Devices from different VLANs can communicate with each other only through Layer 3 routers. An IP router, for example, is required to route IP traffic between VLANs if each VLAN represents an IP subnet.

The IP router might be a traditional router, where each of its interfaces connects to only one VLAN. Traffic to and from a traditional IP router must be VLAN untagged. The IP router can be a VLAN-aware router, where each of its interfaces can connect to one or more VLANs. Traffic to and from a VLAN-aware IP router can be VLAN tagged or untagged.

Adjacent VLAN-aware devices exchange VLAN information with each other by using Generic VLAN Registration Protocol (GVRP). As a result, VLAN information is propagated through a bridged network.

VLANs on a device can be created statically or dynamically, based on the GVRP information exchanged by devices. A VLAN can be static or dynamic (from GVRP), but not both. For more information about GVRP, refer to the *GVRP Settings* section.

Some VLANs can have additional roles, including:

- Voice VLAN: For more information refer to the *Voice VLAN* section.
- Guest VLAN: Set in the *Edit VLAN Authentication Page.*
- Default VLAN: For more information refer to the *Configuring Default VLAN Settings* section.
- Management VLAN (in Layer 2-mode systems): For more information refer to the *Layer 2 IP Addressing* section.

VLAN Configuration Workflow

To configure VLANs:

1. If required, change the default VLAN by using the **Configuring Default VLAN Settings** section.
2. Create the required VLANs by using the **Creating VLANs** section.
3. Set the desired per port VLAN-related configuration using the **Configuring VLAN Interface Settings** section.
4. Assign interfaces to VLANs by using the **Configuring Port to VLAN** section or the **Configuring VLAN to Port** section.
5. You can view the current VLAN port membership for all the interfaces in the **Viewing VLAN Membership** section.

Configuring Default VLAN Settings

At factory default settings the switch automatically creates VLAN 1 as the default VLAN, the default interface status of all ports is Trunk, and all ports are configured as untagged members of the default VLAN.

The default VLAN has the following characteristics:

- It is distinct, non-static/non-dynamic, and all ports are untagged members by default.
- It cannot be deleted.
- It cannot be given a label.
- It cannot be used for any special role, such as unauthenticated VLAN or Voice VLAN.
- If a port is no longer a member of any VLAN, the switch automatically configures the port as an untagged member of the default VLAN. A port is no longer a member of a VLAN if the VLAN is deleted or the port is removed from the VLAN.
- RADIUS servers cannot assign the default VLAN to 802.1x supplicants by using Dynamic VLAN Assignment.

When the VID of the default VLAN is changed, the switch performs the following on all the ports in the VLAN after saving the configuration and rebooting the switch:

- Removes VLAN membership of the ports from the original default VLAN (possible only after reboot).
- Changes the PVID (Port VLAN Identifier) of the ports to the VID of the new default VLAN.
- The original Default VLAN ID is removed from the switch. To be used, it must be recreated.
- Adds the ports as untagged VLAN members of the new default VLAN.

To change the default VLAN:

STEP 1 Click **VLAN Management** > **Default VLAN Settings**. The *Default VLAN Settings Page* opens.

STEP 2 Enter the value for the following field:

- **Current Default VLAN ID—**Displays the current default VLAN ID.
- **Default VLAN ID After Reset—**Enter a new VLAN ID to replace the default VLAN ID after reboot.

STEP 3 Click **Apply**.

STEP 4 Click **Save** (in the upper-right corner of the window) and save the Running Configuration to the Startup Configuration.

The **Default VLAN ID After Reset** becomes the **Current Default VLAN ID** after you reboot the switch.

Creating VLANs

You can create a VLAN, but this has no effect until the VLAN is attached to at least one port, either manually or dynamically. Ports must always belong to one or more VLANs. The Cisco Sx300 Series switch supports 256 VLANs; default VLAN included.

Each VLAN must be configured with a unique VID (VLAN ID) with a value from 1 to 4094. The switch reserves VID 4095 as the Discard VLAN. All packets classified to the Discard VLAN are discarded at ingress, and are never forwarded to a port.

To create a VLAN:

STEP 1 Click **VLAN Management** > **Create VLAN**. The *Create VLAN Page* opens.

The Create VLAN page displays the following fields for all VLANs:

- **VLAN ID**—User-defined VLAN ID.
- **VLAN Name**—User-defined VLAN name.
- **Type**—VLAN type. The possible options are:
  - *Dynamic*—VLAN was dynamically created through Generic VLAN Registration Protocol (GVRP).
  - *Static*—VLAN is user-defined.
  - *Default*—VLAN is the default VLAN.

STEP 2 Click **Add** to add a new VLAN or select an existing VLAN and click **Edit** to modify the VLAN parameters. The *Add/Edit VLAN Page* opens.

The page enables the creation of either a single VLAN or a range of VLANs.

STEP 3 To create a single VLAN, select the **VLAN** radio button, enter the VLAN ID (VID), and optionally the VLAN Name.

To create a range of VLANs, select the **Range** radio button, and specify the range of VLANs to be created by entering the Starting VID and Ending VID, inclusive.

STEP 4 Click **Apply** to create the VLAN(s).

Configuring VLAN Interface Settings

The *Interface Settings Page* displays and enables configuration of VLAN-related parameters for all interfaces. The Cisco Sx300 Series switch supports 256 VLANs; default VLAN included.

To configure the VLAN settings:

STEP 1 Click **VLAN Management** > **Interface Settings**. The *Interface Settings Page* opens.

The Interface Settings page lists all ports or LAGs and their VLAN parameters.

STEP 2 Select an interface type (Port or LAG), and click **Go**.

STEP 3 Select a port or LAG, and click **Edit.** The *Edit Interface Setting Page* opens.

STEP 4 Enter the values for the following fields:

- **Interface—**Select a port/LAG.
- **Interface VLAN Mode—**Select the interface mode for the VLAN. The options are:
  - *General*—The interface can support all functions as defined in the IEEE 802.1q specification. The interface can be a tagged or untagged member of one or more VLANs.
  - *Access*—The interface is an untagged member of a single VLAN. A port configured in this mode is known as an access port.
  - *Trunk*—The interface is an untagged member of one VLAN at most, and is a tagged member of zero or more VLANs. A port configured in this mode is known as a trunk port.
- **PVID—**Enter the Port VLAN ID (PVID) of the VLAN to which incoming untagged and priority tagged frames are classified. The possible values are 1 to 4094.

- **Frame Type**—Select the type of frame that the interface can receive. Frames that are not of the configured frame type are discarded at ingress. These frame types are only available in General mode. Possible values are:
  - *Admit All*—The interface accepts all types of frames: untagged frames, tagged frames, and priority tagged frames.
  - *Admit Tagged Only*—The interface accepts only tagged frames.
  - *Admit Untagged Only*—The interface accepts only untagged and priority frames.
- **Ingress Filtering**—(Available only in General mode) Select to enable ingress filtering. When an interface is ingress filtering enabled, the interface discards all incoming frames that are classified as VLANs of which the interface is not a member. Ingress filtering can be disabled or enabled on general ports. It is always enabled on access ports and trunk ports.
- **Auto Membership in Voice VLAN**—Select to enable Auto Voice VLAN Membership. When this option is enabled on an interface, the switch automatically configures the interface as a member of the Voice VLAN, if the switch detects incoming voice packets based on configured telephony Organizationally Unique Identifiers (OUIs). LLDP-MED network policy does not activate Voice VLAN.
- **Voice VLAN QoS Mode**—Select one of the following values:
  - *All*—Quality of Service (QoS) values configured to the Voice VLAN are applied to all the incoming frames that are received on the interface and are classified to the Voice VLAN.
  - *Telephony Source MAC* Address—The QoS values configured for the Voice VLAN are applied to any incoming frame that is received on the interface, is classified to the Voice VLAN, and has a source MAC address that is configured with telephony OUI. (Telephony OUIs are configured by using the procedure in the **Configuring Telephony OUI** section.)

STEP 5 Click **Apply**. The parameters are set, and the switch is updated.

Defining VLAN Membership

The **Port to VLAN Page**, *VLAN To Port Page,* and *Port VLAN Membership Page* display the VLAN memberships of the ports in various presentations. You can use the **Port to VLAN Page** and the *VLAN To Port Page* to add or remove memberships to or from the VLANs.

When a port is forbidden default VLAN membership, that port is not allowed membership in any other VLAN. An internal VID of 4095 is assigned to the port.

To forward the packets properly, intermediate VLAN-aware devices that carry VLAN traffic along the path between end nodes must either be manually configured or must dynamically learn the VLANs and their port memberships from Generic VLAN Registration Protocol (GVRP).

Untagged port membership between two VLAN-aware devices with no intervening VLAN-aware devices, should be to the same VLAN. In other words, the PVID on the ports between the two devices must be the same if the ports are to send and receive untagged packets to and from the VLAN. Otherwise, traffic might leak from one VLAN to another.

VLAN-tagged frames can pass through VLAN-aware or VLAN-unaware network interconnection devices. If a destination end node is VLAN-unaware, but is to receive traffic from a VLAN, then the last VLAN-aware device (if there is one), must send frames of the destination VLAN to the end node untagged. That is, the egress port that reaches the end node must be an untagged member of the VLAN.

Configuring Port to VLAN

Use the **Port to VLAN Page** to display and configure a VLAN and all its port members on a single page.

To map ports or LAGs to a VLAN:

STEP 1 Click **VLAN Management** > **Port to VLAN**. The **Port to VLAN Page** opens.

STEP 2 Select a VLAN and the interface type (Port or LAG), and click **Go** to display or to change the port characteristic with respect to the VLAN.

The port mode for each port or LAG is displayed with its current port mode (Access, Trunk or General) configured from the *Interface Settings Page*.

Each port or LAG is displayed with its current registration to the VLAN.

STEP 3 Change the registration of an interface to the VLAN by selecting the desired option from the following list:

- **Forbidden**—The interface is not allowed to join the VLAN even from GVRP registration. When a port is not a member of any other VLAN, enabling this option on the port makes the port part of internal VLAN 4095 (a reserved VID).
- **Excluded**—The interface is currently not a member of the VLAN. This is the default for all the ports and LAGs. The port can join the VLAN through GVRP registration.
- **Tagged**—The interface is a tagged member of the VLAN. Frames of the VLAN are sent tagged to the interface VLAN.
- **Untagged**—The interface is an untagged member of the VLAN. Frames of the VLAN are sent untagged to the interface VLAN.
- **PVID**—Select to set the PVID of the interface to the VID of the VLAN. PVID is a per-port setting. You can only configure the PVID of General ports.

STEP 4 Click **Apply**. The interfaces are assigned to the VLAN, and the switch is updated.

You can continue to display and/or configure port membership of another VLAN by selecting another VLAN ID.

Configuring VLAN to Port

Use the *VLAN To Port Page* to map ports to multiple dynamic VLANs.

To assign a port to multiple VLANs:

STEP 1 Click **VLAN Management** > **VLAN to Port**. The *VLAN To Port Page* opens.

STEP 2 Select interface type (Port or LAG), and click **Go**. The following fields are displayed for all interfaces of the selected type:

- **Interface**—Port/LAG ID.
- **Mode**—Interface VLAN mode that was selected in the *Interface Settings Page.*

- **VLANs**—Drop-down list that displays all VLANs of which the interface is a member.
- **LAG**—If interface selected is Port, displays the LAG in which it is a member.

STEP 3 Select a port, and click the **Join VLAN** button. The *Join VLAN To Port Page* opens.

STEP 4 Enter the values for the following fields:

- **Interface**—Select a Port or LAG.
- **Mode**—Displays the port VLAN mode that was selected in the *Interface Settings Page*.
- **Select VLAN**—To associate a port with a VLAN(s), move the VLAN ID(s) from the left list to the right list by using the arrow buttons. The default VLAN might appear in the right list if it is tagged, but it cannot be selected.
- **Tagging**—Select one of the following tagging/PVID options:
  - *Tagged*—Select whether the port is tagged. This is not relevant for Access ports.
  - *Untagged*—Select whether port is untagged. This is not relevant for Access ports.
  - *PVID*—Port PVID is set to this VLAN. If the interface is in access mode or trunk mode, the switch automatically makes the interface an untagged member of the VLAN. If the interface is in general mode, you must manually configure VLAN membership.

STEP 5 Click **Apply**. The settings are modified, and the switch is updated.

Viewing VLAN Membership

The *Port VLAN Membership Page* displays a list of VLANs to which each port belongs.

To view VLAN membership:

STEP 1 Click **VLAN Management** > **Port VLAN Membership**. The *Port VLAN Membership Page* opens.

STEP 2 Select an interface type (Port or LAG), and click **Go**.

The Port VLAN Membership page displays the operational membership of the ports or LAGs:

- **Port** number.
- **Mode—**Port mode defined in the *Interface Settings Page*.
- **PVID—**Port VLAN Identifier of the VLAN to which incoming untagged frames are assigned at ingress. This assumes that no other VLAN assignment mechanism is used, such as MAC-based-VLAN.
- **VLANs—**VLAN to which the port belongs.

GVRP Settings

Adjacent VLAN-aware devices can exchange VLAN information with each other by using Generic VLAN Registration Protocol (GVRP). GVRP is based on the Generic Attribute Registration Protocol (GARP) and propagates VLAN information throughout a bridged network.

Since GVRP requires support for tagging, the port must be configured in Trunk mode or General mode.

When a port joins a VLAN by using GVRP, it is added to the VLAN as a dynamic member, unless this was expressly forbidden in the *VLAN To Port Page*. If the VLAN does not exist, it is dynamically created when Dynamic VLAN creation is enabled for this port.

GVRP must be activated globally as well as on each port. When it is activated, it transmits and receives GARP Packet Data Units (GPDUs). VLANs that are defined but not active are not propagated. To propagate the VLAN, it must be up on at least one port.

Defining GVRP Settings

To define GVRP settings for an interface:

STEP 1 Click **VLAN Management** > **GVRP Settings**. The *GVRP Settings Page* opens.

STEP 2 Select **GVRP Global Status** to enable GVRP globally.

STEP 3 Click **Apply** to set the global GVRP status.

STEP 4 Select an interface type (Port or LAG), and click **Go**. The following fields are displayed in the GVRP Setting Table.

- **Interface—**Port or LAG number.
- **GVRP State—**Displays whether GVRP is enabled/disabled on the interface.
- **Dynamic VLAN Creation—**Displays whether Dynamic VLAN creation is enabled/disabled on the interface. If it is disabled, GVRP can operate but new VLANs are not created.
- **GVRP Registration—**Displays whether VLAN registration through GVRP is enabled/disabled on the port.

STEP 5 To define GVRP settings for a port, select it, and click **Edit.** The *Edit GVRP Setting Page* opens.

STEP 6 Enter the values for the following fields:

- **Interface—**Select the interface (Port or LAG) to be edited.
- **GVRP State—**Select to enable GVRP on this interface.
- **Dynamic VLAN Creation—**Select to enable Dynamic VLAN Creation on this interface.
- **GVRP Registration—**Select to enable VLAN Registration using GVRP on this interface.

STEP 7 Click **Apply**. GVRP settings are modified, and the switch is updated.

VLAN GROUPS

Assigning MAC-based VLAN Groups

Use this feature to assign untagged traffic from specific MAC addresses to a specific VLAN for devices in Layer 2 mode. This assignment is performed in stages:

1. Assign the MAC address to a Group ID (an identifier created by using the *MAC Based Groups Page*).
2. For each interface, assign the VLAN group to a VLAN by using *Mapping Group to VLAN Page*. (The interfaces must be in General mode.)

This feature is only available when the switch in Layer 2 mode.

The VLAN must be created and then bound to the interface.

To assign a MAC address to a VLAN Group:

STEP 1 Click **VLAN Management** > **VLAN Groups** > **MAC Based Groups**. The *MAC Based Groups Page* opens.

STEP 2 Click **Add.** The *Add MAC Based Group* opens.

STEP 3 Enter the values for the following fields:

- **MAC Address—**Enter a MAC address to be assigned to a VLAN group.

  NOTE This MAC address cannot be assigned to any other VLAN group.

- **Mask—**Enter one of the following:
  - *Host*—Source host of the MAC address
  - *Prefix* of the MAC address
- **Group ID—**Enter a user-created VLAN group ID number.

STEP 4 Click **Apply**. The MAC address is assigned to a VLAN group.

Assigning VLAN Group ID to VLAN Per Interface

The *Mapping Group to VLAN Page* displays the MAC-based groups created in the *MAC Based Groups Page.* This feature is only available when the switch is in Layer 2 mode and the port is in General mode.

To assign a VLAN group ID to a VLAN per interface.

STEP 1 Click **VLAN Management** > **VLAN Groups** > **Mapping Group to VLAN**. The *Mapping Group to VLAN Page* opens.

The window displays:

- **Interface—**Type of interface (Port or LAG), through which traffic is received for this group.
- **Group ID—**VLAN group defined in the *MAC Based Groups Page*.
- **VLAN ID—**Traffic is forwarded from the VLAN group to this VLAN.

STEP 2 Click **Add.** The *Add Mapping Group to VLAN* opens. (The interface must be in General mode.)

STEP 3 Enter the values for the following fields:

- **Group Type**—Displays that the group is MAC-based.
- **Interface**—Enter an interface (Port or LAG) through which traffic is received.
- **Group ID**—Select one of the VLAN groups defined in the *MAC Based Groups Page.*
- **VLAN ID**—Select the VLAN to where traffic from the VLAN group is forwarded.

NOTE For each interface, you can select any group and VLAN.

STEP 4 Click **Apply** to set the mapping of the VLAN group to the VLAN. (The MAC based VLAN does not bind the port dynamically to the MAC group VLAN; the interface to which the MAC-based VLAN is defined must be manually added to this VLAN.)

Voice VLAN

The Voice VLAN is used when traffic from VoIP equipment or phones is assigned to a specific VLAN. The switch can automatically detect and add port members to the Voice VLAN, and assign the configured QoS (Quality of Service) to packets from the Voice VLAN.

QoS attributes can be assigned to VoIP packets (both voice and signaling), to prioritize the traffic through the switch. The QoS attributes can be assigned per port to the voice packets in two modes:

- **All**—Quality of Service (QoS) values configured to the Voice VLAN are applied to all of the incoming frames that are received on the interface and are classified to the Voice VLAN.
- **SRC**—The QoS values configured for the Voice VLAN are applied to any incoming frame that is received on the interface, is classified to the Voice VLAN, and has a source MAC address that is configured with telephony OUI. (Telephony OUIs are configured by using the procedure in the **Configuring Telephony OUI** section.)

In MAC addresses, the first three bytes contain a manufacturer ID, known as an Organizationally Unique Identifier (OUI), and the last three bytes contain a unique station ID. The classification of a packet from VoIP equipment or phones is based on the OUI of the packet source MAC address.

Ports can be assigned to Voice VLAN as follows:

- **Static**—Assigned manually to the Voice VLAN (described in the **Configuring VLAN Interface Settings** section).
- **Dynamic**—The port is identified as a candidate to join the Voice VLAN. When a packet with a source OUI MAC address that identifies the remote equipment as voice equipment is seen on the port, the port joins the Voice VLAN as a tagged port. (This is configured by using the process described in the **Configuring VLAN Interface Settings** section.) If the time since the last telephony MAC address was aged out of the MAC address table exceeds the Voice VLAN aging time, the port is removed from the Voice VLAN. The aging time can be changed by using the procedure described in the **Configuring Voice VLAN Properties** section.

The following network scenarios are supported for dynamic assignment:

- A phone is configured with the Voice VLAN ID, and always sends tagged packets.
- A phone sends untagged packets to acquire its initial IP address. A response from the local DHCP server directs the phone to use the Voice VLAN ID. The phone then restarts a DHCP session on the Voice VLAN (tagged).
- If the voice equipment supports the LLDP-MED protocol, the switch sends a LLDP-MED network policy that tells the phone to how to send frames to the switch (for example: tagged, and tagged with what VLAN).

Voice VLAN Options

You can perform the following operations with this feature:

- Enable or disable Voice VLAN as described in the **Configuring Voice VLAN Properties** section.
- Create a new VLAN to serve as the Voice VLAN by using the *Create VLAN Page*, or configure an existing VLAN as described in the **Configuring Voice VLAN Properties** section.

- Assign ports as candidates to the Voice VLAN. (This is configured by using the process described in the **Configuring VLAN Interface Settings** section.)
- Assign the QoS mode per port to one of the following:
  - For a port that has already joined the Voice VLAN, all packets are assigned to the Voice VLAN as described in the **Configuring VLAN Interface Settings** section.
  - Only packets that come from IP phones (based on the source OUI MAC address prefix) by using the procedure described in the **Configuring VLAN Interface Settings** section.
- Enter Voice VLAN Class of Service (with or without remarking the packet VPT) by using the *Voice VLAN Properties Page*. When remark is selected, the switch changes the 802.1p priority of the packet at egress. Set the remarking option as described in the **Configuring Voice VLAN Properties** section.
- Configure and update the Telephony OUI table with up to 128 entries (each entry is a three-octet number) as described in the **Configuring Telephony OUI** section. The switch uses the table to determine if a port has Auto Voice VLAN Membership enabled and will join the voice VLAN.
- Enter the Voice VLAN aging time as described in the **Configuring Voice VLAN Properties** section.

Voice VLAN Constraints

The following constraints exist:

- Only one Voice VLAN is supported.
- The Voice VLAN is not supported by DVA (Dynamic VLAN assignment).
- The Voice VLAN must be a static VLAN created manually.
- A VLAN that is defined as a Voice VLAN cannot be removed.
- A new VLAN ID can be configured for the Voice VLAN only if the current Voice VLAN does not have candidate ports.
- The Voice VLAN cannot be the Guest VLAN.
- The interface VLAN of a candidate port must be in General mode or Trunk mode.

- The Voice VLAN QoS decision has priority over any other QoS decision, except for the Policy/ACL QoS decision.
- The Voice VLAN QoS is applied to candidate ports that have joined the Voice VLAN, and to static ports.
- The voice flow is accepted if the MAC address can be learned by the FDB. (If there is no free space in FDB, no action occurs).

Configuring Voice VLAN Properties

Use the *Voice VLAN Properties Page* to globally configure the Voice VLAN feature by configuring the following:

- VLAN ID of the Voice VLAN
- Traffic-class received by the traffic
- Time interval that the port remains in the Voice VLAN after the last VoIP frame is identified as having an OUI in the table

To enable the feature on a port, it must be globally enabled in the *Interface Settings Page*.

To configure Voice VLAN properties:

STEP 1 Click **VLAN Management** > **Voice VLAN** > **Properties**. The *Voice VLAN Properties Page* opens.

STEP 2 Enter the values for the following fields:

- **Voice VLAN Status—**Select this field to enable the Voice VLAN feature.
- **Voice VLAN ID—**Select the VLAN that is to be the Voice VLAN.
- **Class of Service—**Select to add a CoS level to untagged packets received on the Voice VLAN. The possible values are 0 to 7, where 7 is the highest priority. 0 is used as a best-effort, and is invoked automatically when no other value has been set (default).
- **Remark CoS—**Select to reassign the CoS level to packets received on the Voice VLAN. If this option is selected, the outer user priority will be the new CoS. Otherwise, the outer user priority will be the original CoS, since Trust mode is used.

- **Auto Membership Aging Time—**Enter the interval of time after which the port exits the voice VLAN, if no voice packets are received. The range is from 1 minute to 30 days.

STEP 3 Click **Apply**. The VLAN properties are saved, and the switch is updated.

Configuring Telephony OUI

Organizationally Unique Identifiers (OUIs) are assigned by the Institute of Electrical and Electronics Engineers, Incorporated (IEEE) Registration Authority. Since the number of IP phone manufacturers is limited and well-known, the known OUI values causes the relevant frames, and the port on which they are seen, to be automatically assigned to a Voice VLAN.

The OUI Global table can hold up to 128 OUIs.

Use the *Telephony OUI Page* to view existing OUIs, and add new OUIs.

To add a new Voice VLAN OUI:

STEP 1 Click **VLAN Management** > **Voice VLAN** > **Telephony OUI**. The *Telephony OUI Page* opens.

The Telephone OUI page displays the following fields:

- **Telephony OUI—**First six digits of the MAC address that are reserved for OUIs.
- **Description—**User-assigned OUI description.

Click **Restore OUI Defaults** to delete all of the user-created OUIs, and leave only the default OUIs in the table.

To delete all the OUIs, select the top checkbox. All the OUIs are selected and can be deleted by clicking **Delete**. If you then click **Restore**, the system recovers the known OUIs.

STEP 2 Click **Add.** The *Add Telephony OUI Page* opens.

STEP 3 Enter the values for the following fields:

- **Telephony OUI—**Enter a new OUI.
- **Description—**Enter an OUI name.

STEP 4 Click **Apply**. The OUI is added.

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Configuring the Spanning Tree Protocol

The Spanning Tree Protocol (STP) (IEEE802.1D and IEEE802.1Q) is enabled by default, set to RSTP (Rapid Spanning Tree Protocol) mode, and protects a Layer 2 Broadcast domain from broadcast storms by selectively setting links to standby mode to prevent loops. In standby mode, these links temporarily do not transfer user data. They are automatically re-activated when the topology changes to make it desirable to transfer user data.

This chapter contains the following topics:

- STP Flavors
- Configuring STP Status and Global Settings
- Defining Spanning Tree Interface Settings
- Configuring Rapid Spanning Tree Settings
- Multiple Spanning Tree
- Defining MSTP Properties
- Mapping VLANs to a MST Instance
- Defining MST Instance Settings
- Defining MSTP Interface Settings

STP Flavors

Loops occur when alternate routes exist between hosts. Loops in an extended network can cause Layer 2 switches to forward traffic indefinitely, resulting in increased traffic and reduced network efficiency.

STP provides a tree topology for any arrangement of Layer 2 switches and interconnecting links, creating a unique path between end stations on a network, eliminating loops.

The switch supports the following Spanning Tree Protocol versions:

- Classic STP provides a single path between any two end stations, avoiding and eliminating loops.
- Rapid STP (RSTP) detects network topologies to provide faster convergence of the spanning tree. This is most effective when the network topology is naturally tree-structured, and therefore faster convergence might be possible. RSTP is enabled by default.

  Although Classic STP is guaranteed to prevent Layer 2 forwarding loops in a general network topology, there might be an unacceptable delay before convergence. This means that each bridge or switch in the network needs to decide, if it should actively forward traffic or not on each of its ports.
- Multiple STP (MSTP) detects Layer 2 loops, and attempts to mitigate them by preventing the involved port from transmitting traffic. Since loops exist on a per-Layer 2-domain basis, a situation can occur where there is a loop in VLAN A and no loop in VLAN B. If both VLANs are on Port X, and STP wants to mitigate the loop, it stops traffic on the entire port, including VLAN B traffic, where there is no need to stop traffic.

  Multiple Spanning Tree Protocol (MSTP) solves this problem by enabling several STP instances, so that it is possible to detect and mitigate loops separately in each instance. By associating instances to VLANs, each instance is associated with the Layer 2 domain on which it performs loop detection and mitigation. This enables a port to be stopped in one instance, such as traffic from VLAN A that is causing a loop, while traffic can remain active in another domain where no loop was seen, such as on VLAN B.

  MSTP provides full connectivity for packets allocated to any VLAN. MSTP is based on RSTP. In addition, MSTP transmits packets assigned to various VLANs through different multiple spanning tree (MST) regions. MST regions act as a single bridge.

Configuring STP Status and Global Settings

The STP Status and Global Settings Page contains parameters for enabling STP, RSTP, or MSTP. For detailed configuration of each STP mode, use the STP Interface Settings Page, RSTP Interface Settings Page, and MSTP Properties Page, respectively.

To set STP status and global settings:

STEP 1 Click **Spanning Tree** > **STP Status and Global Settings**. The *STP Status and Global Settings Page* displays.

STEP 2 Enter the parameters.

Global Settings:

- **Spanning Tree State—**Enable or disable STP on the switch.
- **STP Operation Mode—**Select an STP mode.
- Br**idge Protocol Data Unit (BPDU) Handling—**Select how BPDU packets are managed when STP is disabled on the port or the switch. BPDUs are used to transmit spanning tree information.
  - Filtering—Filters BPDU packets when Spanning Tree is disabled on an interface.
  - Flooding—Floods BPDU packets when Spanning Tree is disabled on an interface.
- **Path Cost Default Values—**Selects the method used to assign default path costs to the STP ports. The default path cost assigned to an interface varies according to the selected method.
  - Short—Specifies the range 1 through 65,535 for port path costs.
  - Long—Specifies the range 1 through 200,000,000 for port path costs.

Bridge Settings:

- **Priority—**Sets the bridge priority value. After exchanging BPDUs, the device with the lowest priority becomes the Root Bridge. In the case that all bridges use the same priority, then their MAC addresses are used to determine which is the Root Bridge. The bridge priority value is provided in increments of 4096. For example, 4096, 8192, 12288, and so on.

- **Hello Time—**Set the interval in seconds that a Root Bridge waits between configuration messages. The range is 1 to 10 seconds.
- **Max Age—**Set the interval in seconds that the switch can wait without receiving a configuration message, before attempting to redefine its own configuration.
- **Forward Delay—**Set the interval in seconds that a bridge remains in a learning state before forwarding packets. For more information, refer to *Defining Spanning Tree Interface Settings*.

Designated Root:

- **Bridge ID—**The bridge priority concatenated with the MAC address of the switch.
- **Root Bridge ID—**The Root Bridge priority concatenated with the MAC address of the Root Bridge.
- **Root Port—**The port that offers the lowest cost path from this bridge to the Root Bridge. (This is significant when the bridge is not the root.)
- **Root Path Cost—**The cost of the path from this bridge to the root.
- **Topology Changes Counts—**The total number of STP topology changes that have occurred.
- **Last Topology Change—**The time interval that elapsed since the last topology change occurred. The time is displayed in a days/hours/minutes/seconds format.

STEP 3 Click **Apply**. The switch is updated with the STP Global settings.

Defining Spanning Tree Interface Settings

The STP Interface Settings Page enables you to configure STP on a per-port basis, and to view the information learned by the protocol, such as the designated bridge.

The configuration entered on this page is active for all flavors of the STP protocol.

To configure STP on an interface:

STEP 1 Click **Spanning Tree** > **STP Interface Settings**. The *STP Interface Settings Page* displays.

STEP 2 Select an interface and click **Edit**. The Edit Interface Settings Page displays.

STEP 3 Enter the parameters

- **Interface—**Select the port number or LAG on which Spanning Tree is configured.
- **STP—**Enables or disables STP on the port.
- **Edge Port—**Enables or disables Fast Link on the port. If Fast Link mode is enabled for a port, the port state is automatically placed in the Forwarding state when the port link is up. Fast Link optimizes the STP protocol convergence. The options are:
  - Enable—Enables Fast Link immediately.
  - Auto—Enables Fast Link a few seconds after the interface becomes active. This allows STP to resolve loops before enabling Fast Link.
  - Disable—Disables Fast Link.
- **Path Cost—**Set the port contribution to the root path cost or use the default cost generated by the system.
- **Priority—**Set the priority value of the port. The priority value influences the port choice when a bridge has two ports connected in a loop. The priority is a value from 0 to 240, set in increments of 16.
- **Port State—**Displays the current STP state of a port.
  - Disabled—STP is currently disabled on the port. The port forwards traffic while learning MAC addresses.
  - Blocking—The port is currently blocked, and cannot forward traffic (with the exception of BPDU data) or learn MAC addresses.
  - Listening—The port is in Listening mode. The port cannot forward traffic, and cannot learn MAC addresses.
  - Learning—The port is in Learning mode. The port cannot forward traffic, but it can learn new MAC addresses.
  - Forwarding—The port is in Forwarding mode. The port can forward traffic and learn new MAC addresses.

- **Port Role—**Displays the behavior of the port.
- **Designated Bridge ID—**Displays the bridge priority and the MAC address of the designated bridge.
- **Designated Port ID—**Displays the priority and interface of the selected port.
- **Designated Cost—**Displays the cost of the port participating in the STP topology. Ports with a lower cost are less likely to be blocked if STP detects loops.
- **Forward Transitions—**Displays the number of times the port has changed from the **Blocking** state to **Forwarding** state.
- **Speed—**Displays the speed of the port.
- **LAG—**Displays the LAG to which the port belongs. If a port is a member of a LAG, the LAG settings override the port settings.

STEP 4 Click **Apply**. The interface settings are modified, and the switch is updated.

Configuring Rapid Spanning Tree Settings

Rapid Spanning Tree Protocol (RSTP) detects and uses network topologies that enable a faster STP convergence without creating forwarding loops.

The RSTP Interface Settings Page enables you to configure RSTP per port. Any configuration that is done on this page is active when the global STP mode is set to RSTP or MSTP.

To enter RSTP settings:

STEP 1 Click **Spanning Tree** > **STP Status and Global Settings**. The *STP Status and Global Settings Page* displays. Enable **RSTP**.

STEP 2 Click **Spanning Tree** > **RSTP Interface Settings**. The RSTP Interface Settings Page opens:

STEP 3 Select a port. (Activate Protocol Migration is only available after selecting the port connected to the bridge partner being tested.)

STEP 4 If a link partner is discovered by using STP, click **Activate Protocol Migration** to run a Protocol Migration test. This discovers whether the link partner using STP still exists, and if so whether it has migrated to RSTP or MSTP. If it still exists as an STP link, the device continues to communicate with it by using STP. Otherwise, if it has been migrated to RSTP or MSTP, the device communicates with it using RSTP or MSTP, respectively.

STEP 5 Select an interface, and click **Edit**. The *Edit Rapid Spanning Tree Page* displays.

STEP 6 Enter the parameters

- **Interface—**Set the interface, and specify the port or LAG where RSTP is to be configured.
- **Point-to-Point Administrative Status—**Define the point-to-point link status. Ports defined as Full Duplex are considered Point-to-Point port links.
    - Enable—This port is a RSTP edge port when this feature is enabled, and brings it to Forwarding mode quickly (usually within 2 seconds).
    - Disable—The port is not considered point-to-point for RSTP purposes, which means that STP works on it at regular speed, as opposed to rapid speed.
    - Auto—Automatically determines switch status by using RSTP BPDUs.
- **Point-to-Point Operational Status—**Displays the Point-to-Point operating status if the **Point-to-Point Administrative Status** is set to Auto.
- **Role—**Displays the role of the port that has been assigned by STP to provide STP paths. The possible roles are:
    - Root—Lowest cost path to forward packets to the Root Bridge.
    - Designated—The interface through which the bridge is connected to the LAN, that provides the lowest cost path from the LAN to the Root Bridge.
    - Alternate—Provides an alternate path to the Root Bridge from the root interface.
    - Backup—Provides a backup path to the designated port path toward the Spanning Tree leaves. Backup ports occur when two ports are connected in a loop by a point-to-point link. Backup ports also occur when a LAN has two or more connections connected to a shared segment.
    - Disabled—The port is not participating in Spanning Tree.
- **Mode—**Displays the current Spanning Tree mode: Classic STP or RSTP.

- **Fast Link Operational Status**—Displays whether the Fast Link (Edge Port) is enabled, disabled, or automatic for the interface. The values are:
    - Enabled—Fast Link is enabled.
    - Disabled—Fast Link is disabled.
    - Auto—Fast Link mode is enabled a few seconds after the interface becomes active.
- **Port Status**—Displays the RSTP status on the specific port.
    - Disabled—STP is currently disabled on the port.
    - Blocking—The port is currently blocked, and it cannot forward traffic or learn MAC addresses.
    - Listening—The port is in Listening mode. The port cannot forward traffic, and cannot learn MAC addresses.
    - Learning—The port is in Learning mode. The port cannot forward traffic, however it can learn new MAC addresses.
    - Forwarding—The port is in Forwarding mode. The port can forward traffic and learn new MAC addresses.

STEP 7 Click **Apply**. The switch is updated.

Multiple Spanning Tree

Multiple Spanning Tree Protocol (MSTP) provides solutions to various load balancing scenarios. For example, while port A is blocked in one STP instance, the same port can be placed in the Forwarding State in another STP instance. The MSTP Properties Page contains information for defining global MSTP.

MSTP Workflow

To configure MSTP perform the following:

1. Set the STP Operation Mode to MSTP as described in the **Configuring STP Status and Global Settings** section.
2. Define MTP Instances. Each MST instance calculates and builds a loop free topology to bridge packets from the VLANs that map to the instance. Refer to the **Mapping VLANs to a MST Instance** section.

3. Associate these MTP instances to VLAN(s), deciding which MSTP instance will be active in what VLAN.
4. Configure the MSTP attributes by:
   - **Defining MSTP Properties**
   - **Defining MST Instance Settings**
   - **Mapping VLANs to a MST Instance**
   - **Defining MSTP Interface Settings**

Defining MSTP Properties

The global Multiple Spanning Tree Protocol (MSTP) configures a separate Spanning Tree for each VLAN group and blocks all but one of the possible alternate paths within each Spanning Tree. MSTP allows formation of MST regions that can run multiple MST instances (MSTI). Multiple regions and other STP bridges are interconnected using one single common spanning tree (CST).

MSTP is fully compatible with RSTP bridges, in that an MSTP BPDU can be interpreted by an RSTP bridge as an RSTP BPDU. This not only allows compatibility with RSTP bridges without configuration changes, but also causes any RSTP bridges outside of an MSTP region to see the region as a single RSTP bridge, regardless of the number of MSTP bridges inside the region itself.

For two or more switches to be in the same MST region, they must have the same VLANs to MST instance mapping, the same configuration revision number, and the same region name.

Switches intended to be in the same MST region are never separated by switches from another MST region. If they are separated, the region become two separate regions.

This mapping can be done in the *VLAN to MST Instance Page*.

Configuration on this page applies if the system STP mode is MSTP.

To define MSTP:

STEP 1 Click **Spanning Tree** > **STP Status and Global Settings**. The *STP Status and Global Settings Page* displays. Enable MSTP.

STEP 2 Click **Spanning Tree** > **MSTP Properties**. The *MSTP Properties Page* displays.

STEP 3 Enter the parameters.

- **Region Name—**Define an MSTP region name.
- **Revision—**Define an unsigned 16-bit number that identifies the revision of the current MST configuration. The field range is from 0 to 65535.
- **Max Hops—**Set the total number of hops that occur in a specific region before the BPDU is discarded. Once the BPDU is discarded, the port information is aged out. The field range is from 1 to 40.
- **IST Master—**Displays the region's master.

STEP 4 Click **Apply**. The MSTP properties are defined, and the switch is updated.

Mapping VLANs to a MST Instance

The *VLAN to MST Instance Page* enables you to map each VLAN to a Multiple Spanning Tree Instance (MSTI). For devices to be in the same region, they must have the same mapping of VLANs to MSTIs.

NOTE The same MSTI can be mapped with more than one VLAN, but each VLAN can only have one MST Instance attached to it.

Configuration on this page (and all of the MSTP pages) applies if the system STP mode is MSTP.

Up to seven MST instances can be defined on Cisco Small Business 300 Series switches. For those VLANs that are not explicitly mapped to one of the MST instances, the switch automatically maps them to the CIST (Core and Internal Spanning Tree) instance. The CIST instance is MST instance 0.

To map VLANs to MST Instances:

STEP 1 Click **Spanning Tree** > **VLAN to MST Instance**. The *VLAN to MST Instance Page* displays.

The VLAN to MST Instance page contains the following fields:

- **MST Instance ID—**All MST instances are displayed.
- **VLANs—**All VLANs belonging to the MST instance are displayed.

STEP 2 To add a VLAN to an MST instance, select the MST instance, and click **Edit**. The *Edit MST Instance to VLAN Page* displays.

STEP 3 Enter the parameters.

- **MST Instance ID**—Select the MST instance.
- **VLANs**—Define the VLANs being mapped to this MST instance.
- **Action**—Define whether to **Add** (map) or **Remove** the VLAN to/from the MST instance.

STEP 4 Click **Apply**. The MSTP VLAN mappings are defined, and the switch is updated.

Defining MST Instance Settings

The *MST Instance Settings Page* enables you to configure and view parameters per MST instance. This is the per-instance equivalent to the Configuring STP Status and Global Settings.

To enter MST instance settings:

STEP 1 Click **Spanning Tree** > **MST Instance Settings**. The *MST Instance Settings Page* displays.

STEP 2 Enter the parameters.

- **Instance ID**—Select an MST instance to be displayed and defined.
- **Included VLANs**—Displays the VLANs mapped to the selected instance. The default mapping is that all VLANs are mapped to the common and internal spanning tree (CIST) instance (instance 0).
- **Bridge Priority**—Set the priority of this bridge for the selected MST instance.
- **Designated Root Bridge ID**—Displays the priority and MAC address of the Root Bridge for the MST instance.
- **Root Port**—Displays the root port of the selected instance.
- **Root Path Cost**—Displays the root path cost of the selected instance.

- **Bridge ID—**Displays the bridge priority and the MAC address of this switch for the selected instance.
- **Remaining Hops—**Displays the number of hops remaining to the next destination.

STEP 3 Click **Apply**. The MST Instance configuration is defined, and the switch is updated.

Defining MSTP Interface Settings

The *MSTP Interface Settings Page* enables you to configure the port MSTP settings for every MST instance, and to view information that has currently been learned by the protocol, such as the designated bridge per MST instance.

To configure the ports in an MST instance:

STEP 1 Click **Spanning Tree** > **MSTP Interface Settings**. The *MSTP Interface Settings Page* displays.

STEP 2 Enter the parameters.

- **Instance equals To—**Select the MSTP instance to be configured.
- **Interface Type equals to—**Select whether to display the list of ports or LAGs.

The MSTP parameters for the interfaces on the instance are displayed.

STEP 3 Select an interface, and click **Edit**. The Edit Interface Settings Page displays.

STEP 4 Enter the parameters.

- **Instance ID—**Select the MST instance to be configured.
- **Interface—**Select the interface for which the MSTI settings are to be defined.
- **Interface Priority—**Set the port priority for the specified interface. and MST instance.
- **Path Cost—**Set the port contribution to the root path cost or use the default value. The root path cost is the cost of the switch to the Root Bridge of the specified MST instance.

- **Port State**—Displays the MSTP status of the specific port on a specific MST instance. The parameters are defined as:
  - Disabled—STP is currently disabled.
  - Blocking—The port on this instance is currently blocked, and cannot forward traffic (with the exception of BPDU data) or learn MAC addresses.
  - Listening—The port on this instance is in Listening mode. The port cannot forward traffic, and cannot learn MAC addresses.
  - Learning—The port on this instance is in Learning mode. The port cannot forward traffic, but it can learn new MAC addresses.
  - Forwarding—The port on this instance is in Forwarding mode. The port can forward traffic and learn new MAC addresses.
- **Port Role**—Displays the port or LAG role, per port or LAG per instance, assigned by the MSTP algorithm to provide STP paths:
  - Root—Forwarding packets through this interface provides the lowest cost path to forward packets to the root device.
  - Designated—The interface through which the bridge is connected to the LAN, that provides the lowest root path cost from the LAN to the Root Bridge for the MST instance.
  - Alternate—The interface provides an alternate path to the root device from the root interface.
  - Backup—The interface provides a backup path to the designated port path toward the Spanning Tree leaves. Backup ports occur when two ports are connected in a loop by a point-to-point link. Backup ports also occur when a LAN has two or more connections connected to a shared segment.
  - Disabled—The interface does not participate in the Spanning Tree.
- **Mode**—Displays the current Spanning Tree mode.
  - Classic STP—Classic STP is enabled on the port.
  - Rapid STP—Rapid STP is enabled on the port.
  - MSTP—MSTP is enabled on the port.
- **Type**—Displays the MST type of the port.

   - Boundary Port—A Boundary port attaches MST bridges to a LAN in an outlying region. If the port is a boundary port, it also indicates whether the device on the other side of the link is working in RSTP or STP mode.
   - Master Port—A Master port provides connectivity from an MSTP region to the outlying CIST root.
   - Internal—The port is an internal port.
- **Designated Bridge ID**—Displays the bridge ID number that connects the link or shared LAN to the root.
- **Designated Port ID**—Displays the Port ID number on the designated bridge that connects the link or the shared LAN to the root.
- **Designated Cost**—Displays the cost of the port participating in the STP topology. Ports with a lower cost are less likely to be blocked if STP detects loops.
- **Remaining Hops**—Displays the hops remaining to the next destination.
- **Forward Transitions**—Displays the number of times the port has changed from the Forwarding state to the Blocking state.

STEP 5 Click **Apply**. The switch is updated.

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Managing MAC Address Tables

MAC addresses are stored in the *Static Address* table or the *Dynamic Address* table, along with VLAN and port information. Static addresses are configured by the user in the Static Address table and do not age out. MAC addresses seen in packets arriving at the switch are listed in the Dynamic Address table for a period of time. If another frame with the same source MAC address does not appear on the switch before that time expires, the entry is deleted from the table.

When a frame arrives on the switch, the switch searches for a MAC address that matches a static or dynamic table entry. If a match is found, the frame is marked for egress on a specific port based on the search of the tables. Frames addressed to a destination MAC address that is not found in the tables are flooded to all the ports on the relevant VLAN. These frames are called Unknown Unicast Frames.

The switch supports a maximum of 8,000 of static and dynamic MAC addresses.

This section contains information for defining both static and dynamic MAC address tables and includes the following topics:

- **Configuring Static MAC Addresses**
- **Dynamic MAC Addresses**
- **Defining Reserved MAC Addresses**

Configuring Static MAC Addresses

Static addresses can be assigned to a specific interface and VLAN on the switch. The addresses are bound to the assigned interface. If a static address is seen on another interface, the address is ignored and it is not written to the address table.

The *Static Addresses Page* enables viewing statically-configured MAC addresses and creating new static MAC addresses.

To define a static address:

STEP 1 Click **MAC Address Tables** > **Static Addresses**. The *Static Addresses Page* opens.

The *Static Addresses Page* displays the defined static addresses.

STEP 2 Click **Add**. The *Add Static Address Page* opens.

STEP 3 Enter the parameters.

- **VLAN ID**—Select the VLAN ID for the port.
- **MAC Address**—Enter the interface MAC address.
- **Interface**—Select an interface (port or LAG) for the entry.
- **Status**—Select how the entry is treated. The options are:
  - *Permanent*—The static MAC address is never aged out of the table and if it is saved to the Startup Configuration, it is retained after rebooting.
  - *Delete on reset*—The static MAC address is never aged out of the table
  - *Delete on timeout*—The MAC address is deleted when aging occurs.
  - *Secure*—The MAC address is secure when the interface is in classic locked mode.

STEP 4 Click **Apply**. A new entry is made in the table.

Dynamic MAC Addresses

The Dynamic Address Table contains the MAC addresses acquired by monitoring the source addresses of 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 in the VLAN of the frame.

To prevent the bridging table from overflowing and to make room for new addresses, an address is deleted from the bridging table if no traffic is received from a dynamic MAC address for a certain period. This period of time is the aging interval.

Configuring Dynamic MAC Address Parameters

The *Dynamic Addresses Setting Page* enables entering the aging interval for the MAC address table.

To enter the aging interval for dynamic addresses:

STEP 1 Click **MAC Address Tables** > **Dynamic Address Settings**. The *Dynamic Addresses Setting Page* opens.

STEP 2 Enter **Aging Time**. The aging time is a value between the user-configured value and twice that value minus 1. For example, if you entered 300 seconds, the aging time is between 300 and 599 seconds.

STEP 3 Click **Apply**. The Dynamic MAC Address Table is updated.

Querying Dynamic Addresses

The *Dynamic Addresses Page* enables querying the Dynamic MAC Address table according to the following criteria:

- Interface type
- MAC addresses
- VLAN

This page displays the dynamically-learned MAC addresses. You can clear the dynamic addresses from the MAC address table and specify a query criteria to display a subset of the table, such as the MAC addresses learned on a specific interface. You can also specify how the query results are sorted. If no filter criteria are entered, the entire table is displayed.

To perform query dynamic addresses:

STEP 1 Click **MAC Address Tables** > **Dynamic Addresses**. The *Dynamic Addresses Page* opens.

STEP 2 In the *Filter* block, enter the following query criteria:

- **VLAN ID**—Enter the VLAN ID for which the table is queried.
- **MAC Address**—Enter the MAC address for which the table is queried.

- **Interface**—Select the interface for which the table is queried. The query can search for specific ports or LAGs.
- **Dynamic Address Table Sort Key**—Enter the field by which the table is sorted. The address table can be sorted by VLAN ID, MAC address, or interface.

STEP 3 Select the preferred option for sorting the addresses table in the Dynamic Address Sort Key.

STEP 4 Click **Go**. The Dynamic MAC Address Table is queried and the results are displayed.

Click **Clear Table** to delete all of the dynamic MAC addresses.

Defining Reserved MAC Addresses

When the switch receives a frame using a Destination MAC address that belongs to a reserved range (per the IEEE standard), the frame can be discarded or bridged. The configuration can be set either by reserved MAC address or by reserved MAC address and frame type, as follows:

- Reserved MAC address, frame type and Ethertype for EthertnetV2 frame type
- Reserved MAC address, frame type and DSAP-SSAP for LLC frame type
- Reserved MAC address, frame type and PID for LLC-SNAP frame type

To configure an entry for a reserved MAC address:

STEP 1 Click **MAC Address Tables** > **Reserved MAC Addresses**. The *Reserved MAC Addresses Page* opens.

This page displays the reserved MAC addresses.

STEP 2 Click **Add**. The *Add Reserved MAC Address Page* opens.

STEP 3 Enter the values for the following fields:

- **MAC Address**—Select the MAC address to be reserved.
- **Frame Type**—Select a frame type based on the following criteria:
  - *Ethernet V2*—Applies to Ethernet V2 packets with the specific MAC address.
  - *LLC*—Applies to Logical Link Control (LLC) packets with the specific MAC address.
  - *LLC-SNAP*—Applies to Logical Link Control/Sub-Network Access Protocol (LLC-SNAP) packets with the specific MAC address.
  - *All*—Applies to all the packets with the specific MAC Address.
- **Action**—Select one of the following actions to be taken upon the arriving packet that matches the selected criteria:
  - *Discard*—Delete the packet.
  - *Bridge*—Forward the packet to all VLAN members.

STEP 4 Click **Apply**. A new MAC address is reserved.

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Configuring Multicast Forwarding

This chapter describes the Multicast Forwarding feature, and contains the following topics:

Multicast Forwarding

Multicast forwarding enables one-to-many information dissemination. Multicast applications are useful for dissemination of information to multiple clients, where clients do not require reception of the entire content. A typical application is a Cable-TV like service, where clients can join a channel in the middle of a transmission, and leave before it ends.

The data is sent only to relevant ports. Forwarding the data only to the relevant ports conserves bandwidth and host resources on links.

For Multicast forwarding to work across IP subnets, nodes, and routers must be Multicast-capable. A Multicast-capable node must be able to:

- Send and receive Multicast packets.
- Register the Multicast addresses being listened to by the node with local routers, so that local and remote routers can route the multicast packet to the nodes.

Typical Multicast Setup

While multicast routers route multicast packets between IP subnets, multicast-capable Layer 2 switches forward multicast packets to registered nodes within a LAN or VLAN.

A typical setup involves a router that forwards the Multicast streams between private and/or public IP networks, a switch with Internet Group Membership Protocol (IGMP) snooping capabilities, or Multicast Listener Discovery (MLD) snooping, and a Multicast client that wants to receive a Multicast stream. In this setup, the router sends IGMP queries periodically.

NOTE MLD for IPv6 is derived from the IGMP v2 for IPv4. Even though the description in this section is mostly for IGMP, it also describes coverage of MLD where implied.

These queries reach the switch that in turn floods the queries to the VLAN, and also learns the port where there is a Multicast router (Mrouter). When a host receives the IGMP query message, it responds with an IGMP Join message saying that the host wants to receive a specific Multicast stream and optionally from a specific source. The switch with the IGMP snooping analyzes the Join messages, and learns that the Multicast stream the host has requested must be forwarded to this specific port. It then forwards the IGMP Join to the Mrouter only. Similarly, when the Mrouter receives an IGMP Join message, it learns the interface where it receives the Join messages wants to receive a specific multicast stream. The Mrouter forwards the requested multicast stream to the interface.

Multicast Operation

In a Layer 2 Multicast service, a Layer 2 switch receives a single frame addressed to a specific Multicast address. It creates copies of the frame to be transmitted on each relevant port.

When the switch is IGMP/MLD snooping enabled and receives a frame for a multicast stream, it forwards the multicast frame to all the ports that have registered to receive the multicast stream using IGMP Join messages.

The switch can forward multicast streams based on one of the following options:

- Multicast MAC Group Address
- IP Multicast Group Address (G)
- A combination of the source IP address (S) and the destination IP Multicast Group Address (G) of the Multicast packet.

One of these options can be configured per VLAN.

The system maintains lists of Multicast groups for each VLAN, and this manages the Multicast information that each port should receive. The multicast groups and their receiving ports can be configured statically or learned dynamically using IGMP or Multicast Listener Discovery (MLD) protocols snooping.

Multicast Registration

Multicast registration is the process of listening and responding to Multicast registration protocols. The available protocols are the IGMP for IPv4 and the MLD protocol for IPv6.

When IGMP/MLD snooping is enabled in a switch on a VLAN, it analyzes all of the IGMP/MLD packets it receives from the VLAN connected to the switch and Multicast routers in the network.

When a switch learns that a host is using IGMP/MLD messages to register to receive a multicast stream, optionally from a specific source, the switch adds the registration in its multicast forwarding data base.

IGMP/MLD snooping can effectively reduce Multicast traffic from streaming bandwidth-intensive IP applications. A switch using IGMP/MLD snooping only forwards Multicast traffic to the hosts interested in that traffic. This reduction of Multicast traffic reduces the packet processing at the switch, and also reduces the workload at the end hosts since they do not have to receive and filter all of the Multicast traffic generated in the network.

The following versions are supported:

- IGMP v1/v2/ v3
- MLD v1/v2
- A simple IGMP Snooping Querier

An IGMP Querier is required to facilitate the IGMP protocol on a given subnet. In general, a multicast router is also a IGMP Querier. When there are multiple IGMP Queriers in a subnet, the queriers elect a single querier as the primary querier.

The Sx300 can be configured to be an IGMP Querier as a backup querier, or in situation where a regular IGMP Querier does not exist. The Sx300 is not a full capability IGMP Querier.

If the switch is enabled as a IGMP Querier, it starts after 60 seconds have passed with no IGMP traffic (queries) detected from a Multicast router. In the presence of other IGMP Queriers, the switch might (or might not) stop sending queries, based on the results of the standard querier selection process.

Multicast Address Properties

Multicast addresses have the following properties:

- Each IPv4 Multicast address is in the address range 224.0.0.0 to 239.255.255.255.
- The IPv6 Multicast address is FF00:/8.
- To map an IP multicast group address to an Layer 2 Multicast address:
  - For IPv4, this is mapped by taking the 23 low order bits from the IPv4 address, and adding them to the 01:00:5e prefix. By standard, the upper nine bits of the IP address are ignored, and any IP addresses that only differ in the value of these upper bits are mapped to the same Layer 2 address, since the lower 23 bits which are used are identical. For example, 234.129.2.3 is mapped to a MAC multicast group address 01:00:5e:01:02:03. Up to 32 IP multicast group addresses can be mapped to the same Layer 2 address.
  - For IPv6, this is mapped by taking the 32 low order bits of the Multicast address, and adding them with the prefix of 33:33. For example, the IPv6 Multicast address FF00:1122:3344 is mapped to Layer 2 Multicast 33:33:11:22:33:44.

Defining Multicast Properties

The *Properties Page* enables you to configure the Bridge Multicast filtering status.

By default, all Multicast frames are flooded to all port of the VLAN. To selectively forward only to relevant ports and filter (drop) the Multicast on the rest of the ports, enable Bridge Multicast filtering status in the *Properties Page.*

If filtering is enabled, Multicast frames are forwarded to a subset of the ports in the relevant VLAN as defined in the Multicast Forwarding Data Base (MFDB). Multicast filtering is enforced on all traffic. By default, such traffic is flooded to all relevant ports, but you can limit forwarding to a smaller subset.

A common way of representing Multicast membership is the (S,G) notation where “S” is the (single) source sending a Multicast stream of data, and “G” is the IPv4 or IPv6 group address. If a Multicast client can receive Multicast traffic from any source of a specific Multicast group, this is written as (*,G).

The following are ways of forwarding Multicast frames:

- **MAC Group Address—**Based on the destination MAC in the Ethernet frame.

  NOTE As mentioned in the Multicast Address Properties section, one or more IP multicast group addresses can be mapped into a MAC group address. Forwarding based on MAC group address can result in an IP multicast stream being forwarded out to ports that have no receiver for the stream.

- **IP Group Address—**Based on the destination IP address of the IP packet (*,G).

- **Source Specific IP Group Address—**Based on both the destination IP address and the source IP address of the IP packet (S,G).

By selecting the forwarding mode, you can define the method used by hardware to identify Multicast flow by one of the following options: MAC Group Address, IP Group Address, or Source Specific IP Group Address.

(S,G) is supported by IGMPv3 and MLDv2, while IGMPv1/2 and MLDv1 support only (*.G) which is just the group ID.

The switch supports a maximum of 256 static and dynamic multicast group addresses.

To enable Multicast filtering, and select the forwarding method:

STEP 1 Click **Multicast> Properties**. The *Properties Page* opens.

STEP 2 Enter the parameters.

- **Bridge Multicast Filtering Status—**Enable or disable filtering.
- **VLAN ID—**Select the VLAN ID to set its forwarding method.
- **Forwarding Method for IPv6—**Set the forwarding method for IPv6 addresses. These are used by hardware to identify Multicast flow by one of the following options: MAC Group Address, IP Group Address, or Source Specific IP Group Address.
- **Forwarding Method for IPv4—**Set the forwarding method for IPv4 addresses. These are used by hardware to identify Multicast flow by one of the following options: MAC Group Address, IP Group Address, or Source Specific IP Group Address.

STEP 3 Click **Apply**. The switch is updated.

MAC Group Address

The switch supports forwarding incoming Multicast traffic based on the Multicast group information. This information is derived from the IGMP/MLD packets received or as the result of manual configuration, and stored in the Multicast Forwarding Database (MFDB).

When a frame is received from a VLAN that is configured to forward multicast streams based on MAC group addresses, and its destination address is a Layer 2 Multicast address, the frame is forwarded to all ports that are members of the MAC group address.

The *MAC Group Address Page* has the following functions:

- Query and view information from the Multicast Filtering Database relating to a specific VLAN ID or a specific MAC address group. This data is acquired either dynamically through IGMP/MLD snooping or statically by manual entry.
- Add or delete static entries to this database which provides static forwarding information based on MAC destination addresses.

- Display a list of all ports/LAGs that are a member for each VLAN ID and MAC address group, and enter whether traffic is forwarded to it or not.

For viewing the forwarding information when the mode is *IP Address Group* or *IP and Source Group*, use the *IP Multicast Group Address Page*.

To define and view MAC Multicast groups:

STEP 1 Click **Multicast> MAC Group Address**. The *MAC Group Address Page* opens.

STEP 2 Enter the parameters.

- **VLAN ID Equals To**—Set the VLAN ID of the group to be displayed.
- **MAC Group Address Equals To**—Set the MAC address of the Multicast group to be displayed. If no MAC Group Address is specified, the page displays all the MAC Group Addresses from the selected VLAN.

STEP 3 Click **Go,** and the MAC Multicast group addresses are displayed in the lower block.

STEP 4 Click **Add** to add a static MAC Group Address. The *Add MAC Group Address Page* opens.

STEP 5 Enter the parameters.

- **VLAN ID**—Defines the VLAN ID of the new Multicast group.
- **MAC Group Address**—Defines the MAC address of the new Multicast group.

STEP 6 Click **Apply**, the MAC Multicast group is added, and the switch is updated.

To configure and display the registration for the interfaces within the group, select an address, and click **Details.** The *MAC Group Address Settings Page* opens.

The page displays:

- **VLAN ID**—The VLAN ID of the Multicast group.
- **MAC Group Address**—The MAC address of the group.

STEP 7 Select the port or LAG to be displayed from the **Filter: Interface Type** menu.

STEP 8 Click **Go** to display the port or LAG membership.

STEP 9 Select the way that each interface is associated with the Multicast group:

- **Static**—Attaches the interface to the Multicast group as a static member.

- **Dynamic—**Indicates that the interface was added to the Multicast group as a result of IGMP/MLD snooping.
- **Forbidden—**Specifies that this port is forbidden from joining this group on this VLAN.
- **None—**Specifies that the port is not currently a member of this Multicast group on this VLAN.

STEP 10 Click **Apply**, and the switch is updated.

IP Multicast Group Address

The *IP Multicast Group Address Page* is similar to the *MAC Group Address Page* except that Multicast groups are identified by IP addresses.

The *IP Multicast Group Address Page* enables querying and adding IP Multicast groups.

To define and view IP Multicast groups:

STEP 1 Click **Multicast> IP Multicast Group Address**. The *IP Multicast Group Address Page* opens.

The page displays all of the IP Multicast group addresses learned by snooping.

STEP 2 Enter the parameters required for filtering.

- **VLAN ID equals to—**Define the VLAN ID of the group to be displayed.
- **IP Version equals to—**Select IPv6 or IPv4.
- **IP Multicast Group Address equals to—**Define the IP address of the Multicast group to be displayed. This is only relevant when Forwarding mode is (S,G).
- **Source IP Address equals to—**Define the source IP address of the sending device. If mode is (S,G), enter the sender S. This together with the IP Group Address is the Multicast group ID (S,G) to be displayed. If mode is (*.G), enter an * to indicate that the Multicast group is only defined by destination.

STEP 3 Click **Go**. The results are displayed in the lower block. When Bonjour and IGMP are enabled on a Layer 2 switch, the IP Multicast address of Bonjour is displayed.

STEP 4 Click **Add** to add a static IP Multicast Group Address. The IP Multicast Interface Settings Page opens.

STEP 5 Enter the parameters.

- **VLAN ID—**Defines the VLAN ID of the group to be added.
- **IP Version—**Select the IP address type.
- **IP Multicast Group Address—**Define the IP address of the new multicast group.
- **Source Specific—**Indicates that the entry contains a specific source, and adds the address in the IP Source Address field. If not, the entry is added as a (*,G) entry, an IP group address from any IP source.
- **IP Source Address—**Defines the source address to be included.
- **Filter: Interface Type equals to—**Select the port to display the ports or LAGs memberships. You can click the **Static** radio button to add the specific port or LAG to the IP multicast group.

STEP 6 Click **Apply**. The IP Multicast group is added, and the device is updated.

STEP 7 To configure and display the registration of an IP group address, select an address and click **Details**. The IP Multicast Interface Settings Page opens.

STEP 8 Enter the parameters.

- **VLAN ID—**Enter the VLAN ID of the group to be added.
- **IP Version—**Select the IP version.
- **IP Multicast Group Address—**Enter the IP address of the new Multicast group.
- **IP Source Address—**Enter the sender address. If mode is (S,G), the sender S is displayed. This' together with the IP Group Address is the Multicast group ID (S,G). If mode is (*.G), * indicates that the Multicast group is defined by destination.

STEP 9 Click **Go** to display the ports or LAGs group membership.

STEP 10 For each interface, select its association type. The options are as follows:

- *Static*—Attaches the interface to the Multicast group as a static member.
- *Dynamic*—Indicates that the interface was added to the Multicast group as a result of IGMP/MLD snooping.

- *Forbidden*—Specifies that this port is forbidden from joining this group on this VLAN.
- *None*—Indicates that the port is not currently a member of this Multicast group on this VLAN.

STEP 11 Click **Apply**. The switch is updated.

IGMP Snooping

To support selective multicast forwarding (IPv4), Bridge Multicast filtering must be enabled, and IGMP Snooping must be enabled globally and for each relevant VLAN.

By default, a Layer 2 switch forwards Multicast frames to all ports of the relevant VLAN, essentially treating the frame as if it were a Broadcast. With IGMP Snooping the switch forwards multicast frames to ports that have registered multicast clients.

NOTE The switch supports IGMP Snooping only on static VLANs. It does not support IGMP Snooping on dynamic VLANs.

When IGMP Snooping is enabled globally or on a VLAN, all IGMP packets are forwarded to the CPU. The CPU analyzes the incoming packets, and determines the following:

- Which ports are asking to join which Multicast groups on what VLAN.
- Which ports are connected to Multicast routers (Mrouters) that are generating IGMP queries.
- Which ports are receiving PIM, DVMRP, or IGMP query protocols.

The are displayed on the *IGMP Snooping Page*.

Ports asking to join a specific Multicast group issue an IGMP report that specifies which group(s) the host wants to join. This results in the creation of a forwarding entry in the Multicast forwarding database.

The IGMP Snooping Querier is used to support a Layer 2 Multicast domain of snooping switches in the absence of a Multicast router. For example, where Multicast content is provided by a local server, but the router (if one exists) on that network does not support Multicast.

There should be only one IGMP Querier in a Layer 2 Multicast domain. The switch supports standards-based IGMP Querier election when more than one IGMP Querier is present in the domain.

The speed of IGMP Querier activity should be aligned with the IGMP-snooping-enabled switches. Queries should be sent at a rate that is aligned to the snooping table aging time. If queries are sent at a rate lower than the aging time, the subscriber cannot receive the Multicast packets.

To enable IGMP Snooping and identify the switch as an IGMP Snooping Querier on a VLAN:

STEP 1 Click **Multicast** > **IGMP Snooping**. The *IGMP Snooping Page* opens.

The IGMP Snooping Table displays the IGMP snooping information for the VLANs on the switch. The columns are described in **STEP 4**.

STEP 2 Check Enable (or disable) the IGMP Snooping status.

IGMP Snooping Status globally enables the device monitoring network traffic to determine which hosts have requested to receive Multicast traffic. The switch performs IGMP Snooping if IGMP snooping and Bridge Multicast filtering are both enabled.

STEP 3 Select a VLAN, and click **Edit**. The *Edit IGMP Snooping Page* opens.

There should be only one IGMP Querier in a network. The switch supports standards-based IGMP Querier election. Some of the values of the operational parameters of this table are sent by the elected querier. The other values are derived from the switch.

STEP 4 Enter the parameters.

- **VLAN ID—**Select the VLAN ID where IGMP snooping is defined.
- **IGMP Snooping Status—**Enable or disable the monitoring of network traffic to determine which hosts have asked to be sent Multicast traffic. The switch performs IGMP snooping only if IGMP snooping and Bridge Multicast filtering are both enabled.
- **Operational IGMP Snooping Status—**Displays the current status of the IGMP Snooping for the selected VLAN.
- **MRouter Ports Auto Learn—**Enable or disable auto learning of the ports to which the Mrouter is connected.
- **Query Robustness—**Enter the Robustness Variable value to be used if this switch is the elected querier.

- **Operational Query Robustness—**Displays the robustness variable sent by the elected querier.
- **Query Interval—**Enter the interval between the General Queries to be used if this switch is the elected querier.
- **Operational Query Interval—**The time interval in seconds between General Queries sent by the elected querier.
- **Query Max Response Interval—**Enter the delay used to calculate the Maximum Response Code inserted into the periodic General Queries.
- **Operational Query Max Response Interval—**Displays the Query Max Response Interval included in the General Queries sent by the elected querier.
- **Last Member Query Counter—**Enter the number of IGMP Group-Specific Queries sent before the switch assumes there are no more members for the group, if the switch is the elected querier.
- **Operational Last Member Query Counter—**Displays the operational value of the Last Member Query Counter.
- **Last Member Query Interval—**Displays the Last Member Query Interval sent by the elected querier.
- **Operational Last Member Query Interval—**Displays the Last Member Query Interval sent by the elected querier.
- **Immediate Leave—**Enable Immediate Leave to decrease the time it takes to block a multicast stream sent to a member port when an IGMP Group Leave message is received on that port.
- **IGMP Querier Status—**Enable or disable the IGMP Querier.
- **Administrative Querier Source IP Address—**Select the source IP address of the IGMP Querier. This can be the IP address of the VLAN or it can be the management IP address.
- **Operational Querier Source IP Address—**Displays the source IP address of the elected querier.

- **IGMP Querier Version—**Select the IGMP version used if the switch becomes the elected querier. Select IGMPv3 if there are switches and/or multicast routers in the VLAN that perform source-specific IP multicast forwarding.

STEP 5 Click **Apply**. The switch is updated.

MLD Snooping

To support selective multicast forwarding (IPv6), Bridge Multicast filtering must be enabled, and MLD Snooping must be enabled globally and for each relevant VLAN.

NOTE The switch supports MLD Snooping only on static VLANs. It does not support MLD Snooping on dynamic VLANs

The switch uses this feature to build Multicast membership lists. It uses the lists to forward Multicast packets only to switch ports where there are host nodes that are members of the Multicast groups. The switch does not support MLD Querier.

Hosts use the MLD protocol to report their participation in Multicast sessions.

The switch supports two versions of MLD snooping:

- MLDv1 snooping detects MLDv1 control packets, and sets up traffic bridging based on IPv6 destination Multicast addresses.
- MLDv2 snooping uses MLDv2 control packets to forward traffic based on the source IPv6 address, and the destination IPv6 Multicast address.

The actual MLD version is selected by the Multicast router in the network.

In an approach similar to IGMP snooping, MLD frames are snooped as they are forwarded by the switch from stations to an upstream Multicast router and vice versa. This facility enables a switch to conclude the following:

- On which ports stations interested in joining a specific Multicast group are located
- On which ports Multicast routers sending Multicast frames are located

This knowledge is used to exclude irrelevant ports (ports on which no stations have registered to receive a specific Multicast group) from the forwarding set of an incoming Multicast frame.

If you enable MLD snooping in addition to the manually-configured Multicast groups, the result is a union of the Multicast groups and port memberships derived from the manual setup and the dynamic discovery by MLD snooping. However, only the static definitions are preserved when the system is rebooted.

To enable MLD Snooping:

STEP 1 Click **Multicast** > **MLD Snooping**. The *MLD Snooping Page* opens.

STEP 2 Enable or disable **MLD Snooping Status.** MLD Snooping Status globally enables the device monitoring network traffic to determine which hosts have requested to receive Multicast traffic. The switch performs MLD Snooping if MLD snooping and Bridge Multicast filtering are both enabled.

The MLD Snooping Table block lists the operational MLD snooping information for the VLANs on the switch. For a description of the table columns, see **STEP 3**.

STEP 3 Select a VLAN, and click **Edit**. The *Edit MLD Snooping Page* opens.

STEP 4 Enter the parameters.

- **VLAN ID**—Select the VLAN ID.
- **MLD Snooping Status**—Enable or disable MLD snooping on the VLAN. The switch monitors network traffic to determine which hosts have asked to be sent Multicast traffic. MLD Snooping can be enabled only if Bridge Multicast filtering is enabled on the *Properties Page*.
- **Operational MLD Snooping Status**—Displays the current status of MLD Snooping for the selected VLAN.
- **MRouter Ports Auto-Learn**—Enable or disable Auto Learn for the Multicast router.
- **Query Robustness**—Enter the Robustness Variable value to be used if the switch cannot read this value from messages sent by the elected querier.
- **Operational Query Robustness**—Displays the robustness variable sent by the elected querier.
- **Query Interval**—Enter the Query Interval interval value to be used by the switch if the switch cannot derive the value from the messages sent by the elected querier.
- **Operational Query Interval**—The time interval in seconds between General Queries received from the elected querier.

- **Query Max Response Interval—**Enter Query Max Response delay to be used if the switch cannot read the Max Response Time value from General Queries sent by the elected querier.
- **Operational Query Max Response Interval—**Displays the delay used to calculate the Maximum Response Code inserted into the General Queries.
- **Last Member Query Counter—**Enter the Last Member Query Count to be used if the switch cannot derive the value from the messages sent by the elected querier.
- **Operational Last Member Query Counter—**Displays the operational value of the Last Member Query Counter.
- **Last Member Query Interval**—Enter the Maximum Response Delay to be used if the switch cannot read Max Response Time value from Group-Specific queries sent by the elected querier.
- **Operational Last Member Query Interval—**The Last Member Query Interval sent by the elected querier.
- **Immediate Leave—**When enabled, reduces the time it takes to block unnecessary MLD traffic sent to a switch port.

STEP 5 Click **Apply**. The switch is updated.

IGMP/MLD IP Multicast Group

The IGMP/MLD IP Multicast Group Page displays the IPv4 and IPv6 group address the switch learned from the IGMP/MLD messages it snoops.

There might be a difference between information on this page and, for example, information displayed in the *MAC Group Address Page.* Assuming that the system is in MAC-based groups and a port that requested to join the following Multicast groups 224.1.1.1 and 225.1.1.1, both are mapped to the same MAC Multicast address 01:00:5e:01:01:01. In this case, there is a single entry in the MAC Multicast page, but two entries on this page.

To query for a IP Multicast group:

STEP 1 Click **Multicast** > **IGMP/MLD IP Multicast Group**. The *IGMP/MLD IP Multicast Group Page* opens.

STEP 2 Set the type of snooping group for which to search: IGMP or MLD.

STEP 3 Enter some or all of following query filter criteria:

- **Group Address equals to**—Defines the Multicast group MAC address or IP address to query.
- **Source Address equals to**—Defines the sender address to query.
- **VLAN ID equals to**—Defines the VLAN ID to query.

STEP 4 Click **Go**. The following fields are displayed for each Multicast group:

- **VLAN**—The VLAN ID.
- **Group Address**—The Multicast group MAC address or IP address.
- **Source Address**—The sender address for all of the specified group ports.
- **Included Ports**—The list of ports to where the corresponding multicast stream is forwarded.
- **Excluded Ports**—The list of ports not included in the group.
- **Compatibility Mode**—The oldest IGMP/MLD version of registration from the hosts the switch receives on the IP group address.

Multicast Router Port

A Multicast router (Mrouter) port is a port that connects to a Multicast router. The switch includes the multicast router port(s) when it forwards the multicast streams and IGMP/MLD registration messages. This is required in order for all the multicast routers can in turn forward the multicast streams and propagate the registration messages to other subnets.

On this page, it is possible to statically configure or dynamically detect which ports are connected to Mrouters.

To define Multicast router ports:

STEP 1 Click **Multicast** > **Multicast Router Port**. The *Multicast Router Port Page* opens.

STEP 2 Enter some or all of following query filter criteria:

- **VLAN ID equals to—**Select the VLAN ID for the router ports that are described.
- **IPv4 or IPv6 equals to—**Select the IP version that the multicast router supports.
- **Interface Type equals to—**Select whether to display ports or LAGs.

STEP 3 Click **Go**. The interfaces matching the query criteria are displayed.

STEP 4 For each interface, select its association type. The options are as follows:

- *Static*—The port is statically configured as a multicast router port.
- *Dynamic*—The port is dynamically configured as a multicast router port by a MLD/IGMP query. To enable the dynamic learning of multicast router ports, go to the **Multicast** > **IGMP Snooping Page**, and the **Multicast** > **MLD Snooping Page**
- *Forbidden*—This port is not to be configured as a multicast router port, even if IGMP or MLD queries are received on this port. If **Auto Detect Mrouter Ports** is enabled on this port, the configuration does not succeed.
- *None*—The port is not currently a multicast router port.

STEP 5 Click **Apply** to update the switch.

Defining Forward All Multicast

The *Forward All Page* enables and displays the configuration of the ports and/or LAGs that are to receive all of the multicast stream from a specific VLAN. This feature requires that the Bridge Multicast filtering in the *Properties Page* be enabled. If it is disabled, then all Multicast traffic is flooded to all ports in the switch.

You can statically configure a port to Forward All, if the devices connecting to the port does not support IGMP and/or MLD.

IGMP or MLD messages are not forwarded to the ports are defined as *forward all*.

NOTE The configuration affects only the ports that are members of the selected VLAN.

To define Forward All Multicast:

STEP 1 Click **Multicast** > **Forward All**. The *Forward All Page* opens.

STEP 2 Define the following:

- **VLAN ID equals to**—The VLAN ID the ports/LAGs are to be displayed.
- **Interface Type equals to**—Define whether to display ports or LAGs.

STEP 3 Click **Go**. The status of all ports/LAGs are displayed.

STEP 4 Select the interface that is to be defined as forward all by using the following methods:

- *Static*—The port receives all multicast streams.
- *Dynamic*—(not applicable).
- *Forbidden*—Ports cannot receive any Multicast streams, even if IGMP/MLD snooping designated the port to join a Multicast group.
- *None*—The port is not currently a Forward All port.

STEP 5 Click **Apply**. The switch is updated.

Defining Unregistered Multicast Settings

Multicast frames are generally forwarded to all ports in the VLAN. If IGMP/MLD Snooping is enabled, the switch learns about the existence of Multicast groups, and monitors which ports have joined which Multicast group. Multicast groups can also be statically configured. Multicast groups that were either dynamically learned or statically configured, are considered registered. This enables the switch to forward the Multicast frames (from a registered Multicast group) only to ports that are joined to that Multicast group. The switch forwards Multicast frames (from a registered Multicast group) only to ports that are registered to that Multicast group.

The *Unregistered Multicast Page* enables handling Multicast frames that belong to groups that are not known to the switch (unregistered Multicast groups). Unregistered Multicast frames are usually forwarded to all ports on the VLAN.

You can select a port to receive or filter unregistered multicast streams. The configuration is valid for any VLAN of which it is a member (or will be a member).

This feature ensures that the customer receives only the Multicast groups requested and not others that may be transmitted in the network.

To define unregistered Multicast settings:

STEP 1 Click **Multicast** > **Unregistered Multicast**. The *Unregistered Multicast Page* opens.

STEP 2 Define the following:

- **Interface Type equals to—**The view as all ports or all LAGs.
- **Entry No.**—The entry number in the Unregistered Multicast Table.
- **Interface—**Displays the interface ID.
- **Unregistered Multicast—**Displays the forwarding status of the selected interface. The possible values are:
  - *Forwarding*—Enables forwarding of unregistered Multicast frames to the selected interface.
  - *Filtering*—Enables filtering (rejecting) of unregistered Multicast frames to the selected interface.

STEP 3 Click **Edit**. The *Edit Unregistered Multicast Page* opens.

STEP 4 Define the Unregistered Multicast field.

- **Interface**—Select the interface to be modified.
- **Unregistered Multicast—**Define the forwarding status of the interface. The options are as follows:
  - *Forwarding*—Enables forwarding of unregistered Multicast frames to the selected interface.

- *Filtering*—Enables filtering of unregistered Multicast frames to the selected interface.

STEP 5 Click **Apply**. The settings are saved, and the switch is updated.

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Configuring IP Information

IP interface addresses are configured manually by the user, or auto-configured by a DHCP server. This chapter provides information for defining the switch IP addresses.

It includes the following topics:

Management and IP Interfaces

The factory default setting of the IP address configuration is *DHCP*. This means that the switch acts as a DHCP client, and sends out a DHCP request during boot up.

If the switch receives a DHCP response from the DHCP server with an IP address, it sends Address Resolution Protocol (ARP) packets to confirm that the IP address is unique. If the ARP response shows that the IP address is in use, the switch sends a DHCPDECLINE message to the offering DHCP server, and sends another DHCPDISCOVER packet that restarts the process.

If the switch does not receive a DHCP response in 60 seconds, it continues to send DHCPDISCOVER queries, and adopts the default IP address: 192.168.1.254/24.

IP address collisions occur when the same IP address is used in the same IP subnet by more than one device. Address collisions require administrative actions on the DHCP server and/or the devices that collide with the switch.

When a VLAN is configured to use dynamic IP addresses, the switch issues DHCP requests until it is assigned an IP address from a DHCP server. In Layer 2 mode, only the management VLAN can be configured with a static or dynamic IP address. In Layer 3 mode, up to 32 interfaces (ports, LAGs, and/or VLAN) on the switch can be configured with a static or dynamic IP address. The IP subnets where these IP addresses belong to are known as directly connected/attached IP subnets.

The IP address assignment rules for the switch are as follows:

- When in Layer 2 mode, unless the switch is configured with a static IP address, it issues DHCP queries until a response is received from the DHCP server.
- If the IP address on the switch is changed, the switch issues gratuitous ARP packets to the corresponding VLAN to check IP address collisions. This rule also applies when the switch reverts to the default IP address.
- The system status LED changes to solid green when a new unique IP address is received from the DHCP server. If a static IP address has been set, the system status LED also changes to solid green. The LED flashes when the switch is acquiring an IP address and is currently using the factory default IP address 192.168.1.254.
- The same rules apply when a client must renew the lease, prior to its expiration date through a DHCPREQUEST message.
- When no statically defined or DHCP-acquired IP address is available, the default IP address is used. When the other IP addresses becomes available, the addresses are automatically used. The default IP address is always on the management VLAN.

Managing IPv6

The Internet Protocol version 6 (IPv6) is a network-layer protocol for packet-switched internetworks. IPv6 was designed to replace IPv4, the predominantly deployed Internet protocol.

IPv6 introduces greater flexibility in assigning IP addresses because the address size increases from 32-bit to 128-bit addresses. IPv6 addresses are written as eight groups of four hexadecimal digits, for example FE80:0000:0000:0000:0000:9C00:876A:130B. The abbreviated form, in which a group of zeroes can be left out, and replaced with '::', is also acceptable, for example, ::-FE80::9C00:876A:130B.

IPv6 nodes require an intermediary mapping mechanism to communicate with other IPv6 nodes over an IPv4-only network. This mechanism, called a tunnel, enables IPv6-only hosts to reach IPv4 services, and allows isolated IPv6 hosts and networks to reach an IPv6 node over the IPv4 infrastructure.

The tunneling mechanism uses the ISATAP mechanism. This protocol treats the IPv4 network as a virtual IPv6 local link, with mappings from each IPv4 address to a link local IPv6 address.

The switch detects IPv6 frames by the IPv6 Ethertype.

IP Addressing

The switch can work in a Layer 2 mode or a Layer 3 mode.

- In Layer 2 mode, the switch operates as a Layer 2 VLAN-aware switch, and has no routing capabilities.
- In Layer 3 mode, the switch has IP routing capabilities as well as Layer 2 mode capabilities.

  In Layer 3 mode, the switch does not support MAC based VLAN, Dynamic VLAN Assignment, VLAN Rate Limit, SYN Rate DoS Protection, and Advanced QoS Policers.

Configuring the switch to work in either mode is done by the Console interface, described in the **Console Menu Interface** chapter of the administration guide.

The following sections describe the differences between IP addressing when the switch is in Layer 2 or Layer 3 mode.

Layer 2 IP Addressing

In Layer 2 mode, the switch has a single IP address in the management VLAN. This IP address and the default gateway can be configured with a static IP address, or by DHCP. The static IP address and default gateway for Layer 2 mode are configured on the *IPv4 Interface Page*. In Layer 2 mode, the switch uses the default gateway, if configured, to communicate with devices that are not in the same IP subnet with the switch. By default, VLAN 1 is the management VLAN, but this can be modified. Operating in Layer 2 mode, the switch can only be reached at the configured IP address through its management VLAN.

Layer 3 IP Addressing

In Layer 3 mode, the switch can have multiple IP addresses. Each IP address can be assigned to specified ports, LAGs, or VLANs. These IP addresses are configured in the *IPv4 Interface Page* in Layer 3 mode. This provides more network flexibility versus the Layer 2 mode, in which only a single IP address can be configured. Operating in Layer 3 mode, the switch can be reached at all its IP addresses from the corresponding interfaces.

A predefined, default route is not provided in Layer 3 mode. To remotely manage the switch, a default route must be defined. Any DHCP-assigned default gateways are stored as default routes. In addition, you can manually define default routes. This is defined in the *IP Static Routing Page*.

NOTE The switch can be switched from Layer 2 mode to Layer 3 mode only by using the console interface. When this is done, all configuration settings are returned to their default values. For more information about the console interface, see the **Console Menu Interface** chapter in the administration guide.

All the IP addresses configured or assigned to the switch are also referred as Management IP addresses in this guide.

The following sections include configuration information that is relevant to both Layer 2 and Layer 3 modes.

Defining IPv4 Interface when the Switch is in Layer 2 Mode

To manage the switch by using the web-based switch configuration utility, the IPv4 switch management IP address must be defined and known. The switch IP address can be manually configured or automatically taken from a DHCP server.

To configure the IPv4 switch IP address:

STEP 1 Click **Administration** > **Management Interface** > **IPv4 Interface**. The *IPv4 Interface Page* opens.

STEP 2 Enter the values for the following fields:

- **Management VLAN—**Select the Management VLAN used to access the switch through telnet or the Web GUI. VLAN1 is the default Management VLAN.
- **IP Address Type—**Select one of the following options:
  - **Dynamic—**Discover the IP address using DHCP from the management VLAN.
  - **Static—**Manually define a static IP address.

If a static IP address is used, configure the following fields.

- **IP Address—**Enter the IP address, and configure one of the following fields:
- **Network Mask—**Select and enter the IP address mask.
- **Prefix Length—**Select and enter the length of the IPv4 address prefix.
- **Default Gateway—**Select User Defined and enter the default gateway IP address, or select None to remove the selected default gateway IP address from the interface.
- **Operational Default Gateway—**Displays the current default gateway status.

  NOTE If the switch is not configured with a default gateway, it cannot communicate with other devices that are not in the same IP subnet.

If a dynamic IP address is retrieved from the DHCP server, select the following fields that are enabled:

- **Renew DHCP Address—**The switch dynamic IP address can be renewed any time after it is assigned by a DHCP server. Depending on your DHCP server configuration, the switch might receive a new IP address after the renewal that will cause a loss of connectivity to the web-based switch configuration utility.
- **Auto Configuration via DHCP—**Displays status of auto-configuration feature. You can configure DHCP Auto Configuration from *Administration > File Management > DHCP Auto Configuration*.

STEP 3 Click **Apply**. The IPv4 interface settings are defined, and the switch is updated.

Defining IPv4 Interface when the Switch is in Layer 3 Mode

The *IPv4 Interface Page* is used when the switch is in Layer 3 mode. This mode enables configuring multiple IP addresses for switch management, and provides routing services.

The IP address can be configured on a port, a LAG, or VLAN interface.

Operating in Layer 3 mode, the switch routes traffic between the directly attached IP subnets configured at the switch. The switch continues to bridge traffic between devices in the same VLAN. Additional IPv4 routes for routing to non-directly attached subnets can be configured in the *IP Static Routing Page*.

NOTE The switch software consumes one VLAN ID (VID) for every IP address configured on a port or LAG. The switch takes the first VID that is not used starting from 4094.

To configure the IPv4 addresses:

STEP 1 Click **IP Configuration** > **Management and IP Interface** > **IPv4 Interface.** The *IPv4 Interface Page* opens.

This page displays the following fields:

- **Interface—**Interface for which the IP address is defined.
- **IP Address Type—**IP address defined as static or DHCP.
  - *Static*—Entered manually.
  - *DHCP*—Received from DHCP server.
- **IP Address—**Configured IP address for the interface.

- **Mask**—Configured IP address mask.
- **Status**—Results of the IP address duplication check.
  - *No Entry*—The IP address is unknown.
  - *Tentative*—There is no final result for the IP address duplication check.
  - *Valid*—The IP address collision check was completed, and no IP address collision was detected.
  - *Valid-Duplicated*—The IP address duplication check was completed, and a duplicate IP address was detected.
  - *Duplicated Without Valid*—A duplicated IP address was detected for the default IP address.

STEP 2 **Click Add.** The *Add IPv4 Interface Page* opens.

STEP 3 Select one of the following fields:

- **Interface**—Select Port, LAG, or VLAN as the interface associated with this IP configuration, and select a value for the interface from the list.
- **IP Address Type**—Select one of the following options:
  - **Dynamic IP Address**—Receive the IP address from a DHCP server.
  - **Static IP Address—**Enter the IP address.

STEP 4 If Static Address was selected, enter the **IP Address** for this interface.

STEP 5 Enter the Network Mask or Prefix Length for this IP address.

- **Network Mask—**IP mask for this address.
- **Prefix Length—**Length of the IPv4 prefix.

STEP 6 Click **Apply**. The IPv4 address settings are defined, and the switch is updated.

Defining IPv6 Global Configuration

The *IPv6 Global Configuration Page* defines the frequency of the IPv6 ICMP error messages generated by the switch.

To define IPv6 global parameters:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Global Configuration**.

In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Global Configuration**.

The *IPv6 Global Configuration Page* opens.

STEP 2 Enter the values for the following fields:

- **ICMPv6 Rate Limit Interval**—Enter the time limit.
- **ICMPv6 Rate Limit Bucket Size**—Enter the maximum number of ICMP error message that can be sent by the switch per interval.

STEP 3 Click **Apply**. The IPv6 address settings are defined, and the switch is updated.

Defining an IPv6 Interface

The *IPv6 Interfaces Page* displays the switch's IPv6 interface parameters and *enables* configuring this interface. An IPv6 interface can be configured on a port, a LAG, VLAN, or ISATAP tunnel interface. The switch supports one IPv6 interface as an IPv6 end device.

A tunnel interface is configured with an IPv6 address based on the settings defined in the *IPv6 Tunnel Page*.

To configure IPv6 interfaces:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Interfaces**.

In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Interfaces**.

The *IPv6 Interfaces Page* opens.

This page displays the IPv6 interfaces already configured.

STEP 2 Click **Add** to add a new IPv6 interface, that is to define on which interface IPv6 is enabled. The *Add IPv6 Interface Page* opens.

STEP 3 Enter the values.

- **IPv6 Interface—**Select a specific port, LAG, VLAN, or ISATAP tunnel.
- **Number of DAD Attempts—**Enter the number of consecutive neighbor solicitation messages that are sent while Duplicate Address Detection (DAD) is performed on the interface's Unicast IPv6 addresses. DAD verifies the uniqueness of new Unicast IPv6 addresses before the addresses are assigned. New addresses remain in a tentative state during DAD verification. Entering **0** in this field disables duplicate address detection processing on the specified interface. Entering **1** in this field indicates a single transmission without follow-up transmissions.
- **IPv6 Address Auto Configuration—**Enable automatic address configuration from the DHCP server. Address auto-configuration is stateful (DHCP). If enabled, the switch supports IPv6 stateless address auto configuration of site local and global IP address from the IPv6 router advertisement received on the interface. The switch does not support stateful address auto configuration.
- **Send ICMPv6 Messages—**Enable generating unreachable destination messages.

STEP 4 Click **Apply** to enable IPv6 processing on the selected interface. Regular IPv6 interfaces have the following addresses automatically configured:

- Link local address using EUI-64 format interface ID based on a device's MAC address
- All node link local Multicast addresses (FF02::1)
- Solicited-Node Multicast address (format FF02::1:FFXX:XXXX)

STEP 5 Click **IPv6 Address Table** to manually assign IPv6 addresses to the interface, if required. This page is described in the **"Defining IPv6 Addresses"** section.

Defining IPv6 Addresses

To assign an IPv6 address to an IPv6 Interface:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Addresses**.
In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Addresses**.

The *IPv6 Address Page* opens.

STEP 2 Select an interface, and click **Go**. The interface is displayed in the IPv6 Address Table.

STEP 3 Click **Add**. The Add IPv6 Address Page opens.

STEP 4 Enter the values for the fields.

- **IPv6 Interface—**Displays the interface where the address is automatically completed, based on the filter.
- **IPv6 Address Type—**Select Link Local or Global as the type of IPv6 address to add.
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **IPv6 Address—**The switch supports one IPv6 interface. In additional to the default link local and multicast addresses, the device also automatically adds global addresses to the interface based on the router advertisements it receives. The device supports a maximum of 128 addresses at the interface. Each address must be a valid IPv6 address that is specified in hexadecimal format by using 16-bit values separated by colons.

  NOTE You cannot configure any IPv6 addresses directly on a ISATAP tunnel interface.
- **Prefix Length—**The length of the Global IPv6 prefix as a decimal value from 0-128 indicating the number of the high-order contiguous bits of the address comprise the prefix (the network portion of the address).

- **EUI-64—**Select to use the EUI-64 parameter to identify the interface ID portion of the Global IPv6 address by using the EUI-64 format based on a device MAC address.

STEP 5 Click **Apply**. The switch is updated.

Defining an IPv6 Default Router List

The *IPv6 Default Router List Page* enables configuring and viewing the default IPv6 router addresses. This list contains 0 or more routers that are candidates to become the switch default router for non-local traffic. The switch randomly selects a router from the list. The switch supports one static IPv6 default router. Dynamic default routers are routers that have sent router advertisements to the switch IPv6 interface.

When adding or deleting IP addresses, the following events occur:

- When removing an IP interface, all the default router IP addresses are removed.
- Dynamic IP addresses cannot be removed.
- An alert message is displayed after an attempt is made to insert more than a single user-defined address.
- An alert message is displayed when attempting to insert a non-link local type address, meaning 'fe80:'.

To define a default router:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Default Router List**.
In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Default Router List**.

The *IPv6 Default Router List Page* opens.

This page displays the following fields for each default router:

- **Default Router IPv6 Address—**Link local IP address of the default router.
- **Interface—**Outgoing IPv6 interface where the default router resides.
- **Type—**The default router configuration that includes the following options:
    - *Static—*The default router was manually added to this table through the **Add** button.

- *Dynamic*—The default router was dynamically configured.

State—The default router status options are:

- *Incomplete*—Address resolution is in process. Default router has not yet responded.
- *Reachable*—Positive confirmation was received within the *Reachable Time.*
- *Stale*—Previously-known neighboring network is unreachable, and no action is taken to verify its reachability until it is necessary to send traffic.
- *Delay*—Previously-known neighboring network is unreachable. The switch is in Delay state for a predefined *Delay Time.* If no confirmation is received, the state changes to Probe.
- *Probe*—Neighboring network is unavailable, and Unicast Neighbor Solicitation probes are being sent to verify the status.

STEP 2 Click **Add** to add a static default router. The *Add Default Router Page* opens.

The window displays the Link Local Interface. The interface can be a port, LAG, VLAN, or tunnel.

STEP 3 Enter the static default router IP address in the Default Router IPv6 Address field.

STEP 4 Click **Apply**. The default router is defined, and the switch is updated.

Configuring IPv6 Tunnels

The ISATAP (Intra-Site Automatic Tunnel Addressing Protocol) enables encapsulating IPv6 packets within IPv4 packets for transmission over IPv4 networks. You must first manually enable and configure an ISATAP tunnel. Then you manually define an IPv6 interface at the ISATAP tunnel. Then the switch automatically configures the link local IPv6 address to the IPv6 interface.

When defining ISATAP tunnels, note the following:

- An IPv6 link local address is assigned to the ISATAP interface. The initial IP address is assigned to the interface, which is then activated.
- If an ISATAP interface is active, the ISATAP router IPv4 address is resolved via DNS by using ISATAP-to-IPv4 mapping. If the ISATAP DNS record is not resolved, ISATAP host name-to-address mapping is searched in the host mapping table.

- When the ISATAP router IPv4 address is not resolved via the DNS process, the ISATAP IP interface remains active. The system does not have a default router for ISATAP traffic until the DNS process is resolved.

To configure an IPv6 Tunnel:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Tunnel**. In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Tunnel**.

The *IPv6 Tunnel Page* opens.

STEP 2 Enter the values for the following fields:

- **Tunnel Number—**Displays the automatic tunnel router domain number.
- **Tunnel Type—**Always displayed as ISATAP.
- **Source IPv4 Address—**Disable the ISATAP tunnel, or enable the ISATAP tunnel over an IPv4 interface. The IPv4 address of the selected IPv4 interface used to form part of the IPv6 address over the ISATAP tunnel interface. The IPv6 address has a 64-bit network prefix of fe80::, with the rest of the 64-bit formed by concatenating 0000:5EFE and the IPv4 address.
    - *Auto*—Automatically selects the lowest IPv4 address from among all of its configured IPv4 interfaces.
    - *None*—Disable the ISATAP tunnel.
    - *Manual*—Manually configure an IPv4 address. The IPv4 address configured must be one of the IPv4 addresses at the switch IPv4 interfaces.
- **Tunnel Router's Domain Name—**A global string that represents a specific automatic tunnel router domain name. The name can either be the default name (ISATAP) or a user defined name.
- **Query Interval—**The number of seconds from 10-3600 between DNS queries (before the IP address of the ISATAP router is known) for this tunnel. The interval can be the default value (10 seconds) or a user defined interval.
- **ISATAP Solicitation Interval—**The number of seconds from 10-3600 between ISATAP router solicitations messages, when there is no active ISATAP router. The interval can be the default value (10 seconds) or a user defined interval.

- **ISATAP Robustness**—Used to calculate the interval for the DNS or router solicitation queries. The bigger the number, the more frequent the queries. The default value is 3. The range is 1-20.

  NOTE The ISATAP tunnel is not operational if the underlying IPv4 interface is not in operation.

STEP 3 Click **Apply**. The tunnel is defined, and the switch is updated.

Defining IPv6 Neighbors Information

The *IPv6 Neighbors Page* enables configuring and viewing the list of IPv6 neighbors on the IPv6 interface. The IPv6 Neighbor table (also known as IPv6 Neighbor Discovery Cache) displays the MAC addresses of the IPv6 neighbors that are in the same IPv6 subnet as the switch. This is used to verify the reachability of this neighbor. This is the IPv6 equivalent of the IPv4 ARP table. When the switch needs to communicate with its neighbors, the switch uses the IPv6 Neighbor Table to determine the MAC addresses based on their the IPv6 addresses.

This page displays the neighbors that were automatically detected or manually configured entries. Each entry displays to which interface the neighbor is connected, the neighbor's IPv6 and MAC addresses, the entry type (static or dynamic), and the state of the neighbor.

To define IPv6 neighbors:

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Neighbors**.
In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Neighbors**.

The *IPv6 Neighbors Page* opens.

STEP 2 Select a **Clear Table** option to clear some or all of IPv6 addresses in the IPv6 Neighbors Table.

- *Static Only*—Deletes the static IPv6 address entries.
- *Dynamic Only*—Deletes the dynamic IPv6 address entries.
- *All Dynamic & Static*—Deletes the static and dynamic address entries IPv6 address entries.

The following fields are displayed for the neighboring interfaces:

- **Interface**—Neighboring IPv6 interface type.
- **IPv6 Address**—IPv6 address of a neighbor.
- **MAC Address**—MAC address mapped to the specified IPv6 address.
- **Type**—Neighbor discovery cache information entry type (static or dynamic).
- **State**—Specifies the IPv6 neighbor status. The values are:
  - *Incomplete*—Address resolution is working. The neighbor has not yet responded.
  - *Reachable*—Neighbor is known to be reachable.
  - *Stale*—Previously-known neighbor is unreachable. No action is taken to verify its reachability until traffic must be sent.
  - *Delay*—Previously-known neighbor is unreachable. The interface is in Delay state for a predefined Delay Time. If no reachability confirmation is received, the state changes to Probe.
  - *Probe*—Neighbor is no longer known to be reachable, and Unicast Neighbor Solicitation probes are being sent to verify the reachability.

STEP 3 Click **Add**. The *Add IPv6 Neighbors Page* opens.

The *Add IPv6 Neighbors Page* provides information for adding a neighbor to be monitored.

STEP 4 Enter the values for the following fields:

- **Interface**—The neighboring IPv6 interface to be added.
- **IPv6 Address**—Enter the IPv6 network address assigned to the interface. The address must be a valid IPv6 address.
- **MAC Address**—Enter the MAC address mapped to the specified IPv6 address.

STEP 5 Click **Apply**. The switch is updated.

Modifying an IPv6 Neighbor

STEP 1 In Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Neighbors**.

In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Neighbors**.

The *IPv6 Neighbors Page* opens.

STEP 2 Select an interface, and click **Edit.** The *Edit IPv6 Neighbors Page* opens.

STEP 3 Enter the values for the following fields:

- **IPv6 Address—**Select a valid IPv6 address.
- **MAC Address—**Select the MAC address mapped to the specified IPv6 address.
- **Type—**Select the type of the neighbor discovery cache information entry.
  - *Static*—The static neighbor discovery cache entries.
  - *Dynamic*—The dynamic neighbor discovery cache entries.

STEP 4 Click **Apply**. The switch is updated.

Viewing IPv6 Route Tables

The *IPv6 Routes Table Page* displays the IPv6 Routes table. The table contains a single default route (IPv6 address ::0) that uses the default router selected from the IPv6 Default Router List to send packets to destination devices that are not in the same IPv6 subnet as the switch. In addition to the default route, the table also contains dynamic routes which are ICMP redirect routes received from IPv6 routers by using ICMP redirect messages. This could happen when the default router the switch uses is not the router for traffic to the IPv6 subnets that the switch wants to communicate to.

To view IPv6 routing entries in Layer 2 mode, click **Administration** > **Management Interface** > **IPv6 Routes**. In Layer 3 mode, click **IP Configuration** > **Management and IP Interface** > **IPv6 Routes**.

The *IPv6 Routes Table Page* opens.

This page displays the following fields:

- **IPv6 Address—**The IPv6 subnet address.
- **Prefix Length—**IP route prefix length for the destination IPv6 subnet address. It is preceded by a forward slash.
- **Interface—**Interface used to forward the packet.

- **Next Hop—**Address where the packet is forwarded. Typically, this is the address of a neighboring router. This must be a link local address.
- **Metric—**Value used for comparing this route to other routes with the same destination in the IPv6 router table. All default routes have the same value.
- **Life Time—**Time period that the packet can be sent, and resent, before being deleted.
- **Route Type—**How the destination is attached, and the method used to obtain the entry. The following values are:
    - *Local*—The manually configured switch IPv6 address.
    - *Dynamic*—The destination is indirectly attached IPv6 subnet address. The entry was obtained dynamically via the ICMP protocol.

Defining IPv4 Static Routing

When the switch is in Layer 3 mode, this page enables configuring and viewing IPv4 static routes on the switch. When routing traffic, the next hop is decided based on the longest prefix match (LPM algorithm). A destination IPv4 address may match multiple routes in the IPv4 Static Route Table. The switch uses the matched route with the highest subnet mask, that is, the longest prefix match.

To define an IP static route:

STEP 1 Click **IP Configuration** > **IP Static Routes**.

The *IP Static Routing Page* opens.

STEP 2 Click **Add.** The *Add IP Static Route Page* opens.

STEP 3 Enter the values for the following fields:

- **Destination IP Prefix—**Enter the destination IP address prefix.
- **Mask—**Select and enter information for one of the following:
    - **Network Mask—**The IP route prefix for the destination IP.
    - **Prefix Length—**The IP route prefix for the destination IP.
- **Next Hop Router IP Address—**Enter the next hop IP address or IP alias on the route.

NOTE You cannot configure a static route through a directly-connected IP subnet where the switch gets its IP address from a DHCP server.

- **Route Type**—Select the route type.
  - *Reject*—Rejects the route and stops routing to the destination network via all gateways. This ensures that if a frame arrives with the destination IP of this route, it is dropped.
  - *Remote*—Indicates that the route is a remote path.
- **Metric**—Enter the administrative distance to the next hop. The range is 1–255.

STEP 4 Click **Apply**. The IP Static route is added, and switch is updated.

Enabling ARP Proxy

The Proxy ARP technique is used by a device on a given IP subnet to answer ARP queries for a network address that is not on that network.

The ARP Proxy is aware of the traffic destination, and offers another MAC address in reply. Serving as an ARP Proxy for another host effectively directs LAN traffic destination to the host. The captured traffic is then typically routed by the Proxy to the intended destination by using another interface, or by using a tunnel.

The process in which an ARP query request for a different IP address, for proxy purposes, results in the node responding with its own MAC address is sometimes referred to as publishing.

This page enables configuring the status of the ARP proxy feature. After it is enabled on this page, it is enabled on all of the IP interfaces.

To enable ARP Proxy on the switch:

STEP 1 Click **IP Configuration** > **ARP Proxy**.

The *ARP Proxy Page* opens.

STEP 2 Select **ARP Proxy** to enable the switch to respond to ARP requests for remotely-located nodes with the switch MAC address.

STEP 3 Click **Apply**. The ARP proxy is enabled, and the switch is updated.

Defining UDP Relay

The UDP Relay feature is only available when the switch is in Layer 3 mode. Switches do not typically route IP broadcast packets between IP subnets. However, if configured, the switch can relay specific UDP broadcast packets received from its IPv4 interfaces to specific destination IP addresses.

To configure the relaying of UDP packets received from a specific IPv4 interface with a specific destination UDP port, add a UDP Relay:

STEP 1 Click **IP Configuration** > **UDP Relay**. The *UDP Relay Page* opens.

STEP 2 Click **Add.** The *Add UDP Relay Page* opens.

STEP 3 Select the **Source IP Interface** to where the switch is to relay UDP broadcast packets based on a configured UDP Destination Port. The interface must be one of the IPv4 interfaces configured on the switch.

STEP 4 Enter the **UDP Destination Port** number for the packets that the switch is to relay. The range is from 1-65535.

STEP 5 Enter the **Destination IP Address** that receives the UDP packet relays. If this field is 0.0.0.0, UDP packets are discarded. If this field is 255.255.255.255, UDP packets are flooded to all IP interfaces.

STEP 6 Click **Apply**. The UDP relay settings are defined, and the switch is updated.

DHCP Relay

The switch can act as a DHCP Relay agent that listens for DHCP messages, and relays them between DHCP servers and clients that reside in different VLANs or IP subnets.

DHCP Relay must be enabled globally and per VLAN.

In Layer 2 mode, the switch can relay DHCP messages received from a VLAN to one or more configured DHCP servers. When the DHCP Relay receives a DHCP message from a station, it adds option 82 to the frame to retain the input VLAN and input port. When a response is received from a DHCP server, the feature removes option 82 from the frame, and uses the option to determine where the station is connected. In this mode, the DHCP Relay discards all DHCP frames received from stations already containing option 82.

In Layer 3 mode, the switch can relay DHCP messages received from its IPv4 interfaces to one or more configured DHCP servers. The switch puts the IPv4 address into the message giaddr before relaying it to the servers. It uses the switch IPv4 address of the interface where the message is received. The switch uses the giaddr from the response to determine how to forward the response back to the DHCP client.

DHCP Relay Limitations

In Layer 2 mode, the switch inserts its own DHCP option 82 with ingress VLAN and ingress port information in the DHCP message it receives from the DHCP clients. Because of this, the DHCP servers must support DHCP option 82. The switch discards DHCP messages with option 82 that it receives from the DHCP clients.

In Layer 3 mode, the feature can only be enabled on the IPv4 interfaces.

Defining DHCP Relay Properties

The *Properties Page* enables configuring the DHCP Relay status on the switch, and the IP addresses of the DHCP server where the DHCP messages are relayed.

To use this feature, it is necessary to activate the DHCP Relay on the ingress interface where the DHCP messages are to be relayed. This can be done in the *DHCP Relay Interfaces Page*.

Option 82 inserts additional information to the packets sent from the host. The DHCP server passes the configuration information to hosts on a TCP/IP network. This permits the DHCP server to limit the address allocation to authorized hosts. DHCP with Option 82 can only be enabled if DHCP Relay is enabled.

To configure the DHCP Relay feature:

STEP 1 Click **IP Configuration** > **DHCP Relay** > **Properties**. The *Properties Page* opens.

STEP 2 Enter the values for the following fields:

- **DHCP Relay—**Select to enable or disable DHCP Relay.
- **Option 82—**Select Option 82 to enable insertion of the device MAC address and input parameters into packets for identification of the device. This option is configurable only in Layer 3 mode.
- **DHCP Server Table—**Displays the list of DHCP servers.

STEP 3 Click **Add** to enter the IP address of the DHCP server. The *Add DHCP Properties Page* opens.

STEP 4 Enter the value for the following field:

- **IP version—**Displays that only IPv4 is supported.
- **DHCP Server IP Address—**Enter the DHCP server IP address.

STEP 5 Click **Apply**. The DHCP server is defined, and the switch is updated.

Use the *DHCP Relay Interfaces Page* to configure the interfaces that support DHCP Relay.

Defining DHCP Relay Interfaces

This page enables configuring the port, LAG, or VLAN interfaces that support the DHCP Relay functions. For the DHCP Relay to function, it also must be activated globally in the *Properties Page*.

To define the DHCP Relay interfaces:

STEP 1 Click **IP Configuration** > **DHCP Relay** > **DHCP Relay Interfaces**. The *DHCP Relay Interfaces Page* opens.

This page displays the interface where DHCP Relay is defined, and the IP address. In Layer 3, port, LAG, or VLANs are offered; in Layer 2 only VLANs are offered.

STEP 2 Click **Add**. The *Add DHCP Interface Page (Layer 2)* opens.

STEP 3 Enter the **Interface** value.

- If the switch is in Layer 2 mode, select the VLAN that is to be DHCP Relay enabled.
- If the switch is in Layer 3 mode, select whether the interface is for a port, VLAN, or LAG.

STEP 4 Click **Apply**. A DHCP Relay interface is defined, and the switch is updated.

Configuring ARP

The switch maintains an ARP (Address Resolution Protocol) Table for all the known devices that reside in its directly connected IP subnets. A directly connected IP subnet is the subnet that a IPv4 interface of the switch is connected to. When the switch needs to send/route a packet to a local device, it searches the ARP Table to obtain the MAC address of the device. The ARP Table contains both static and dynamic addresses. Static address are manually configured and do not age out. The switch creates dynamic addresses from the ARP packets it receives. Dynamic addresses age out after a configured time.

The *ARP Table Page* enables viewing dynamic ARP entries that the switch has learned, changing the ARP entry aging time, clearing ARP entries, and adding or deleting static ARP entries.

NOTE In Layer 2 mode, the IP, MAC address mapping information in ARP Table is used by the switch to forward the traffic originated by the switch. In Layer 3 mode, the mapping information is used for Layer 3 routing as well as to forward the generated traffic.

To define the ARP tables:

STEP 1 Click **IP Configuration** > **ARP**. The *ARP Table Page* opens.

STEP 2 Enter the parameters.

- **ARP Entry Age Out**—Enter the number of seconds that dynamic addresses can remain in the ARP table. A dynamic address ages out after the time it is in the table exceeds the ARP Entry Age Out time. When a dynamic address ages out, it is deleted from the table, and needs to be relearned to be entered into the table again.

- **Clear ARP Table Entries—**Select the type of ARP entries to be cleared the system.
  - *All*—Deletes all of the static and dynamic addresses immediately.
  - *Dynamic*—Deletes all of the dynamic addresses immediately.
  - *Static*—Deletes all of the static addresses immediately.
  - *Normal Age Out*—Deletes dynamic addresses based on the configured ARP Entry Age Out time.

The ARP Table displays the following fields:

- **Interface—**The IPv4 Interface of the directly connected IP subnet where the IP device resides.
- **IP Address—**The IP address of the IP device.
- **MAC Address—**The MAC address of the IP device.
- **Status—**Whether the entry was manually entered or dynamically learned.

STEP 3 Click **Apply.** The ARP global settings are modified, and the switch is updated.

STEP 4 Click **Add**. The *Add ARP Entry Page (Layer 3)* opens.

STEP 5 Enter the parameters.

- **IP Version—**The IP address format supported by the host. Only IPv4 is supported.
- **Interface—**IPv4 interface on the switch.
  - For devices in Layer 2 mode, there is only one directly connected IP subnet which is always in the management VLAN. All the static and dynamic addresses in the ARP Table reside in the management VLAN.
  - For devices in Layer 3 mode, an IPv4 interface can be configured on a port, LAG or VLAN. Select the desired interface from the list of configured IPv4 interfaces on the switch.
- **IP Address—**Enter the IP address of the local device.
- **MAC Address—**Enter the MAC address of the local device.

STEP 6 Click **Apply**. The ARP entry is defined, and the switch is updated.

Domain Name Systems

The Domain Name System (DNS) translates user-defined domain names into IP addresses for the purpose of locating and addressing these objects.

As a DNS client the switch resolves domain names to IP addresses through one or more configured DNS servers.

Defining DNS Servers

The *DNS Servers Page* enables configuring the DNS servers and the default domain used by the switch.

To configure DNS servers:

STEP 1 Click **IP Configuration** > **Domain Name System** > **DNS Servers**. The *DNS Servers Page* opens.

STEP 2 Enter the parameters.

- **DNS**—Select to enable the switch as a DNS client to resolve DNS names into IP addresses through one or more configured DNS servers.
- **Default Domain Name—**Enter the default DNS domain name (1–158 characters). The switch appends to all non-fully qualified domain names (FQDN) turning them into FQDNs.
- **Type—**Displays the default domain type options:
  - *DHCP*—The default domain name is dynamically assigned by the DHCP server.
  - *Static*—The default domain name is user-defined.
  - N/A—No default domain name.

DNS Server Table:

- **DNS Server—**The IP addresses of the DNS servers. Up to eight DNS servers can be defined.
- **Server State—**The active DNS server. There can be only one active server. Each static server has a priority, a lower value means a higher priority. When first time the request is sent, static server with lowest priority is chosen. If after two retries there is no response from this server, the next server with

the next lowest priority is selected. If none of the static servers respond, the first dynamic server on the table, sorted by IP address (low to high), is selected.

STEP 3 Click **Add.** The *Add DNS Server Page* opens.

STEP 4 Enter the parameters.

- **IP Version—**Select Version 6 for IPv6 or Version 4 for IPv4.
- **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are:
    - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
    - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface—**If the IPv6 address type is Link Local, select whether it is received through VLAN2 or ISATAP.
- **DNS Server IP Address—**Enter the DNS server IP address.
- **Set DNS Server Active—**Select to activate the new DNS server.

STEP 5 Click **Apply**. The DNS server is added, and the switch is updated.

Mapping DNS Hosts

The switch saves the frequently-queried domain names acquired from the DNS servers into the local DNS cache. The cache can hold up to 64 static entries, 64 dynamic entries, and one entry for each IP address configured on the switch by DHCP. Name resolution always begins by checking these static entries, continues by checking the local DNS cache, and ends by sending requests to the external DNS server.

The *Host Mapping Page* enables configure static mappings between a DNS host name and an IP address.

Several IP addresses are supported per DNS per host name.

To add a domain name and its IP address:

STEP 1 Click **IP Configuration** > **Domain Name System** > **Host Mapping**. The *Host Mapping Page* opens.

This page displays the following fields:

- **Host Name—**User-defined domain name, up to 158 characters.
- **IP Address—**The host name IP address.

STEP 2 Click **Add.** The *Add Host Mapping Page* opens.

STEP 3 Enter the parameters.

- **IP Version—**Select Version 6 for IPv6 or Version 4 for IPv4.
- **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are:
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface—**If the IPv6 address type is Link Local, select whether it is received through VLAN2 or ISATAP.
- **Host Name—**Enter a domain name, up to 158 characters.
- **IP Address—**Enter an IP v4 IP address or enter up to four IPv6 host IP addresses. Addresses 2–4 are backup addresses.

STEP 4 Click **Apply**. The DNS host is added, and the switch is updated.

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Configuring Security

This chapter describes various aspects of security and access control. The system handles various types of security. Some features are used for more than a single type of security or control, and so they appear twice in the list of topics below. The following list of topics describes the various types of security features described in this chapter:

Permission to administer the switch is detailed in the following sections:

- **Defining Users**
- **TACACS+ Configuration**
- **Configuring RADIUS Parameters**
- **Management Access Authentication**
- **Access Profiles**
- **Configuring TCP/UDP Services**

Protection from attacks directed at the switch CPU is detailed in the following sections:

- **Configuring TCP/UDP Services**
- **Defining Storm Control**

Access control of end-users to the network through the switch is detailed in the following sections:

- **Management Access Authentication**
- **Access Profiles**
- **Defining Users**
- **TACACS+ Configuration**
- **Configuring RADIUS Parameters**
- **Configuring Port Security**

- **802.1X**

Protection from other network users is detailed in the following sections. These are attacks that pass through, but are not directed at, the switch.

- **Denial of Service Prevention**
- **Configuring TCP/UDP Services**
- **Defining Storm Control**
- **Configuring Port Security**

Defining Users

A user, in this context, is a system administrator or superuser, who manages the switch.

The default username is **cisco** and the default password is **cisco**. The first time that you log in with the default username and password, you are required to enter a new password.

Setting User Accounts

The *User Accounts Page* enables entering additional users that are permitted to manage the switch or changing the passwords of existing users.

NOTE It is not permitted to delete all users. If all users are selected, the **Delete** button is disabled.

To add a new user:

STEP 1 Click **Administration** > **User Accounts**. The *User Accounts Page* displays.

This page displays the users defined in the system.

STEP 2 Click **Add** to add a new user or click **Edit** to modify a user. The *Add (or Edit) a User Account Page* displays.

STEP 3 Enter the parameters.

- **User Name**—Enter a new username.

- **Password**—Enter a password. If the password strength and complexity is defined, the user password must comply with the policy. This is configured in the **Setting Password Complexity Rules** section.
- **Confirm Password**—Enter the password again.
- **Password Strength Meter**—Displays the strength of password. The policy for password strength and complexity are configured in the *Password Strength Page*.

STEP 4 Click **Apply**. The user is added, and the switch is updated.

Setting Password Complexity Rules

Passwords are used to authenticate users accessing the switch. Password management consists of setting general password complexity rules and the specific user passwords. Various aspects of password complexity are minimum password length, number of character classes, and the requirement that a new password be different from the previous one.

The *Password Strength Page* enables setting password complexity, as well as aging (the length of time during which the password is valid).

To define password complexity rules:

STEP 1 Click **Security** > **Password Strength**. The *Password Strength Page* displays.

STEP 2 Select **Enable Password Complexity Settings** to apply minimal complexity rules for passwords.

STEP 3 Enter the parameters.

- **Minimal Password Length**—Enter the minimal number of characters required for passwords.
- **Minimal Number of Character Classes**—Enter the character classes that must comprise a password: lower case letters (1), upper case letters (2), digits (3), or special characters (4).
- **The New Password Must Be Different than the Current One**—If selected, the new password cannot be the same as the current password.
- **Password Aging**—If selected, the user is prompted to change the password when the **Password Aging Time** expires.

- **Password Aging Time—**Enter the number of days that can elapse before the user must change the password. The default is 180 days.

STEP 4 Click **Apply**. The password settings are set, and the switch is updated.

TACACS+ Configuration

The switch is a *Terminal Access Controller Access Control System* (TACACS+) client that relies on a TACACS+ server to provide centralized security, authorizing and authenticating users attempting to access and administer the switch.

TACACS+ provides the following services:

- **Authentication—**Provides authentication of administrators logging onto the switch by using usernames and user-defined passwords.
- **Authorization—**Performed at login. After the authentication session is completed, an authorization session starts using the authenticated username. The TACACS+ server then checks user privileges.

The TACACS+ protocol ensures network integrity, through encrypted protocol exchanges between the device and the TACACS+ server.

TACACS+ is supported only with IPv4.

TACACS+ servers cannot be used as 802.1X authentication servers to verify credentials of network users trying to join the networks through the switch.

Some TACACS+ servers support a single connection that enables the device to receive all information in a single connection. If the TACACS+ server does not support this, the device reverts back to multiple connections.

Configuring Default TACACS+ Parameters

The *TACACS+ Page* enables adding, removing, and editing the TACACS+ servers. You can define the default parameters, such as the key string used to encrypt communications with the TACACS+ server. A user must be configured on the TACACS+ to have privilege level 15 to be granted permission to administer the switch.

To define a TACACS+ server and default TACACS+ server authentication parameters:

STEP 1 Click **Security** > **TACACS+**. The *TACACS+ Page* displays.

The TACACS+ Server Table displays the default parameters and the previously-defined TACACS+ servers.

STEP 2 Enter the default **Key String**. This is the authentication and encryption key used for communicating with the TACACS+ servers. The switch can be configured to use this key or to use a key for an individual server (described in the **Adding a TACACS+ Server** section). If you do not enter a key string in this field, the key individual server key must match the encryption key used by the TACACS+ server. If you enter a key string here and a key string for an individual TACACS+ server, the key string configured for the individual TACACS+ server takes precedence.

STEP 3 In the **Timeout for Reply** field, enter the amount of time that passes before the connection between the switch and the TACACS+ server times out. If a value is not entered in the *Add TACACS+ Server Page* for a specific server, the value is taken from this field.

STEP 4 Click **Apply**. The TACACS+ settings and the switch are updated.

Adding a TACACS+ Server

STEP 1 Click **Security** > **TACACS+**. The *TACACS+ Page* displays.

STEP 2 Click **Add.** The *Add TACACS+ Server Page* displays.

STEP 3 Enter the parameters.

- **Server IP Address—**Enter the TACACS+ server IP address.
- **Priority—**Enter the order that this TACACS+ server is used. Zero is the highest priority TACACS+ server and is the first server used. If it cannot establish a session with the high priority server, the switch will try the next highest priority server.
- **Key String—**Enter the authentication and encryption key for the TACACS+ server. The key must match the encryption key configured on the TACACS+ server. Select **Use Default** to use the key string defined under the TACACS+ Default Parameters.
- **Timeout for Reply—**Enter the amount of time that passes before the connection between the switch and the TACACS+ server times out. Select **Use Default** to use the default value displayed on the page.
- **Authentication IP Port—**Enter the port number through which the TACACS+ session occurs. The default is port 49.
- **Single Connection—**Select to enable a single open connection between the switch and the TACACS+ server.

STEP 4 Click **Apply**. The TACACS+ server is added, and the switch is updated.

Configuring RADIUS Parameters

Remote Authorization Dial-In User Service (RADIUS) servers provide a centralized 802.1X or MAC-based network access control. The switch is a RADIUS client that relies on a RADIUS server to provide centralized security, authorizing and authenticating users attempting to access and administer the switch.

For the RADIUS server to grant access to the web-based switch configuration utility, the RADIUS server must return cisco-avpair = shell:priv-lvl=15.

Use this page to enable the configuration of the RADIUS server parameters the switch uses to communicate with the servers.

To set the default RADIUS parameters:

STEP 1 Click **Security** > **RADIUS**. The *RADIUS Page* displays.

The RADIUS table displays the specific parameters for each defined RADIUS server.

STEP 2 Enter the default RADIUS parameters. Values entered in the *Default Parameters* and apply to all servers. If a value is not entered for a specific server the switch uses the values in these fields.

- **IP Version—**Displays the supported IP version: IPv6 and/or IPv4 subnet.
- **Retries—**Enter the number of transmitted requests that are sent to the RADIUS server before a failure is considered to have occurred.
- **Timeout for Reply—**Enter the number of seconds that the switch waits for an answer from the RADIUS server before retrying the query, or switching to the next server.
- **Dead Time—**Enter the number of minutes that elapse before a non-responsive RADIUS server is bypassed for service requests. If the value is 0, the server is not bypassed.
- **Key String—**Enter the default key string used for authenticating and encrypting the RADIUS attributes communicated between the switch and the RADIUS server. This key must match the key configured on the Radius server. A key string is used to encrypt communications by using MD5. A key configured for an individual RADIUS server has precedence over the default key that is used if there is no key provided for an individual server.

STEP 3 Click **Apply**. The RADIUS settings for the switch are updated.

Adding a RADIUS Server

STEP 1 Click **Security** > **RADIUS**. The *RADIUS Page* displays.

STEP 2 Click **Add.** The *Add RADIUS Server Page* displays.

This page provides fields that must be entered individually for a server.

STEP 3 Enter the fields for each server. To use the default values entered in the *RADIUS Page*, select **Use Default**.

- **IP Version**—Select the IP version of the RADIUS server IP address.
- **Server IP Address—**Enter the address of the RADIUS server.
- **Priority—**Enter the priority of the server. The priority determines the order the switch attempts to contact the servers to authenticate a user. The switch will start with the highest priority RADIUS server first. Zero is the highest priority.
- **Key String—**Enter the key string used for authenticating and encrypting the RADIUS attributes communicated between the switch and the RADIUS server. This key must match the key configured on the individual Radius server. If this field is left blank, the switch attempts to authenticate to the RADIUS server by using the default Key String.
- **Timeout for Reply—**Enter the number of seconds the switch waits for an answer from the RADIUS server before retrying the query, or switching to the next server. If there is no value entered in this field, the switch uses the default timeout value.
- **Authentication Port—**Enter the UDP port number of the RADUS server for authentication requests.
- **Accounting Port—**Enter the UDP port number of the RADUS server for accounting requests.
- **Number of Retries—**Enter the number of requests that are sent to the RADIUS server before a failure is considered to have occurred. Select **Use Default** to use the default value for the number of retries.
- **Dead Time—**Enter the number of minutes that must pass before a non-responsive RADIUS server is bypassed for service requests. Select **Use Default** to use the default value for the dead time. If you enter 0 minutes, there is no dead time.

- **Usage Type**—Enter the RADIUS server authentication type. The options are:
    - *Login*—RADIUS server is used for authenticating users that want to administer the switch.
    - *802.1X*—RADIUS server is used for authentication in 802.1x Access Control.
    - *All*—RADIUS server is used for authenticating user that wants to administer the switch and for authentication in 802.1X Access Control.

STEP 4 Click **Apply**. The RADIUS server is added, and the switch is updated.

Management Access Authentication

You can assign authentication methods to management access methods, such as SSH, console, Telnet, HTTP, and HTTPS. This authentication can be performed locally or on an external server, such as a TACACS+ or a RADIUS server.

User authentication occurs in the order that the authentication methods are selected. If the first authentication method is not available, the next selected method is used. For example, if the selected authentication methods are RADIUS and Local, and all configured RADIUS servers are queried in priority order and do not reply, the user is authenticated locally.

If an authentication method fails or the user has insufficient privilege level, the user is denied access to the switch. In other words, if authentication fails at an authentication method, the switch stops; it does not continue and does not attempt to use the next authentication method.

To define authentication methods for an access method:

STEP 1 Click **Security** > **Management Access Authentication**. The *Management Access Authentication Page* displays.

STEP 2 Select an access method from the **Application** list.

STEP 3 Use the arrows to move the authentication method between the Optional Methods column and the Selected Methods column. The first method selected is the first method that is used.

- *RADIUS*—User is authenticated on a RADIUS server. You must have configured one or more RADIUS servers.
- *TACACS+*—User authenticated on the TACACS+ server. You must have configured one or more TACACS+ servers.
- *None*—User is allowed to access the switch without authentication.
- *Local*—Username and password is checked against the data stored on the local switch. These username and password pairs are defined in the *User Accounts Page*.

  NOTE The **Local** or **None** authentication method must always be selected last. All authentication methods selected after **Local** or **None** are ignored.

STEP 4 Click **Apply**. The selected authentication methods are associated with the access method.

Access Profiles

Management Access Authentication configures the authentication methods to be used to authenticate and authorize users from different management access methods. Management Access Profiles limit management access from specific interfaces and/or sources.

Only users who pass both the active access profile and management access authentication are given management access to the switch.

Access Profile Rules, Filters, and Elements

Access profiles consist of rules for allowing access to the switch. Each access profile can consist of one or more rules. The rules are executed in order of their priority within the access profile (top to bottom).

Rules are composed of filters that include the following elements:

- **Access Methods**—Methods for accessing and managing the switch:
  - Telnet
  - Secure Telnet (SSH)
  - Hypertext Transfer Protocol (HTTP)

  - Secure HTTP (HTTPS)
  - Simple Network Management Protocol (SNMP)
  - All of the above

- **Action**—Permit or deny access to an interface or source address.
- **Interface**—Which ports, LAGs, or VLANs are permitted to access or denied access to the web-based switch configuration utility.
- **Source IP Address**—IP addresses or subnets. Access to management methods might differ among user groups. For example, one user group might be able to access the switch module only by using an HTTPS session, while another user group might be able to access the switch module by using both HTTPS and Telnet sessions.

Active Access Profile

The *Access Profiles Page* displays the access profiles and all access profiles created by users. Only a one access profile can be active on the switch and any attempt to access the switch must fit the rules in the active access profile.

The lookup in the active access profile is done by using a first-match method. The switch looks to see if the active access profile explicitly permits management access to the switch. If no match is found, access is denied.

When an attempt to access the switch is in violation of the active access profile, the switch generates a SYSLOG message to alert the system administrator of the attempt.

If a console-only access profile has been activated, the only way to deactivate it is through a direct connection from the management station to the physical console port on the switch.

After an access profile has been defined, additional rules can be added or edited by using the *Profiles Rules Page*.

Displaying, Adding, or Activating an Access Profile

To display, add, or select a different active access profile:

STEP 1 Click **Security** > **Mgmt Access Method** > **Access Profiles**. The *Access Profiles Page* displays.

This page displays all of the access profiles, active and inactive.

STEP 2 To change the active access profile, select a profile from the **Active Access Profile** drop down menu and click **Apply**. This makes the chosen profile the active access profile.

A caution message is displayed if you selected Console Only. If you continue, you are immediately disconnected from the web-based switch configuration utility and can access the switch only through the console port.

A caution message displays if you selected any other access profile, warning you that, depending on the selected access profile, you might be disconnected from the web-based switch configuration utility.

STEP 3 Click **OK** to select the active access profile or click **Cancel** to discontinue the action.

STEP 4 Click **Add** to open the *Add Access Profile Page*. The page allows you to configure a new profile and one rule. Go to the **Defining Profile Rules** section for instructions on how to construct a rule.

STEP 5 Enter the parameters.

- **Access Profile Name—**Enter an access profile name. The access profile name can contain up to 32 characters.
- **Rule Priority—**Enter the rule priority. When the packet is matched to a rule, user groups are either granted or denied access to the switch. The rule priority is essential to matching packets to rules, as packets are matched on a first-match basis. One is the highest priority.
- **Management Method—**Select the management method for which the rule is defined. Users with this access profile can only access the switch by using the management method selected. The options are:
  - *All*—Assigns all management methods to the rule.
  - *Telnet*—Users requesting access to the switch who meet the Telnet access profile criteria are permitted or denied access.
  - *Secure Telnet (SSH)*—Users requesting access to the switch who meet the SSH access profile criteria, are permitted or denied access.
  - *HTTP*—Assigns HTTP access to the rule. Users requesting access to the switch who meet the HTTP access profile criteria, are permitted or denied.
  - *Secure HTTP (HTTPS)*—Users requesting access to the switch who meet the HTTPS access profile criteria, are permitted or denied.

  - *SNMP*—Users requesting access to the switch who meet the SNMP access profile criteria are permitted or denied.

- **Action**—Select the action attached to the rule. The options are:
  - *Permit*—Permits access to the switch if the user matches the settings in the profile.
  - *Deny*—Denies access to the switch if the user matches the settings in the profile.
- **Applies to Interface**—Select the interface attached to the rule. The options are:
  - *All*—Applies to all ports, VLANs, and LAGs.
  - *User Defined*—Applies only to the port, VLAN, or LAG selected.
- **Applies to Source IP Address**—Select the type of source IP address to which the access profile applies. The *Source IP Address* field is valid for a subnetwork. Select one of the following values:
  - *All*—Applies to all types of IP addresses.
  - *User Defined*—Applies to only those types of IP addresses defined in the fields.
- **IP Version**—Select the supported IP version of the source address, IPv6 or IPv4.
- **IP Address**—Enter the source IP address.
- **Mask**—Select the format for the subnet mask for the source IP address, and enter a value in one of the fields:
  - **Network Mask**—Select the subnet to which the source IP address belongs and enter the subnet mask in dotted decimal format.
  - **Prefix Length**—Select the Prefix Length and enter the number of bits that comprise the source IP address prefix.

STEP 6 Click **Apply**. The access profile is created, and the switch is updated. You can now select this access profile as the active access profile.

Defining Profile Rules

Access profiles can contain up to 128 rules to determine who is permitted to manage and access the switch, and the access methods that may be used.

Each rule in an access profile contains an action and a criteria (one or more parameters) to match. Each rule has a priority; rules with the lowest priority are checked first. If the incoming packet matches a rule, the action associated with the rule is performed. If no matching rule is found within the active access profile, the packet is dropped.

For example, you can limit access to the switch from all IP addresses except IP addresses that are allocated to the IT management center. In this way, the switch can still be managed and has gained another layer of security.

To define profile rules:

STEP 1 Click **Security** > **Mgmt Access Method** > **Profile Rules**. The *Profiles Rules Page* displays.

STEP 2 Select the Filter field, and an access profile. Click **Go**.

The selected access profile is displayed in the Profile Rule Table.

STEP 3 Click **Add** to add a rule to it. The *Add Profile Rule Page* displays.

STEP 4 Enter the parameters.

- **Access Profile Name**—Select an access profile.
- **Rule Priority**—Enter the rule priority. When the packet is matched to a rule, user groups are either granted or denied access to the switch. The rule priority is essential to matching packets to rules, as packets are matched on a first-fit basis.
- **Management Method**—Select the management method for which the rule is defined. The options are:
  - *All*—Assigns all management methods to the rule.
  - *Telnet*—Users requesting access to the switch who meet the Telnet access profile criteria are permitted or denied access.
  - *Secure Telnet (SSH)*—Users requesting access to the switch who meet the Telnet access profile criteria, are permitted or denied access.

  - *HTTP*—Assigns HTTP access to the rule. Users requesting access to the switch who meet the HTTP access profile criteria, are permitted or denied.
  - *Secure HTTP (HTTPS)*—Users requesting access to the switch who meet the HTTPS access profile criteria, are permitted or denied.
  - *SNMP*—Users requesting access to the switch who meet the SNMP access profile criteria are permitted or denied.
- **Action**—Select **Permit** to permit the users that attempt to access the switch by using the configured access method from the interface and IP source defined in this rule. Or select **Deny** to deny access.
- **Applies to Interface**—Select the interface attached to the rule. The options are:
  - *All*—Applies to all ports, VLANs, and LAGs.
  - *User Defined*—Applies only to the port, VLAN, or LAG selected.
- **Applies to Source IP Address**—Select the type of source IP address to which the access profile applies. The *Source IP Address* field is valid for a subnetwork. Select one of the following values:
  - *All*—Applies to all types of IP addresses.
  - *User Defined*—Applies to only those types of IP addresses defined in the fields.
- **IP Version**—Select the supported IP version of the source address: IPv6 or IPv4.
- **IP Address**—Enter the source IP address.
- **Mask**—Select the format for the subnet mask for the source IP address, and enter a value in one of the field:
  - *Network Mask*—Select the subnet to which the source IP address belongs and enter the subnet mask in dotted decimal format.
  - *Prefix Length*—Select the Prefix Length and enter the number of bits that comprise the source IP address prefix.

STEP 5 Click **Apply,** and the rule is added to the access profile.

Configuring TCP/UDP Services

The *TCP/UDP Services Page* enables TCP or UDP-based services on the switch, usually for security reasons.

The switch offers the following TCP/UDP services:

- Telnet—disabled by factory default
- SSH—disabled by factory default
- HTTP—enabled by factory default
- HTTPS—disabled by factory default
- SNMP—disabled by factory default

The active TCP connections are also displayed in this window.

To configure TCP/UDP services:

STEP 1 Click **Security** > **TCP/UDP Services**. The *TCP/UDP Services Page* displays.

STEP 2 Enable or disable TCP/UDP services on the displayed services.

The TCP Services table displays the following information:

- **Service Name**—Management access method through which the switch is offering the service.
- **Type**—IP protocol the service uses.
- **Local IP Address**—Local IP address through which the switch is offering the service.
- **Local Port**—Local TCP port through which the switch is offering the service.
- **Remote IP Address**—IP address of the remote device that is requesting the service.
- **Remote Port**—TCP port of the remote device that is requesting the service.
- **State**—Status of the service.

The UDP Services table displays the following information:

- **Service Name**—Management access method through which the switch is offering the service.
- **Type**—IP protocol the service uses.

- **Local IP Address—**Local IP address through which the switch is offering the service.
- **Local Port—**Local UDP port through which the switch is offering the service.
- **Application Instance—**The service instance of the UDP service. (For example, when two senders send to the same destination.)

STEP 3 Click **Apply**. The services are added, and the switch is updated.

Defining Storm Control

When Broadcast, Multicast, or Unknown Unicast frames are received, they are duplicated, and a copy is sent to all possible egress ports. This means that in practice they are sent to all ports belonging to the relevant VLAN. In this way, one ingress frame is turned into many, creating the potential for a storm.

Storm protection enables you to limit the number of frames entering the switch and to define the types of frames that are counted towards this limit.

When a threshold (limit) is entered in the system, the port discards traffic after that threshold is reached. The port remains blocked until the traffic rate drops below this threshold. It then resumes normal forwarding.

To define Storm Control:

STEP 1 Click **Security** > **Storm Control**. The *Storm Control Page* displays.

This page displays storm control parameters for all ports.

All the fields on this page are described in the *Edit Storm Control Page* except for the **Storm Control Rate Threshold (%)**. It displays the percent of the total available bandwidth for unknown unicast, multicast, and Broadcast packets before storm control is applied at the port. The default value is 10% of the maximum rate of the port and is set in the *Edit Storm Control Page*.

STEP 2 Select a port and click **Edit.** The *Edit Storm Control Page* displays.

STEP 3 Enter the parameters.

- **Port—**Select the port for which storm control is enabled.
- **Storm Control—**Select to enable Storm Control.

- **Storm Control Rate Threshold—**Enter the maximum rate at which unknown packets can be forwarded.
- **Storm Control Mode—**Select one of the modes:
  - *Unknown Unicast, Multicast & Broadcast*—Counts unknown Unicast, Broadcast, and Multicast traffic together towards the bandwidth threshold.
  - *Multicast & Broadcast*—Counts Broadcast and Multicast traffic together towards the bandwidth threshold.
  - *Broadcast Only*—Counts only Broadcast traffic towards the bandwidth threshold.

STEP 4 Click **Apply**. Storm control is modified, and the switch is updated.

Configuring Port Security

Network security can be increased by limiting access on a port to users with specific MAC addresses. The MAC addresses can be either dynamically learned or statically configured.

Port security monitors received and learned packets. Access to locked ports is limited to users with specific MAC addresses.

Port Security has two modes:

- **Classic Lock—**All learned MAC addresses on the port are locked, and the port does not learn any new MAC addresses. The learned addresses are not subject to aging or re-learning.
- **Limited Dynamic Lock—**The switch learns MAC addresses up to the configured limit of allowed addresses. After the limit is reached the switch does not learn additional addresses. In this mode, the addresses are subject to aging and re-learning.

When a frame from a new MAC address is detected on a port where it is not authorized (the port is classically locked, and there is a new MAC address, or the port is dynamically locked, and the maximum number of allowed addresses has been exceeded), the protection mechanism is invoked, and one of the following actions can take place:

- Frame is discarded
- Frame is forwarded
- Port is shut down

When the secure MAC address is seen on another port, the frame is forwarded, but the MAC address is not learned on that port.

In addition to one of these actions, you can also generate traps, and limit their frequency and number to avoid overloading the devices.

NOTE If you want to use 802.1X on a port, it must be multiple host mode (see the *802.1x, Host and Session Authentication Page)*.

The *Port Security Page* displays security parameters for all ports and LAGs, and enables their modification.

To configure port security:

STEP 1 Click **Security** > **Port Security**. The *Port Security Page* displays.

This page displays information either for all ports or for all LAGs, depending on which interface type is selected.

STEP 2 Select an interface to be modified, and click **Edit.** The *Edit Port Security Interface Settings Page* displays.

STEP 3 Enter the parameters.

- **Interface**—Select the interface name.
- **Interface Status**—Select to lock the port.
- **Learning Mode**—Select the type of port locking. To configure this field, the Interface Status must be unlocked. The Learning Mode field is enabled only if the *Lock Interface* field is locked. To change the Learning Mode, the Lock Interface must be cleared. After the mode is changed, the Lock Interface can be reinstated. The options are:
  - *Classic Lock*—Locks the port immediately, regardless of the number of addresses that have already been learned.

  - *Limited Dynamic Lock*—Locks the port by deleting the current dynamic MAC addresses associated with the port. The port learns up to the maximum addresses allowed on the port. Both re-learning and aging of MAC addresses are enabled.

- **Max No. of Addresses Allowed**—Enter the maximum number of MAC addresses that can be learned on the port if *Limited Dynamic Lock* learning mode is selected. The range is 0-256. The default is 0 indicating that only static addresses are supported on the interface.

- **Action on Violation**—Select an action to be applied to packets arriving on a locked port. The options are:

  - *Discard*—Discards packets from any unlearned source.

  - *Forward*—Forwards packets from an unknown source without learning the MAC address.

  - *Shutdown*—Discards packets from any unlearned source, and shuts down the port. The port remains shut down until reactivated, or until the switch is rebooted.

- **Trap**—Select to enable traps when a packet is received on a locked port. This is relevant for lock violations. For Classic Lock, this is any new address received. For Limited Dynamic Lock, this is any new address that exceeds the number of allowed addresses.

- **Trap Frequency**—Enter minimum time (in seconds) that elapses between traps.

STEP 4 Click **Apply**. Port security is modified, and the switch is updated.

802.1X

Port-based access control has the effect of creating two types of access on the switch ports. One point of access enables uncontrolled communication, regardless of the authorization state (*uncontrolled port*). The other point of access authorizes communication between the host and the switch.

The 802.1x is an IEEE standard for port based network access control. The 802.1x framework enables a device (the supplicant) to request port access from a remote device (authenticator) to which it is connected. Only when the supplicant requesting port access is authenticated and authorized is the supplicant permitted to send data to the port. Otherwise, the authenticator discards the supplicant data unless the data is sent to a Guest VLAN and/or non-authenticated VLANs.

Authentication of the supplicant is performed by an external RADIUS server through the authenticator. The authenticator monitors the result of the authentication.

In the 802.1x standard, a device can be a supplicant and an authenticator at a port simultaneously, requesting port access and granting port access. However, this device is only the authenticator, and does not take on the role of a supplicant.

The following varieties of 802.1X exist:

- **Single session 802.1X**:
  - **A1**—Single-session/single host. In this mode, the switch, as an authenticator supports one 802.1x session and grants permission to use the port to the authorized supplicant at a port. All the access by the other devices received from the same port are denied until the authorized supplicant is no longer using the port or the access is to the unauthenticated VLAN or guest VLAN.
  - Single session/multiple hosts—This follows the 802.1x standard. In this mode, the switch as an authenticator allows any device to use a port as long as it has been granted permission to a supplicant at the port.
- **Multi-Session 802.1X**—Every device (supplicant) connecting to a port must be authenticated and authorized by the switch (authenticator) separately in a different 802.1x session. This is the only mode that supports Dynamic VLAN Assignment (DVA).

Dynamic VLAN Assignment (DVA)

Dynamic VLAN Assignment (DVA) is also referred as RADIUS VLAN Assignment in this guide. When a port is in Multiple Session mode and is DVA-enabled, the switch automatically adds the port as an untagged member of the VLAN that is assigned by the RADIUS server during the authentication process. The switch classifies untagged packets to the assigned VLAN if the packets are originated from the devices or ports that are authenticated and authorized.

For a device to be authenticated and authorized at a port with DVA enabled:

- The RADIUS server must authenticate the device and dynamically assign a VLAN to the device.
- The assigned VLAN must not be the default VLAN and must have been created at the switch.
- The switch must not be configured to use both a DVA and a MAC-based VLAN group together.
- A RADIUS server must support DVA with RADIUS attributes tunnel-type (64) = VLAN (13), tunnel-media-type (65) = 802 (6), and tunnel-private-group-id = a VLAN ID.

Authentication Methods

The authentication methods can be:

- 802.1x—The switch supports the authentication mechanism as described in the standard to authenticate and authorize 802.1x supplicants.
- MAC-based—The switch can be configured to use this mode to authenticate and authorized devices that do not support 802.1x. The switch emulates the supplicant role on behalf of the non 802.1x capable devices, and uses the MAC address of the devices as the username and password when communicating with the RADIUS servers. MAC addresses for username and password must be entered in lower case and with no deliminating characters (for example: aaccbb55ccff). To use MAC-based authentication at a port:
  - A Guest VLAN must be defined
  - The port must be Guest VLAN enabled.
  - The packets from the first supplicant at the port before it is authorized must be untagged packets.

You can configure a port to use 802.1x, MAC-based, or 802.1x and MAC-based authentication. If a port is configured to use both 802.1x and MAC-based authentication, 802.1x supplicant has precedence over non-802.1x device. The 802.1x supplicant preempts an authorized but non-802.1x device at a port that is configured with a single session.

Unauthenticated VLANs and the Guest VLAN

Unauthenticated VLANs and Guest VLAN provide access to services that do not require the subscribing devices or ports to be 802.1x or MAC-Based authenticated and authorized.

An unauthenticated VLAN is a VLAN that allows access by both authorized and unauthorized devices or ports. You can configure one or more VLAN to be an unauthenticated in the **Creating VLANs** section in the **Configuring Security** chapter. An unauthenticated VLAN has the following characteristics:

- It must be a static VLAN, and cannot be the Guest VLAN or the Default VLAN.
- The member ports must be manually configured as tagged members.
- The member ports must be trunk and/or general ports. An access port cannot be member of an unauthenticated VLAN.

The Guest VLAN, if configured, is a static VLAN with the following characteristics.

- Must be manually defined from an existing static VLAN.
- Is automatically available only to unauthorized devices or ports of devices that are connected and Guest VLAN enabled.
- If a port is Guest VLAN enabled, the switch automatically adds the port as untagged member of the Guest VLAN when the port is not authorized, and remove the port from the Guest VLAN when the first supplicant of the port is authorized.
- The Guest VLAN cannot be used as the Voice VLAN and an unauthenticated VLAN.

The switch also uses the Guest VLAN for the authentication process at ports configured with Multiple Session mode and MAC-Based Authentication. Therefore, you must configure a Guest VLAN before you can use the MAC authentication mode.

802.1X Parameters Workflow

Define the 802.1X parameters as follows:

1. Set a time range(s) using the *Time Range Page* that is used in the *Edit Port Authentication Page. This is optional.*
2. Define one or more static VLANs as unauthenticated VLANs as described in the **Defining 802.1X Properties** section. 802.1x authorized and unauthorized devices or ports can always send or receive packets to or from unauthenticated VLANs. *This is optional.*
3. Define 802.1X settings for each port by using the *Edit Port Authentication Page*. Note the following:
   a. On this page, DVA can be activated on a port by selecting the RADIUS VLAN Assignment field.
   b. You can select the Guest VLAN field to have untagged incoming frames go to the guest VLAN.
4. Define host authentication parameters for each port using the *Port Authentication Page*.
5. View 802.1X authentication history using the *Authenticated Hosts Page*.

Defining 802.1X Properties

The *802.1X Properties Page* is used to globally enable 802.1X. For 802.1X to function, it must be activated both globally and individually on each port.

To define port-based authentication:

STEP 1 Click **Security** > **802.1X** > **Properties**. The *802.1X Properties Page* displays.

STEP 2 Enter the parameters.

- **Port Based Authentication**—Enable or disable port-based, 802.1X authentication.
- **Authentication Method**—Select the user authentication methods. The options are:
  - *RADIUS, None*—Perform port authentication first by using the RADIUS server. If no response is received from RADIUS (for example, if the server is down), then no authentication is performed, and the session is permitted.

  - *RADIUS*—Authenticate the user on the RADIUS server. If no authentication is performed, the session is not permitted
  - *None*—Do not authenticate the user. Permit the session.

- **Guest VLAN**—Select to enable the use of a Guest VLAN for unauthorized ports. If a Guest VLAN is enabled, all unauthorized ports automatically join the VLAN selected in the *Guest VLAN ID* field. If a port is later authorized, it is removed from the Guest VLAN.
- **Guest VLAN ID**—Select the guest VLAN from the list of VLANs.
- **Guest VLAN Timeout**—Define a time period:
  - After linkup, if the software does not detect the 802.1X supplicant, or the authentication has failed, the port is added to the Guest VLAN, only after the *Guest VLAN timeout* period has expired.
  - If the port state changes from *Authorized* to *Not Authorized*, the port is added to the Guest VLAN only after the *Guest VLAN* timeout has expired.

The VLAN Authentication Table displays all VLANs, and indicates whether authentication has been enabled on them.

STEP 3 Click **Apply**. The 802.1X properties are modified, and the switch is updated.

Configuring Unauthenticated VLANs

When a port is 802.1x-enabled, unauthorized ports or devices are not allowed to access a VLAN unless the VLAN is a Guest VLAN or unauthenticated VLAN. You can make a static VLAN an authenticated VLAN by using the procedure in the **Defining 802.1X Properties** section, allowing both 802.1x authorized and unauthorized devices or ports to send or receive packets to or from unauthenticated VLANs. You must manually add VLAN port membership by using the Port to VLAN page.

STEP 1 Click **Security** > **802.1X** > **Properties**. The *802.1X Properties Page* displays.

STEP 2 Select a VLAN, and click **Edit**. The *Edit VLAN Authentication Page* displays.

STEP 3 Select a VLAN.

STEP 4 Optionally, uncheck **Authentication** to make the VLAN an unauthenticated VLAN.

STEP 5 Click **Apply,** and the switch is updated.

Defining 802.1X Port Authentication

The *Port Authentication Page* enables configuration of several of the 802.1X parameters for each port. Since some of the configuration changes are only possible while the port is in *Force Authorized* state, such as the authentication method. We recommended that you change the port control to *Force Authorized* before making changes. When the configuration is complete, return the port control to its previous state.

NOTE A port with 802.1x defined on it cannot become a member of a LAG.

To define 802.1X authentication:

STEP 1 Click **Security** > **802.1X** > **Port Authentication**. The *Port Authentication Page* displays.

This page displays authentication settings for all ports.

Modifying 802.1X Port Authentication Settings

STEP 1 Click **Security** > **802.1X** > **Port Authentication**. The *Port Authentication Page* displays.

STEP 2 Select a port, and click **Edit.** The *Edit Port Authentication Page* displays.

STEP 3 Enter the parameters.

- **Port**—Select a port.
- **User Name—**Displays the username of the port.
- **Current Port Control—**Displays the current port authorization state. If the state is *Authorized*, the port is either authenticated or the *Administrative Port Control* is *Force Authorized*. Conversely, if the state is *Unauthorized*, then the port is either not authenticated or the *Administrative Port Control* is *Force Unauthorized*.

- **Administrative Port Control—**Select the Administrative Port Authorization state. The options are:
  - *Force Unauthorized*—Denies the interface access by moving the interface into the unauthorized state. The switch does not provide authentication services to the client through the interface.
  - *Auto*—Enables port-based authentication and authorization on the switch. The interface moves between an authorized or unauthorized state based on the authentication exchange between the switch and the client.
  - *Force Authorized*—Authorizes the interface without authentication.
- **RADIUS VLAN Assignment—**Select to enable Dynamic VLAN assignment on the selected port. Dynamic VLAN assignment is possible only when the 802.1X mode is set to multiple session. (After authentication, the port joins the supplicant VLAN as an untagged port in that VLAN.)

TIP For the Dynamic VLAN Assignment feature to work, the switch requires the following VLAN attributes to be sent by the RADIUS server (as defined in RFC 3580):

[64] Tunnel-Type = VLAN (type 13)

[65] Tunnel-Medium-Type = 802 (type 6)

[81] Tunnel-Private-Group-Id = VLAN ID

- **Guest VLAN—**Select to indicate that the usage of a previously-defined Guest VLAN is enabled for the switch. The options are:
  - *Selected*—Enables using a Guest VLAN for unauthorized ports. If a Guest VLAN is enabled, the unauthorized port automatically joins the VLAN selected in the *Guest VLAN ID* field in the *802.1X Port Authentication Page*.

    After an authentication failure and if Guest VLAN is activated globally on the given port, the guest VLAN is automatically assigned to the unauthorized ports as an Untagged VLAN.
  - *Cleared*—Disables Guest VLAN on the port.

- **Authentication Method**—Select the authentication method for the port. The options are:
    - *802.1X Only*—802.1X authentication is the only authentication method performed on the port.
    - *MAC Only*—Port is authenticated based on the supplicant MAC address. Only 8 MAC-based authentications can be used on the port.
    - *802.1X and MAC*—Both 802.1X and MAC-based authentication are performed on the switch. The 802.1X authentication takes precedence.

  NOTE For MAC authentication to succeed, the Radius server supplicant username and password must be the supplicant MAC address. The MAC address must be in lower case letters and entered without the ":" or "-" separators; for example: 0020aa00bbcc.

- **Periodic Reauthentication**—Select to enable port re-authentication attempts after the specified Reauthentication Period.
- **Reauthentication Period**—Enter the number of seconds after which the selected port is reauthenticated.
- **Reauthenticate Now**—Select to enable immediate port re-authentication.
- **Authenticator State**—Displays the defined port authorization state. The options are:
    - *Force-Authorized*—Controlled port state is set to Force-Authorized (forward traffic).
    - *Force-Unauthorized*—Controlled port state is set to Force-Unauthorized (discard traffic).

      NOTE If the port is not in Force-Authorized or Force-Unauthorized, it is in Auto Mode and the authenticator displays the state of the authentication in progress. After the port is authenticated, the state is shown as Authenticated.

- **Time Range**—Enable a limit on the time that the specific port is authorized for use if 802.1x has been enabled (Port -Based authentication is checked).
- **Time Range Name**—Select the profile that specifies the time range.
- **Quiet Period**—Enter the number of seconds that the switch remains in the quiet state following a failed authentication exchange.

- **Resending EAP**—Enter the number of seconds that the switch waits for a response to an Extensible Authentication Protocol (EAP) request/identity frame from the supplicant (client) before resending the request.
- **Max EAP Requests**—Enter the maximum number of EAP requests that can be sent. If a response is not received after the defined period (supplicant timeout), the authentication process is restarted.
- **Supplicant Timeout**—Enter the number of seconds that lapses before EAP requests are resent to the supplicant.
- **Server Timeout**—Enter the number of seconds that lapses before the switch resends a request to the authentication server.
- **Termination Cause**—Displays the reason for which the port authentication was terminated, if applicable.

STEP 4 Click **Apply**. The port settings are defined, and the switch is updated.

Defining Host and Session Authentication

The *Host and Session Authentication Page* enables defining the mode in which 802.1X operates on the port and the action to perform if a violation has been detected.

The 802.1X modes are:

- *Single*—Only a single authorized host can access the port. (Port Security cannot be enabled on a port in single-host mode.)
- *Multiple Host (802.1X)*—Multiple hosts can be attached to a single 802.1X-enabled port. Only the first host must be authorized, and then the port is wide-open for all who want to access the network. If the host authentication fails, or an EAPOL-logoff message is received, all attached clients are denied access to the network.
- *Multiple Sessions*—Enables number of specific authorized hosts to access the port. Each host is treated as if it were the first and only user and must be authenticated. Filtering is based on the source MAC address.

To define 802.1X advanced settings for ports:

STEP 1 Click **Security** > **802.1X** > **Host and Session Authentication**. The *Host and Session Authentication Page* displays.

802.1X authentication parameters are described for all ports. All fields except the following are described in the *Edit Host and Session Authentication Page*.

- **Status**—Displays the host status. An asterisk indicates that the port is either not linked or is down. The options are:
  - *Unauthorized*—Either the port control is *Force Unauthorized* and the port link is down, or the port control is *Auto* but a client has not been authenticated via the port.
  - *Force-Authorized*—Clients have full port access.
  - *Single-host Lock*—Port control is *Auto* and only a single client has been authenticated by using the port.
  - *Multiple Hosts*—Port control is *Auto* and Multiple Hosts mode is enabled. At least one client has been authenticated.
  - *Multiple Sessions*—Port control is *Auto* and Multiple Sessions mode is enabled. At least one session has been authenticated.
  - *Not in Auto Mode*—Auto port control is not enabled.
- **Number of Violations**—Displays the number of packets that arrive on the interface in single-host mode, from a host whose MAC address is not the supplicant MAC address.

STEP 2 Select a port, and click **Edit.** The *Edit Host and Session Authentication Page* displays.

STEP 3 Enter the parameters.

- **Port**—Enter a port number for which host authentication is enabled.
- **Host Authentication**—Select one of the modes described above in *Defining Host and Session Authentication*.
- **Action on Violation**—Select the action to be applied to packets arriving in Single Session/Single Host mode, from a host whose MAC address is not the supplicant MAC address. The options are:
  - *Discard*—Discards the packets.
  - *Forward*—Forwards the packets.

  - *Shutdown*—Discards the packets and shuts down the port. The ports remains shut down until reactivated, or until the switch is rebooted.

- **Traps**—Select to enable traps.
- **Trap Frequency**—Defines how often traps are sent to the host. This field can be defined only if multiple hosts are disabled.

STEP 4 Click **Apply**. The settings are defined, and the switch is updated.

Viewing Authenticated Hosts

The *Authenticated Hosts Page* displays details about those users that have been authenticated. These details include such details as the username used to authenticate the user, the station MAC address, and the length of time that the user has been logged on.

To view details about authenticated users:

STEP 1 Click **Security** > **802.1X** > **Authenticated Hosts**. The *Authenticated Hosts Page* displays.

This page displays the following fields:

- **User Name**—Supplicant names that were authenticated on each port.
- **Port**—Number of port.
- **Session time**—Amount of time (in seconds) that the supplicant was logged on the port.
- **Authentication Method**—Method by which the last session was authenticated. The options are:
  - *None*—No authentication is applied; it is automatically authorized.
  - *RADIUS*—Supplicant was authenticated by a RADIUS server.
- **MAC Address**—Displays the supplicant MAC address.

Defining Time Ranges

The *Time Range Page* enables the definition of the time period that 802.1X is active at the 802.1x-enabled ports. A Time Range must be configured with an absolute start and end time. If a time range has an absolute time range but no recurring range and it is configured to a 802.1x enabled port, the port is 802.1x active from the absolute start time to the end time.

If a time-range includes both absolute and recurring ranges, the port is activated only if the both absolute start time and the recurring time range have been reached. The port is deactivated either of the time ranges has been reached. The recurring time range is added to the absolute time range by using the *Recurring Range Page*.

If a time range has one or more recurring ranges and is configured to a 802.1x-enabled port, the port is 802.1x active within the time period(s) defined in the recurring range(s) that are also within the absolute start and end time of the time range.

When a 802.1x enabled port is out of its assigned time range and/or recurring time range, it is 802.1x inactive and is equivalent to Force Unauthorized.

The switch supports a maximum of 20 absolute time ranges.

All time specifications are interpreted as local time (Daylight Saving Time does not affect this).

To ensure that the time range entries take effect at the desired times, the software clock should be set by the user or by SNTP. If the software clock is not set in this way, the time range is not applied.

A total of 20 time ranges can be defined.

A possible use for this feature is if you want to limit access of computers to the network only during business hours, after which they are locked, and access to the rest of the network is blocked.

To add an absolute time range:

STEP 1 Click **Security** > **802.1X** > **Time Range**. The *Time Range Page* displays.

STEP 2 Click **Add**. The *Add Absolute Time Range Page* displays.

STEP 3 Enter the parameters.

- **Time Range Name—**Enter a time range name.

- **Absolute Starting Time—**Define the absolute start time:
- *Immediate*—Click to indicate that the time range starts when the time range is created.
- *Date* and *Time*—Select the absolute start date and time.
- **Absolute Ending Time—**Define the absolute end time:
- *Infinite*—Click to indicate that the time range never ends.
- *Date* and *Time*—Select the absolute start date and time.

STEP 4 Click **Apply**. The time range is created.

Defining a Recurring Range

The *Recurring Range Page* enables the creation of a recurring range that can then be added to a previously-defined time range (created in the *Time Range Page).*

All time specifications are interpreted as local time (Daylight Saving Time does not affect this).

To add a recurring time range:

STEP 1 Click **Security** > **802.1X** > **Recurring Range**. The *Recurring Range Page* displays.

This page displays the recurring time ranges that have been defined.

STEP 2 Click **Add,** and the *Add Recurring Range Page* displays.

STEP 3 Enter the parameters.

- **Time Range Name—**Select the time range to which the recurring range will be added.
- **Recurring Starting Time—**Enter the day of the week and the time at which the recurring range begins.
- **Recurring Ending Time—**Enter the day of the week and time on which the recurring range ends.

STEP 4 Click **Apply**. The recurring range is added to the time range.

Denial of Service Prevention

Denial of Service (DoS) Prevention increases network security by preventing packets with certain IP address parameters from entering the network. Denial of Service eliminates packets with headers or contents known to be signals of malicious intent.

Denial of Service Prevention enables network managers to:

- Deny packets that contain reserved IP addresses (*Martian Addresses Page*)
- Prevent TCP connections from a specific interface (*SYN Filtering Page*) and rate limit the packets (*SYN Rate Protection Page)*
- Configure the blocking of certain ICMP packets (*ICMP Filtering Page*)
- Discard fragmented IP packets from a specific interface (*IP Fragments Filtering Page*)
- Deny attacks from Stacheldraht Distribution, Invasor Trojan, and Back Office Trojan.

Denial of Service Security Suite Settings

The Denial of Service Prevention feature is a set of predefined rules that protect the network from malicious attacks. The *Denial of Service Security Suite Settings* enables activating the security suite.

The Denial of Service pages enable filtering of traffic. This protects the network from a Denial of Service and Distributed Denial of Service attacks.

NOTE Before activating Denial of Service Prevention, you must unbind all Access Control Lists (ACLs) or advanced QoS policies that are bound to a port. ACL and advanced QoS policies are not active when a port has Denial of Service Protection.

To enter Denial of Service Prevention global settings:

STEP 1 Click **Security** > **Denial of Service Prevention** > **Security Suite Settings**. The *Security Suite Settings* displays.

STEP 2 Select **DoS Prevention** to enable the Denial of Service Prevention feature.

- **Disable—**Disable the feature.
- **System-Level Prevention—**prevents attacks from Stacheldraht Distribution, Invasor Trojan, and Back Orifice Trojan.
- **Interface-Level Prevention—**prevents Martian Address, SYN, ICMP, and IP Fragments attacks.

STEP 3 If System-Level Prevention or System-Level and Interface-Level Prevention is selected, enable one or more of the following DoS Prevention options:

- **Stacheldraht Distribution—**Discards TCP packets with source TCP port equal to 16660.
- **Invasor Trojan—**Discards TCP packets with destination TCP port equal to 2140 and source TCP port equal to 1024.
- **Back Office Trojan—**Discards UDP packets with destination UDP port equal to 31337 and source UDP port equal to 1024.

STEP 4 Click **Apply**. The Denial of Service prevention Security Suite settings are defined, and the switch is updated.

STEP 5 If Interface-Level Prevention is selected, click the appropriate **Edit** button to configure the desired prevention.

Defining Martian Addresses

The *Martian Addresses Page* enables entering those addresses that indicate an attack if they are seen on the network.

The switch supports a set of reserved Martian addresses that are illegal from the view point of the IP protocol. The supported reserved Martian addresses are:

- Addresses defined to be illegal in the *Martian Addresses Page*.
- Some of the addresses are illegal from the viewpoint of the protocol, such as loopback addresses, including the following ranges:
  - **0.0.0.0/8 (Except 0.0.0.0/32 as a Source Address)—**Addresses in this block refer to source hosts on this network.
  - **127.0.0.0/8—**Used as the Internet host loopback address.
  - **192.0.2.0/24—**Used as the TEST-NET in documentation and example codes.
  - **224.0.0.0/4 (As a Source IP Address)—**Used in IPv4 Multicast address assignments, and is formerly known as Class D Address Space.
  - **240.0.0.0/4 (Except 255.255.255.255/32 as a Destination Address)—**Reserved address range, and is formerly known as Class E Address Space.

You can also add new Martian Addresses for DoS prevention. Packets that have a Martian addresses are discarded.

To define Martian addresses:

STEP 1 Click **Security** > **Denial of Service Prevention** > **Martian Addresses**. The *Martian Addresses Page* displays.

STEP 2 Select Reserved Martian Addresses and click **Apply** to include the reserved Martian Addresses in the System Level Prevention list. The list of reserved Martian Addresses is displayed in the Martian Address Table.

STEP 3 To add a Martian address click **Add**. The *Add Martian Addresses Page* displays.

STEP 4 Enter the parameters.

- **IP Version—**Indicates the supported IP version. Currently, support is only offered for IPv4.
- **IP Address—**Enter the Martian IP addresses for which Denial of Service Prevention is enabled. The values are:
  - **From reserved List—**Select a well-known IP address from the reserved list.
  - **New IP Address—**Enter an IP address.

- **Mask—**Enter the mask of the IP address to define the range of IP addresses for which Denial of Service prevention is enabled. The values are:
  - **Network Mask—**Network mask in dotted decimal format.
  - **Prefix Length—**Enter the prefix of the IP address to define the range of IP addresses for which Denial of Service prevention is enabled.

STEP 5 Click **Apply**. The Martian addresses are defined, and the switch is updated.

Define SYN Filtering

The *SYN Filtering Page* enables filtering TCP packets that contain a SYN flag, and are destined for a specific IP address and/or port.

To define SYN filtering:

STEP 1 Click **Security** > **Denial of Service Prevention** > **SYN Filtering**. The *SYN Filtering Page* displays.

This page displays the existing SYN filters.

STEP 2 Click **Add**. The *Add SYN Filtering Page* displays.

STEP 3 Enter the parameters.

- **Interface—**Select the interface on which the filter is defined.
- **IPv4 Address—**Enter the IP address for which the filter is defined, or select *All Addresses*.
- **Network Mask—**Enter the Network mask for which the filter is enabled in IP address format.
- **TCP Port—**Select the destination TCP port being filtered:
  - *Known Ports*—Select a port from the list.
  - *User Defined*—Enter a port number.
  - *All Ports*—Select to indicate that all ports are filtered.

STEP 4 Click **Apply**. The SYN filter is defined, and the switch is updated.

Define SYN Rate Protection

The *SYN Rate Protection Page* enables rate limiting the number of SYN packets on the ingress. This mitigates the effect of Denial of Service attacks, such as a SYN flood against servers, by rate limiting the number of new connections.

To define SYN rate protection:

STEP 1 Click **Security** > **Denial of Service Prevention** > **SYN Rate Protection**. The *SYN Rate Protection Page* displays.

This page displays the SYN rate protection currently defined per interface.

STEP 2 Click **Add**. The *Add SYN Rate Protection Page* displays.

STEP 3 Enter the parameters.

- **Interface—**Select the interface on which the rate protection is being defined.
- **IP Address—**Enter the IP address for which the SYN rate protection is defined or select *All Addresses*. If you enter the IP address, enter either the mask or prefix length.
- **Network Mask—**Select the format for the subnet mask for the source IP address, and enter a value in one of the field:
  - *Mask*—Select the subnet to which the source IP address belongs and enter the subnet mask in dotted decimal format.
  - *Prefix Length*—Select the Prefix Length and enter the number of bits that comprise the source IP address prefix.
- **SYN Rate Limit—**Enter the number of SYN packets allowed.

STEP 4 Click **Apply**. The SYN rate protection is defined, and the switch is updated.

Define ICMP Filtering

The *ICMP Filtering Page* enables the blocking of ICMP packets from certain sources. This can reduce the load on the network in case of an ICMP flood Denial of Service attack.

To define ICMP filtering:

STEP 1 Click **Security** > **Denial of Service Prevention** > **ICMP Filtering**. The *ICMP Filtering Page* displays.

This page displays the rules by which the ICMP packets are blocked on each interface.

STEP 2 Click **Add**. The *Add ICMP Filtering Page* displays.

STEP 3 Enter the parameters.

- **Interface**—Select the interface on which the ICMP filtering is being defined.
- **IP Address**—Enter the IPv4 address for which the ICMP packet filtering is activated or select *All* to block ICMP packets from all source addresses. If you enter the IP address, enter either the mask or prefix length.
- **Network Mask**—Select the format for the subnet mask for the source IP address, and enter a value in one of the field:
  - *Mask*—Select the subnet to which the source IP address belongs and enter the subnet mask in dotted decimal format.
  - *Prefix Length*—Select the Prefix Length and enter the number of bits that comprise the source IP address prefix.

STEP 4 Click **Apply**. The ICMP filtering is defined, and the switch is updated.

Define IP Fragmented Blocking

The *IP Fragmented Page* enables blocking fragmented IP packets.

To define fragmented IP blocking:

STEP 1 Click Security > Denial of Service Prevention > IP Fragments Filtering. The *IP Fragments Filtering Page* displays.

This page displays the fragmented IP blocking per interface.

STEP 2 Click **Add**. The *Add IP Fragments Filtering Page* displays.

STEP 3 Enter the parameters.

- **Interface—**Select the interface on which the IP fragmentation is being defined.
- **IP Address—**Enter an IP network from which the fragmented IP packets is filtered or select **All** to block IP fragmented packets from all addresses. If you enter the IP address, enter either the mask or prefix length.
- **Network Mask—**Select the format for the subnet mask for the source IP address, and enter a value in one of the field:
    - *Mask*—Select the subnet to which the source IP address belongs and enter the subnet mask in dotted decimal format.
    - *Prefix Length*—Select the Prefix Length and enter the number of bits that comprise the source IP address prefix.

STEP 4 Click **Apply**. The IP fragmentation is defined, and the switch is updated.

Access Control

The Access Control List (ACL) feature is part of the security mechanism. ACL definitions serve as one of the mechanisms to define traffic flows that should be given a specific Quality of Service (QoS). For more information see the **Configuring QoS** section in the **Configuring Quality of Service** chapter.

ACLs enable network managers to define patterns (filter and actions) for ingress traffic. Packets, entering the switch on a port or LAG with an active ACL, are either admitted or denied entry.

This chapter contains the following topics:

Access Control Lists

An Access Control List (ACL) is an ordered list of classification filters and actions. Each single classification rule, together with its action, is called an Access Control Element (ACE).

Each ACE is made up of filters that determine traffic groups and associated actions. A single ACL may contain one or more ACEs, which are matched against the contents of incoming frames. Either a DENY or PERMIT action is applied to frames whose contents match the filter.

The switch support a maximum of 512 ACLs, and a maximum of 512 ACEs.

When a packet matches an ACE filter, the ACE action is taken and that ACL processing is stopped. If the packet does not match the ACE filter, the next ACE is processed. If all ACEs of an ACL have been processed without finding a match, and if another ACL exists, it is processed in a similar manner. If no match is found to any ACE in all relevant ACLs, the packet is dropped (as a default action). Because of this default drop action you must explicitly add ACEs into the ACL to permit all traffic, including management traffic, such as telnet, HTTP or SNMP that is directed to the switch itself.

If IGMP/MLD snooping is enabled at a port bound with an ACL, add ACE filters in the ACL to forward IGMP/MLD packets to the switch. Otherwise, IGMP/MLD snooping will fail at the port.

The order of the ACEs within the ACL is significant, since they are applied in a first-fit manner. The ACEs are processed sequentially, starting with the first ACE.

ACLs can be used for security, for example by permitting or denying certain traffic flows, and also for traffic classification and prioritization in the QoS Advanced mode.

NOTE A port can be either secured with ACLs or configured with advanced QoS policy, but not both.

There can only be one ACL per port, with the exception that it is possible to associate both an IP-based ACL and an IPv6-based ACL with a single port. To associate more than one ACL with a port, a policy with one or more class maps must be used (see *Configuring a Policy Table in QoS Advanced Mode*). The following types of ACLs can be defined (depending on which part of the frame header is examined):

- MAC ACL—Examines Layer 2 fields only, as described in *Defining MAC-based ACLs*
- IP ACL—Examines the L3 layer of IP frames, as described in *IPv4-based ACLs*
- IPv6 ACL—Examines the L3 layer of IPv4 frames as described in *Defining IPv6-Based ACL*

If a frame matches the filter in an ACL, it is defined as a flow with the name of that ACL. In advanced QoS, these frames can be referred to using this Flow name, and QoS can be applied to these frames (see *QoS Advanced Mode*).

Creating ACLs Workflow

To create ACLs and associate them with an interface, perform the following:

1. Create one or more of the following types of ACLs:
   a. MAC-based ACL by using the *MAC Based ACL Page* and the *MAC Based ACE Page*
   b. IP-based ACL by using the *IPv4 Based ACL Page* and the *IPv4 Based ACE Page*
   c. IPv6-based ACL by using the *IPv6 Based ACL Page* and the *IPv6 Based ACE Page*
2. Associate the ACL with interfaces by using the *ACL Binding Page.*

Modifying ACLs Workflow

An ACL can only be modified if it is not in use. The following describes the process of unbinding an ACL in order to modify it:

- If the ACL does not belong to a QoS Advanced Mode class map, but it has been associated with an interface, unbind it from the interface using the *ACL Binding Page*.
- If the ACL is part of the class map and not bound to an interface, then it can be modified.
- If the ACL is part of a class map contained in a policy bound to an interface, you must perform the chain of unbinding as follows:
  - Unbind the policy containing the class map from the interface by using *Policy Binding.*
  - Delete the class map containing the ACL from the policy using the *Configuring a Policy* (**Edit**).
  - Delete the class map containing the ACL, by using *Defining Class Mapping*.

Only then can the ACL be modified, as described in the sections of this chapter.

Defining MAC-based ACLs

MAC-based ACLs are used to filter traffic based on Layer 2 fields. MAC-based ACLs check all frames for a match.

MAC-based ACLs are defined in the *MAC Based ACL Page*. The rules are defined in the *MAC Based ACE Page.*

To define a MAC-based ACL:

STEP 1 Click **Access Control** > **MAC Based ACL**. The *MAC Based ACL Page* opens.

This page displays a list of all currently defined MAC-based ACLs.

STEP 2 Click **Add**. The *Add MAC Based ACL Page* opens.

STEP 3 Enter the name of the new ACL in the **ACL Name** field. ACL names are case-sensitive.

STEP 4 Click **Apply**. The MAC-based ACL is added, and the switch is updated.

Adding Rules to a MAC-based ACL

To add rules (ACEs) to an ACL:

STEP 1 Click **Access Control** > **MAC Based ACE**. The *MAC Based ACE Page* opens.

STEP 2 Select an ACL, and click **Go**. The ACEs in the ACL are listed.

STEP 3 Click **Add**. The *Add MAC Based ACE Page* opens.

STEP 4 Enter the parameters.

- **ACL Name—**Displays the name of the ACL to which an ACE is being added.
- **Priority—**Enter the priority of the ACE. ACEs with higher priority are processed first. One is the highest priority.
- **Action—**Select the action taken upon a match. The options are:
  - **Permit—**Forward packets that meet the ACE criteria.
  - **Deny—**Drop packets that meet the ACE criteria.

  - **Shutdown**—Drop packets that meet the ACE criteria, and disable the port from where the packets were received. Such ports can be reactivated from the *Port Settings Page*.

- **Destination MAC Address**—Select Any if all destination addresses are acceptable or User defined to enter a destination address or a range of destination addresses.
- **Destination MAC Address Value**—Enter the MAC address to which the destination MAC address will be matched and its mask (if relevant).
- **Destination MAC Wildcard Mask**—Enter the mask to define a range of MAC addresses. Note that this mask is different than in other uses, such as subnet mask. Here, setting a bit as **1** indicates don't care and **0** indicates to mask that value. For example, the value: "FFFFFF000000" indicates that only the first three bytes of the destination MAC address are used.
- **Source MAC Address**—Select Any if all source address are acceptable or User defined to enter a source address or range of source addresses.
- **Source MAC Address Value**—Enter the MAC address to which the source MAC address will be matched and its mask (if relevant).
- **Source MAC Wildcard Mask**—Enter the mask to define a range of MAC addresses.
- **VLAN ID**—Enter the VLAN ID section of the VLAN tag to match.
- **802.1p**—Select **Include** to use 802.1p.
- **802.1p Value**—Enter the 802.1p value to be added to the VPT tag.
- **802.1p Mask**—Enter the wildcard mask to be applied to the VPT tag.
- **Ethertype**—Enter the frame Ethertype to be matched.

STEP 5 Click **Apply**. The Add MAC Based ACE is defined, and the switch is updated.

IPv4-based ACLs

IPv4-based ACLs are used to check IPv4 packets, while other types of frames, such as ARPs, are not checked.

The following fields can be matched:

- IP protocol (by name for well-known protocols, or directly by value)
- Source/destination ports for TCP/UDP traffic
- Flag values for TCP frames
- ICMP and IGMP type and code
- Source/destination IP addresses (including wildcards)
- DSCP/IP-precedence value

NOTE ACLs are also used as the building elements of flow definitions for per-flow QoS handling (see *QoS Advanced Mode*).

The *IPv4 Based ACL Page* enables adding ACLs to the system. The rules are defined in the *IPv4 Based ACE Page.*

IPv6 ACLs are defined in the *IPv6 Based ACL Page*.

Defining an IPv4-based ACL

To define an IPv4-based ACL:

STEP 1 Click **Access Control** > **IPv4 Based ACL**. The *IPv4 Based ACL Page* opens.

This page displays all currently defined IPv4-based ACLs.

STEP 2 Click **Add**. The *Add IPv4 Based ACL Page* opens.

STEP 3 Enter the name of the new ACL in the **ACL Name** field. The names are case-sensitive.

STEP 4 Click **Apply**. The IPv4-based ACL is defined, and the switch is updated.

Adding Rules (ACEs) to an IPv4-Based ACL

To add rules (ACEs) to an IPv4-based ACL:

STEP 1 Click **Access Control** > **IPv4 Based ACE**. The *IPv4 Based ACE Page* opens.

STEP 2 Select an ACL, and click **Go**. All currently-defined IP ACEs for the selected ACL are displayed.

STEP 3 Click **Add**. The *Add IPv4 Based ACE Page* opens.

STEP 4 Enter the parameters.

- **ACL Name—**Displays the name of the ACL.
- **Priority—**Enter the priority. ACEs with higher priority are processed first.
- **Action—**Select the action assigned to the packet matching the ACE. The options are as follows:
  - **Permit—**Forward packets that meet the ACE criteria.
  - **Deny—**Drop packets that meet the ACE criteria.
  - **Shutdown—**Drop packet that meets the ACE criteria and disable the port to which the packet was addressed. Ports are reactivated from the *Port Management* page.
- **Protocol—**Select to create an ACE based on a specific protocol or protocol ID. Select Any (IPv4) to accept all IP protocols. Otherwise select one of the following protocols from the drop-down list:
  - **ICMP—**Internet Control Message Protocol
  - **IGMP—**Internet Group Management Protocol
  - **IP in IP—**IP in IP encapsulation
  - **TCP—**Transmission Control Protocol
  - **EGP—**Exterior Gateway Protocol
  - **IGP—**Interior Gateway Protocol
  - **UDP—**User Datagram Protocol
  - **HMP—**Host Mapping Protocol
  - **RDP—**Reliable Datagram Protocol.
  - **IDPR—**Inter-Domain Policy Routing Protocol
  - **IPV6—**IPv6 over IPv4 tunneling
  - **IPV6:ROUT—**Matches packets belonging to the *IPv6 over IPv4 route through a gateway*
  - **IPV6:FRAG—**Matches packets belonging to the IPv6 over IPv4 Fragment Header

  - **IDRP**—Inter-Domain Routing Protocol
  - **RSVP**—ReSerVation Protocol
  - *AH—Authentication Header*
  - *IPV6:ICMP*—Internet Control Message Protocol
  - *EIGRP—Enhanced Interior Gateway Routing Protocol*
  - *OSPF—Open Shortest Path First*
  - *IPIP—IP in IP*
  - *PIM—Protocol Independent Multicast*
  - *L2TP*—Layer 2 *Tunneling Protocol*
  - *ISIS*—IGP-specific protocol
- **Protocol ID to Match**—Instead of selecting the name, enter the protocol ID.
- **Source IP Address**—Select *Any* if all source address are acceptable or *User defined* to enter a source address or range of source addresses.
- **Source IP Address Value**—Enter the IP address to which the source IP address will be matched.
- **Source IP Wildcard Mask**—Enter the mask to define a range of IP addresses.
- **Destination IP Address**—Select *Any* if all destination address are acceptable or *User defined* to enter a destination address or range of destination addresses.
- **Destination IP Address Value**—Enter the IP address to which the destination MAC address will be matched.
- **Destination IP Wildcard Mask—**Enter the mask to define a range of IP addresses.
- **Source Port**—Select one of the following:
  - *Any*—Match to all source ports.
  - *Single*—Enter a single TCP/UDP source port to which packets are matched. This field is active only if 800/6-TCP or 800/17-UDP is selected in the Select from List drop-down menu.

  - *Range*—Select a range of TCP/UDP source ports to which the packet is matched. There are eight different port ranges that can be configured (shared between source and destination ports). TCP and UDP protocols each have eight port ranges.

- **Destination Port**—Select one of the available values that are the same as for the Source Port field described above.

  NOTE You must specify the IP protocol for the ACE before you can enter the source and/or destination port.

- **TCP Flags**—Select one of more TCP flags with which to filter packets. Filtered packets are either forwarded or dropped. Filtering packets by TCP flags increases packet control, which increases network security.

- **Type of Service—The service type of the IP packet.**

  - **Any**—Any service type

  - **DSCP to Match**—Differentiated Serves Code Point (DSCP) to match

  - **IP Precedence to match**—IP precedence is a model of TOS (type of service) that the network uses to help provide the appropriate QoS commitments. This model uses the 3 most significant bits of the service type byte in the IP header, as described in RFC 791 and RFC 1349.

- **ICMP**—If the IP protocol of the ACL is ICMP, select the ICMP message type used for filtering purposes. Either select the message type by name or enter the message type number:

  - **Any**—All message types are accepted.

  - **Select from list**—Select message type by name.

  - **ICMP Type to Match**—Number of message type to be used for filtering purposes.

- **ICMP Code**—The ICMP messages can have a code field that indicates how to handle the message. Select one of the following options to configure whether to filter on this code:

  - **Any**—Accept all codes.

  - **User defined**—Enter an ICMP code for filtering purposes.

- **IGMP—**If the ACL is based on IGMP, select the IGMP message type to be used for filtering purposes. Either select the message type by name or enter the message type number:
    - **Any—**All message types are accepted.
    - **Select from list—**Select message type by name.
    - **IGMP Type to match—**Number of message type that will be used for filtering purposes.

STEP 5 Click **Apply**. The IPv4-based ACE is defined, and the switch is updated.

IPv6-based ACLs

The *IPv6 Based ACL Page* displays and enables the creation of IPv6 ACLs, which check pure IPv6-based traffic. IPv6 ACLs do not check IPv6-over-IPv4 or ARP packets.

NOTE ACLs are also used as the building elements of flow definitions for per-flow QoS handling (see *QoS Advanced Mode*).

Defining an IPv6-based ACL

To define an IPv6-based ACL:

STEP 1 Click **Access Control** > **IPv6 Based ACL**. The *IPv6 Based ACL Page* opens.

This window displays the list of defined ACLs and their contents

STEP 2 Click **Add**. The *Add IPv6-based ACL Page* opens.

STEP 3 Enter the name of a new ACL in the **ACL Name** field. The names are case-sensitive.

STEP 4 Click **Apply**. The IPv6-based ACL is defined, and the switch is updated.

Defining a Rule (ACE) for an IPv6-based ACL

STEP 1 Click **Access Control** > **IPv6 Based ACE**. The *IPv6 Based ACE Page* opens.

This window displays the ACE (rules) for a specified ACL (group of rules).

STEP 2 Select an ACL, and click **Go**. All currently-defined IP ACEs for the selected ACL are displayed.

STEP 3 Click **Add**. The *Add IPv6 Based ACE Page* opens.

STEP 4 Enter the parameters.

- **ACL Name—**Displays the name of the ACL to which an ACE is being added.
- **Priority—**Enter the priority. ACEs with higher priority are processed first.
- **Action—**Select the action assigned to the packet matching the ACE. The options are as follows:
  - *Permit*—Forward packets that meet the ACE criteria.
  - *Deny*—Drop packets that meet the ACE criteria.
  - *Shutdown*—Drop packets that meet the ACE criteria, and disable the port to which the packets were addressed. Ports are reactivated from the *Port Management* page.
- **Protocol—**Select to create an ACE based on a specific protocol. Select *Any (IPv6)* to accept all IP protocols. Otherwise select one of the following protocols:
  - *TCP*—Transmission Control Protocol. Enables two hosts to communicate and exchange data streams. TCP guarantees packet delivery, and guarantees that packets are transmitted and received in the order they were sent.
  - *UDP*—User Datagram Protocol. Transmits packets but does not guarantee their delivery.
  - *ICMP*—Matches packets to the Internet Control Message Protocol (ICMP).
- **Protocol ID to Match—**Enter the ID of the protocol to be matched.
- **Source IP Address—**Select *Any* if all source address are acceptable or *User defined* to enter a source address or range of source addresses.

- **Source IP Address Value**—Enter the IP address to which the source IP address will be matched and its mask (if relevant).
- **Source IP Prefix Length**—Enter the prefix length of the source IP address.
- **Destination IP Address**—Select *Any* if all destination address are acceptable or *User defined* to enter a destination address or a range of destination addresses.
- **Destination IP Address Value**—Enter the IP address to which the destination MAC address will be matched and its mask (if relevant).
- **Destination IP Prefix Length**—Enter the prefix length of the IP address.
- **Source Port**—Select one of the following:
    - *Any*—Match to all source ports.
    - *Single*—Enter a single TCP/UDP source port to which packets are matched. This field is active only if 800/6-TCP or 800/17-UDP is selected in the IP Protocol drop-down menu.
    - *Range*—Select a range of TCP/UDP source ports to which the packet is matched.
- **Destination Port**—Select one of the available values. (They are the same as for the Source Port field described above).

  NOTE You must specify the IPv6 protocol for the ACL before you can configure the source and/or destination port.
- **TCP Flags**—Select one of more TCP flags with which to filter packets. Filtered packets are either forwarded or dropped. Filtering packets by TCP flags increases packet control, which increases network security.
    - Set—Match if the flag is SET.
    - Unset—Match if the flag is Not SET.
    - Don't care—Ignore the TCP flag.
- **Type of Service**—The service type of the IP packet.
- **ICMP**—If the ACL is based on ICMP, select the ICMP message type that will be used for filtering purposes. Either select the message type by name or enter the message type number. If all message types are accepted, select *Any*.
    - *Any*—All message types are accepted.

- *Select from list*—Select message type by name from the drop-down list.
- *ICMP Type to Match*—Number of message type that will be used for filtering purposes.

- **ICMP Code**—The ICMP messages may have a code field that indicates how to handle the message. Select one of the following options, to configure whether to filter on this code:
  - *Any*—Accept all codes.
  - *User defined*—Enter an ICMP code for filtering purposes.

STEP 5 Click **Apply**.

Defining ACL Binding

When an ACL is bound to an interface, its ACE rules are applied to packets arriving at that interface. Packets that do not match any of the ACEs in the ACL are matched to a default rule, whose action is to drop unmatched packets.

Although each interface can be bound to only one ACL, multiple interfaces can be bound to the same ACL by grouping them into a policy-map, and binding that policy-map to the interface.

After an ACL is bound to an interface, it cannot be edited, modified, or deleted until it is removed from all the ports to which it is bound or in use.

To bind an ACL to an interface:

STEP 1 Click **Access Control** > **ACL Binding**. The *ACL Binding Page* opens.

STEP 2 Select an interface type **Ports/LAGs** (Port or LAG).

STEP 3 Click **Go**. The list of ports/LAGs is displayed. For each type of interface selected, all interfaces of that type are displayed with a list of their current ACLs:

- **Interface**—Identifier of interface.
- **MAC ACL**—ACLs of type MAC that are bound to the interface (if any).
- **IPv4 ACL**—ACLs of type IPv4 that are bound to the interface (if any).
- **IPv6 ACL**—ACLs of type IPv6 that are bound to the interface (if any).

NOTE To unbind all ACLs from an interface, select the interface, and click **Clear**.

STEP 4 Select an interface, and click **Edit**. The *Edit ACL Binding Page* opens.

STEP 5 Select the **Interface** to which the ACLs are to be bound.

STEP 6 Select one of the following:

- **Select MAC Based ACL**—Select a MAC-based ACL to be bound to the interface.
- **Select IPv4 Based ACL**—Select an IPv4-based ACL to be bound to the interface.
- **Select IPv6 Based ACL**—Select an IPv6-based ACL to be bound to the interface.

STEP 7 Click **Apply**. The ACL binding is modified, and the switch is updated.

NOTE If no ACL is selected, the ACL(s) that is previously bound to the interface is unbound.

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Configuring Quality of Service

The Quality of Service feature is applied throughout the network to ensure that network traffic is prioritized according to required criteria and the desired traffic receives preferential treatment.

This chapter contains the following topics:

QoS Features and Components

The QoS feature is used to optimize network performance.

QoS provides the following:

- Classification of incoming traffic to traffic classes, based on attributes, including:
  - Device Configuration
  - Ingress interface
  - Packet content
  - Combination of these attributes

QoS includes the following:

- **Traffic Classification—**Classifies each incoming packet as belonging to a specific traffic flow, based on the packet contents and/or the port.The classification is done by ACL (Access Control List), and only traffic that meets the ACL criteria is subject to CoS or QoS classification
- **Assignment to Hardware Queues—**Assigns incoming packets to forwarding queues. Packets are sent to a particular queue for handling as a function of the traffic class to which they belong.
- **Other Traffic Class-Handling Attribute—**Applies QoS mechanisms to various classes, including bandwidth management.

QoS Modes

The QoS mode that is selected applies to all interfaces in the system.

- Basic Mode—Class of Service (CoS).

  All traffic of the same class receives the same treatment, which is the single QoS action of determining the egress queue on the egress port, based on the indicated QoS value in the incoming frame. This is the VLAN Priority Tag (VPT) 802.1p value in Layer 2 and the Differentiated Service Code Point (DSCP) value for IPv4 or Traffic Class (TC) value for IPv6 in Layer 3. When operating in Basic Mode, the switch trusts this external assigned QoS value. The external assigned QoS value of a packet determines its traffic class and QoS.

  The header field to be trusted is entered in the *Global Settings Page*. For every value of that field, an egress queue is assigned where the frame is sent in the *CoS/802.1p to Queue Page* or the *DSCP to Queue Page* (depending on whether the trust mode is CoS/802.1p or DSCP, respectively).

- Advanced Mode—Per-flow Quality of Service (QoS).

  In advanced mode, a per flow QoS consists of a class map and a policer:

  - A class map defines the kind of traffic in a flow, and contains one or more ACLs. Packets that match the ACLs belong to the flow.
  - A policer applies the configured QoS to a flow. The QoS configuration of a flow may consist of egress queue, the DSCP or CoS/802.1p value, and actions on out of profile (excess) traffic.

- Disable Mode

  In this mode all traffic is mapped to a single best effort queue, so that no type of traffic is prioritized over another.

Only a single mode can be active at a time. When the system is configured to work in QoS Advanced mode, settings for QoS Basic mode are not active and vice versa.

When the mode is changed, the following occurs:

- When changing from QoS Advanced mode to any other mode, policy profile definitions and class maps are deleted. ACLs bonded directly to interfaces remain bonded.
- When changing from QoS Basic mode to Advanced mode, the QoS Trust mode configuration in Basic mode is not retained.
- When disabling QoS, the shaper and queue setting (WRR/SP bandwidth setting) are reset to default values.

All other user configurations remain intact.

QoS Workflow

To configure general QoS parameters, perform the following:

1. Choose the QoS mode (Basic, Advanced, or Disabled, as described in the **"QoS Modes"** section) for the system by using the *QoS Properties Page.* The following steps in the workflow, assume that you have chosen to enable QoS.
2. Assign each interface a default CoS/802.1p priority by using the *QoS Properties Page*.
3. Assign the schedule method (Strict Priority or WRR) and bandwidth allocation for WRR to the egress queues by using the *Queue Page*.
4. Designate an egress queue to each IP DSCP/TC value with the *DSCP to Queue* Page. If the switch is in DSCP trusted mode, incoming packets are put into the egress queues based on the their DSCP/TC value.
5. Designate an egress queue to each CoS/802.1p priority. If the switch is in CoS/802.1 trusted mode, all incoming packets will be put into the designated egress queues according to the CoS/802.1p priority in the packets. This is done by using the *CoS/802.1p to Queue Page*.
6. If required for Layer 3 traffic only, assign a queue to each DSCP/TC value, by using the *DSCP to Queue Page.*

7. Enter bandwidth and rate limits in the following pages:

   a. Set egress shaping per queue by using the *Egress Shaping Per Queue Page.*

   b. Set ingress rate limit and egress shaping rate per port by using the *Bandwidth Page.*

   c. Set VLAN ingress rate limit by using the *VLAN Ingress Rate Limit Page*

8. Configure the selected mode by performing one of the following:

   a. Configure Basic mode, as described in *Workflow to Configure Basic QoS Mode*

   b. Configure Advanced mode, as described in *Workflow to Configure Advanced QoS Mode*.

Configuring QoS

Displaying QoS Properties

Displaying QoS Properties

The *QoS Properties Page* contains fields for setting the QoS mode for the system (Basic, Advanced, or Disabled, as described in the **"QoS Modes"** section). In addition, the default CoS priority for each interface can be defined.

To select the QoS mode:

STEP 1 Click **Quality of Service** > **General** > **QoS Properties**. The *QoS Properties Page* opens.

STEP 2 Select the **QoS Mode** (Disable, Basic, or Advanced) that will be active on the switch and click **Apply**.

STEP 3 Select **Port/LAG** to display/modify all ports/LAGs and their CoS information.

The following fields are displayed for all ports/LAGs:

- **Interface—**Type of interface.
- **Default CoS—**Default VPT value for incoming packets that do not have a VLAN Tag. The default CoS is 0. The default is only relevant for untagged frames and only if the system is in Basic mode and *Trust CoS* is selected in the *Global Settings Page*.

Select **Restore Defaults** to restore the factory CoS default setting for this interface.

Modifying Interface Default CoS Value

STEP 1 Click **Quality of Service** > **General** > **QoS Properties**. The *QoS Properties Page* opens.

STEP 2 Select an interface, and click **Edit**. The *Edit Interface CoS Configuration Page* opens.

STEP 3 Enter the parameters.

- **Interface—**Select the interface.
- **Default CoS—**Select the default CoS (Class-of-Service) value to be assigned for incoming packets (that do not have a VLAN tag). The range is 0-7.

STEP 4 Click **Apply**. The interface default CoS value is set, and the switch is updated.

Configuring QoS Queues

The switch supports four queues for each interface. Queue number four is the highest priority queue. Queue number one is the lowest priority queue.

There are two ways of determining how traffic in queues is handled, Strict Priority and Weighted Round Robin (WRR).

Strict Priority—Egress traffic from the highest-priority queue is transmitted first. Traffic from the lower queues is processed only after the highest queue has been transmitted, thus providing the highest level of priority of traffic to the highest numbered queue.

Weighted Round Robin (WRR)—In WRR mode the number of packets sent from the queue is proportional to the weight of the queue (the higher the weight the more frames are sent). For example, if all four queues are WRR and the default weights are used, queue 1 receives 1/15 of the bandwidth (assuming all queues are saturated and there is congestion), queue 2 receives 2/15, queue 3 receives 4/15 and queue 4 receives 8 /15 of the bandwidth. The type of WRR algorithm used in the device is not the standard Deficit WRR (DWRR), but rather Shaped Deficit WRR (SDWRR).

The queuing modes can be selected in the *Queue Page.* When the queuing mode is by strict priority, the priority sets the order in which queues are serviced, starting with queue_4 (the highest priority queue) and going to the next lower queue when each queue is completed.

When the queuing mode is Weighted Round Robin, queues are serviced until their quota has been used up and then another queue is serviced.

It is also possible to assign some of the lower queues to WRR, while keeping some of the higher queues in strict priority. In this case traffic for the strict priority queues is always sent before traffic from the WRR queues. Only after the strict priority queues have been emptied is traffic from the WRR queues forwarded. (The relative portion from each WRR queue depends on its weight).

To select the priority method and enter WRR data.

STEP 1 Click **Quality of Service** > **General** > **Queue**. The *Queue Page* opens.

STEP 2 Enter the parameters.

- **Queue—**Displays the queue number.
- **Scheduling Method:** Select one of the following options:
  - **Strict Priority—**Traffic scheduling for the selected queue and all higher queues is based strictly on the queue priority.
  - **WRR—**Traffic scheduling for the selected queue is based on WRR. The period time is divided between the WRR queues that are not empty, meaning they have descriptors to egress. This happens only if strict priority queues are empty.
  - **WRR Weight—**If WRR is selected, enter the WRR weight assigned to the queue.
  - **% of WRR Bandwidth—**Displays the amount of bandwidth assigned to the queue. These values represent the percent of the WRR weight.

STEP 3 Click **Apply**. The queues are configured, and the switch is updated.

Mapping CoS/802.1p to a Queue

The *CoS/802.1p to Queue Page* maps 802.1p priorities to egress queues. The CoS/802.1p to Queue Table determines the egress queues of the incoming packets based on the 802.1p priority in their VLAN Tags. For incoming untagged packets, the 802.1p priority will be the default CoS/802.1p priority assigned to the ingress ports.

Default Mapping Queues

802.1p Values (0-7, 7 being the highest)	Queue (4 queues 1-4, 4 being the highest priority)	Queue (2 queues: Normal and High)	Notes
0	1	Normal	Background

802.1p Values (0-7, 7 being the highest)	Queue (4 queues 1-4, 4 being the highest priority)	Queue (2 queues: Normal and High)	Notes
1	1	Normal	Best Effort
2	2	Normal	Excellent Effort
3	3	Normal	Critical Application LVS phone SIP
4	3	Normal	Video
5	4	High	Voice Cisco IP phone default
6	4	High	Interwork Control LVS phone RTP
7	4	High	Network Control

By changing the CoS/802.1p to Queue mapping and the Queue schedule method and bandwidth allocation, it is possible to achieve the desired quality of services in a network.

The CoS/802.1p to Queue mapping is applicable only if one of the following exists:

- The switch is in QoS Basic mode and CoS/802.1p trusted mode
- The switch is in QoS Advanced mode and the packets belong to flows that are CoS/802.1p trusted

To map CoS values to egress queues:

STEP 1 Click **Quality of Service** > **General** > **CoS/802.1p to Queue**. The *CoS/802.1p to Queue Page* opens.

STEP 2 Enter the parameters.

- **802.1p—**Displays the 802.1p priority tag values to be assigned to an egress queue, where 0 is the lowest and 7 is the highest priority.
- **Output Queue—**Select the egress queue to which the 802.1p priority is mapped. Four egress queues are supported, where Queue 4 is the highest priority egress queue and Queue 1 is the lowest priority.

- **Restore Defaults—**Click to restore all queues to the factory default CoS/802.1pto Queue mapping.

STEP 3 For each 802.1p priority select the Output Queue to which it is mapped.

STEP 4 Click **Apply**. 801.1p priority values to queues are mapped, and the switch is updated.

Mapping DSCP to Queue

The DSCP (IP *Differentiated Services Code Point*) to Queue Page maps DSCP to egress queues. The DSCP to Queue Table determines the egress queues of the incoming IP packets based on their DSCP values. The original VPT (VLAN Priority Tag) of the packet is unchanged.

By simply changing the DSCP to Queue mapping and the Queue schedule method and bandwidth allocation, it is possible to achieve the desired quality of services in a network.

The DSCP to Queue mapping is applicable to IP packets if:

- The switch is in QoS Basic mode and DSCP trusted mode, or
- The switch is in QoS Advanced mode and the packets belongs to flows that is DSCP trusted

Non-IP packets are always classified to the best-effort queue

To map DSCP to queues:

STEP 1 Click **Quality of Service** > **General** > **DSCP to Queue**. The *DSCP to Queue Page* opens.

The *DSCP to Queue Page* contains **Ingress DSCP**. It displays the DSCP value in the incoming packet and its associated class.

STEP 2 Select the **Output Queue** (traffic forwarding queue) to which the DSCP value is mapped.

STEP 3 Click **Apply**. The switch is updated.

Configuring Bandwidth

The *Bandwidth Page* enables network managers to define two sets of values that determine how much traffic the system can receive and send.

The ingress rate limit is the number of bits per second that can be received from the ingress interface. Excess bandwidth above this limit is discarded.

The following values are entered for egress shaping:

- Committed Information Rate (CIR) sets the average maximum amount of data allowed to be sent on the egress interface, measured in bits per second
- Committed Burst Shape (CBS) is the burst of data that is allowed to be sent, even though it is above the CIR. This is defined in number of bytes of data.

To enter bandwidth limitation:

STEP 1 Click **Quality of Service** > **General** > **Bandwidth**. The *Bandwidth Page* opens.

The *Bandwidth Page* displays bandwidth information for each interface.

The % column is the ingress rate limit for the port divided by the total port bandwidth.

STEP 2 Select an interface, and click **Edit**. The *Edit Bandwidth Page* opens.

STEP 3 Select the **Port/LAG** interface.

STEP 4 Enter the fields for the selected interface:

- **Ingress Rate Limit—**Select to enable the ingress rate limit, which is defined in the field below.
- **Ingress Rate Limit—**Enter the maximum amount of bandwidth allowed on the interface.
- **Egress Shaping Rate—**Select to enable egress shaping on the interface.
- **Committed Information Rate (CIR)—**Enter the maximum bandwidth for the egress interface.
- **Committed Burst Size (CBS)—**Enter the maximum burst size of data for the egress interface in bytes of data. This amount can be sent even if it temporarily increases the bandwidth beyond the allowed limit.

STEP 5 Click **Apply**. The bandwidth settings are modified, and the switch is updated.

Configuring Egress Shaping per Queue

In addition to limiting transmission rate per port, which is done in the *Bandwidth Page,* the switch can limit the transmission rate of selected egressing frames on a per-queue per-port basis. Egress rate limiting is performed by shaping the output load.

The switch limits all frames except for management frames. Any frames that are not limited are ignored in the rate calculations, meaning that their size is not included in the limit total.

Per-queue Egress rate shaping can be disabled.

To define egress shaping per queue:

STEP 1 Click **Quality of Service** > **General** > **Egress Shaping per Queue**. The *Egress Shaping Per Queue Page* opens.

The *Egress Shaping Per Queue Page* displays the rate limit and burst size for each queue.

STEP 2 Select an interface type (Port or LAG), and click **Go**. The list of ports/LAGs is displayed.

STEP 3 Select a port/LAG, and click **Edit**. The *Edit Egress Shaping Per Queue Page* opens.

This page enables shaping the egress for up to four queues on each interface.

STEP 4 Select the **Interface**.

STEP 5 For each queue that is required, enter the following fields:

- **Enable Shaping**—Select to enable egress shaping on this queue*.*
- **Committed Information Rate (CIR)**—Enter the maximum rate (CIR) in Kbits per second (Kbps). CIR is the average maximum amount of data that can be sent.
- **Committed Burst Size (CBS)**—Enter the maximum burst size (CBS) in bytes. CBS is the maximum burst of data allowed to be sent even if a burst exceeds CIR.

STEP 6 Click **Apply**. The bandwidth settings are modified, and the switch is updated.

Configuring VLAN Rate Limit

NOTE The VLAN Rate Limit feature is not available when the switch is in Layer 3 mode.

Rate limiting per VLAN, performed in the *VLAN Ingress Rate Limit Page,* enables traffic limiting on VLANs. QoS rate limiting (configured in the *Policy Table Page*) has priority over VLAN rate limiting. For example, if a packet is subject to QoS rate limits but is also subject to VLAN rate limiting, and the rate limits conflict, the QoS rate limits take precedence.

When VLAN ingress rate limiting is configured, it limits aggregate traffic from all the ports on the switch.

VLAN Rate Limiting is configured at the device level and rate limits are applied independently for each device in the network. If there is more than one device in the system (for example if a network includes 2 Cisco 24-port 10/100 switches participating in the same VLAN), the configured VLAN rate limit values will be applied on each of the devices independently.

To define the VLAN ingress rate limit:

STEP 1 Click **Quality of Service** > **General** > **VLAN Ingress Rate Limit**. The *VLAN Ingress Rate Limit Page* opens.

This page displays the VLAN Ingress Rate Limit Table.

STEP 2 Click **Add**. The *Add VLAN Ingress Rate Limit Page* opens.

STEP 3 Enter the parameters.

- **VLAN ID—**Select a VLAN.
- **Committed Information Rate (CIR)—**Enter the average maximum amount of data that can be accepted into the VLAN in Kilobytes per second.
- **Committed Burst Size (CBS)—**Enter the maximum burst size of data for the egress interface in bytes of data. This amount can be sent even if it temporarily increases the bandwidth beyond the allowed limit. Cannot be entered for LAGs.

STEP 4 Click **Apply**. The VLAN rate limit is added, and the switch is updated.

TCP Congestion Avoidance

The *TCP Congestion Avoidance Page* enables activating a TCP congestion avoidance algorithm. The algorithm breaks up or avoids TCP global synchronization in a congested node, where the congestion is due to various sources sending packets with the same byte count.

To configure TCP congestion avoidance:

STEP 1 Click **Quality of Service** > **General** > **TCP Congestion Avoidance**. The *TCP Congestion Avoidance Page* opens.

STEP 2 Click **Enable** to enable TCP congestion avoidance, and click **Apply**.

QoS Basic Mode

In QoS Basic mode, a specific domain in the network can be defined as trusted. Within that domain, packets are marked with 802.1p priority and/or DSCP to signal the type of service they require. Nodes within the domain use these fields to assign the packet to a specific output queue. The initial packet classification and marking of these fields is done in the ingress of the trusted domain.

Workflow to Configure Basic QoS Mode

To configure Basic QoS mode, perform the following:

1. Select Basic mode for the system by using the *QoS Properties Page.*
2. Select the trust-behavior using the *Global Setting Page*. The switch supports CoS/802.1p trusted mode and DSCP trusted mode. CoS/802.1p trusted mode uses the 802.1p priority in the VLAN tag. DSCP trusted mode use the DSCP value in the IP header.
3. If there is any port that, as an exception, should not trust the incoming CoS mark, disable the QoS state on that port using the *Interface Settings Page.*

   Enable or disable the global selected trusted mode at the ports by using the *Interface Settings Page*. If a port is disabled without trusted mode, all its ingress packets are forward in best effort. It is recommended that you disable the trusted mode at the ports where the CoS/802.1p and/or DSCP values in the incoming packets are not trustworthy. Otherwise, it might negatively affect the performance of your network

Configuring Global Settings

The *Global Settings Page* contains information for enabling Trust on the switch (see the *Trust Mode* field below). This configuration is active when the QoS mode is Basic mode. Packets entering a QoS domain are classified at the edge of the QoS domain.

To define the Trust configuration:

STEP 1 Click **Quality of Service** > **QoS Basic Mode** > **Global Settings**. The *Global Settings Page* opens.

STEP 2 Select the **Trust Mode** while the switch is in Basic mode. If a packet CoS level and DSCP tag are mapped to separate queues, the Trust mode determines the queue to which the packet is assigned:

- **CoS/802.1p**—Traffic is mapped to queues based on the VPT field in the VLAN tag, or based on the per-port default CoS/802.1p value (if there is no VLAN tag on the incoming packet), the actual mapping of the VPT to queue can be configured in the mapping CoS/802.1p to Queue Page.
- **DSCP**—All IP traffic is mapped to queues based on the DSCP field in the IP header. The actual mapping of the DSCP to queue can be configured in the DSCP to Queue Page. If traffic is not IP traffic, it is mapped to the best effort queue.

STEP 3 Select **Override Ingress DSCP** to override the original DSCP values in the incoming packets with the new values according to the DSCP Override Table. When Override Ingress DSCP is enabled, the switch will use the new DSCP values for egress queueing. It also replaces the original DSCP values in the packets with the new DSCP values.

NOTE The frame is mapped to an egress queue using the new, rewritten value, and not by the original DSCP value.

STEP 4 If **Override Ingress DSCP** was enabled, click **DSCP Override Table** to reconfigure DSCP. The *DSCP Override Table Page* opens.

For more information about this page, see the *Out of Profile DSCP Mapping Page*, which provides the same fields.

STEP 5 Click **Apply**. The switch is updated.

Interface QoS Settings

The *Interface Settings Page* enables configuring QoS on each port of the switch, as follows:

QoS State Disabled on an Interface—All inbound traffic on the port is mapped to the best effort queue and no classification/prioritization takes place.

QoS State of the Port is Enabled—Port prioritize traffic on ingress is based on the system wide configured trusted mode, which is either CoS/802.1p trusted mode or DSCP trusted mode.

To enter QoS settings per interface:

STEP 1 Click **Quality of Service** > **QoS Basic Mode** > **Interface Settings**. The *Interface Settings Page* opens.

STEP 2 Select **Port** or **LAG** to display the list of ports or LAGs.

The list of ports/LAGs is displayed. **QoS State** displays whether QoS is enabled on the interface.

STEP 3 Select an interface, and click **Edit**. The *Edit QoS Interface Settings* opens.

STEP 4 Select **Port** or **LAG** the interface.

STEP 5 Click to enable or disable **QoS State** for this interface.

STEP 6 Click **Apply**. The switch is updated.

QoS Advanced Mode

Frames that match an ACL and were permitted entrance are implicitly labeled with the name of the ACL that permitted their entrance. Advanced mode QoS actions can then be applied to these flows.

In QoS advanced mode, the switch uses policies to support per flow QoS. A policy and its components have the following characteristics and relationships:

- A policy contains one or more class maps.
- A class map defines a flow with one or more associating ACLs. Packets that match only ACL rules (ACE) in a class map with Permit (forward) action are considered belonging to the same flow, and are subjected to the same quality of services. Thus, a policy contains one or more flows, each with a user defined QoS.
- The QoS of a class map (flow) is enforced by the associating policer. There are two type of policers, single policer and aggregate policer. Each policer is configured with a QoS specification. A single policer applies the QoS to a single class map, and thus to a single flow, based on the policer QoS specification. An aggregate policer applies the QoS to one or more class maps, and thus one or more flows. An aggregate policer can support class maps from different policies.
- Per flow QoS are applied to flows by binding the policies to the desired ports. A policy and its class maps can be bound to one or more ports, but each port is bound with at most one policy.

Notes:

- Single policer and aggregation policer are available when the switch is in Layer 2 mode
- An ACL can be configured to one or more class maps regardless of policies.
- A class map can belong to only one policy.
- When a class map using single policer is bound to multiple ports, each port has its own instance of single policer; each applying the QoS on the class map (flow) at a port independent of each other.
- An aggregate policer will apply the QoS to all its flow(s) in aggregation regardless of policies and ports.

Advanced QoS settings consist of three parts:

- Definitions of the rules to match. All frames matching a single group of rules are considered to be a *flow*.
- Definition of the actions to be applied to frames in each flow that match the rules.
- Binding the combinations of rules and action to one or more interfaces.

Workflow to Configure Advanced QoS Mode

To configure Advanced QoS mode, perform the following:

1. Select Advanced mode for the system by using the *QoS Properties Page.*
2. If internal DSCP values are different from those used on incoming packets, map the external values to internal values by using the *Click* **Quality of Service** > **QoS Advanced Mode** > **Out of Profile DSCP Mapping***. The Out of Profile DSCP Mapping Page opens. DSCP Remarking Page.*
3. Create ACLs, as described in *Create ACL Workflow*.
4. If ACLs were defined, create class maps and associate the ACLs with them by using the *Class Mapping Page.*
5. Create a policy using the Policy Table Page, and associate the policy with one or more class maps using the Policy Class Map Page. You can also specify the QoS, if needed, by assigning a policer to a class map when you associate the class map to the policy.

   Single Policer—Create a policy that associates a class map with a single policer by using the *Policy Class Maps Page* and the *Class Mapping Page.* Within the policy, define the single policer.

   Aggregate Policer—Create a QoS action for each flow that sends all matching frames to the same policer (aggregate policer) by using the *Aggregate Policer Page*. Create a policy that associates a class map with the aggregate policer by using the *Policy Class Maps Page.*
6. Bind the policy to an interface by using the *Policy Binding Page.*

Configuring Out-of-Profile DSCP Remarking

When a policer is assigned to a class maps (flows), you can specify the action to take when the amount of traffic in the flow(s) has exceed the QoS-specified limits. The portion of the traffic that causes the flow to exceed its QoS limit is referred to as *out-of-profile packets*.

If the exceed action is Out of Profile DSCP, the switch remaps the original DSCP value of the out-of-profile IP packets with a new value based on the Out of Profile DSCP Mapping Table. The switch uses the new values to assign resources and the egress queues to these packets. The switch also physically replaces the original DSCP value in the out of profile packets with the new DSCP value.

To use the out-of-profile DSCP exceed action, remap the DSCP value in the Out Of Profile DSCP Mapping Table. Otherwise the action is null, because the DSCP value in the table remaps the packets to itself by factory default.

The *Click* **Quality of Service** > **QoS Advanced Mode** > **Out of Profile DSCP Mapping***. The Out of Profile DSCP Mapping Page opens. DSCP Remarking Page* enables sets the *change-the-DSCP-value* of traffic entering or leaving the switch.

This feature changes the DSCP tags for incoming traffic switched between trusted QoS domains. Changing the DSCP values used in one domain, sets the priority of that type of traffic to the DSCP value used in the other domain to identify the same type of traffic.

These settings are active when the system is in the QoS basic mode, and once activated they are active globally.

For example: Assume that there are three levels of service: Silver, Gold, and Platinum and the DSCP incoming values used to mark these levels are 10, 20, and 30 respectively. If this traffic is forwarded to another service provider that has the same three levels of service, but uses DSCP values 16, 24, and 48, **Out of Profile DSCP Mapping** changes the incoming values as they are mapped to the outgoing values.

To map DSCP values:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Out of Profile DSCP Mapping**. The Out of Profile *DSCP Mapping Page* opens. **DSCP In** displays the DSCP value of the incoming packet that needs to be remarked to an alternative value.

STEP 2 Select the **DSCP Out** value to where the incoming value is mapped.

STEP 3 Click **Apply**. The switch is updated with the new DSCP remarking table.

Defining Class Mapping

A Class Map defines a traffic flow with ACLs (Access Control Lists). A MAC ACL, IP ACL, and IPv6 ACL can be combined into a class map. Class maps are configured to match packet criteria on a match-all or match-any basis. They are matched to packets on a first-fit basis, meaning that the action associated with the first-matched class map is the action performed by the system. Packets that matches the same class map are considered to belong to the same flow.

NOTE Defining class maps does not have any effect on QoS; it is an interim step, enabling the class maps to be used later.

If more complex sets of rules are needed, several class maps can be grouped into a super-group called a policy (see the **Configuring a Policy** section).

The *Class Mapping Page* shows the list of defined class maps and the ACLs comprising each, and enables you to add/delete class maps.

To define a class map:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Class Mapping**. The *Class Mapping Page* opens.

This page displays the already-defined class maps.

STEP 2 Click **Add**. The *Add Class Mapping Page* opens.

A new class map is added by selecting one or two ACLs and giving the class map a name. If a class map has two ACLs, you can specify that a frame must match both ACLs, or that it must match either one or both of the ACLs selected.

STEP 3 Enter the parameters.

- **Class Map Name—**Enter the name of a new class map.
- **Match ACL Type—**The criteria that a packet must match in order to be considered to belong to the flow defined in the class map. The options are:
  - **IP—**A packet must match either of the IP based ACLs in the class map.
  - **MAC—**A packet must match the MAC based ACL in the class map.
  - **IP and MAC—**A packet must match the IP based ACL and the MAC based ACL in the class map.
  - **IP or MAC—**A packet must match either the IP based ACL or the MAC based ACL in the class map.
- **IP—**Select the IPv4 based ACL or the IPv6 based ACL for the class map.

- **MAC—**Select the MAC based ACL for the class map.
- **Preferred ACL—**Select whether packets are first matched to an IP-based ACL or a MAC-based ACL.

STEP 4 Click **Apply**. The switch is updated.

QoS Policers

You can measure the rate of traffic that matches a pre-defined set of rules, and to enforce limits, such as limiting the rate of file-transfer traffic that is allowed on a port.

This can be done by using the ACLs in the class map(s) to match the desired traffic, and by using a policer to apply the QoS on the matching traffic.

NOTE QoS policers are not supported when the switch is in Layer 3 mode.

A policer is configured with a QoS specification. There are two kinds of policers:

- **Single (Regular) Policer—**A single policer applies the QoS to a single class map, and to a single flow based on the policer's QoS specification. When a class map using single policer is bound to multiple ports, each port has its own instance of single policer; each applying the QoS on the class map (flow) at ports that are otherwise independent of each other. A single policer is created in the *Policy Class Maps Page.*
- **Aggregate Policer—**An aggregate policer applies the QoS to one or more class maps, and one or more flows. An aggregation policer can support class maps from different policies. An aggregate policer applies QoS to all its flow(s) in aggregation regardless of policies and ports. An aggregate policer is created in the *Aggregate Policer Page.*

  An aggregate policer is defined if the policer is to be shared with more than one class.

Each policer is defined with its own QoS specification with a combination of the following parameters:

- A maximum allowed rate, called a Committed Information Rate (CIR), measured in Kbps.
- An amount of traffic, measured in bytes, called a Committed Burst Size (CBS). This is traffic that is allowed to pass as a temporary burst even if it is above the defined maximum rate.

- An action to be applied to frames that are over the limits (called out-of-profile traffic), where such frames can be passed as is, dropped, or passed, but remapped to a new DSCP value that marks them as lower-priority frames for all subsequent handling within the device.

Assigning a policer to a class map is done when a class map is added to a policy. If the policer is an aggregate policer, you must create it using the *Aggregate Policer Page*.

Defining Aggregate Policers

An aggregate policer applies the QoS to one or more class maps, therefore one or more flows. An aggregation policer can support class maps from different policies and will apply the QoS to all its flow(s) in aggregation regardless of policies and ports.

NOTE The switch supports aggregate policers and single policers only when operating in Layer 2 mode.

To define an aggregate policer:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Aggregate Policer**. The *Aggregate Policer Page* opens.

This page displays the existing aggregate policers.

STEP 2 Click **Add**. The *Add Aggregate Policer Page* opens.

STEP 3 Enter the parameters.

- **Aggregate Policer Name—**Enter the name of the Aggregate Policer.
- **Ingress Committed Information Rate** (CIR)—Enter the maximum bandwidth allowed in bits per second. See description in the *Bandwidth Page.*
- **Ingress Committed Burst Size (CBS)**—Enter the maximum burst size (even if it goes beyond the CIR) in bytes. See description in the *Bandwidth Page.*
- **Exceed Action—**Select the action to be performed on incoming packets that exceed the CIR. Possible values are:
  - *Forward*—Packets exceeding the defined CIR value are forwarded.
  - *Drop*—Packets exceeding the defined CIR value are dropped.

- *Out of Profile DSCP*—The DSCP values of packets exceeding the defined CIR value are remapped to a value based on the Out Of Profile DSCP Mapping Table.

STEP 4 Click **Apply**. The switch is updated.

Configuring a Policy

The *Policy Table Map Page* displays the list of advanced QoS polices defined in the system. The page also allows you to create and delete polices. Only those policies that are bound to an interface are active (see *Policy Binding Page*).

Each policy consists of:

- One or more class maps of ACLs which define the traffic flows in the policy.
- One or more aggregates that applies the QoS to the traffic flows in the policy.

After a policy has been added, class maps can be added by using the *Policy Class Maps Page.*

To add a QoS policy:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Policy Class Maps**. The *Policy Class Maps Page* opens.

This page displays the list of defined policies.

STEP 2 Click **Policy Class Map Table** to display the *Policy Class Maps Page*.
OR
Click **Add** to open the *Add Policy Page*.

STEP 3 Enter the name of the new policy in the New Policy field.

STEP 4 Click **Apply**. The QoS policy profile is added, and the switch is updated.

Policy Class Maps

One or more class maps can be added to a policy. A class map defines the type of packets that are considered to belong to the same traffic flow.

NOTE You cannot configure a policer to a class map when the switch is operating in Layer 3 mode. The switch supports policers only in Layer 2 mode.

To add a class map to a policy:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Policy Class Maps**. The *Policy Class Maps Page* opens.

STEP 2 Select a policy in the Filter, and click **Go**. All class maps in that policy are displayed.

STEP 3 To add a new class map, click **Add**. The *Add Policy Class Map Page* opens.

STEP 4 Enter the parameters.

- **Policy Name—**Displays the policy to which the class map is being added.
- **Class Map Name—**Select an existing class map to be associated with the policy. Class maps are created in the *Class Mapping Page*.
- **Action Type—**Select the action regarding the ingress CoS/802.1p and/or DSCP value of all the matching packets.
  - **None—**Ignore the ingress CoS/802.1p and/or DSCP value. The matching packets are sent as best effort.
  - **Trust CoS/802.1p, DSCP—**If this option is selected, the switch will trust the CoS/802.1p and DSCP of the matching packet. If a packet is an IP packet, the switch will put the packet in the egress queue based on its DSCP value and the DSCP to Queue Table. Otherwise, the egress queue of the packet is based on the packet's CoS/802.1p value and the CoS/802.1p to Queue Table.

- **Set**—If this option is selected, use the value entered in the **New Value** box to determine the egress queue of the matching packets as follows:

  If the new value (0..7) is a CoS/802.1p priority, use the priority value and the CoS/802.1p to Queue Table to determine the egress queue of all the matching packets.

  If the new value (0..63) is a DSCP, use the new DSCP and the DSCP to Queue Table to determine the egress queue of the matching IP packets.

  Otherwise, use the new value (1..4) as the egress queue number for all the matching packets.

- **Police Type**—Available in Layer 2 Mode only. Select the policer type for the policy. The options are:
  - *None*—No policy is used.
  - *Single*—The policer for the policy is a single policer.
  - *Aggregate*—The policer for the policy is an aggregate policer.

- **Aggregate Policer**—Available in Layer 2 Mode only. If **Police Type** is *Aggregate*, select a previously-defined (in the *Aggregate Policer Page*) aggregate policer.

If **Police Type** is *Single*, enter the following QoS parameters:

- **Ingress Committed Information Rate (CIR)**—Enter the CIR in Kbps. See description in the *Bandwidth Page.*
- **Ingress Committed Burst Size (CBS)**—Enter the CBS in bytes. See description in the *Bandwidth Page.*
- **Exceed Action**—Select the action assigned to incoming packets exceeding the CIR. The options are:
  - *None*—No action.
  - *Drop*—Packets exceeding the defined CIR value are dropped.
  - *Out of Profile DSCP*—IP packets exceeding the defined CIR are forwarding with a new DSCP derived from the Out Of Profile DSCP Mapping Table.

STEP 5 Click **Apply**.

Policy Binding

The *Policy Binding Page* shows which policy profile is bound and to which port. When a policy profile is bound to a specific port, it is active on that port. Only one policy profile can be configured on a single port, but a single policy can be bound to more than one port.

When a policy is bound to a port, it filters and applies QoS to ingress traffic that belongs to the flows defined in the policy. The policy does not apply to traffic egress to the same port.

To edit a policy, it must first be removed (unbound) from all those ports to which it is bound.

To define policy binding:

STEP 1 Click **Quality of Service** > **QoS Advanced Mode** > **Policy Binding**. The *Policy Binding Page* opens.

STEP 2 Select a **Policy Name**.

STEP 3 Select the **Interface Type** assigned to the policy.

STEP 4 Click **Apply**. The QoS policy binding is defined, and the switch is updated.

Managing QoS Statistics

Viewing Policer Statistics

A Single Policer is bound to a class map from a single policy. An Aggregate Policer is bound to one or more class maps from one or more policies.

Viewing Single Policer Statistics

The *Single Policer Statistics Page* indicates the number of in-profile and out-of-profile packets that are received from an interface that meet the conditions defined in the class map of a policy.

NOTE This page is not displayed when the switch is in Layer 3 mode.

To view policer statistics:

STEP 1 Click **Quality of Service** > **QoS Statistics** > **Single Policer Statistics**. The *Single Policer Statistics Page* opens.

This page displays the following fields:

- **Interface—**Statistics are displayed for this interface.
- **Policy—**Statistics are displayed for this policy.
- **Class Map—**Statistics are displayed for this class map.
- **In-Profile Bytes—**Number of in-profile bytes received.
- **Out-of-Profile Bytes—**Number of out-profile bytes received.

STEP 2 Click **Add.** The *Add Single Policer Statistics Page* opens.

STEP 3 Enter the parameters.

- **Interface—**Select the interface for which statistics are accumulated.
- **Policy Name—**Select the policy name.
- **Class Map Name—**Select the class name.

STEP 4 Click **Apply**. An additional request for statistics is created and the switch is updated.

Viewing Aggregated Policer Statistics

To view aggregated policer statistics:

STEP 1 Click **Quality of Service** > **QoS Statistics** > **Aggregate Policer Statistics**. The *Aggregate Policer Statistics Page* opens.

This page displays the following fields:

- **Aggregate Policer Name—**Policer on which statistics are based.
- **In-profile bytes—**Number of in-profile packets that were received.
- **Out-of-profile bytes—**Number of out-of-profile packets that were received.

STEP 2 Click **Add** and the *Add Aggregate Policer Statistics Page* opens.

STEP 3 Select an **Aggregate Policer Name**, one of the previously-created Aggregate Policers for which statistics will be displayed.

STEP 4 Click **Apply**. An additional request for statistics is created, and the switch is updated.

Viewing Queues Statistics

The *Queues Statistics Page* displays queue statistics, including statistics of forwarded and dropped packets, based on interface, queue, and drop precedence.

NOTE QoS Statistics are shown only when the switch is in QoS Advanced Mode only. This change is made in **General** > **QoS Properties**.

To view Queues Statistics:

STEP 1 Click **Quality of Service** > **QoS Statistics** > **Queues Statistics**. The *Queues Statistics Page* opens.

This page displays the following fields:

- **Counter Set**—The options are:
  - *Set 1*—Displays the statistics for Set 1 that contains all interfaces and queues with a high DP (Drop Precedence).
  - *Set 2*—Displays the statistics for Set 2 that contains all interfaces and queues with a low DP.
- **Interface**—Queue statistics are displayed for this interface.
- **Queue**—Packets were forwarded or tail dropped from this queue.
- **Drop Precedence**—Lowest drop precedence has the lowest probability of being dropped.
- **Total packets**—Number of packets forwarded or tail dropped.
- **Tail Drop packets**—Percentage of packets that were tail dropped.

STEP 2 Click **Add.** The *Add Queues Statistics Page* opens.

STEP 3 Enter the parameters.

- **Counter Set**—Select the counter set:
  - *Set 1*—Displays the statistics for Set 1 that contains all interfaces and queues with a high DP (Drop Precedence).
  - *Set 2*—Displays the statistics for Set 2 that contains all interfaces and queues with a low DP.
- **Interface**—Select the ports for which statistics are displayed. The options are:
  - *Port*—Selects the port on the selected unit number for which statistics are displayed.
  - *All Ports*—Specifies that statistics are displayed for all ports.
- **Queue**—Select the queue for which statistics are displayed.
- **Drop Precedence**—Enter drop precedence that indicates the probability of being dropped.

STEP 4 Click **Apply**. The Queue Statistics counter is added, and the switch is updated.

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Configuring SNMP

This chapter describes the Simple Network Management Protocol (SNMP) feature that provides a method for managing network devices.

It includes the following topics:

SNMP Versions and Workflow

The switch functions as SNMP agent and supports SNMP v1, v2, and v3. It also reports system events to trap receivers using the traps defined in the MIB that it supports.

SNMP v1 and v2

To control access to the system, a list of community entries is defined. Each community entry consists of a *community strin*g and its access privilege. Only SNMP messages with the suitable community string and operation are responded to by the system.

SNMP agents maintain a list of variables that are used to manage the switch. The variables are defined in the *Management Information Base* (MIB). The MIB presents the variables controlled by the agent.

NOTE SNMPv2 protocol has known security vulnerabilities, and it is recommended to use SNMPv3.

SNMP v3

In addition to the functionality provided by SNMP v1 and v2, SNMP v3 applies access control and new trap mechanisms to SNMPv1 and SNMPv2 PDUs. SNMPv3 also defines a User Security Model (USM) that includes:

- **Authentication—**Provides data integrity and data origin authentication.
- **Privacy—**Protects against disclosure message content. *Cipher Block-Chaining* (CBC) is used for encryption. Either authentication alone is enabled on an SNMP message, or both authentication and privacy are enabled on an SNMP message. However, privacy cannot be enabled without authentication.
- **Timeliness—**Protects against message delay or playback attacks. The SNMP agent compares the incoming message time stamp to the message arrival time.
- **Key Management—**Defines key generation, key updates, and key use. The switch supports SNMP notification filters based on *Object IDs* (OID). OIDs are used by the system to manage device features.

SNMP Workflow

NOTE The switch comes with SNMP turned off by default. Before you can configure SNMP, you must turn on SNMP by using *Security-> TCP/UDP Services.*

The following is the recommended series of actions for configuring SNMP:

If you decide to use SNMP v1 or v2:

Define a community by using the *Add SNMP Community Page.* The community can be associated with an access rights and view in Basic mode or with a group in Advanced mode. (See the *Communities Page* for information on Basic and Advanced modes.) There are two ways to define access rights to a community:

- Basic mode - The access rights of a community can configure with Read Only, Read Write, or SNMP Admin. In addition, you can restrict the access to the community to only certain MIB objects using a view. views are defined in the SNMP Views Page
- Advanced Mode - The access rights to a community is defined by a group. You can configure the group with a specific security model. The access rights in a group is defined by the Read, Write, and Notify access to the desired views Groups are defined in the SNMP Views Page.

If you decide to use SNMP v3:

1. Define the SNMP engine, one time, by using the *Engine ID Page.*
2. If desired, define SNMP view(s) by using the *SNMP Views Page.*
3. Define groups by using the *Groups Page.*
4. Define users by using the *SNMP Users Page,* where they can be associated with a group.

Traps and Notifications Management for SNMP v1, v2, or v3:

1. Enable or disable traps by using the *Trap Settings Page.*
2. Optionally, define a notification filter(s) by using the *Notification Filter Page.*
3. Define a notification recipient(s) by using the *SNMPv1,2 Notification Recipient Page* and/or *SNMPv3 Notification Recipient Page*, respectively.

Supported MIBs

The following standard MIBs are supported:

- CISCO-CDP-MIB.mib

- CISCO-SMI.mib
- CISCO-TC.mib
- CISCO-VTP-MIB.mib
- diffserv.mib
- draft-ietf-bridge-8021x.mib
- draft-ietf-bridge-rstpmib-04.mib
- draft-ietf-entmib-sensor-mib.mib
- draft-ietf-hubmib-etherif-mib-v3-00.mib
- draft-ietf-syslog-device-mib.mib
- ianaaddrfamnumbers.mib
- ianaifty.mib
- ianaprot.mib
- inet-address-mib.mib
- ip-forward-mib.mib
- ip-mib.mib
- lldp.mib
- p-bridge-mib.mib
- q-bridge-mib.mib
- RFC-1212.mib
- rfc1213.mib
- rfc1389.mib
- rfc1493.mib
- rfc1611.mib
- rfc1612.mib
- rfc1757.mib
- rfc1850.mib
- rfc1907.mib

- rfc2011.mib
- rfc2012.mib
- rfc2013.mib
- rfc2096.mib
- rfc2233.mib
- rfc2571.mib
- rfc2572.mib
- rfc2573.mib
- rfc2574.mib
- rfc2575.mib
- rfc2576.mib
- rfc2613.mib
- rfc2618.mib
- rfc2620.mib
- rfc2665.mib
- rfc2668.mib
- rfc2674.mib
- rfc2737.mib
- rfc2851.mib
- rfc2925.mib
- rfc3621.mib
- rfc4668.mib
- rfc4670.mib
- rmon2.mib
- SNMPv2-CONF.mib
- SNMPv2-SMI.mib
- SNMPv2-TC.mib

- trunk.mib
- udp-mib.mib

Model OIDs

The following are the switch model *Object IDs* (OIDs):

Model Name	Description	Ports	Object ID
SG 300-10	10-port Gigabit Managed Switch	g1-g10	9.6.1.83.10.1
SG 300-10MP	10-port Gigabit PoE Managed Switch	g1-g10	9.6.1.83.10.3
SG 300-10P	10-port Gigabit PoE Managed Switch	g1-g10	9.6.1.83.10.2
SG 300-20	20-port Gigabit Managed Switch	g1-g20	9.6.1.83.20.1
SG 300-28	28-port Gigabit Managed Switch	g1-g28	9.6.1.83.28.1
SG 300-28P	28-port Gigabit PoE Managed Switch	g1-g28	9.6.1.83.28.2
SG 300-52	52-port Gigabit Managed Switch	g1-g52	9.6.1.83.52.1
SF 300-08	8-port 10/100 Managed Switch	e1-e8	9.6.1.82.08.4
SF 302-08	8-port 10/100 Managed Switch	e1-e8, g1-g2	9.6.1.82.08.1
SF 302-08MP	8-port 10/100 PoE Managed Switch	e1-e8, g1-g2	9.6.1.82.08.3
SF 302-08P	8-port 10/100 PoE Managed Switch	e1-e8, g1-g2	9.6.1.82.08.2
SF 300-24	24-port 10/100 Managed Switch	e1-e24, g1-g4	9.6.1.82.24.1
SF 300-24P	24-port 10/100 PoE Managed Switch	e1-e24, g1-g4	9.6.1.82.24.2
SF 300-48	48-port 10/100 Managed Switch	e1-e48, g1-g4	9.6.1.82.48.1
SF 300-48P	48-port 10/100 PoE Managed Switch	e1-e48, g1-g4	9.6.1.82.48.2

The Object IDs are placed under: enterprises(1).cisco(9).otherEnterprises(6).ciscosb(1).

The MIB root is 1.3.6.1.4.1.9.6.1.101.

SNMP Engine ID

The Engine ID is only used by SNMPv3 entities to uniquely identify them. An SNMP agent is considered an authoritative SNMP engine. This means that the agent responds to incoming messages (Get, GetNext, GetBulk, Set), and sends Trap messages to a manager. The agent's local information is encapsulated in fields in the message.

Each SNMP agent maintains local information that is used in SNMPv3 message exchanges (not relevant for SNMPv1 or SNMPv2). The default SNMP Engine ID is comprised of the enterprise number and the default MAC address. The SNMP engine ID must be unique for the administrative domain, so that no two devices in a network have the same engine ID.

The local information is stored in four MIB variables that are read-only (snmpEngineId, snmpEngineBoots, snmpEngineTime, and snmpEngineMaxMessageSize).

CAUTION When the engine ID is changed, all configured users and groups are erased.

To define the SNMP engine ID:

STEP 1 Click **SNMP** > **Engine ID**. The *Engine ID Page* opens.

STEP 2 Select the **Local Engine ID**.

- **Use default**—Select to use the device-generated engine ID. The default Engine ID is based on the switch MAC address, and is defined per standard as:
  - *First 4 octets*—First bit = 1, the rest is the IANA enterprise number.
  - *Fifth octet*—Set to 3 to indicate the MAC address that follows.
  - *Last 6 octets*—MAC address of the switch.
- **None**—No Engine ID is used.

- **User defined—**Enter the local device engine ID. The field value is a hexadecimal string **(range: 10 - 64)**. Each byte in the hexadecimal character strings is represented by two hexadecimal digits. Each byte can be separated by a period or a colon.

STEP 3 Click **Apply**. The switch is updated.

Configuring SNMP Views

A view is a user-defined label for a collection of MIB tree subtrees. Each subtree ID is defined by the *Object ID* (OID) of the root of the relevant subtrees. In extreme cases, this subtree can be a leaf, only. Well-known names can be used to specify the root of the desired subtree or an OID can be entered (see *Model OIDs*).

Each subtree is either included or excluded in the view being defined.

The *SNMP Views Page* enables creating and editing SNMP views. The default views (Default, DefaultSuper) cannot be changed.

Views can be attached to groups in the *Groups Page*.

To define SNMP views:

STEP 1 Click **SNMP** > **Views**. The *SNMP Views Page* opens.

STEP 2 Select the user-defined views from the **Filter: View Name** list. The following views exist by default:

- **Default—**Default SNMP view for read and read/write views.
- **DefaultSuper—**Default SNMP view for administrator views.

Other views can be added.

- **Object ID Subtree—**Displays the subtree to be included or excluded in the SNMP view.
- **Object ID Subtree View Type—**Displays whether the defined subtree is included or excluded in the selected SNMP view.

STEP 3 Click **Add** to define new views. The *Add View Page* opens.

STEP 4 Enter the parameters.

- **View Name—**Enter a view name.
- **Object ID Subtree—**Select the node in the MIB tree that is included or excluded in the selected SNMP view. The options to select the object are as follows:
  - *Select from List*—Enables you to navigate the MIB tree. Press the *Up* arrow to go to the level of the selected node's father and siblings; press the *Down* arrow to descend to the level of the selected node's descendents. Click nodes in the view to pass from one node to its brother. Use the scrollbar to bring siblings in view.
  - *User defined*—Enter an OID not offered in the *Select from List* option (if required). All descendents of this node are included or excluded in the view.

STEP 5 Select or deselect **Include in view.**

- If *Select from list* is used, the **Object Identifier of the selected node** is included in or excluded from the view if the **Include in view** option is selected or not selected.
- If *User defined* is used, the **entered Object Identifier** is included in or excluded from the view if the **Include in view** option is selected or not selected.

STEP 6 Click **Apply**. If you used *Select from list,* the object identifier of the selected node is included in or excluded from the view as determined by the **Include in view** option is selected.

If you used **Object ID**, the entered object identifier is included in or excluded from the view if the **Include in view** option is selected. This means that the node and its descendents are included or excluded from the view. The SNMP views are defined, and the switch is updated.

Creating SNMP Groups

In SNMPv1 and SNMPv2, a community string is sent along with the SNMP frames. The community string acts as a password to gain access to a SNMP agent. However, neither the frames nor the community string are encrypted. So SNMPv1 and SNMPv2 are not secure. In SNMPv3, there are two security mechanisms, and both can be configured.

- Authentication—The switch checks that the SNMP user is an authorized system administrator. This is done for each and every frame.
- Privacy—SNMP frames can carry encrypted data.

Thus, in SNMPv3, there are three levels of security:

- No security
- Authentication
- Authentication and privacy (Note that two groups with the same name, one with authentication and one with privacy, must be added.)

In addition, SNMPv3 provides for a way to control what even authorized and authenticated users can see and perform, by associating each user with a group.

A group is a label for a logical entity (combination of attributes). A group is operational only when it is associated with an SNMP user or an SNMP community.

A group also has an attribute that tells if members should have read, write, and/or notify privileges for the view.

To create an SNMP group:

STEP 1 Click **SNMP** > **Groups**. The *Groups Page* opens.

This page displays the existing SNMP groups.

STEP 2 Click **Add**. The *Add Group Page* opens.

STEP 3 Enter the parameters.

- **Group Name**—Enter a new group name for which privileges are being defined. The field range is up to 30 ASCII characters.
- **Security Model**—Select the SNMP version attached to the group.

- **Security Level**—Define the security level attached to the group. Security levels apply to SNMPv3 only.
  - *No Authentication*—Neither the Authentication nor the Privacy security levels are assigned to the group.
  - *Authentication*—Authenticates SNMP messages, and ensures the SNMP message origin is authenticated but does not encrypt them, meaning that they can be intercepted and read.
  - *Privacy*—Encrypts SNMP messages.
- **Views**—Define the group access rights per group. The options are:
  - *Read*—Management access is read-only for the selected view. Otherwise, a user or a community associated with this group, is able to read all MIBs except those that control SNMP itself.
  - *Write*—Management access is write for the selected view. Otherwise, a user or a community associated with this group, is able to write all MIBs except those that control SNMP itself.
  - *Notify*—Sends only traps with contents that is included in the SNMP view selected for notification. Otherwise, there is no restriction on the contents of the traps. This can only be selected for SNMP v3.

STEP 4 Click **Apply**. The SNMP Group is defined, and the switch is updated.

Managing SNMP Users

An SNMP user is defined by the login credentials (username, passwords, and authentication method), and by the context and scope in which it operates by association with a group and an Engine ID.

After a user is authenticated, it takes on the attributes of its group, and can then see or not see the views associated with this group.

The *SNMP Users Page* enables the creation of SNMPv3 users. An SNMPv3 user is the combination of a user along with a method that is used to authenticate the user and a password. SNMP user login credentials are verified using the local database.

Groups enable network managers to assign access rights to specific features, or feature aspects, to an entire group of users instead of to a single user.

A user can only be a member of a single group.

To create an SNMPv3 user, the following must first exist:

- An engine ID must first be configured on the switch. This can be done in the *Engine ID Page*.
- An SNMPv3 group must be available. An SNMPv3 group can be defined in the *Groups Page*.

SNMP users are not saved to the configuration file for security reasons. If SNMP users are provisioned and you save the configuration, the SNMP users are not retained; you must manually re-enter them.

To display SNMP users and define new ones:

STEP 1 Click **SNMP** > **Users**. The *SNMP Users Page* opens.

This page displays existing users.

STEP 2 Click **Add.** The *Add User Page* opens.

This page provides information for assigning SNMP access control privileges to SNMP users.

STEP 3 Enter the parameters.

- **User Name—**Enter a name for the user.
- **Engine ID—**Select either the local or remote SNMP entity to which the user is connected. Changing or removing the local SNMP Engine ID deletes the SNMPv3 User Database. To receive both informs and request information, you must define both a local and remote user.
  - *Local—*User is connected to a local SNMP entity. The user can request information but does not receive inform messages.
  - *Remote—*User is connected to a remote SNMP entity. If the remote Engine ID is defined, remote devices receive inform messages, but cannot make requests for information.

    Enter the remote engine ID.
- **Group Name—**Select the SNMP groups to which the SNMP user belongs. SNMP groups are defined in the *Add Group Page*.

- **Authentication Method**—Select the Authentication method. The options are:
  - *None*—No user authentication is used.
  - *MD5 Password*—Users must enter a password that is encrypted using the MD5 authentication method.
  - *SHA Password*—Users must enter a password that is encrypted by using the SHA (Secure Hash Algorithm) authentication method.
  - *MD5 Key*—Users are authenticated by using a valid MD5 key.
  - *SHA Key*—Users are authenticated by using a valid SHA key.
- **Password**—If authentication is accomplished by either a MD5 or a SHA password, enter the local user password. Local user passwords are compared to the local database and can contain up to 32 ASCII characters.
- **Authentication Key**—If the authentication method is either an MD5 or SHA key, enter the MD5 or SHA authentication key. If the MD5 key is selected, 16 bytes are required. If the SHA key is selected, 20 bytes are required.
- **Privacy Key**—If the Authentication Method is either a MD5 or a SHA key, enter the MD5 or SHA privacy key. If the MD5 key is selected, 16 bytes are required. If the SHA key is selected, 20 bytes are required.

STEP 4 Click **Apply**. The switch is updated.

Defining SNMP Communities

Access rights in SNMPv1 and SNMPv2 are managed by defining communities in the *Communities Page*. The community name is a type of shared password between the SNMP management station and the device. It is used to authenticate the SNMP management station.

Communities are only defined in SNMPv1 and v2 because SNMP v3 works with users instead of communities. The users belong to groups that have access rights assigned to them.

The *Communities Page* associates communities with access rights, either directly (Basic mode) or through groups (Advanced mode):

- Basic mode - The access rights of a community can configure with Read Only, Read Write, or SNMP Admin. In addition, you can restrict the access to the community to only certain MIB objects using a view. views are defined in the SNMP Views Page
- Advanced Mode - The access rights to a community is defined by a group. You can configure the group with a specific security model. The access rights in a group is defined by the Read, Write, and Notify access to the desired views Groups are defined in the SNMP Views Page.

To define SNMP communities:

STEP 1 Click **SNMP** > **Communities**. The *Communities Page* opens.

This page displays the Basic and Advanced tables.

STEP 2 Click **Add.** The *Add SNMP Community Page* opens.

This page enables network managers to define and configure new SNMP communities.

STEP 3 **SNMP Management Station**—Click **User defined** to enter the management station IP address that can access the SNMP community. Or click **All** to indicate that any IP device can access the SNMP community.

- **IP Version**—Select either IPv4 or IPv6.
- **IPv6 Address Type**—Select the supported IPv6 address type if IPv6 is used). The options are:
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface**—If the IPv6 address type is Link Local, select whether it is received through VLAN2 or ISATAP.
- **IP Address**—Enter the SNMP management station IPv4 address.

- **Community String**—Enter the community name (password) used to authenticate the management station to the device.
- **Basic**—Select this mode for a selected community. In this mode, there is no connection to any group. You can only choose the community access level (R/O, R/W, or Admin) and, optionally, further qualify it for a specific view. By default, it applies to the entire MIB. If this is selected, enter the following fields:
  - *Access Mode*—Select the access rights of the community. The options are:

    Read Only—Management access is restricted to read-only. Changes cannot be made to the community.

    Read Write—Management access is read-write. Changes can be made to the device configuration, but not to the community.

    SNMP Admin—User has access to all device configuration options, as well as permissions to modify the community. Admin is equivalent to Read Write for all MIBs except for the SNMP MIBs. Admin is required for access to the SNMP MIBs.
  - *View Name*—Select an SNMP view (a collection of MIB subtrees to which access is granted).
- **Advanced**—Select this mode for a selected community.
  - *Group Name*—Select an SNMP group that determines the access rights.

STEP 4 Click **Apply**. The SNMP Community is defined, and the switch is updated.

Defining Trap Settings

The *Trap Settings Page* enables configuring whether SNMP notifications are sent from the switch, and for which cases. The recipients of the SNMP notifications can be configured in the *SNMPv1,2 Notification Recipient Page*, or the *SNMPv3 Notification Recipient Page*.

To define trap settings:

STEP 1 Click **SNMP** > **Trap Settings**. The *Trap Settings Page* opens.

STEP 2 Select **Enable** for **SNMP Notifications** to specify that the switch can send SNMP notifications.

STEP 3 Select **Enable** for **Authentication Notifications** to enable SNMP authentication failure notification.

STEP 4 Click **Apply**. The SNMP Trap settings are defined, and the switch is updated.

Notification Recipients

Trap messages are generated to report system events, as defined in RFC 1215. The system can generate traps defined in the MIB that it supports.

Trap receivers (aka Notification Recipients) are network nodes where the trap messages are sent by the switch. A list of trap receivers is defined as the targets of trap messages.

A trap receiver entry contains the IP address of the node and the SNMP credentials corresponding to the version that will be included in the trap message. When an event arises that requires a trap message to be sent, it is sent to every node listed in the trap receiver list.

The *SNMPv1,2 Notification Recipient Page* and the *SNMPv3 Notification Recipient Page* enable configuring the destination to which SNMP notifications are sent, and the types of SNMP notifications that are sent to each destination (traps or informs). The *Add/Edit* pop-ups enable configuring the attributes of the notifications.

An SNMP notification is a message sent from the switch to the SNMP management station indicating that a certain event has occurred, such as a link up/down.

It is also possible to filter certain notifications. This can be done by creating a filter in the *Notification Filter Page* and attaching it to an SNMP notification recipient. The notification filter enables filtering the type of SNMP notifications that are sent to the management station based on the OID of the notification that is about to be sent.

Defining SNMPv1,2 Notification Recipients

To define a recipient in SNMPv1,2:

STEP 1 Click **SNMP** > **Notification Recipient SNMPv1,2**. The *SNMPv1,2 Notification Recipient Page* opens.

This page displays recipients for SNMPv1,2.

STEP 2 Click **Add.** The *Add SNMP Notification Recipient Page* opens.

STEP 3 Enter the parameters.

- **IP Version—**Select either IPv4 or IPv6.
- **IPv6 Address Type—**Select either *Link Local* or *Global*.
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface**—If the IPv6 address type is Link Local, select whether it is received through VLAN2 or ISATAP.
- **Recipient IP Address—**Enter the IP address of where the traps are sent.
- **UDP Port—**Enter the UDP port used for notifications on the recipient device.
- **Community String—**Enter the community string of the trap manager.
- **Notification Type—**Select whether to send traps or informs. If both are required, two recipients must be created.
- **Notification Version—**Select the trap SNMP version.

  Either SNMPv1 or SNMPv2 may be used as the version of traps, with only a single version enabled at a single time.

- **Notification Filter—**Select to enable filtering the type of SNMP notifications sent to the management station. The filters are created in the *Notification Filter Page*.
- **Filter Name—**Select the SNMP filter that defines the information contained in traps (defined in the *Notification Filter Page*).
- **(Inform) Timeout—**Enter the number of seconds the device waits before re-sending informs. Timeout range: 1-300, default: 15.
- **(Inform) Retries—**Enter the number of times that the device resends an inform request. Retires range:1-255, default: 3

STEP 4 Click **Apply**. The SNMP Notification Recipient settings are defined, and the switch is updated.

Defining SNMPv3 Notification Recipients

To define a recipient in SNMPv3:

STEP 1 Click **SNMP** > **Notification Recipient SNMPv3**. The *SNMPv3 Notification Recipient Page* opens.

This page displays recipients for SNMPv3.

STEP 2 Click **Add.** The *Add SNMP Notification Recipient Page* opens.

STEP 3 Enter the parameters.

- **IP Version**—Select either IPv4 or IPv6.
- **IPv6 Address Type—**Select the IPv6 address type (if IPv6 is used). The options are:
  - *Link Local*—The IPv6 address uniquely identifies hosts on a single network link. A link local address has a prefix of **FE80**, is not routable, and can be used for communication only on the local network. Only one link local address is supported. If a link local address exists on the interface, this entry replaces the address in the configuration.
  - *Global*—The IPv6 address is a global Unicast IPV6 type that is visible and reachable from other networks.
- **Link Local Interface—**Select the link local interface (if IPv6 Address Type Link Local is selected) from the list.

- **Recipient IP Address—**Enter the IP address of where the traps are sent.
- **UDP Port—**Enter the UDP port used to for notifications on the recipient device.
- **User Name—**Enter the user to whom SNMP notifications are sent.
- **Security Level—**Select how much authentication is applied to the packet. The options are:
  - *No Authentication*—Indicates the packet is neither authenticated nor encrypted.
  - *Authentication*—Indicates the packet is authenticated but not encrypted.
  - *Privacy*—Indicates the packet is both authenticated and encrypted.
- **Notification Type—**Select whether to send traps or informs. If both are required, two recipients must be created.
- **Notification Filter—**Select to enable filtering the type of SNMP notifications sent to the management station. The filters are created in the *Notification Filter Page*.
- **Filter Name—**Select the SNMP filter that defines the information contained in traps (defined in the *Notification Filter Page*).
- **(Inform) Timeout—**Enter the amount of time (seconds) the device waits before re-sending informs/traps. Timeout: Range 1-300, default 15
- **(Inform) Retries—**Enter the number of times that the device resends an inform request. Retries: Range 1-255, default 3

STEP 4 Click **Apply**. The SNMP Notification Recipient settings are defined, and the switch is updated.

SNMP Notification Filters

The *Notification Filter Page* enables configuring SNMP notification filters and Object IDs (OIDs) that are checked. After creating a notification filter, it is possible to attach it to a notification recipient in the *SNMPv1,2 Notification Recipient Page*, and *SNMP v3 Notification Recipient page*.

The notification filter enables filtering the type of SNMP notifications that are sent to the management station based on the OID of the notification to be sent.

To define a notification filter:

STEP 1 Click **SNMP** > **Notification Filter**. The *Notification Filter Page* opens.

The *Notification Filter Page* displays notification information for each filter. The table is able to filter notification entries by Filter Name.

STEP 2 Click **Add**. The *Add Notification Filter Page* opens.

STEP 3 Enter the parameters.

- **Filter Name—**Enter a name.
- **Object ID Subtree—**Select the node in the MIB tree that is included or excluded in the selected SNMP view. The options are:
    - *Select from List*—Enables you to navigate the MIB tree. Click *Up* to go to the level of the selected node's father and siblings. Click *Down* to descend to the level of the selected node's descendents. Click the nodes in the view to pass from one node to its brother. Use the scrollbar to bring siblings into view.
    - *Object ID*—Enter an OID not offered in the *Select from List* option (if required). All descendents of this node are included or excluded in the view.
    - If *Select from list* is used, the **object identifier of the selected node** is included in or excluded from the view if the **Include in filter option is selected**.
    - If *Object ID* is used, the **entered object identifier** is included in or excluded from the view if the **Include in filter option is selected**.

- **Include in filter—**If you used *Select from list,* the object identifier of the selected node is included in or excluded from the notification filter if the **Include in filter option is selected.** If you used **Object ID**, the entered object identifier is included in or excluded from the notification filter if the **Include in filter option is selected**. This means that the node and its descendents are included or excluded from the notification filter.

STEP 4 Click **Apply**. The SNMP views are defined, and the switch is updated.

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Console Menu Interface

The switch provides a menu-driven console interface for basic configuration of the switch. The console interface is useful for switch configuration when:

- The switch does not have a defined IP address, the IP address is not known, or only a direct serial cable connection can be used to communicate with the switch.
- You must configure features, such as SSL/SSH certificate, that can not be done by using the web-based switch configuration utility.

A connection between the switch and your PC can be established by using a serial cable, by establishing a Telnet session, or by using terminal emulation application.

This chapter discusses the following topics:

Connecting By Using a Terminal Emulation Application

To establish a connection to the console interface by using a terminal emulation application (Microsoft HyperTerminal in Windows XP is used here as an example), configure the application as follows:

STEP 1 In the PC desktop, click the **Start** button.

STEP 2 Select **Programs** > **Accessories** > **Communications** > **HyperTerminal**. The HyperTerminal - Connection Description window displays.

STEP 3 Enter a name for this connection, and optionally select an icon for the application shortcut that is created.

STEP 4 Click **OK**. The Connect To window displays.

STEP 5 If you connected to the switch with serial cable, select the COM port that links your PC to the switch from the Connect drop-down list. Otherwise, select **TCP/IP**.

STEP 6 Continue to the **"Communicating by Using a Serial Cable Connection"** section or the **"Communicating By Using a TCP/IP Connection"** section.

Communicating by Using a Serial Cable Connection

In this procedure, Com 1 is used for the example. The parameter on your system might be different.

To display the console menu:

STEP 1 Configure the **COM1 Properties** > **Port Settings** with the following connection parameters:

- Rate in bits per second = 115,200
- Data bits = 8
- Parity = None
- Stop bits = 1
- Flow control = None

STEP 2 Click **OK**. The HyperTerminal window displays.

STEP 3 In the HyperTerminal window, press **Enter** once or twice until the login menu displays. Press **Ctrl-R** to refresh the Menu CLI Login or to jump to the Menu CLI Login from any other window.

STEP 4 Enter **cisco** (default) as the User Name.

STEP 5 Enter the password **cisco** (default).

STEP 6 Press **Enter**.

NOTE If this is the first time you have logged in, or the switch has been reset to factory defaults, you are asked to change your password. (See the **Username & Password Settings** section to create and save a new password.)

STEP 7 Select **Execute** or press **Enter**. The *Switch Main Menu* displays.

STEP 8 Continue to the **Console Interface Main Menu** section.

Communicating By Using a TCP/IP Connection

It is assumed that in the terminal emulation application, you have selected TCP/IP.

NOTE Telnet must be enabled on the switch.

To display the console menu:

STEP 1 Enter the IP address of the switch in the Host Address field.

STEP 2 Click **OK**. The terminal emulation displays.

STEP 3 Press **Enter** once or twice until the login menu displays. Press **Ctrl-R** to refresh the Menu CLI Login or to jump to the Menu CLI Login from any other window.

STEP 4 Select Edit to allow modification of the parameters.

STEP 5 Enter **cisco** (default) as the User Name.

STEP 6 Enter the password **cisco** (default).

STEP 7 Press **Enter**.

NOTE If this is the first time you have logged in or the switch has been reset to factory defaults, you are asked to change your password. The Change User Password is displayed. Use these options to create and save a new password. See **"Change User Password"** on **page 312**.

The *Switch Main Menu* displays.

STEP 8 Continue to the **Console Interface Main Menu** section.

Connecting By Using Telnet

Telnet is disabled by default. It must be enabled by using the web-based switch configuration utility or the console interface and a serial cable connection. The procedure for enabling Telnet by using the console interface is described in the **Telnet Configuration** section.

To open the console interface by running Telnet in the Windows command-line:

STEP 1 Select **Start** > **Run**.

STEP 2 Enter **CMD** in the Open field and press **Enter**.

STEP 3 Type **telnet,** a space, and the switch IP address. For example:

```
c:\>telnet 192.168.1.114
```

STEP 4 Press **Enter**. The **Login** displays. Press **Ctrl-R** to refresh the Menu CLI Login or to jump to the Menu CLI Login from any other window.

STEP 5 Enter **cisco** (default) as the User Name.

STEP 6 Enter the password **cisco** (default).

STEP 7 Press **Enter**.

NOTE If this is the first time you have logged in or the switch has been reset to factory defaults, you are asked to change your password. The Change User Password is displayed. Use these options to create and save a new password.

Otherwise, the *Switch Main Menu* displays.

STEP 8 Continue to the **Console Interface Main Menu** section.

Console Configuration Menu Navigation

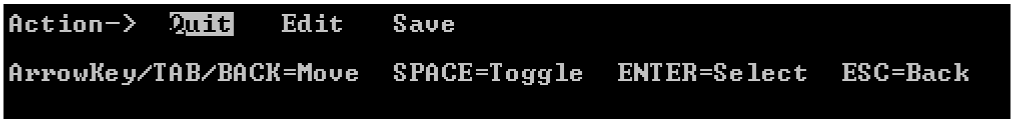
The console interface has two parts, the *options list* and the *action list*. Navigate through the configuration parameters by using the options list. Manage the Running Configuration by using the action list. For example, your workflow to change a parameter value is:

1. Navigate to the appropriate options list.
2. Select **Edit** by using the arrow keys to navigate to and highlight the action and press **Enter**. (If there are no parameters that can be changed by the system administrator, the action list does not display.)
3. Use the arrow keys to navigate to the correct field.
4. Enter the parameter values or use the **spacebar** to toggle the values.
5. Press ESC to return to the action list.
6. Select **Save** by using the arrow keys to navigate to and highlight the action.
7. Press **Enter**. Your parameter values are saved to the Running Configuration.

To navigate through the lists:

- Use the up or down arrow keys to move up or down the list. You can also type the number of the desired option to select it.
- Use the left or right arrow keys to move left or right in a list.
- Press **Enter** to select a menu option.
- Press **Esc** to navigate from the options list to the action list.

The available actions are listed at the bottom of each screen.



```
Action->  Quit   Edit   Save
ArrowKey/TAB/BACK=Move  SPACE=Toggle  ENTER=Select  ESC=Back
```

If you **Quit** without saving the changes, the changes to the parameter values made in this session are ignored.

Console Interface Main Menu

Each console interface menu lists the options in a numbered list.

The *Switch Main Menu* provides the following options:

- System Configuration Menu
- Port Status
- Port Configuration
- System Mode
- Help
- Logout

System Configuration Menu

Use the System Configuration Menu to select one of the following options:

- System Information
- Management Settings
- Username & Password Settings
- Security Settings
- VLAN Management
- IP Configuration
- File Management
- Delete Startup Configuration
- Reboot to Factory Defaults
- Reboot System

System Information

Path: **Switch Main Menu** > **System Configuration Menu** > **System Information**

Use the *System Information* menu to view the switch firmware versions and general system information. You can also change the hostname or location description.

- Versions
- General System Information

Versions

Path: **Switch Main Menu** > **System Configuration Menu** > **System Information** > **Versions**

Versions displays the software, boot, and hardware firmware versions.

General System Information

Path: **Switch Main Menu** > **System Configuration Menu** > **System Information** > **General System Information**

General System Information displays general information about the switch. You can change the system contact details, host name, and system location information.

Management Settings

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings**

The *Management Settings* menu provides the following options:

- Serial Port Configuration
- Telnet Configuration
- SSH Configuration
- SNMP Configuration

Serial Port Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings**

Use *Serial Port Configuration* to view or change the baud rate of the configuration port. If you are using a Windows HyperTerminal application and you change the baud rate parameter value, you must logoff the application and reset the session to match the values.

Telnet Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings**

Telnet Configuration displays the Telnet connection timeout value and the status of the Telnet service. You can enable or disable the Telnet service and set the timeout value in minutes. If you do not want the Telnet session to timeout, enter a value of 0 minutes.

SSH Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings**

Use the *SSH Configuration* menu to view or configure the following options:

- SSH Server Configuration
- SSH Server Status
- SSH Crypto Key Generation
- SSH Keys Fingerprints

SSH Server Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings** > **SSH Configuration**

Use *SSH Server Configuration* to enable or disable the SSH Server. The SSH Server Port can be modified by entering a port value.

SSH Server Status

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings** > **SSH Server Status**

Use *SSH Server Status* to view the SSH server status, the RSA and DSA key status, and any open SSH sessions.

Select **Refresh** to update the screen.

SSH Crypto Key Generation

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings** > **SSH Configuration** > **SSH Crypto Key Generation**

Use *SSH Crypto Key Generation* to view the SSH Public Key Length or to generate an SSH Crypto Key.

To generate an SSH Crypto Key:

STEP 1 Select **Edit**.

STEP 2 Use the **SPACE** bar to toggle between the RSA and DSA options.

STEP 3 Press **ESC** to return to the Action List.

STEP 4 Select **Execute**, and press **Enter**. An *operation complete* message will be displayed when the key generation is complete.

STEP 5 Use UP arrow key to go the Action list.

SSH Keys Fingerprints

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings** > **SSH Configuration** > **SSH Keys Fingerprints**

SSH Keys Fingerprints displays the RSA and DSA keys (if those keys were generated).

Select **Refresh** to update the screen.

SNMP Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **Management Settings**

Use *SNMP Configuration* to enable or disable SNMP on the switch.

Username & Password Settings

Path: **Switch Main Menu** > **System Configuration Menu** > **Username & Password Settings**

Use *Username & Password Settings* to configure the user names and passwords of those accessing the switch. Up to five users can be added. The factory default username is **cisco**. The factory default password is **cisco**.

Security Settings

Path: **Switch Main Menu** > **System Configuration Menu**

Use *Security Settings* to configure security on the switch, as well as to generate and display the SSL certificate.

SSL Certificate Generation

Path: **Switch Main Menu** > **System Configuration Menu** > **Security Settings**

Use *Certificate Generation* to create a device-generated SSL certificate.

- Public Key Length—Specifies the SSL RSA key length. (Range: 512–2048)
- Organization Name—Specifies the organization name. (1–64 characters)
- Locality or City Name—Specifies the location or city name. (1–64 characters)
- State or Province Name—Specifies the state or province name. (1–64 characters)
- Country Name—Specifies the country name. (use 2 character code)
- Validity Term—Specifies number of days certification is valid. (Range: 30–3650)

Show Certificate

Path: **Switch Main Menu** > **System Configuration Menu** > **Security Settings**

Use *Show Certificate* to view the internal SSL certificate.

Disable Active Management Access Profile

Path: **Switch Main Menu** > **System Configuration Menu** > **Security Settings**

Use this option to disable management access profiles.

If you choose this option, you are prompted for confirmation. Type **Y** to confirm.

VLAN Management

Path: **Switch Main Menu** > **System Configuration Menu**

Use the VLAN Management menu to set the default VLAN. Changes to the default VLAN take effect only after you reboot the switch.

Select **Default VLAN Setup** to display the *Default VLAN Setup*.

IP Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration**

Use the *IP Configuration* menu to configure the following options:

- IPv4 Address Configuration
- IPv6 Address Configuration
- HTTP Configuration
- HTTPS Configuration
- Network Configuration
- IPv4 Default Route (Layer 3 devices only)

IPv4 Address Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration**

Use the *IPv4 Address Configuration Menu* to configure the switch IPv4 address.

IPv4 Address Settings

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration**

Use *IP Address - Add/IP Address Settings* to add or change the switch IPv4 address.

- IPv4 Address—Enter the IPv4 address that you want to assign to the switch if the switch is disabled as a DHCP client. Verify that the IP address does not conflict with another device on the network.
- Subnet Mask—Enter the subnet mask that you want to assign to the switch.
- Default Gateway—Enter the default gateway address for the switch (**IPv4 Address Settings**).
- Management VLAN—Enter the management VLAN ID (**IPv4 Address Settings**).
- DHCP Client—Use the **Spacebar** to enable or disable the DHCP client.

- Interface Type—Select the interface type, LAG, VLAN, or GE (IPv4 Address Add).
- Interface Number—Enter the interface number (IPv4 Address Add).

IPv4 Address Table

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration**

The *IP Address Table* displays the IPv4 addresses in Layer 3.

- Delete/Keep—Use the SPACE bar to toggle between **Delete** and **Keep**. When the action is executed, this entry is acted upon based on your selection.

IPv6 Address Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **IPv6 Address Configuration**

Use the *IPv6 Address Configuration* menu to configure the switch IPv6 address.

IPv6 Interface Enable

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **IPv6 Address Configuration** > **IPv6 Interface Enable**

Use *IPv6 Interface Enable* to select the IPv6 interface.

IPv6 Address Settings

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **IPv6 Address Configuration**

Use the *IPv6 Address Settings* option to configure the IPv6 address for each interface of the switch.

- **IPv6 Address—**The device supports one IPv6 interface. In additional to the default link local and multicast addresses, the switch automatically adds global addresses to the interface based on the router advertisements it receives. The device supports a maximum of 128 addresses at the interface. Each address must be a valid IPv6 address that is specified in hexadecimal format by using 16-bit values separated by colons.

- **Prefix Length—**The length of the Global IPv6 prefix as a decimal value from 0-128 indicating the number of the high-order contiguous bits of the address comprise the prefix (the network portion of the address).
- **Interface Type—**IPv6 address, interface type (VLAN, LAG, FE, GE)

IPv6 Address Table

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration>IPv6 Address Configuration>IPv6 Address Table**

The *IPv6 Address Table* displays the IPv6 addresses for each interface.

IPv6 ISATAP Tunnel

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration>IPv6 Address Configuration>IPv6 ISATAP Enable**

Use the *ISATAP Tunnel* option to enable, and to configure the IPv6 ISATAP Tunnel parameters. See the **Defining an IPv6 Interface** section in the **Configuring IP Information** chapter for more information.

IPv6 ISATAP Interface Show

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **IPv6 Address Configuration>IPv6 ISATAP Interface Show**

The *ISATAP Interface Show* option displays the active ISATAP Tunnel information.

IPv6 Default Gateway

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration>IPv6 Address Configuration>IPv6 Default Gateway**

Use the *IPv6 Default Gateway* option to enable or disable, and to specify the interface that will function as the IPv6 default gateway.

HTTP Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **HTTP Configuration**

Use the *HTTP Configuration* option to enable or disable the HTTP server, and set the HTTP Server port number.

HTTPS Configuration

Path: Switch Main Menu > **System Configuration Menu** > **IP Configuration** > **HTTPS Configuration**

Use the *HTTPS Configuration* option to enable or disable the HTTPS server, set the HTTPS server port number, or check the status of the HTTPS Certificate.

Network Configuration

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration**

Use the *Network Configuration Menu* to configure the following options:

- Ping <IPv4>
- Ping <IPv6>
- TraceRoute IPv4
- TraceRoute IPv6
- Telnet Session

Ping IPv4

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **Network Configuration** > **Ping IPv4**

Use the *Ping IPv4* option to enter the IPv4 address that you want to test.

Select Execute to begin the test. The ping results are displayed in the Status and Statistics fields.

Ping IPv6

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **Network Configuration** > **Ping IPv6**

Use the *Ping IPv6* option to enter the IPv6 address, interface type (VLAN, LAG, FE, GE), and interface ID number that you want to test.

Select Execute to begin the test. The ping results are displayed in the Status and Statistics fields.

TraceRoute IPv4

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **Network Configuration** > **TraceRoute IPv4**

Use the *TraceRoute IPv4* option to enter the IPv4 address for the network route you want to trace.

Select **Execute** to begin the test. The results are displayed in the Status field.

After the traceroute test is complete, it displays the IP address, status, and statistics of the traceroute test.

TraceRoute IPv6

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **Network Configuration** > **TraceRoute IPv6**

Use the *TraceRoute IPv6* option to enter the IPv6 address for the network route you want to trace.

Select **Execute** to begin the test. TraceRoute displays the IP address, status, and statistics of the traceroute test in the Status and Results fields.

Telnet Session

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **Network Configuration** > **Telnet Session**

Use *Telnet Session Configuration* to enter the IP Address of the location you want to reach by using a Telnet connection.

IPv4 Default Route (Layer 3 devices only)

Path: **Switch Main Menu** > **System Configuration Menu** > **IP Configuration** > **IPv4 Default Route**

Use *IPv4 Default Route* to set the Next Hop IP Address for the switch.

File Management

Path: **Switch Main Menu** > **System Configuration Menu** > **File Management**

Use the *File Management Menu* to upload or download files or change the Active Image.

- Upgrade/Backup <IPv4>
- Upgrade/Backup <IPv6>
- Active Image

There are two firmware images, Image1 and Image2, stored on the switch. One of the images is identified as the *active image* and other image is identified as the **inactive image**. The switch boots from the image you set as the active image.

When you upgrade the firmware, the new image is always replaces the image identified as the inactive image. After uploading new firmware on the switch, the switch continues to boot by using the active image (the old version) until you change the status of the new image to be the active image. You can change the image identified as the inactive image to the active image by using the procedure in the **Active Image** section.

Upgrade / Backup <IPv4>

Path: **Switch Main Menu** > **System Configuration Menu** > **File Management** > **Upgrade/Backup <IPv4>**

Use *Upgrade/Backup <IPv4>* to upload or download files, such as the startup configuration, boot, or image file via a TFTP server.

Upgrade / Backup <IPv6>

Path: **Switch Main Menu** > **System Configuration Menu** > **File Management** > **Upgrade/Backup <IPv6>**

Use *Upgrade/Backup <IPv6>* to upload or download files, such as the startup configuration, boot, or image file via a TFTP server.

To download a new boot and image, perform the following:

STEP 1 If required, download the new boot code. DO NOT REBOOT THE DEVICE. Set the Source File to TFTP and the Destination File to **boot** by using the SPACE bar to toggle the values. File Name is the name of the boot file to be downloaded. IP Address is the IP address of the TFTP server.

STEP 2 If required, download the new firmware image. Set the Source File to TFTP and the Destination File to **image** by using the SPACE bar to toggle the values. File Name is the name of the image file to be downloaded. IP Address is the IP address of the TFTP server.

STEP 3 Change the active image using the *Active Image* menu.

STEP 4 Reboot the switch.

Active Image

Path: **Switch Main Menu** > **System Configuration Menu** > **File Management** > **Active Image**

The *Active Image* screen displays and configures whether Image 1 or Image 2 is active, and the firmware version associated with the image.

Delete Startup Configuration

Delete the Startup Configuration.

Path: **Switch Main Menu** > **System Configuration Menu** > **Delete Startup Configuration**

If the switch is rebooted, it is restored to the factory default settings. Type **Y** to delete the configuration, or type **N** to cancel.

Reboot to Factory Defaults

Reboot to Factory Defaults will delete the Startup Configuration and reboot the switch. Any settings that are not saved to a file are lost after this action is selected.

If there is a configuration on a TFTP server, the switch downloads the configuration.

Path: **Switch Main Menu** > **System Configuration Menu** > **Reset to Factory Defaults**

To restore the switch to the factory default settings, select **Reset to Factory Defaults** and press **Enter**. You will be asked if you want to continue. Type **Y** to restore the switch default settings, or type **N** to cancel.

Reboot System

Path: **Switch Main Menu** > **System Configuration Menu** > **Reboot System**

Select **Reboot System** and press **Enter** if you want to restart the switch. You will be asked if you want to continue. Type **Y** to reboot the switch, or type **N** to cancel.

Port Status

Path: **Switch Main Menu** > **Port Status**

'The Port Status option from the Switch Main Menu displays the status of the ports for switches without PoE. The Port Status option from the Switch Main Menu for switches with PoE displays the Port Status Menu that includes Port Status and PoE Status options. Use *Port Configuration* and *PoE Configuration* to change the configuration of the ports.

Port Status

Path: **Switch Main Menu** > **Port Status** > **Port Status Menu** > **Port Status**

Port Status displays the port numbers, enable status, link status, speed, and flow control status (the flow of packet transmissions) of non-PoE ports. Twelve ports are displayed at one time. Use the arrow keys to scroll up or down the list.

PoE Status

Path: **Switch Main Menu** > **Port Status** > **PoE Status**

PoE Status displays the status of the PoE ports.

Port Configuration

Path: **Switch Main Menu** > **Port Configuration**

Use the *Port Configuration Menu* to change Port Configuration and PoE configuration.

Port Configuration

Path: **Switch Main Menu** > **Port Configuration Menu** > **Port Configuration**

Use the *Port Configuration* option to change the parameters of the non-PoE ports. You can enable or disable the ports, enable or disable Auto Negotiation, set the speed and duplex (Auto, 10H, 100H, 10F, 100F, 1000F), and set Flow Control (On, Off, Auto). Twelve ports are displayed at one time. Use the arrow keys to scroll up or down the list.

PoE Configuration

Path: **Switch Main Menu** > **Port Configuration Menu** > **PoE Configuration**

Use *Port Configuration* to change the PoE parameters on the PoE ports. You can set the port Priority (Low, High, or Critical), enable PoE, disable PoE, and set the Power Allocation (in mW).

System Mode

Path: **Switch Main Menu** > **System Mode**

Use *System Mode* to set the switch to Layer 2 or Layer 3.

Help

Path: **Switch Main Menu** > **Help**

Select Help to view information on how to navigate the options in the console interface.

Logout

Path: **Switch Main Menu** > **Logout**

Select Logout to end the current console session.