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ADMINISTRATION GUIDE

Cisco Small Business 200 Series Smart Switch Administration Guide Release 1.3

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Getting Started

This section provides an introduction to the web-based configuration utility, and covers the following topics:

- **Starting the Web-based Configuration Utility**
- **Quick Start Device Configuration**
- **Interface Naming Conventions**
- **Window Navigation**

Starting the Web-based Configuration Utility

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

If you are using a pop-up blocker, make sure it is disabled.

Browser Restrictions

- If you are using older versions of Internet Explorer, you cannot directly use an IPv6 address to access the device. 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 the IPv6 link local address to access the device from your browser.

Launching the Configuration Utility

To open the web-based configuration utility:

-
- STEP 1** Open a Web browser.
- STEP 2** Enter the IP address of the device you are configuring in the address bar on the browser, and then press **Enter**.

NOTE When the device is using the factory default IP address of 192.168.1.254, its power LED flashes continuously. When the device 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.

NOTE If you have not previously selected a language for the GUI, the language of the Login page is determined by the language(s) requested by your browser and the languages configured on your device. If your browser requests Chinese, for example, and Chinese has been loaded into your device, the Login page is automatically displayed in Chinese. If Chinese has not been loaded into your device, the Login page appears in English.

The languages loaded into the device have a language and country code (en-US, en-GB and so on). For the Login page to be automatically displayed in a particular language, based on the browser request, both the language and country code of the browser request must match those of the language loaded on the device. If the browser request contains only the language code without a country code (for example: fr). The first embedded language with a matching language code is taken (without matching the country code, for example: fr_CA).

To log in to the device configuration utility:

-
- STEP 1** Enter the username/password. The password can contain up to 64 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 device 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 appears. See Password Expiration for additional information.
- STEP 4** Choose whether to select **Disable Password Complexity Enforcement** or not. For more information on password complexity, see the Setting Password Complexity Rules section.
- STEP 5** Enter the new password and click **Apply**.

When the login attempt is successful, the Getting Started page appears.

If you entered an incorrect username or password, an error message appears and the Login page remains displayed on the window. If you are having problems logging in, please see the [Launching the Configuration Utility](#) section in the Administration Guide for additional information.

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

HTTP/HTTPS

You can either open an HTTP session (not secured) by clicking **Log In**, or you can open an HTTPS (secured) session, by clicking **Secure Browsing (HTTPS)**. You are asked to approve the logon with a default RSA key, and an HTTPS session is opened.

- NOTE** There is no need to input the username/password prior to clicking the **Secure Browsing (HTTPS)** button.

For information on how to configure HTTPS, see [SSL Server](#).

Password Expiration

The New Password page appears:

- The first time you access the device 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.



CAUTION

Unless the Running Configuration is copied to the Startup Configuration, rebooting the device will remove all changes made since the last time the file was saved. Save the Running Configuration to the Startup Configuration before logging off to preserve any changes you made during this session.

A flashing red X icon to the left of the **Save** application link indicates that Running Configuration changes have not yet been saved to the Startup Configuration file. The flashing can be disabled by clicking on the **Disable Save Icon Blinking** button on the **Copy/Save Configuration** page

When the device auto-discovers a device, such as an IP phone (see [What is a Smartport](#)), and it configures the port appropriately for the device. These configuration commands are written to the Running Configuration file. This causes the Save icon to begin blinking when the you log on even though you did not make any configuration changes.

When you click **Save**, the Copy/Save Configuration page appears. 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 device.

When a timeout occurs or you intentionally log out of the system, a message appears and the Login page appears, 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 Device Configuration

To simplify device 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
	Change Management Applications and Services	TCP/UDP Services page
	Change Device IP Address	IPv4 Interface page
	Create VLAN	Create VLAN page
	Configure Port Settings	Port Setting page
Device 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 page
	Backup Device Configuration	Download/Backup Configuration/Log page
	Configure QoS	QoS Properties page
	Configure Port Mirroring	Port and VLAN Mirroring page

There are two hot links on the Getting Started page that take you to Cisco web pages for more information. Clicking on the **Support** link takes you to the device product support page, and clicking on the **Forums** link takes you to the Small Business Support Community page.

Interface Naming Conventions

Within the GUI, interfaces are denoted by concatenating the following elements:

- **Type of interface:** The following types of interfaces are found on the various types of devices:
 - **Fast Ethernet (10/100 bits)**—These are displayed as **FE**.
 - **Gigabit Ethernet ports (10/100/1000 bits)**—These are displayed as **GE**.
 - **LAG (Port Channel)**—These are displayed as **LAG**.
 - **VLAN**—These are displayed as **VLAN**.
 - **Tunnel** —These are displayed as **Tunnel**.
- **Interface Number: Port, LAG, tunnel or VLAN ID**


Window Navigation

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


Application Header

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

Application Links

Application Link Name	Description
	<p>A flashing 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. The flashing of the red X can be disabled on the Copy/Save Configuration page.</p> <p>Click Save to display the Copy/Save Configuration page. Save the Running Configuration file by copying it to the Startup Configuration file type on the device. After this save, the red X icon and the Save application link are no longer displayed. When the device is rebooted, it copies the Startup Configuration file type to the Running Configuration and sets the device parameters according to the data in the Running Configuration.</p>
Username	Displays the name of the user logged on to the device. The default username is cisco . (The default password is cisco).

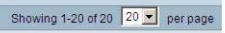

Application Links (Continued)

Application Link Name	Description
Language Menu	<p>This menu provides the following options:</p> <ul style="list-style-type: none"> ▪ Select a language: Select one of the languages that appear in the menu. This language will be the web-based configuration utility language. ▪ Download Language: Add a new language to the device. ▪ Delete Language: Deletes the second language on the device. The first language (English) cannot be deleted. ▪ Debug: Used for translation purposes. If you select this option, all web-based configuration utility labels disappear and in their place are the IDs of the strings that correspond to the IDs in the language file. <p>NOTE To upgrade a language file, use the Upgrade/Backup Firmware/Language page.</p>
Logout	Click to log out of the web-based switch configuration utility.
About	Click to display the device name and device version number.
Help	Click to display the online help.
	<p>The SYSLOG Alert Status icon appears when a SYSLOG message, above the <i>critical</i> 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, Click Status and Statistics > View Log > RAM Memory.</p>

Management Buttons

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

Management Buttons

Button Name	Description
	Use the pull-down menu to configure the number of entries per page.
	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 device.
Apply	Click to apply changes to the Running Configuration on the device. If the device 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 device.
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 any changes were not applied to the Running Configuration, a message appears.

Management Buttons (Continued)

Button Name	Description
Copy Settings	<p>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 the selected entry to multiple entries, as described below:</p> <ol style="list-style-type: none">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	<p>After selecting an entry in the table, click Delete to remove.</p>
Details	<p>Click to display the details associated with the entry selected.</p>
Edit	<p>Select the entry and click Edit. The Edit page appears, and the entry can be modified.</p> <ol style="list-style-type: none">1. Click Apply to save the changes to the Running Configuration.2. Click Close to return to the main page.
Go	<p>Enter the query filtering criteria and click Go. The results are displayed on the page.</p>
Test	<p>Click Test to perform the related tests.</p>

Status and Statistics

This section describes how to view device statistics.

It covers the following topics:

- **Viewing Ethernet Interfaces**
- **Viewing Etherlike Statistics**
- **Viewing 802.1X EAP Statistics**
- **Managing RMON**

Viewing Ethernet Interfaces

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 and/or set the refresh rate:

STEP 1 Click **Status and Statistics > Interface**.

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 **View All Interfaces Statistics** to see all ports on a single page.

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 and/or set the refresh rate:

STEP 1 Click **Status and Statistics > Etherlike**.

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**—Frames that were 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 rejected due to excessive collisions.
- **Oversize Packets**—Packets greater than 2000 octets received.
- **Internal MAC Receive Errors**—Frames rejected because of receiver errors.
- **Pause Frames Received**—Received flow control pause frames.
- **Pause Frames Transmitted**—Flow control pause frames transmitted from the selected interface.

To clear statistics counters:

- Click **Clear Interface Counters** to clear the selected interfaces counters.
- Click **View All Interfaces Statistics** to see all ports on a single page.

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 and/or set the refresh rate:

STEP 1 Click **Status and Statistics > 802.1x EAP**.

STEP 2 Select the **Interface** 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.

To clear statistics counters:

- Click **Clear Interface Counters** to clear the selected interfaces counters.
 - Click **Clear All Interface Counters** to clear the counters of all interfaces.
-

Managing RMON

RMON (Remote Networking Monitoring) is an SNMP specification that enables an SNMP agent in the device 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 the correct thresholds set relative to your network's base line.

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

With this feature, you can perform the following actions:

- View the current statistics (since the counter values 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 specify 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 information regarding physical layer errors. The information displayed is according to the RMON standard. An oversized packet is defined as an Ethernet frame with the following criteria:

- Packet length is greater than MRU byte size.
- Collision event has not been detected.
- Late collision event has not been detected.
- Received (Rx) error event has not been detected.
- Packet has a valid CRC.

To view RMON statistics and/or set the refresh rate:

-
- STEP 1** Click **Status and Statistics > RMON > Statistics**.
- 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**—Number of octets received, including bad packets and FCS octets, but excluding framing bits.
- **Drop Events**—Number of packets dropped.
- **Packets Received**—Number of good packets received, including 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 2000 octets) received.
- **Fragments**—Number of fragments (packets with less than 64 octets, excluding framing bits, but including FCS octets) received.
- **Jabbers**—Total number 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. A Jabber packet is defined as an Ethernet frame that satisfies the following criteria:
 - Packet data length is greater than MRU.
 - Packet has an invalid CRC.
 - Received (Rx) Error Event has not been detected.

- **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 greater than 1024 Bytes**—Number of frames, containing 1024-2000 bytes, and Jumbo Frames, that were received.

To clear statistics counters:

- Click **Clear Interface Counters** to clear the selected interfaces counters.
- Click **View All Interfaces Statistics** to see all ports on a single page.

Configuring RMON History

The RMON feature enables monitoring statistics per interface.

The History Control Table page defines 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 appears in the History Table page that can be viewed by clicking **History Table**.

To enter RMON control information:

-
- STEP 1** Click **Status and Statistics > RMON > History**. The fields displayed on this page are defined in the Add RMON History page, below. The only field is that is on this page and not defined in the Add page is:
- **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**.
- STEP 3** Enter the parameters.
- **New History Entry**—Displays the number of the new History table entry.
 - **Source Interface**—Select the type of interface from which 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 are collected from the ports. The field range is 1-3600.
 - **Owner**—Enter the RMON station or user that requested the RMON information.
- STEP 4** Click **Apply**. The entry is added to the History Control Table page, and the Running Configuration file is updated.
- STEP 5** Click **History Table** to view the actual statistics.
-

Viewing the RMON History Table

The History Table page displays interface-specific statistical network samplings. The samples were configured in the History Control table described above.

To view RMON history statistics:

-
- STEP 1** Click **Status and Statistics > RMON > History**.
- STEP 2** Click **History Table**.
- STEP 3** From the **History Entry No.** list, select the entry number of the sample to display.

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 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 excluding 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 2000 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 2000 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

You can control the occurrences that trigger an alarm and the type of notification that occurs. This is performed as follows:

- **Events Page**—Configures what happens when an alarm is triggered. This can be any combination of logs and traps.

- **Alarms Page**—Configures the occurrences that trigger an alarm.

To define RMON events:

STEP 1 Click **Status and Statistics > RMON > Events**.

This page displays previously defined events.

STEP 2 Click **Add**.

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.
- **Notification Type**—Select the type of action that results from this event. Values are:
 - *None*—No action occurs when the alarm goes off.
 - *Log (Event Log Table)*—Add a log entry to the Event Log table when the alarm is triggered.
 - *Trap (SNMP Manager and SYSLOG Server)*—Send a trap to the remote log server when the alarm goes off.
 - *Log and Trap*—Add a log entry to the Event Log table and send a trap to the remote log server when the alarm goes off.
- **Time**—The time of the event. (This is a read-only table in the parent window and cannot be defined).
- **Owner**—Enter the device or user that defined the event.

STEP 4 Click **Apply**. The RMON event is saved to the Running Configuration file.

STEP 5 Click **Event Log Table** to display the log of alarms that have occurred and that have been logged (see description below).

Viewing the RMON Events Logs

The Event Log Table page displays the log of events (actions) that occurred. Two types of events can be logged: *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 **Status and Statistics > RMON > Events**.

STEP 2 Click **Event Log Table**.

This page displays the following fields:

- **Event Entry No.**—Event's log entry number.
- **Log No.**—Log number (within the event).
- **Log Time**—Time that the log entry was entered.
- **Description**—Description of event that triggered the alarm.

Defining RMON Alarms

RMON alarms provide a mechanism for setting thresholds and sampling intervals to generate exception events on any counter 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, no rising events are 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, which 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 **Status and Statistics > RMON > Alarms**. All previously-defined alarms are displayed. The fields are described in the Add RMON Alarm page below. In addition to those fields, the following field appears:
- **Counter Value**—Displays the value of the statistic during the last sampling period.
- STEP 2** Click **Add**.
- 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:
 - *Absolute*—If the threshold is crossed, an alarm is generated.
 - *Delta*—Subtracts the last sampled value from the current value. The difference in the values is compared to the threshold. If the threshold was crossed, an alarm is generated.
 - **Rising Threshold**—Enter the value that triggers the rising threshold alarm.
 - **Rising Event**—Select an event to be performed when a rising event is triggered. Events are created in the Events page.
 - **Falling Threshold**—Enter the value that triggers the falling threshold alarm.
 - **Falling Event**—Select an event 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 value triggers the rising threshold alarm.
 - *Falling Alarm*—A falling value triggers the falling threshold alarm.
 - *Rising and Falling*—Both rising and falling 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 saved to the Running Configuration file.

Administration: System Log

This section describes the System Log feature, which enables the device to generate several independent logs. Each log is a set of messages describing system events.

The device generates the following local logs:

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

In addition, you can send messages to remote SYSLOG servers in the form of SNMP traps and SYSLOG messages.

This section covers 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*—Detailed information about an event.

You can select different severity levels for RAM and Flash logs. These logs 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 > Log Settings**.

STEP 2 Enter the parameters.

- **Logging**—Select to enable message logging.
- **Syslog Aggregator**—Select to enable the aggregation of SYSLOG messages and traps. If enabled, identical and contiguous SYSLOG messages and traps are aggregated over the specified Max Aggregation 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 was aggregated.
- **Max Aggregation Time**—Enter the interval of time that SYSLOG messages are aggregated.

- **Originator Identifier**—Enables adding an origin identifier to SYSLOG messages. The options are:
 - *None*—Do not include the origin identifier in SYSLOG messages.
 - *Hostname*—Include the system hostname in SYSLOG messages.
 - *IPv4 Address*—Include the IPv4 address of the sending interface in SYSLOG messages.
 - *IPv6 Address*—Include the IPv6 address of the sending interface in SYSLOG messages.
 - *User Defined*—Enter a description to be included in SYSLOG messages.
- **RAM Memory Logging**—Select the severity levels of the messages to be logged to the RAM.
- **Flash Memory Logging**—Select the severity levels of the messages to be logged to the Flash memory.

STEP 3 Click **Apply**. The Running Configuration file 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**.

STEP 2 Click **Add**.

STEP 3 Enter the parameters.

- **Server Definition**—Select whether to identify the remote log server by IP address or name.
- **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/Name**—Enter the IP address or domain name of the log server.
- **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 Running Configuration file is updated.

Viewing Memory Logs

The device 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 that were saved in the RAM (cache) in chronological order. 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 top of the page has a button that allows you to Disable Alert Icon Blinking. **Click** to toggle between disable and enable.

This page contains 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 the Flash memory, in chronological order. The minimum severity for logging is configured in the Log Settings page. Flash logs remain when the device is rebooted. You can clear the logs manually.

To view the Flash logs, click **Status and Statistics > View Log > Flash Memory**.

This page contains 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.

Administration: File Management

This section describes how system files are managed.

The following topics are covered:

- **System Files**
- **Upgrade/Backup Firmware/Language**
- **Download/Backup Configuration/Log**
- **Configuration Files Properties**
- **Copy/Save Configuration**
- **DHCP Auto Configuration**

System Files

System files are files that contain configuration information, firmware images or boot code.

Various actions can be performed with these files, such as: selecting the firmware file from which the device boots, copying various types of configuration files internally on the device, or copying files to or from an external device, such as an external server.

The possible methods of file transfer are:

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

Configuration files on the device are defined by their *type*, and contain the settings and parameter values for the device.

When a configuration is referenced on the device, it is referenced by its *configuration file type* (such as *Startup Configuration* or *Running Configuration*), as opposed to a file name that can be modified by the user.

Content can be copied from one configuration 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 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 device:

- **Running Configuration**—Contains the parameters currently being used by the device to operate. This is the only file type that is modified when you change parameter values on the device.

If the device is rebooted, the Running Configuration is lost. The Startup Configuration, stored in Flash, overwrites the Running Configuration, stored in RAM.

To preserve any changes you made to the device, you must save the Running Configuration to the Startup Configuration, or another file type.

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

The Startup Configuration is retained in Flash and is preserved when the device is rebooted. At this time, the Startup Configuration is copied to RAM and identified as the Running Configuration.

- **Mirror Configuration**—A copy of the Startup Configuration, created by the device when the following conditions exist:
 - The device 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.

The option of automatically copying the Running Configuration to the mirror configuration can be disabled in the Configuration Files Properties page.

- **Backup Configuration**—A manual copy of a configuration file used 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.
- **Firmware**—The program that controls the operations and functionality of the device. More commonly referred to as the *image*.
- **Boot Code**—Controls the basic system startup and launches the firmware image.
- **Language File**—The dictionary that enables the web-based configuration utility 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 second language, as described in [Upgrade/Backup Firmware/Language](#) section.
- Save configuration files on the device to a location on another device as described in the [Download/Backup Configuration/Log](#) section.
- Clear the Startup Configuration or Backup Configuration file types as described in the [Configuration Files Properties](#) section.
- Copy one configuration file type to another configuration file type as described in the [Copy/Save Configuration](#) section.
- Enable automatically uploading a configuration file from a DHCP server to the device, as described in the [DHCP Auto Configuration](#) section.

This section covers the following topics:

- **Upgrade/Backup Firmware/Language**
- **Download/Backup Configuration/Log**
- **Configuration Files Properties**
- **Copy/Save Configuration**
- **DHCP Auto Configuration**

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 or upgrade a second language file.

The following methods for transferring files are supported:

- HTTP/HTTPS that uses the facilities provided by the browser
- TFTP that requires a TFTP server
- Secure Copy Protocol (SCP) that requires an SCP server

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

A single firmware image is stored on the device. After new firmware has been successfully loaded into the device, the device needs to be rebooted prior to the new firmware taking effect. The Summary page continues to show the previous image prior to the reboot.

Upgrade/Backing Firmware or Language File

To upgrade or backup a software image or language file:

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

STEP 2 Click the Transfer Method. Proceed as follows:

- If you selected **TFTP**, go to **STEP 3**.
- If you selected **via HTTP/HTTPS**, go to **STEP 4**.
- If you selected **via SCP**, go to **STEP 5**.

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

Select one of the following **Save Actions**:

- **Upgrade**—Specifies that the file type on the device is to be replaced with a new version of that file type located on a TFTP server.
- **Backup**—Specifies that a copy of the file type is to be saved to a file on another device.

Enter the following fields:

- **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).
- **TFTP Server Definition**—Select whether to specify the TFTP server by IP address or domain name.
- **IP Version**—Select whether an IPv4 or an IPv6 address is used.
- **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 is used) from the list.
- **TFTP Server IP Address/Name**—Enter the IP address or the domain name of the TFTP server.
- **(For Upgrade) Source File Name**—Enter the name of the source file.
- **(For Backup) Destination File Name**—Enter the name of the backup file.

STEP 4 If you selected **via HTTP/HTTPS**, you can only **Upgrade**. Enter the parameters as described in this step.

- **File Type**—Select one of the following file types:
 - *Firmware Image*—Select this to upgrade the firmware image.
 - *Language*—Select this to upgrade the language file.
- **File Name**—Click **Browse** to select a file or enter the path and source file name to be used in the transfer.

STEP 5 If you selected **via SCP (Over SSH)**, see **SSH Client Authentication** for instructions. Then, enter the following fields: (only unique fields are described, for non-unique fields, see the descriptions above)

- **Remote SSH Server Authentication**—To enable SSH server authentication (which is disabled by default), click **Edit**. This takes you to the **SSH Server Authentication** page to configure the SSH server, and return to this page. Use the **SSH Server Authentication** page to select an SSH user authentication method (password or public/private key), set a username and password on the device (if the password method is selected), and generate an RSA or DSA key if required.

SSH Client Authentication—Client authentication can be done in one of the following ways:

- **Use SSH Client System Credentials**—Sets permanent SSH user credentials. Click **System Credentials** to go to the SSH User Authentication page where the user/password can be set once for all future use.
- **Use SSH Client One-Time Credentials**—Enter the following:
 - *Username*—Enter a username for this copy action.
 - *Password*—Enter a password for this copy.

NOTE The username and password for one-time credential will not saved in configuration file.

Select one of the following **Save Actions**:

- **Upgrade**—Specifies that the file type on the device is to be replaced with a new version of that file type located on a TFTP server.
- **Backup**—Specifies that a copy of the file type is to be saved to a file on another device.

Enter the following fields:

- **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).
- **SCP Server Definition**—Select whether to specify the SCP server by IP address or by domain name.
- **IP Version**—Select whether an IPv4 or an IPv6 address is used.
- **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.
- **Link-Local Interface**—Select the link local interface from the list.
- **SCP Server IP Address/Name**—Enter the IP address or domain name of the SCP server.
- **(For Upgrade) Source File Name**—Enter the name of the source file.
- **(For Backup) Destination File Name**—Enter the name of the backup file.

STEP 6 Click **Apply**. If the files, passwords and server addresses are correct, one of the following may happen:

- If SSH server authentication is enabled (in the SSH Server Authentication page), and the SCP server is trusted, the operation succeeds. If the SCP server is not trusted, the operation fails and an error is displayed.

- If SSH server authentication is not enabled, the operation succeeds for any SCP server.

Download/Backup Configuration/Log

The Download/Backup Configuration/Log page enables:

- Backing up configuration files or logs from the device to an external device.
- Restoring configuration files from an external device to the device.

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 *overwrites* 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 device must be rebooted for the restored Startup Configuration to be used as the Running Configuration. You can reboot the device by using the process described in the [Rebooting the Device](#) section.

Configuration File Backwards Compatibility

When restoring configuration files from an external device to the device, the following compatibility issues might arise:

- **Change Queues Mode from 4 to 8**—Queue-related configurations must be examined and adjusted to meet QoS objectives with the new Queues mode. See the *CLI Reference Guide* for a listing of these QoS commands.
- **Change Queues Mode from 8 to 4**—Queue-related configuration commands that conflict with the new Queues mode are rejected, meaning that the download of the configuration file fails. Use the System Mode and Stack Management page to change the Queues mode.
- **Change the System Mode**—If the System mode is contained in a configuration file that is downloaded to the device, and the file's System mode matches the current System mode, this information is ignored.

Otherwise, if the System mode is changed, the following cases are possible:

- If the configuration file is downloaded onto the device (using the Download/Backup Configuration/Log page), the operation is aborted, and a message is displayed indicating that the System mode must be changed in the System Mode and Stack Management page.
- If the configuration file is downloaded during an automatic configuration process, the Startup Configuration file is deleted and the device reboots automatically in the new System mode. The device is configured with an empty configuration file. See [DHCP Auto Configuration](#).
- See [Configuration After Reboot](#) for a description of what happens when the stacking modes are changed.

Downloading or Backing-up a Configuration or Log File

To backup or restore the system configuration file:

STEP 1 Click **Administration > File Management > Download/Backup Configuration/Log**.

STEP 2 Select the **Transfer Method**.

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

Select either Download or Backup as the **Save Action**.

Download Save Action—Specifies that the file on another device replaces a file type on the device. Enter the following fields:

- a. **Server Definition**—Select whether to specify the TFTP server by IP address or by domain name.
- b. **IP Version**—Select whether an IPv4 or an IPv6 address is used.

NOTE If the server is selected by name in the Server Definition, there is no need to select the IP Version related options.

- 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 from the list.
- e. **TFTP Server**—Enter the IP address of the TFTP server.
- f. **Source File Name**—Enter the source file name. File names cannot contain slashes (\ or /), cannot start with a period (.), and must include between 1 and 160 characters. (Valid characters: A-Z, a-z, 0-9, “.”, “-”, “_”).
- g. **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).

Backup Save Action—Specifies that a file type is to be copied to a file on another device. Enter the following fields:

- a. **Server Definition**—Select whether to specify the TFTP server by IP address or by domain name.
- 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 from the list.
- e. **TFTP Server IP Address/Name**—Enter the IP address or domain name of the TFTP server.
- f. **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).
- g. **Sensitive Data**—Select how sensitive data should be included in the backup file. The following options are available:
 - *Exclude*—Do not include sensitive data in the backup.
 - *Encrypted*—Include sensitive data in the backup in its encrypted form.

- *Plaintext*—Include sensitive data in the backup in its plaintext form.

NOTE The available sensitive data options are determined by the current user SSD rules. For details, refer to Secure Sensitive Data Management > SSD Rules page.

- Destination File Name**—Enter the destination file name. File names cannot contain slashes (\ or /), the leading letter of the file name must not be a period (.), and the file name must be between 1 and 160 characters. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_").
- Click **Apply**. The file is upgraded or backed up.

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

Select the **Save Action**.

If **Save Action** is *Download* (replacing the file on the device with a new version from another device), do the following. Otherwise, go to the next procedure in this step.

- Source File Name**—Click **Browse** to select a file or enter the path and source file name to be used in the transfer.
- 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).
- Click **Apply**. The file is transferred from the other device to the device.

If **Save Action** is *Backup* (copying a file to another device), do the following:

- 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).
- Sensitive Data**—Select how sensitive data should be included in the backup file. The following options are available:
 - *Exclude*—Do not include sensitive data in the backup.
 - *Encrypted*—Include sensitive data in the backup in its encrypted form.
 - *Plaintext*—Include sensitive data in the backup in its plaintext form.

NOTE The available sensitive data options are determined by the current user SSD rules. For details, refer to Secure Sensitive Data Management > SSD Rules page.

- Click **Apply**. The file is upgraded or backed up.

STEP 5 If you selected via **SCP (Over SSH)**, see **SSH Client Configuration Through the GUI** for instructions. Then enter the following fields:

- **Remote SSH Server Authentication**—To enable SSH server authentication (it is disabled by default), click **Edit**, which takes you to the **SSH Server Authentication** page to configure this, and return to this page. Use the **SSH Server Authentication** page to select an SSH user authentication method (password or public/private key), set a username and password on the device, if the password method is selected, and generate an RSA or DSA key if required.

SSH Client Authentication—Client authentication can be done in one of the following ways:

- **Use SSH Client**—Sets permanent SSH user credentials. Click **System Credentials** to go to the SSH User Authentication page where the user/ password can be set once for all future use.
- **Use SSH Client One-Time Credentials**—Enter the following:
 - *Username*—Enter a username for this copy action.
 - *Password*—Enter a password for this copy.
- **SCP Server Definition**—Select whether to specify the TFTP server by IP address or by domain name.
- **IP Version**—Select whether an IPv4 or an IPv6 address is used.
- **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.
- **Link-Local Interface**—Select the link local interface from the list.
- **SCP Server IP Address/Name**—Enter the IP address or domain name of the TFTP server.

If **Save Action** is *Download* (replacing the file on the device with a new version from another device), enter the following fields.

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

If **Save Action** is *Backup* (copying a file to another device), enter the following fields (in addition to those fields listed above):

- **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).
- **Sensitive Data**—Select how sensitive data should be included in the backup file. The following options are available:
 - *Exclude*—Do not include sensitive data in the backup.
 - *Encrypted*—Include sensitive data in the backup in its encrypted form.
 - *Plaintext*—Include sensitive data in the backup in its plaintext form.

NOTE The available sensitive data options are determined by the current user SSD rules. For details, refer to [Secure Sensitive Data Management > SSD Rules](#) page.

- **Destination File Name**—Name of file being copied to.

STEP 6 Click **Apply**. The file is upgraded or backed up.

Configuration Files Properties

The Configuration Files Properties page allows you to see when various system configuration files were created. It also enables deleting the Startup Configuration and Backup Configuration files. You cannot delete the other configuration file types.

To set whether mirror configuration files will be created, clear configuration files and see when configuration files were created:

-
- STEP 1** Click **Administration > File Management > Configuration Files Properties**.
- STEP 2** If required, disable **Auto Mirror Configuration**. This disables the automatic creation of mirror configuration files. When disabling this feature, the mirror configuration file, if it exists, is deleted. See [System Files](#) for a description of mirror files and why you might not want to automatically create mirror configuration files.
- STEP 3** If required, select either the Startup Configuration, Backup Configuration or both and click **Clear Files** to delete these files.

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.
-

Copy/Save Configuration

When you click **Apply** on any window, changes that you made to the device 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 on another device.



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

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

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

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

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

- If you are backing up a configuration file, select one of the following formats for the backup file.
 - **Exclude**—Sensitive data is not included in the backup file.
 - **Encrypted**—Sensitive data is included in the backup file in encrypted form.
 - **Plaintext**—Sensitive data is included in the backup file in plain text.

NOTE The available sensitive data options are determined by the current user SSD rules. For details, refer to Secure Sensitive Data Management > SSD Rules page.

STEP 4 The **Save Icon Blinking** field indicates whether an icon blinks when there is unsaved data. To disable/enable this feature, click **Disable/Enable Save Icon Blinking**.

STEP 5 Click **Apply**. The file is copied.

DHCP Auto Configuration

Auto configuration enables passing configuration information to hosts on a TCP/IP network. Based on this protocol, the Auto Configuration feature enables a device to download configuration files from a TFTP/SCP server.

The device can be configured as a DHCPv4 client in which auto configuration from a DHCPv4 server is supported and/or a DHCPv6 client in which auto configuration from a DHCPv6 server is supported.

By default, the device is enabled as a DHCP client when the Auto Configuration feature is enabled.

The Auto Configuration process also supports downloading a configuration file that includes sensitive information, such as RADIUS server keys and SSH/SSL keys, by using the Secured Copy Protocol (SCP) and the Secure Sensitive Data (SSD) feature (See [Security: Secure Sensitive Data Management](#)).

DHCPv4 Auto Configuration is triggered in the following cases:

- After reboot when an IP address is allocated or renewed dynamically (using DHCPv4).
- Upon an explicit DHCPv4 renewal request and if the device and the server are configured to do so.
- Upon automatic renewal of the DHCPv4 lease.

DHCPv6 Auto Configuration is triggered when the following conditions are fulfilled:

- When a DHCPv6 server sends information to the device. This occurs in the following cases:
 - When an interface, which is IPv6 enabled, is defined as a DHCPv6 stateless configuration client.
 - When DHCPv6 messages are received from the server (for example, when you press the **Restart** button on IPv6 Interfaces page,
 - When DHCPv6 information is refreshed by the device.
 - After rebooting the device when stateless DHCPv6 client is enabled.
- When the DHCPv6 server packets contain the configuration filename option.

DHCP Server Options

DHCP messages might contain the configuration server name/address and the configuration file name/path (these are optional options). These options are found in the **Offer** message coming from the DHCPv4 servers and in the **Information Reply** messages coming from DHCPv6 servers.

Backup information (configuration server name/address and configuration file name/path) can be configured in the Auto Configuration page. This information is used when the DHCPv4 message does not contain this information (but it is not used by DHCPv6).

Auto Configuration Download Protocol (TFTP or SCP)

The Auto Configuration download protocol can be configured, as follows:

- **Auto By File Extension**—(Default) If this option is selected, a user-defined file extension indicates that files with this extension are downloaded using SCP (over SSH), while files with other extensions are downloaded using TFTP. For example, if the file extension specified is .xyz, files with the .xyz extension are downloaded using SCP, and files with the other extensions are downloaded using TFTP.
- **TFTP Only**—The download is done through TFTP regardless of the file extension of the configuration file name.
- **SCP Only**—The download is done through SCP (over SSH) regardless of the file extension of the configuration file name.

SSH Client Authentication Parameters

By default, remote SSH server authentication is disabled, so that the device accepts any remote SSH server out of the box. You can enable remote SSH server authentication to only allow connections from servers found in the trusted server list.

SSH Client Authentication parameters are required to access the SSH server by the client (which is the device). The default SSH Client authentication parameters are:

- SSH Authentication method: by username/password
- SSH username: anonymous
- SSH password: anonymous

NOTE The SSH Client authentication parameters can also be used when downloading a file for manual download (a download that is not performed through the DHCP Auto Configuration feature).

Auto Configuration Process

When the Auto Configuration process is triggered, the following sequence of events occurs:

- The DHCP server is accessed to acquire the TFTP/SCP server name/address and configuration file name/path (DHCPv4 options: 66, 150, and 67, DHCPv6 options: 59 and 60).
- If a server and configuration file options were not supplied by the DHCP server, then:
 - **For DHCPv4:** The user-defined, backup configuration file name is used.
 - **For DHCPv6:** The process is halted.
- If the DHCP server did not send these options and the backup TFTP/SCP server address parameter is empty then:
 - **For DHCPv4:**
SCP—The Auto Configuration process is halted.
TFTP—The device sends TFTP Request messages to a limited Broadcast address (for IPv4) or ALL NODES address (for IPv6) on its IP interfaces and continues the process of Auto Configuration with the first answering TFTP server.
 - **For DHCPv6:** The Auto Configuration process is halted.
- If the configuration filename was supplied by the DHCP server (DHCPv4: option 67, DHCPv6: option 60), then the copy protocol (SCP/TFTP) is selected as described in [Auto Configuration Download Protocol \(TFTP or SCP\)](#).
- When downloading using SCP, the device accepts any specified SCP/SSH server (without authentication) if either of the following is true:
 - The SSH server authentication process is disabled. Note that by default the SSH server authentication is disabled in order to allow downloading configuration file for devices with factory default configuration (for example out-of-box devices).

- The SSH Server is configured in the SSH Trusted Servers list.

If the SSH server authentication process is enabled, and the SSH server is not found in the SSH Trusted Servers list, the Auto Configuration process is halted.

- If the information is available, the TFTP/SCP server is accessed to download the file from it.

The download process is done only if the new configuration filename is different from the current configuration filename (even if the current configuration file is empty).

- A SYSLOG message is generated acknowledging that the Auto Configuration process is completed.

Configuring DHCP Auto Configuration

Workflow

To configure DHCP Auto Configuration.

1. Configure the DHCPv4 and/or DHCPv6 servers to send the required options. this process is not described in this guide.
2. Configure Auto Configuration parameters.
3. Set the IP Address Type to Dynamic in the IPv4 Interface page.

Web Configuration

The DHCP Auto Configuration page is used to perform the following actions when the information is not provided in a DHCP message:

- Enable the DHCP auto configuration feature.
- Specify the download protocol.
- Configure the device to receive configuration information from a specific file on a specific server.

Note the following regarding the DHCP auto configuration process:

- A configuration file that is placed on the TFTP/SCP server must match the form and format requirements of the 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.

- In IPv4, to ensure that the device configuration functions as intended, due to allocation of different IP addresses with each DHCP renew cycle, it is recommended that IP addresses 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 auto configuration:

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

STEP 2 Enter the values.

- **Auto Configuration Via DHCP**—Select this field to enable DHCP Auto Configuration. This feature is enabled by default, but can be disabled here.
- **Download Protocol**—Select one of the following options:
 - *Auto By File Extension*—Select to indicate that auto configuration uses the TFTP or SCP protocol depending on the extension of the configuration file. If this option is selected, the extension of the configuration file does not necessarily have to be given. If it is not given, the default extension is used (as indicated below).
 - *File Extension for SCP*—If **Auto By File Extension** is selected, you can indicate a file extension here. Any file with this extension is downloaded using SCP. If no extension is entered, the default file extension **.scp** is used.
 - *TFTP Only*—Select to indicate that only the TFTP protocol is to be used for auto configuration.
 - *SCP Only*—Select to indicate that only the SCP protocol is to be used for auto configuration.
- **SSH Settings for SCP**—When using SCP for downloading the configuration files, select one of the following options:
 - *Remote SSH Server Authentication*—Click on the **Enable/Disable** link to navigate to the SSH Server Authentication page. There you can enable authentication of the SSH server to be used for the download and enter the trusted SSH server if required.
 - *SSH Client Authentication*—Click on the System Credentials link to enter user credentials in the SSH User Authentication page.

STEP 3 Enter the following optional information to be used if no configuration file name was received from the DHCP server.

- **Backup Server Definition**—Select **By IP address** or **By name** to configure the server.
- **IP Version**—Select whether an IPv4 or an IPv6 address is used.
- **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 is used) from the list.
- **Backup Server IP Address/Name**—Enter the IP address or the name of the server to be used if no server IP address was specified in the DHCP message.
- **Backup Configuration File Name**—Enter the path and file name of the file to be used if no configuration file name was specified in the DHCP message.

STEP 4 Click **Apply**. The parameters are copied to the Running Configuration file.

Administration: General Information

This section describes how to view system information and configure various options on the device.

It covers the following topics:

- **Device Models**
- **System Information**
- **Rebooting the Device**
- **Monitoring Fan Status**
- **Defining Idle Session Timeout**
- **Pinging a Host**

Device Models

All models can be fully managed through the web-based switch configuration utility.

NOTE The following port conventions are used:

- GE is used for Gigabit Ethernet (10/100/1000) ports.
- FE is used for Fast Ethernet (10/100) ports.

The following table describes the various models, the number and type of ports on them and their PoE information.

Smart Switch Models

Model Name	Product ID (PID)	Description of Ports on Device	Power Dedicated to PoE	No. of Ports that Support PoE
SG200-18	SLM2016T	16 GE ports + 2 GE special-purpose combo ports	N/A	N/A
SG200-26	SLM2024T	24 GE ports + 2 GE special-purpose combo-ports	N/A	N/A
SG200-26P	SLM2024PT	24 GE ports + 2 GE special-purpose combo-ports	100W	12 ports FE1-FE6, FE13 - FE18
SG200-50	SLM2048T	48 GE ports + 2 GE special-purpose combo-ports	N/A	N/A
SG200-50P	SLM2048PT	48 GE ports + 2 GE special-purpose combo-ports	180W	24 ports FE1-FE12, FE25 - FE36
SF200-24	SLM224GT	24 FE ports + 2 GE special-purpose combo-ports	N/A	N/A
SF200-24P	SLM224PT	24 FE ports + 2 GE special-purpose combo-ports	100W	12 ports FE1- FE6, FE13 - FE18
SF200-48	SLM248GT	48 FE ports + 2 GE special-purpose combo-ports	N/A	N/A

System Information

The System Summary page provides a graphic view of the device, and displays device status, hardware information, firmware version information, general PoE status, and other items.

Displaying the System Summary

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

The System Summary page contains system and hardware information.

System Information:

- **System Description**—A description of the system.
- **System Location**—Physical location of the device. Click **Edit** to go the System Settings page to enter this information.
- **System Contact**—Name of a contact person. Click **Edit** to go the System Settings page to enter this information.
- **Host Name**—Name of the device. Click **Edit** to go the System Settings page to enter this information. By default, the device hostname is composed of the word *device* concatenated with the three least significant bytes of the device 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**—Device MAC address.
- **Jumbo Frames**—Jumbo frame support status. This support can be enabled or disabled by using the Port Settings page of the Port Management menu.

NOTE Jumbo frames support takes effect only after it is enabled, and after the device is rebooted.

TCP/UDP Services Status:

- **HTTP Service**—Displays whether HTTP is enabled/disabled.

- **HTTPS Service**—Displays whether HTTPS is enabled/disabled.
- **SNMP Service**—Displays whether SNMP is enabled/disabled.

Other Summary Information:

- **Model Description**—Device model description.
- **Serial Number**—Serial number.
- **PID VID**—Part number and version ID.

PoE Power Information:

- **Maximum Available PoE Power (W)**—Maximum available power that can be delivered by the PoE.
- **Total PoE Power Consumption (W)**—Total PoE power delivered to connected PoE devices.
- **PoE Power Mode**—Port Limit or Class Limit.

Configuring the System Settings

To enter system settings:

STEP 1 Click **Administration > System Settings**.

STEP 2 View or modify the system settings.

- **System Description**—Displays a description of the device.
- **System Location**—Enter the location where the device is physically located.
- **System Contact**—Enter the name of a contact person.
- **Host Name**—Select the host name of this device. This is used in the prompt of CLI commands:
 - *Use Default*—The default hostname (System Name) of these switches is: *switch123456*, where 123456 represents the last three bytes of the device 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).

- **Custom Login Screen Settings**—To display text on the Login page, enter the text in the **Login Banner** text box. Click **Preview** to view the results.

NOTE When you define a login banner from the web-based configuration utility, it also activates the banner for the CLI interfaces (Console, Telnet, and SSH).

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

Rebooting the Device

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

You can back up the configuration by using *Administration > File Management > Copy/Save Configuration* or clicking **Save** at the top of the window. You can also upload the configuration from a remote device. See the [Download/Backup Configuration/Log](#) section.

There are cases when you might prefer to set the time of the reboot for some time in the future. This could happen for example in one of the following cases:

- You are performing actions on a remote device, and these actions might create loss of connectivity to the remote device. Pre-scheduling a reboot restores the working configuration and enables restoring the connectivity to the remote device. If these actions are successful, the delayed reboot can be cancelled.
- Reloading the device cause loss of connectivity in the network, thus by using delayed reboot, you can schedule the reboot to a time that is more convenient for the users (e.g. late night).

To reboot the device:

STEP 1 Click **Administration > Reboot**.

STEP 2 Click one of the **Reboot** buttons to reboot the device.

- **Reboot**—Reboots the device. Since any unsaved information in the Running Configuration is discarded when the device 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.

The following options are available:

- *Immediate*—Reboot immediately.
- *Date*—Enter the date (month/day) and time (hour and minutes) of the schedule reboot. This schedules a reload of the software to take place at the specified time (using a 24-hour clock). If you specify the month and day, the reload is scheduled to take place at the specified time and date. If you do not specify the month and day, the reload takes place at the specified time on the current day (if the specified time is later than the current time) or on the next day (if the specified time is earlier than the current time). Specifying 00:00 schedules the reload for midnight. The reload must take place within 24 days.

NOTE This option can only be used if the system time has either been set manually or by SNTP.

- *In*—Reboot within the specified number of hours and minutes. The maximum amount of time that can pass is 24 days.
- **Reboot to Factory Defaults**—Reboots the device by using the factory default configuration. This process erases the Startup Configuration file, and the backup configuration file. The mirror configuration file is not deleted when restoring to factory default.
- **Clear Startup Configuration File**—Check to clear the startup configuration on the device for the next time it boots up.

NOTE Clearing the Startup Configuration File and Rebooting is not the same as Rebooting to Factory Defaults. Rebooting to Factory Defaults is more intrusive.

Monitoring Fan Status

The Health page displays the fan status on all devices with fans. Depending on the model, there are one or more fans on a device. Some models have no fans at all.

On devices on which a temperature sensor is assembled, for protecting the device hardware in case it overheats, the following actions are performed by the device if it overheats and during the cool down period after overheating:

Event	Action
At least one temperature sensor exceeds the Warning threshold	<p>The following are generated:</p> <ul style="list-style-type: none"> ▪ SYSLOG message ▪ SNMP trap
At least one temperature sensor exceeds the Critical threshold	<p>The following are generated:</p> <ul style="list-style-type: none"> ▪ SYSLOG message ▪ SNMP trap <p>The following actions are performed:</p> <ul style="list-style-type: none"> ▪ System LED is set to solid amber (if hardware supports this). ▪ Disable Ports — When the Critical temperature has been exceeded for two minutes, all ports will be shut down. ▪ (On devices that support PoE) Disable the PoE circuitry so that less power is consumed and less heat is emitted.
Cool down period after the Critical threshold was exceeded (all sensors are lower than the Warning threshold - 2 °C).	<p>After all the sensors cool down to Warning Threshold minus 2 degree C, the PHY will be re-enabled, and all ports brought back up.</p> <p>If FAN status is OK, the ports are enabled.</p> <p>(On devices that support PoE) the PoE circuitry is enabled.</p>

To view the device health parameters, click **Status and Statistics > Health**.

The Health page displays the following fields:

- **Fan Status**—Fan status. The following values are possible:
 - OK—Fan is operating normally.
 - Fail—Fan is not operating correctly.
 - N/A—Fan ID is not applicable for the specific model.
- **Fan Direction**—(On relevant devices) The direction that the fans are working in (for example: Front to Back).

Defining Idle Session Timeout

The *Idle Session Timeout* configures the time interval during which the HTTP session can remain idle before it times out and you must log in again to reestablish the session.

- **HTTP Session Timeout**
- **HTTPS Session Timeout**

To set the idle session timeout of an HTTP or HTTPS session:

-
- STEP 1** Click **Administration > Idle Session Timeout**.
- STEP 2** Select the timeout for the each session from the corresponding list. The default timeout value is 10 minutes.
- STEP 3** Click **Apply** to set the configuration settings on the device.
-

Pinging a Host

Ping is a utility used to test if a remote host can be reached and to measure the round-trip time for packets sent from the device to a destination device.

Ping operates by sending Internet Control Message Protocol (ICMP) echo request packets to the target host and waiting for an ICMP response, sometimes called a pong. It measures the round-trip time and records any packet loss.

To ping a host:

STEP 1 Click **Administration > Ping**.

STEP 2 Configure ping by entering the fields:

- **Host Definition**—Select whether to specify hosts by their IP address or name.
- **IP Version**—If the host is identified by its IP address, select either IPv4 or IPv6 to indicate that it will be entered in the selected format.
- **IPv6 Address Type**—Select Link Local or Global as the type of IPv6 address to enter.
 - *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 from where it is received.
- **Host IP Address/Name**—Address or host name of the device to be pinged. Whether this is an IP address or host name depends on the Host Definition.
- **Ping Interval**—Length of time the system waits between ping packets. Ping is repeated the number of times configured in the "Number of Pings" field, whether the ping succeeds or not. Choose to use the default interval or specify your own value.
- **Number of Pings**—The number of times the ping operation is performed. Choose to use the default or specify your own value.

- **Status**—Displays whether the ping succeeded or failed.

STEP 3 Click **Activate Ping** to ping the host. The ping status appears and another message is added to the list of messages, indicating the result of the ping operation.

STEP 4 View the results of ping in the **Ping Counters and Status** section of the page.

Administration: Time Settings

Synchronized system clocks provide a frame of reference between all devices on the network. Network time synchronization is critical because every aspect of managing, securing, planning, and debugging a network involves determining when events occur. Without synchronized clocks, accurately correlating log files between devices when tracking security breaches or network usage is impossible.

Synchronized 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 file systems reside.

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

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

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

- **System Time Options**
- **SNTP Modes**
- **Configuring System Time**

System Time Options

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

As part of the boot process, the device always configures the time, time zone, and DST. These parameters are obtained from the PC running the GUI, SNTP, values set manually, or if all else fails, from the factory defaults.

Time

The following methods are available for setting the system time on the device:

- **Manual**—You must manually set the time.
- **From PC**—Time can be received from the PC by using browser information.

The configuration of time from the computer is saved to the Running Configuration file. You must copy the Running Configuration to the Startup Configuration in order to enable the device to use the time from the computer after reboot. The time after reboot is set during the first WEB login to the device.

When you configure this feature for the first time, if the time was not already set, the device sets the time from the PC.

This method of setting time works with both HTTP and HTTPS connections.

- **SNTP**—Time can be received from SNTP time servers. SNTP ensures accurate network time synchronization of the device up to the millisecond by using an SNTP server for the clock source. When specifying an SNTP server, if choosing to identify it by hostname, three suggestions are given in the GUI:
 - time-a.timefreq.bldrdoc.gov
 - time-b.timefreq.bldrdoc.gov
 - time-c.timefreq.bldrdoc.gov

After the time has been set by any of the above sources, it is not set again by the browser.

NOTE SNTP is the recommended method for time setting.

Time Zone and Daylight Savings Time (DST)

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

- Dynamic configuration of the device 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 becomes the Operational time zone and DST, only if the dynamic configuration is disabled or fails.

NOTE The DHCP server must supply DHCP option 100 in order for dynamic time zone configuration to take place.

SNTP Modes

The device can receive the system time from an SNTP server in one of the following ways:

- **Client Broadcast Reception (passive mode)**
SNTP servers broadcast the time, and the device listens to these broadcasts. When the device is in this mode, there is no need to define a Unicast SNTP server.
- **Client Broadcast Transmission (active mode)**—The device, as an SNTP client, periodically requests SNTP time updates. This mode works in either of the following ways:
 - **SNTP Anycast Client Mode**—The device broadcasts time request packets to all SNTP servers in the subnet, and waits for a response.
 - **Unicast SNTP Server Mode**—The device sends Unicast queries to a list of manually-configured SNTP servers, and waits for a response.

The device supports having all of the above modes active at the same time and selects the best system time received from an SNTP server, according to an algorithm based on the closest stratum (distance from the reference clock).

Configuring System Time

Selecting Source of System Time

Use the System Time page to select the system time source. If the source is manual, you can enter the time here.



CAUTION If the system time is set manually and the device is rebooted, the manual time settings must be reentered.

To define system time:

STEP 1 Click **Administration > Time Settings > System Time**.

The following fields are displayed:

- **Actual Time (Static)**—System time on the device. This shows the DHCP time zone or the acronym for the user-defined time zone if these were defined.
- **Last Synchronized Server**—Address, stratum and type of the SNTP server from which time was last taken.

STEP 2 Enter these parameters:

Clock Source Settings—Select the source used to set the system clock.

- **Main Clock Source (SNTP Servers)**—If you enable this, the system time is obtained from an SNTP server. To use this feature, you must also configure a connection to an SNTP server in the SNTP Interface Settings page. Optionally, enforce authentication of the SNTP sessions by using the SNTP Authentication page.
- **Alternate Clock Source (PC via active HTTP/HTTPS sessions)**—Select to set the date and time from the configuring computer using the HTTP protocol.

NOTE The Clock Source Setting needs to be set to either of the above in order for RIP MD5 authentication to work. This also helps features that associate with time, for example:

Manual Settings—Set the date and time manually. 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 Settings—The local time is used via the DHCP server or Time Zone offset.

- **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 device.*

NOTE The DHCP Client supports Option 100 providing dynamic time zone setting.

- **Time Zone from DHCP**—Displays the acronym of the time zone configured from the DHCP server. This acronym appears in the **Actual Time** field
- **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.
- **Time Zone Acronym**—Enter a user-defined name that represents the time zone you have configured. This acronym appears in the **Actual Time** field.

Daylight Savings Settings—Select how DST is defined:

- **Daylight Savings**—Select to enable Daylight Saving Time.
- **Time Set Offset**—Enter the number of minutes offset from GMT ranging from 1—1440. The default is 60.
- **Daylight Savings Type**—Click one of the following:
 - *USA*—DST is set according to the dates used in the USA.
 - *European*—DST is set according to the dates used by the European Union and other countries that use this standard.
 - *By Dates*—DST is set manually, typically for a country other than the USA or a European country. Enter the following parameters:
 - *Recurring*—DST occurs on the same date every year.

Selecting *By Dates* allows customization of the start and stop of DST:

- **From**—Day and time that DST starts.
- **To**—Day and time that DST ends.

Selecting *Recurring* allows different customization of the start and stop of DST:

- **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 written to the Running Configuration file.

Adding a Unicast SNTP Server

Up to 16 Unicast SNTP servers can be configured.

NOTE To specify a Unicast SNTP server by name, you must first configure DNS server(s) on the device (see [DNS Settings](#)). In order to add a Unicast SNTP server, check the box to enable **SNTP Client Unicast**.

To add a Unicast SNTP server:

STEP 1 Click **Administration > Time Settings > SNTP Unicast**.

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

- **SNTP Server**—SNTP server IP address. The preferred server, or hostname, is chosen according to its stratum level.

- **Poll Interval**—Displays whether polling is enabled or disabled.
- **Authentication Key ID**—Key Identification used to communicate between the SNTP server and device.
- **Stratum Level**—Distance from the reference clock expressed as a numerical value. An SNTP server cannot be the primary server (stratum level 1) unless polling interval is enabled.
- **Status**—SNTP server status. The possible values 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 device.
 - *In Process*—Occurs when the SNTP server has not fully trusted its own time server (i.e. when first booting up the SNTP server).
- **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.
- **Source**—How SNTP server was defined, for example: manually or from DHCPv6 server.
- **Interface**—Interface on which packets are received.

STEP 2 To add a Unicast SNTP server, enable **SNTP Client Unicast**.

STEP 3 Click **Add**.

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 select a well-known SNTP server by name from the list.

NOTE To specify a well-known SNTP server, the device 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 **DNS Settings**)

- **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 NTP 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 NTP 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 device 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.

Configuring the SNTP Mode

The device can be in active and/or passive mode (see [SNTP Modes](#) for more information).

To enable receiving SNTP packets from all servers on the subnet and/or to enable transmitting time requests to SNTP servers:

STEP 1 Click **Administration > Time Settings > SNTP Multicast/Anycast**.

STEP 2 Select from the following options:

- **SNTP IPv4 Multicast Client Mode (Client Broadcast Reception)**—Select to receive system time IPv4 Multicast transmissions from any SNTP server on the subnet.
- **SNTP IPv6 Multicast Client Mode (Client Broadcast Reception)**—Select to receive system time IPv6 Multicast transmissions from any SNTP server on the subnet.
- **SNTP IPv4 Anycast Client Mode (Client Broadcast Transmission)**—Select to transmit SNTP IPv4 synchronization packets requesting system time information. The packets are transmitted to all SNTP servers on the subnet.
- **SNTP IPv6 Anycast Client Mode (Client Broadcast Transmission)**—Select to transmit SNTP IPv6 synchronization packets requesting system time information. The packets are transmitted to all SNTP servers on the subnet.

STEP 3 If the system is in Layer 3 system mode, click **Add** to enter the interface for SNTP reception/transmission.

STEP 4 Click **Apply** to save the settings to the Running Configuration file.

Defining SNTP Authentication

SNTP clients can authenticate responses by using HMAC-MD5. An SNTP server is associated with a key, which is used as input together with the response itself to the MD5 function; the result of the MD5 is also included in the response packet.

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

The authentication key is created on the SNTP server in a separate process that depends on the type of SNTP server you are using. Consult with the SNTP server system administrator for more information.

Workflow

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- STEP 1** Enable authentication in the SNTP Authentication page.
 - STEP 2** Create a key in the SNTP Authentication page.
 - STEP 3** Associate this key with an SNTP server in the SNTP Unicast page.
-

To enable SNTP authentication and define keys:

-
- STEP 1** Click **Administration > Time Settings > SNTP Authentication**.
 - STEP 2** Select **SNTP Authentication** to support authentication of an SNTP session between the device and an SNTP server.
 - STEP 3** Click **Apply** to update the device.
 - STEP 4** Click **Add**.
 - 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 device to synchronize to it.
 - **Trusted Key**—Select to enable the device to receive synchronization information only from a SNTP server by using this authentication key.
 - STEP 6** Click **Apply**. The SNTP Authentication parameters are written to the Running Configuration file.
-
-

Administration: Diagnostics

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

It covers the following topics:

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

Testing Copper Ports

The Copper Test page displays the results of integrated cable tests performed on copper cables by the Virtual Cable Tester (VCT).

VCT performs two types of tests:

- Time Domain Reflectometry (TDR) technology tests the quality and characteristics of a copper cable attached to a port. Cables of up to 140 meters long can be tested. These results are displayed in the Test Results block of the Copper Test page.
- DSP-based tests are performed on active GE links to measure cable length. These results are displayed in the Advanced Information block of the Copper Test page.

Preconditions to Running the Copper Port Test

Before running the test, do the following:

- (Mandatory) Disable Short Reach mode (see the Port Management > Green Ethernet > Properties page)

- (Optional) Disable EEE (see the Port Management > Green Ethernet > Properties page)

Use a CAT5 data cable when testing cables using (VCT).

Accuracy of the test results can have an error range of +/- 10 for Advanced Testing and +/- 2 for basic testing.



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 Test**.
- STEP 2** Select the port on which to run the test.
- STEP 3** Click **Copper Test**.
- STEP 4** When the message appears, click **OK** to confirm that the link can go down or **Cancel** to abort the test.

The following fields are displayed in the Test Results block:

- **Last Update**—Time of the last test conducted on the port.
- **Test Results**—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.
- **Operational Port Status**—Displays whether port is up or down.

If the port being tested is a Giga port, the **Advanced Information** block contains the following information, which is refreshed each time you enter the page:

- **Cable Length:** Provides an estimate for the length.
- **Pair**—Cable wire pair being tested.
- **Status**—Wire pair status. Red indicates fault and Green indicates status OK.
- **Channel**—Cable channel indicating whether the wires are straight or cross-over.
- **Polarity**—Indicates if automatic polarity detection and correction has been activated for the wire pair.
- **Pair Skew**—Difference in delay between wire pairs.

NOTE TDR tests cannot be performed when the port speed is 10Mbit/Sec.

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**.

This page contains 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 device to send a copy of network packets seen on one device port, multiple device ports, or an entire VLAN to a network monitoring connection on another port on the device. 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 processes 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 device 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.

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 ports.

To enable mirroring:

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

This page contains 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 (Rx), outgoing from the port (Tx), or both.
- **Status**— Displays one of the following values:
 - *Active*—Both source and destination interfaces are up and forwarding traffic.
 - *Not Ready*—Either source or destination (or both) are down or not forwarding traffic for some reason.

STEP 2 Click **Add** to add a port or VLAN to be mirrored.

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. If a port is identified as an analyzer destination port, it remains the analyzer destination port until all entries are removed.
- **Source Interface**—Select 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 to the Running Configuration.

Viewing CPU Utilization and Secure Core Technology

This section describes the Secure Core Technology (SCT) and how to view CPU usage.

The device handles the following types of traffic, in addition to end-user traffic:

- Management traffic
- Protocol traffic
- Snooping traffic

Excessive traffic burdens the CPU, and might prevent normal device operation. The device uses the Secure Core Technology (SCT) feature to ensure that the device receives and processes management and protocol traffic, no matter how much total traffic is received. SCT is enabled by default on the device and cannot be disabled.

There are no interactions with other features.

To display CPU utilization:

STEP 1 Click **Administration > Diagnostics > CPU Utilization**.

The CPU Utilization page appears.

The CPU Input Rate field displays the rate of input frames to the CPU per second.

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

STEP 2 Select the **Refresh Rate** (time period in seconds) that passes before the statistics are refreshed. A new sample is created for each time period

Administration: Discovery

This section provides information for configuring Discovery.

It covers the following topics:

- [Configuring Bonjour Discovery](#)
- [LLDP and CDP](#)
- [Configuring LLDP](#)
- [Configuring CDP](#)

Configuring Bonjour Discovery

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

Bonjour in Layer 2 System Mode

Bonjour Discovery can only be enabled globally, and not on a per-port or per-VLAN basis. The device advertises the services enabled by the administrator.

When Bonjour Discovery and IGMP are both enabled, the IP Multicast address of Bonjour appears on the Adding IP Multicast Group Addresses page.

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

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

To globally enable Bonjour:

-
- STEP 1** Click **Administration > Discovery - Bonjour**.
- STEP 2** Select **Enable** to enable Bonjour Discovery globally on the device.
- STEP 3** Click **Apply**. Bonjour is enabled or disabled on the device according to the selection.
-

LLDP and CDP

LLDP (Link Layer Discovery Protocol) and CDP (Cisco Discovery Protocol) are link layer protocols for directly-connected LLDP and CDP-capable neighbors to advertise themselves and their capabilities to each other. By default, the device sends an LLDP/CDP advertisement periodically to all its interfaces and terminates and processes incoming LLDP and CDP packets as required by the protocols. In LLDP and CDP, advertisements are encoded as TLV (Type, Length, Value) in the packet.

The following CDP/LLDP configuration notes apply:

- CDP/LLDP can be globally enabled or disabled and enabled/disabled per port. The CDP/LLDP capability of a port is relevant only if CDP/LLDP is globally enabled.
- If CDP/LLDP is globally enabled, the device filters out incoming CDP/LLDP packets from ports that are CDP/LLDP-disabled.
- If CDP/LLDP is globally disabled, the device can be configured to discard, VLAN-aware flooding, or VLAN-unaware flooding of all incoming CDP/LLDP packets. VLAN-aware flooding floods an incoming CDP/LLDP packet to the VLAN where the packet is received excluding the ingress port. VLAN-unaware flooding floods an incoming CDP/LLDP packet to all the ports excluding the ingress port. The default is to discard CDP/LLDP packets when CDP/LLDP is globally disabled. You can configure the discard/flooding of incoming CDP and LLDP packets from the CDP Properties page and the LLDP Properties page respectively.

- Auto Smartport requires CDP and/or LLDP to be enabled. Auto Smartport automatically configures an interface based on the CDP/LLDP advertisement received from the interface.
- CDP and LLDP end devices, such as IP phones, learn the voice VLAN configuration from CDP and LLDP advertisements. By default, the device is enabled to send out CDP and LLDP advertisement based on the voice VLAN configured at the device. Refer to the Voice VLAN and Auto Voice VLAN sections for details.

NOTE CDP/LLDP does not distinguish if a port is in a LAG. If there are multiple ports in a LAG, CDP/LLDP transmit packets on each port without taking into account the fact that the ports are in a LAG.

The operation of CDP/LLDP is independent of the STP status of an interface.

If 802.1x port access control is enabled at an interface, the device transmits and receives CDP/LLDP packets to and from the interface only if the interface is authenticated and authorized.

If a port is the target of mirroring, then according to CDP/LLDP it is considered down.

NOTE CDP and LLDP are link layer protocols for directly-connected CDP/LLDP capable devices to advertise themselves and their capabilities. In deployments where the CDP/LLDP-capable devices are not directly connected and are separated with CDP/LLDP-incapable devices, the CDP/LLDP-capable devices may be able to receive the advertisement from other device(s) only if the CDP/LLDP-incapable devices flood the CDP/LLDP packets they receives. If the CDP/LLDP-incapable devices perform VLAN-aware flooding, then CDP/LLDP-capable devices can hear each other only if they are in the same VLAN. A CDP/LLDP-capable device may receive advertisement from more than one device if the CDP/LLDP-incapable devices flood the CDP/LLDP packets.

Configuring LLDP

This section describes how to configure LLDP. It covers the following topics:

- **LLDP Overview**
- **Setting LLDP Properties**
- **Editing LLDP Port Settings**
- **LLDP MED Network Policy**

- [Configuring LLDP MED Port Settings](#)
- [Displaying LLDP Port Status](#)
- [Displaying LLDP Local Information](#)
- [Displaying LLDP Neighbors Information](#)
- [Accessing LLDP Statistics](#)
- [LLDP Overloading](#)

LLDP Overview

LLDP is a protocol that enables network managers to troubleshoot and enhance network management in multi-vendor environments. LLDP standardizes 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.

LLDP is a link layer protocol. By default, the device terminates and processes all incoming LLDP packets as required by the protocol.

The LLDP protocol has an extension called LLDP Media Endpoint Discovery (LLDP-MED), which provides and accepts information from media endpoint devices such as VoIP phones and video phones. For further information about LLDP-MED, see [LLDP MED Network Policy](#).

LLDP Configuration Workflow

Following are examples of actions that can be performed with the LLDP feature and in a suggested order. You can refer to the LLDP/CDP section for additional guidelines on LLDP configuration. LLDP configuration pages are accessible under the **Administration > Discovery LLDP** menu.

1. Enter LLDP global parameters, such as the time interval for sending LLDP updates using the LLDP Properties page.
2. Configure LLDP per port by using the Port Settings page. On this page, interfaces can be configured to receive/transmit LLDP PDUs, send SNMP notifications, specify which TLVs to advertise, and advertise the device's management address.

3. Create LLDP MED network policies by using the LLDP MED Network Policy page.
4. Associate LLDP MED network policies and the optional LLDP-MED TLVs to the desired interfaces by using the LLDP MED Port Settings page.
5. If Auto Smartport is to detect the capabilities of LLDP devices, enable LLDP in the Smartport Properties page.
6. Display overloading information by using the LLDP Overloading page.

Setting LLDP Properties

The LLDP Properties page enables entering LLDP general parameters, such as enabling/disabling the feature globally and setting timers.

To enter LLDP properties:

STEP 1 Click **Administration > Discovery - LLDP > Properties**.

STEP 2 Enter the parameters.

- **LLDP Status**—Select to enable LLDP on the device (enabled by default).
- **LLDP Frames Handling**—If LLDP is not enabled, select the action to be taken if a packet that matches the selected criteria is received:
 - *Filtering*—Delete the packet.
 - *Flooding*—Forward the packet to all VLAN members.
- **TLV Advertise Interval**—Enter the rate in seconds at which LLDP advertisement updates are sent, or use the default.
- **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.

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 device. For a description of LLDP MED, refer to the LLDP MED Network Policy section.

STEP 4 Click **Apply**. The LLDP properties are added to the Running Configuration file.

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.

The LLDP-MED TLVs to be advertised can be selected in the LLDP MED Port Settings page, and the management address TLV of the device may be configured.

To define the LLDP port settings:

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

This page contains the port LLDP information.

STEP 2 Select a port and click **Edit**.

This page provides the following fields:

- **Interface**—Select the port to edit.
- **Administrative Status**—Select the LLDP publishing option for the port. The values are:
 - *Tx Only*—Publishes 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** to send notifications to SNMP notification recipients; for example, an 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 page.

- **Available Optional TLVs**—Select the information to be published by the device 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 device. The value equals the sysDescr object.
 - *System Capabilities*—Primary functions of the device, and whether or not these functions are enabled in 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.
 - *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 device:
 - *Auto Advertise*—Specifies that the software would automatically choose a management address to advertise from all the IP addresses of the product. In case of multiple IP addresses the software chooses the

lowest IP address among the dynamic IP addresses. If there are no dynamic addresses, the software chooses the lowest IP address among the static IP addresses.

- *None*—Do not advertise the management IP address.
- *Manual Advertise*—Select this option and the management IP address to be advertised.
- **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 written to the Running Configuration file.

LLDP MED Network Policy

LLDP Media Endpoint Discovery (LLDP-MED) is an extension of LLDP that provides the following additional capabilities to support media endpoint devices. Some of the features of the LLDP Med Network Policy are:

- Enables the advertisement and discovery of network policies for real-time applications such as voice and/or video.
- 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.
- Troubleshooting information. LLDP MED sends alerts to network managers upon:
 - Port speed and duplex mode conflicts
 - QoS policy misconfigurations

Setting LLDP MED Network Policy

An LLDP-MED network policy is a related set of configuration settings for a specific real-time application such as voice, or video. A network policy, if configured, can be included in the outgoing LLDP packets to the attached LLDP media endpoint device. The media endpoint device must send its traffic as specified in the network policy it receives. For example, a policy can be created for VoIP traffic that instructs VoIP phone to:

- Send voice traffic on VLAN 10 as tagged packet and with 802.1p priority 5.
- Send voice traffic with DSCP 46.

Network policies are associated with ports by using the LLDP MED Port Settings page. An administrator can manually configure one or more network policies and the interfaces where the policies are to be sent. It is the administrator's responsibility to manually create the VLANs and their port memberships according to the network policies and their associated interfaces.

In addition, an administrator can instruct the device to automatically generate and advertise a network policy for voice application based on the voice VLAN maintained by the device. Refer the Auto Voice VLAN section for details on how the device maintains its voice VLAN.

To define an LLDP MED network policy:

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

This page contains previously-created network policies.

STEP 2 Select **Auto** for LLDP-MED Network Policy for Voice Application if the device is to automatically generate and advertise a network policy for voice application based on the voice VLAN maintained by the device.

NOTE When this box is checked, you may not manually configure a voice network policy.

STEP 3 Click **Apply** to add this setting to the Running Configuration file.

STEP 4 To define a new policy, click **Add**.

STEP 5 Enter the values:

- **Network Policy Number**—Select the number of the policy to be created.
- **Application**—Select the type of application (type of traffic) for which the network policy is being defined.
- **VLAN ID**—Enter the VLAN ID to which the traffic must 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. This is the CoS value.
- **DSCP Value**—Select the DSCP value to associate with application data sent by neighbors. This informs them how they must mark the application traffic they send to the device.

STEP 6 Click **Apply**. The network policy is defined.

NOTE You must manually configure the interfaces to include the desired manually-defined network policies for the outgoing LLDP packets using the LLDP MED Port Settings.

Configuring LLDP MED Port Settings

The LLDP MED Port Settings page enables the selection of the LLDP-MED TLVs and/or the network policies to be included in the outgoing LLDP advertisement for the desired interfaces. Network Policies are configured using the LLDP MED Network Policy page.

NOTE If LLDP-MED Network Policy for Voice Application (LLDP-MED Network Policy Page) is Auto and Auto Voice VLAN is in operation, then the device automatically generates an LLDP-MED Network Policy for Voice Application for all the ports that are LLDP-MED enabled and are members of the voice VLAN.

To configure LLDP MED on each port:

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

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

STEP 2 The message at the top of the page indicates whether the generation of the LLDP MED Network Policy for the voice application is automatic or not (see [LLDP Overview](#)). Click on the link to change the mode.

STEP 3 To associate additional LLDP MED TLV and/or one or more user-defined LLDP MED Network Policies to a port, select it, and click **Edit**.

STEP 4 Enter the parameters:

- **Interface**—Select the interface to configure.
- **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 device by moving them to the *Selected Optional TLVs* list.
- **Available Network Policies**—Select the LLDP MED policies to be published by LLDP by moving them to the *Selected Network Policies* list. These were created in the LLDP MED Network Policy page. To include one or more user-defined network policies in the advertisement, you must also select *Network Policy* from the Available Optional TLVs.

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 5 Click **Apply**. The LLDP MED port settings are written to the Running Configuration file.

Displaying LLDP Port Status

The LLDP Port Status Table page contains the LLDP global information for every port.

STEP 1 To view the LLDP port status, click **Administration > Discovery - LLDP > LLDP Port Status**.

STEP 2 Click **LLDP Local Information Detail** to see the details of the LLDP and LLDP-MED TLVs sent to the neighbor.

STEP 3 Click **LLDP Neighbor Information Detail** to see the details of the LLDP and LLDP-MED TLVs received from the neighbor.

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 device appears.
- **System Name**—Name of device.
- **System Description**—Description of the device (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 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**.

STEP 2 On the bottom of the page, click **LLDP Port Status Table**.

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 3 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 device appears.
- **System Name**—Name of device.
- **System Description**—Description of the device (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,.
- **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.

802.3 Energy Efficient Ethernet (EEE) (If device supports EEE)

- **Local Tx**—Indicates the time (in micro seconds) that the transmitting link partner waits before it starts transmitting data after leaving Low Power Idle (LPI mode).
- **Local Rx**—Indicates the time (in micro seconds) that the receiving link partner requests that the transmitting link partner waits before transmission of data following Low Power Idle (LPI mode).
- **Remote Tx Echo**—Indicates the local link partner's reflection of the remote link partner's Tx value.
- **Remote Rx Echo**—Indicates the local link partner's reflection of the remote link partner's Rx value.

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 device 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

- **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 contains information that was received 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 > LLDP Neighbors Information**.

This page contains 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 device.
- **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**.

This page contains 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.

Management Address Table

- **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.

802.3 Energy Efficient Ethernet (EEE)

- **Remote Tx**—Indicates the time (in micro seconds) that the transmitting link partner waits before it starts transmitting data after leaving Low Power Idle (LPI mode).
- **Remote Rx**—Indicates the time (in micro seconds) that the receiving link partner requests that the transmitting link partner waits before transmission of data following Low Power Idle (LPI mode).
- **Local Tx Echo**—Indicates the local link partner's reflection of the remote link partner's Tx value.
- **Local Rx Echo**—Indicates the local link partner's reflection of the remote link partner's Rx value.

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 Table

- **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 Table**—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**.

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 as LLDP and LLDP-MED TLVs into the LLDP packets. LLDP overload occurs when the total amount of information to be included in a LLDP packet exceed the maximum PDU size supported by an interface.

The LLDP Overloading page displays the number of bytes of LLDP/LLDP-MED information, the number of available bytes for additional LLDP information, and the overloading status of every interface.

To view LLDP overloading information:

STEP 1 Click **Administration > Discovery - LLDP > LLDP Overloading**.

This page contains the following fields for each port:

- **Interface**—Port identifier.
- **Total (Bytes)**—Total number of bytes of LLDP information in each packet

- **Left to Send (Bytes)**—Total number of available bytes left for additional LLDP information in each 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**.

This page contains 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 Inventory**
 - *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 bytes of LLDP information in each packet
- **Left to Send (Bytes)**—Total number of available bytes left for additional LLDP information in each packet.

Configuring CDP

This section describes how to configure CDP.

It covers the following topics:

- **Setting CDP Properties**
- **Editing CDP Interface Settings**
- **Displaying CDP Local Information**
- **Displaying CDP Neighbors Information**
- **Viewing CDP Statistics**

Setting CDP Properties

Similar to LLDP, CDP (Cisco Discovery Protocol) is a link layer protocol for directly connected neighbors to advertise themselves and their capabilities to each other. Unlike LLDP, CDP is a Cisco proprietary protocol.

CDP Configuration Workflow

The followings is sample workflow in configuring CDP on the device. You can also find additional CDP configuration guidelines in the LLDP/CDP section.

-
- STEP 1** Enter the CDP global parameters using the CDP Properties page
 - STEP 2** Configure CDP per interface using the Interface Setting page
 - STEP 3** If Auto Smartport is to detect the capabilities of CDP devices, enable CDP in the Smartport Properties page.

See [Identifying Smartport Type](#) for a description of how CDP is used to identify devices for the Smartport feature.

To enter CDP general parameters:

-
- STEP 1** Click **Administration > Discovery - CDP > Properties**.
 - STEP 2** Enter the parameters.
 - **CDP Status**—Select to enable CDP on the device.
 - **CDP Frames Handling**—If CDP is not enabled, select the action to be taken if a packet that matches the selected criteria is received:
 - *Bridging*—Forward the packet based on the VLAN.
 - *Filtering*—Delete the packet.
 - *Flooding*—VLAN unaware flooding that forwards incoming CDP packets to all the ports excluding the ingress ports.
 - **CDP Voice VLAN Advertisement**—Select to enable the device to advertise the voice VLAN in CDP on all of the ports that are CDP enabled, and are member of the voice VLAN. The voice VLAN is configured in the Voice VLAN Properties page.
 - **CDP Mandatory TLVs Validation**—If selected, incoming CDP packets not containing the mandatory TLVs are discarded and the invalid error counter is incremented.
 - **CDP Version**—Select the version of CDP to use.

- **CDP Hold Time**—Amount of time that CDP 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. The following options are possible:
 - *Use Default*—Use the default time (180 seconds)
 - *User Defined*—Enter the time in seconds.
- **CDP Transmission Rate**—The rate in seconds at which CDP advertisement updates are sent. The following options are possible:
 - *Use Default*—Use the default rate (60 seconds)
 - *User Defined*—Enter the rate in seconds.
- **Device ID Format**—Select the format of the device ID (MAC address or serial number).
- **Source Interface**—IP address to be used in the TLV of the frames. The following options are possible:
 - *Use Default*—Use the IP address of the outgoing interface.
 - *User Defined*—Use the IP address of the interface (in the **Interface** field) in the address TLV.
- **Interface**—If *User Defined* was selected for **Source Interface**, select the interface.
- **Syslog Voice VLAN Mismatch**—Check to send a SYSLOG message when a voice VLAN mismatch is detected. This means that the voice VLAN information in the incoming frame does not match what the local device is advertising.
- **Syslog Native VLAN Mismatch**—Check to send a SYSLOG message when a native VLAN mismatch is detected. This means that the native VLAN information in the incoming frame does not match what the local device is advertising.
- **Syslog Duplex Mismatch**—Check to send a SYSLOG message when duplex information is mismatched. This means that the duplex information in the incoming frame does not match what the local device is advertising.

STEP 3 Click **Apply**. The LLDP properties are defined.

Editing CDP Interface Settings

Use the Interface Settings page to activate LLDP and remote log server notification per port, and to select the TLVs included in LLDP PDUs.

By setting these properties it is possible to select the types of information to be provided to devices that support the LLDP protocol.

The LLDP-MED TLVs to be advertised can be selected in the LLDP MED Interface Settings page.

To define the CDP interface settings:

STEP 1 Click **Administration > Discovery - CDP > Interface Settings**.

This page contains the following CDP information for each interface.

- **CDP Status**—CDP publishing option for the port.
- **Reporting Conflicts with CDP Neighbors**—Displays the status of the reporting options that are enabled/disabled in the **Edit** page (Voice VLAN/ Native VLAN/Duplex).
- **No. of Neighbors**—Number of neighbors detected.

The bottom of the page has four buttons:

- **Copy Settings**—Select to copy a configuration from one port to another.
- **Edit**—Fields explained in Step 2 below.
- **CDP Local Information Details**—Takes you to the Administration > Discovery - CDP > CDP Local Information page.
- **CDP Neighbor Information Details**—Takes you to the Administration > Discovery - CDP > CDP Neighbor Information page.

STEP 2 Select a port and click **Edit**.

This page provides the following fields:

- **Interface**—Select the interface to be defined.
- **CDP Status**—Select to enable/disable the CDP publishing option for the port.

NOTE The next three fields are operational when the device has been set up to send traps to the management station.

- **Syslog Voice VLAN Mismatch**—Select to enable the option of sending a SYSLOG message when a voice VLAN mismatch is detected. This means that the voice VLAN information in the incoming frame does not match what the local device is advertising.
- **Syslog Native VLAN Mismatch**—Select to enable the option of sending a SYSLOG message when a native VLAN mismatch is detected. This means that the native VLAN information in the incoming frame does not match what the local device is advertising.
- **Syslog Duplex Mismatch**—Select to enable the option of sending a SYSLOG message when duplex information mismatch is detected. This means that the duplex information in the incoming frame does not match what the local device is advertising.

STEP 3 Enter the relevant information, and click **Apply**. The port settings are written to the Running Configuration.

Displaying CDP Local Information

To view information that is advertised by the CDP protocol about the local device:

STEP 1 Click **Administration > Discovery - CDP > CDP Local Information**.

STEP 2 Select a local port, and the following fields are displayed:

- **Interface**—Number of the local port.
- **CDP State**—Displays whether CDP is enabled or not.
- **Device ID TLV**
 - **Device ID Type**—Type of the device ID advertised in the device ID TLV.
 - **Device ID**—Device ID advertised in the device ID TLV.
- System Name TLV
 - **System Name**—System name of the device.
- Address TLV
 - **Address1-3**—IP addresses (advertised in the device address TLV).
- Port TLV

- **Port ID**—Identifier of port advertised in the port TLV.
- Capabilities TLV
 - **Capabilities**—Capabilities advertised in the port TLV)
- Version TLV
 - **Version**—Information about the software release on which the device is running.
- Platform TLV
 - **Platform**—Identifier of platform advertised in the platform TLV.
- Native VLAN TLV
 - **Native VLAN**—The native VLAN identifier advertised in the native VLAN TLV.
- Full/Half Duplex TLV
 - **Duplex**—Whether port is half or full duplex advertised in the full/half duplex TLV.
- Appliance TLV
 - **Appliance ID**—Type of device attached to port advertised in the appliance TLV.
 - **Appliance VLAN ID**—VLAN on the device used by the appliance, for instance if the appliance is an IP phone, this is the voice VLAN.
- Extended Trust TLV
 - **Extended Trust**—Enabled indicates that the port is trusted, meaning that the host/server from which the packet is received is trusted to mark the packets itself. In this case, packets received on such a port are not re-marked. Disabled indicates that the port is not trusted in which case, the following field is relevant.
- CoS for Untrusted Ports TLV
 - **CoS for Untrusted Ports**—If Extended Trust is disabled on the port, this field displays the Layer 2 CoS value, meaning, an 802.1D/802.1p priority value. This is the COS value with which all packets received on an untrusted port are remarked by the device.
- Power TLV

- **Request ID**—Last power request ID received echoes the Request-ID field last received in a Power Requested TLV. It is 0 if no Power Requested TLV was received since the interface last transitioned to Up.
- **Power Management ID**—Value incremented by 1 (or 2, to avoid 0) each time any one of the following events occur:
 - Available-Power or Management Power Level fields change value
 - A Power Requested TLV is received with a Request-ID field which is different from the last-received set (or when the first value is received)
 - The interface transitions to Down
- **Available Power**—Amount of power consumed by port.
- **Management Power Level**—Displays the supplier's request to the powered device for its Power Consumption TLV. The device always displays “No Preference” in this field.

Displaying CDP Neighbors Information

The CDP Neighbors Information page displays CDP information received from neighboring devices.

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

To view the CDP neighbors information:

STEP 1 Click **Administration > Discovery - CDP > CDP Neighbor Information**.

This page contains the following fields for the link partner (neighbor):

- **Device ID**—Neighbors device ID.
- **System name**—Neighbors system name.
- **Local Interface**—Number of the local port to which the neighbor is connected.
- **Advertisement Version**—CDP protocol version.
- **Time to Live (sec)**—Time interval (in seconds) after which the information for this neighbor is deleted.

- **Capabilities**—Capabilities advertised by neighbor.
- **Platform**—Information from Platform TLV of neighbor.
- **Neighbor Interface**—Outgoing interface of the neighbor.

STEP 2 Select a device, and click **Details**.

This page contains the following fields about the neighbor:

- **Device ID**—Identifier of the neighboring device ID.
- **Local Interface**—Interface number of port through which frame arrived.
- **Advertisement Version**—Version of CDP.
- **Time to Live**—Time interval (in seconds) after which the information for this neighbor is deleted.
- **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.
- **Platform**—Identifier of the neighbors platform.
- **Neighbor Interface**—Interface number of the neighbor through which frame arrived.
- **Native VLAN**—Neighbors native VLAN.
- **Duplex**—Whether neighbors interface is half or full duplex.
- **Addresses**—Neighbors addresses.
- **Power Drawn**—Amount of power consumed by neighbor on the interface.
- **Version**—Neighbors software version.

NOTE Clicking on the **Clear Table** button disconnect all connected devices if from CDP, and if Auto Smartport is enabled change all port types to default.

Viewing CDP Statistics

The CDP Statistics page displays information regarding Cisco Discovery Protocol (CDP) frames that were sent or received from a port. CDP packets are received from devices attached to the switches interfaces, and are used for the Smartport feature. See [Configuring CDP](#) for more information.

CDP statistics for a port are only displayed if CDP is enabled globally and on the port. This is done in the CDP Properties page and the CDP Interface Settings page.

To view CDP statistics:

STEP 1 Click **Administration > Discovery - CDP > CDP Statistics**.

The following fields are displayed for every interface:

Packets Received/Transmitted:

- **Version 1**—Number of CDP version 1 packets received/transmitted.
- **Version 2**—Number of CDP version 2 packets received/transmitted.
- **Total**—Total number of CDP packets received/transmitted.

The CDP Error Statistics section displays the CDP error counters.

- **Illegal Checksum**—Number of packets received with illegal checksum value.
- **Other Errors**—Number of packets received with errors other than illegal checksums.
- **Neighbors Over Maximum**—Number of times that packet information could not be stored in cache because of lack of room.

To clear all counters on all interfaces, click **Clear All Interface Counters**. To clear all counters on an interface, select it and click **Clear All Interface Counters**.

Port Management

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

It covers the following topics:

- **Configuring Ports**
- **Setting Port Configuration**
- **Configuring Link Aggregation**
- **Configuring Green Ethernet**

Configuring Ports

To configure ports, perform the following actions:

1. Configure port by using the Port Settings page.
2. Enable/disable the Link Aggregation Control (LAG) protocol, and configure the potential member ports to the desired LAGs by using the LAG Management page. By default, all LAGs are empty.
3. Configure the Ethernet parameters, such as speed and auto-negotiation for the LAGs by using the LAG Settings page.
4. Configure the LACP parameters for the ports that are members or candidates of a dynamic LAG by using the LACP page.
5. Configure Green Ethernet and 802.3 Energy Efficient Ethernet by using the Properties page.
6. Configure Green Ethernet energy mode and 802.3 Energy Efficient Ethernet per port by using the Port Settings page.
7. If PoE is supported and enabled for the device, configure the device as described in **Port Management: PoE**.

Setting 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 Settings page.

To configure port settings:

STEP 1 Click **Port Management > Port Settings**.

STEP 2 Select **Jumbo Frames** to support packets of up to 10 Kb in size. If **Jumbo Frames** is not enabled (default), the system supports packet size up to 2,000 bytes. For jumbo frames to take effect, the device must be rebooted after the feature is enabled.

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 device is rebooted.

STEP 4 To update the port settings, select the desired port, and click **Edit**.

STEP 5 Modify the following parameters:

- **Interface**—Select the port number.
- **Port Type**—Displays the port type and speed. The possible options are:
 - *Copper Ports*—Regular, not Combo, support the following values: 10M, 100M, and 1000M (type: Copper).
 - *Combo Ports Copper*—Combo port connected with copper CAT5 cable, supports the following values: 10M, 100M, and 1000M (type: ComboC).
 - *Combo Fiber*—*SFP Fiber Gigabit Interface Converter Port* with the following values: 100M and 1000M (type: ComboF).
 - *10G-Fiber Optics*—Ports with speed of either 1G or 10G.

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

- **Port Description**—Enter the port user-defined name or comment.
- **Administrative Status**—Select whether the port must be Up or Down when the device is rebooted.

- **Operational Status**—Displays whether the port is currently Up or Down. If the port is down because of an error, the description of the error is displayed.
- **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, dot1x single host violation, loopback detection, or STP loopback guard. The reactivate operation brings the port up without regard to why the port was suspended.
- **Auto-Negotiation**—Select to enable auto-negotiation on the port. Auto-negotiation enables a port to advertise its transmission speed, duplex mode, and Flow Control abilities to the port link partner.
- **Operational Auto-Negotiation**—Displays the current auto-negotiation status on the port.
- **Administrative Port Speed**—Configure the speed of the port. The port type determines which the available speeds. 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. At port speed of 1G, the mode is always full duplex. The possible options are:
 - *Full*—The interface supports transmission between the device and the client in both directions simultaneously.
 - *Half*—The interface supports transmission between the device and the client in only one direction at a time.
- **Operational Duplex Mode**—Displays the ports current duplex mode.
- **Auto Advertisement**—Select the capabilities advertised by auto-negotiation when it is enabled. 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.
- **Operational Advertisement**—Displays the capabilities currently published to the ports neighbor. The possible options are those specified in the *Administrative Advertisement* field.
- **Neighbor Advertisement**—Displays the capabilities advertised by the neighboring device (link partner).
- **Back Pressure**—Select the Back Pressure mode on the port (used with Half Duplex mode) to slow down the packet reception speed when the device is congested. It disables the remote port, preventing it from sending packets by jamming the signal.
- **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 options are:

- *MDIX*—Select to swap the port's transmit and receives pairs.
- *MDI*—Select to connect this device to a station by using a straight through cable.
- *Auto*—Select to configure this device to automatically detect the correct pinouts for the connection to another device.
- **Operational MDI/MDIX**—Displays the current MDI/MDIX setting.

STEP 6 Click **Apply**. The Port Settings are written to the Running Configuration file.

Configuring Link Aggregation

This section describes how to configure LAGs. It covers the following topics:

- [Link Aggregation Overview](#)
- [Static and Dynamic LAG Workflow](#)
- [Defining LAG Management](#)
- [Configuring LAG Settings](#)
- [Configuring LACP](#)

Link Aggregation Overview

Link Aggregation Control Protocol (LACP) is part of the IEEE specification (802.3az) that enables you to bundle several physical ports together to form a single logical channel (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 is disabled on it. The group of ports assigned to a static LAG are always active members. After a LAG is manually created, the LACP option cannot be added or removed, until the LAG is edited and a member is removed (which can be added prior to applying), then the LACP button become available for editing.
- *Dynamic*—A LAG is dynamic if LACP is enabled on it. The group of ports assigned to dynamic LAG are candidate ports. LACP determines which candidate ports are active member ports. The non-active candidate 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 and Multicast traffic based on Layer 2 or Layer 3 packet header information.

The device supports 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

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 device 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 a LAG, the configuration of the LAG is applied 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.

Default Settings and Configuration

Ports are not members of a LAG and are not candidates to become part of a LAG.

Static and Dynamic LAG Workflow

After a LAG has been manually created, LACP cannot be added or removed until the LAG is edited and a member is removed. Only then the LACP button become available for editing.

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

1. Disable LACP on the LAG to make it static. Assign up to eight member ports to the static LAG by selecting and moving the ports from the **Port List** to the **LAG Members** list. Select the load balancing algorithm for the LAG. Perform these actions in the LAG Management page.
2. Configure various aspects of the LAG, such as speed and flow control by using the LAG Settings page.

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

1. Enable 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 various aspects of the LAG, such as speed and flow control by using the LAG Settings page.
3. Set the LACP priority and timeout 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.

To select the load balancing algorithm of the LAG:

STEP 1 Click **Port Management > Link Aggregation > LAG Management**.

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

- *MAC Address*—Perform load 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 saved to the Running Configuration file.

To define the member or candidate ports in a LAG.

STEP 1 Select the LAG to be configured, and click **Edit**.

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. This field can only be enabled after moving a port to the LAG in the next field.
- **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**. LAG membership is saved to the Running Configuration file.

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 settings or reactivate a suspended LAG:

STEP 1 Click **Port Management > Link Aggregation > LAG Settings**.

STEP 2 Select a LAG, and click **Edit**.

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 be Up or 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 .
- **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 speed 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.
- **Administrative Flow Control**—Set Flow Control to either **Enable** or **Disable** or enable the **Auto-Negotiation** of Flow Control on the LAG.
- **Operational Flow Control**—Displays the current Flow Control setting.

STEP 4 Click **Apply**. The Running Configuration file is updated.

Configuring LACP

A dynamic LAG is LACP-enabled, and LACP is run on every candidate port defined in the LAG.

LACP Priority and Rules

LACP system priority and LACP port priority are both used to 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. Both the local and remote switches have a LACP system priority.

The following algorithm is used to determine whether LACP port priorities are taken from the local or remote device: the local LACP System Priority is compared to the remote LACP System Priority. The device with the lowest priority controls candidate port selection to the LAG. If both priorities are the same, the local and remote MAC addresses are compared. The priority of the device with the lowest MAC address controls candidate port selection to the LAG.

A dynamic LAG 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 the dynamic LAG, the device on the controlling end of the link uses port priorities to determine which ports are bundled into the LAG and which ports are put in hot-standby mode. Port priorities on the other device (the non-controlling end of the link) are ignored.

The following are additional rules used to select the active or standby ports in a dynamic LACP:

- 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.

LACP With No Link Partner

In order for LACP to create a LAG, the ports on both link ends should be configured for LACP, meaning that the ports send LACP PDUs and handle received PDUs.

However, there are cases when one link partner is temporarily not configured for LACP. One example for such case is when the link partner is on a device, which is in the process of receiving its configuration using the auto-config protocol. This device's ports are not yet configured to LACP. If the LAG link cannot come up, the device cannot ever become configured. A similar case occurs with dual-NIC network-boot computers (e.g. PXE), which receive their LAG configuration only after they bootup.

When several LACP-configured ports are configured, and the link comes up in one or more ports but there are no LACP responses from the link partner for those ports, the first port that had link up is added to the LACP LAG and becomes active (the other ports become non-candidates). In this way, the neighbor device can, for example, get its IP Address using DHCP and get its configuration using auto-configuration.

Setting LACP Parameter Settings

Use the LACP page to configure the candidate ports for the LAG and to configure the LACP parameters per port.

With all factors equal, when the LAG is configured with more candidate ports than the maximum number of active ports allowed (8), the device selects ports as active from the dynamic LAG on the device 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**.

STEP 2 Enter the LACP System Priority. See [LACP Priority and Rules](#).

STEP 3 Select a port, and click **Edit**.

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. See [Setting LACP Parameter Settings](#).
- **LACP Timeout**—Time interval between the sending and receiving of consecutive LACP PDUs. Select the periodic transmissions of LACP PDUs, which occur at either a **Long** or **Short** transmission speed, depending upon the expressed LACP timeout preference.

STEP 5 Click **Apply**. The Running Configuration file is updated.

Configuring Green Ethernet

This section describes the Green Ethernet feature that is designed to save power on the device.

It contains the following sections:

- [Green Ethernet Overview](#)
- [Setting Global Green Ethernet Properties](#)
- [Setting Green Ethernet Properties for Ports](#)

Green Ethernet Overview

Green Ethernet is a common name for a set of features that is designed to be environmentally friendly, and to reduce the power consumption of a device. Green Ethernet is different from EEE in that green ethernet energy-detect is enabled on all devices where only the Gigabyte ports are enable with EEE.

The Green Ethernet feature can reduce overall power usage in the following 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**—This feature provides for power savings on a short length of cable. After cable length is analyzed, the power usage is adjusted for various cable lengths. If the cable is shorter than 50 meters, the device 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 Combo ports.

This mode is globally disabled by default. It cannot be enabled if EEE mode is enabled (see below).

In addition to the above Green Ethernet features, the **802.3az Energy Efficient Ethernet (EEE)** is found on devices supporting GE ports. EEE reduces power consumption when there is no traffic on the port. See **802.3az Energy Efficient Ethernet Feature** for more information (available on GE models only).

EEE is enabled globally by default. On a given port, if EEE is enabled, short reach mode be disabled. If Short Reach Mode is enabled, EEE be grayed out.

These modes are configured per port, without taking into account the LAG membership of the ports.

The device LEDs are power consumers. Since most of the time the devices are in an unoccupied room, having these LEDs lit is a waste of energy. The Green Ethernet feature enables you to disable the port LEDs (for link, speed, and PoE) when they are not required, and to enable the LEDs if they are needed (debugging, connecting additional devices etc.).

On the System Summary page, the LEDs that are displayed on the device board pictures are not affected by disabling the LEDs.

Power savings, current power consumption and cumulative energy saved 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.

The saved energy displayed is only related to Green Ethernet. The amount of energy saved by EEE is not displayed.

Power Saving by Disabling Port LEDs

The Disable Port LEDs feature allows the user to save extra power consumed by device LEDs. Since most of the time the devices are in an unoccupied room, having these LEDs lit is a waste of energy. The Green Ethernet feature enables you to disable the port LEDs (for link, speed, and PoE) when they are not required, and to enable the LEDs if they are needed (debugging, connecting additional devices etc.).

On the System Summary page, the LEDs that are displayed on the device board pictures are not affected by disabling the LEDs.

On the Green Ethernet -> Properties page, the device enables the user to disable the ports LEDs in order to save power.

802.3az Energy Efficient Ethernet Feature

This section describes the 802.3az Energy Efficient Ethernet (EEE) feature.

It covers the following topics:

- **802.3az EEE Overview**
- **Advertise Capabilities Negotiation**
- **Link Level Discovery for 802.3az EEE**
- **Availability of 802.3az EEE**
- **Default Configuration**
- **Interactions Between Features**
- **802.3az EEE Configuration Workflow**

802.3az EEE Overview

802.3az EEE is designed to save power when there is no traffic on the link. In Green Ethernet, power is reduced when the port is down. With 802.3az EEE, power is reduced when the port is up, but there is no traffic on it.

802.3az EEE is only supported on devices with GE ports.

When using 802.3az EEE, systems on both sides of the link can disable portions of their functionality and save power during periods of no traffic.

802.3az EEE supports IEEE 802.3 MAC operation at 100 Mbps and 1000 Mbps:

LLDP is used to select the optimal set of parameters for both devices. If LLDP is not supported by the link partner, or is disabled, 802.3az EEE still be operational, but it might not be in the optimal operational mode.

The 802.3az EEE feature is implemented using a port mode called Low Power Idle (LPI) mode. When there is no traffic and this feature is enabled on the port, the port is placed in the LPI mode, which reduces power consumption dramatically.

Both sides of a connection (device port and connecting device) must support 802.3az EEE for it to work. When traffic is absent, both sides send signals indicating that power is about to be reduced. When signals from both sides are received, the Keep Alive signal indicates that the ports are in LPI status (and not in Down status), and power is reduced.

For ports to stay in LPI mode, the Keep Alive signal must be received continuously from both sides.

Advertise Capabilities Negotiation

802.3az EEE support is advertised during the Auto-Negotiation stage. Auto-Negotiation provides a linked device with the capability to detect the abilities (modes of operation) supported by the device at the other end of the link, determine common abilities, and configure itself for joint operation. Auto-Negotiation is performed at the time of link-up, on command from management, or upon detection of a link error. During the link establishment process, both link partners exchange their 802.3az EEE capabilities. Auto-Negotiation functions automatically without user interaction when it is enabled on the device.

NOTE If Auto-Negotiation is not enabled on a port, the EEE is disabled. The only exception is if the link speed is 1GB, then EEE still e enabled even though Auto-Negotiation is disabled.

Link Level Discovery for 802.3az EEE

In addition to the capabilities described above, 802.3az EEE capabilities and settings are also advertised using frames based on the organizationally-specific TLVs defined in Annex G of IEEE Std 802.1AB protocol (LLDP). LLDP is used to further optimize 802.3az EEE operation after auto-negotiation is completed. The 802.3az EEE TLV is used to fine tune system wake-up and refresh durations.

Availability of 802.3az EEE

Please check the release notes for a complete listing of products that support EEE.

Default Configuration

By default, 802.3az EEE and EEE LLDP are enabled globally and per port.

Interactions Between Features

The following describe 802.3az EEE interactions with other features:

- If auto-negotiation is not enabled on the port, the 802.3az EEE operational status is disabled. The exception to this rule is that if the link speed is 1gigabyte, EEE still be enabled even though Auto-Negotiation is disabled.
- If 802.3az EEE is enabled and the port is going Up, it commences to work immediately in accordance with the maximum wake time value of the port.
- On the GUI, the EEE field for the port is not available when the Short Reach Mode option on the port is checked.
- If the port speed on the GE port is changed to 10Mbit, 802.3az EEE is disabled. This is supported in GE models only.

802.3az EEE Configuration Workflow

This section describes how to configure the 802.3az EEE feature and view its counters.

-
- STEP 1** Ensure that auto-negotiation is enabled on the port by opening the **Port Management > Port Settings** page.
- Select a port and open the Edit Port Setting page.
 - Select **Auto Negotiation** field to ensure that it is Enabled.
- STEP 2** Ensure that **802.3 Energy Efficient Ethernet (EEE)** is globally enabled in the Port Management > Green Ethernet > Properties page (it is enabled by default). This page also displays how much energy has been saved.
- STEP 3** Ensure that 802.3az EEE is enabled on a port by opening the Green Ethernet > Port Settings page.
- Select a port, open the Edit Port Setting page.
 - Check the **802.3 Energy Efficient Ethernet (EEE)** mode on the port (it is enabled by default).
 - Select whether to enable or disable advertisement of 802.3az EEE capabilities through LLDP in **802.3 Energy Efficient Ethernet (EEE) LLDP** (it is enabled by default).
- STEP 4** To see 802.3 EEE-related information on the local device, open the Administration > Discovery LLDP > LLDP Local Information page, and view the information in the 802.3 Energy Efficient Ethernet (EEE) block.
- STEP 5** To display 802.3az EEE information on the remote device, open the Administration > Discovery LLDP > LLDP Neighbor Information pages, and view the information in the 802.3 Energy Efficient Ethernet (EEE) block.

Setting Global Green Ethernet Properties

The Properties page displays and enables configuration of the Green Ethernet mode for the device. It also displays the current power savings.

To enable Green Ethernet and EEE and view power savings:

-
- STEP 1** Click **Port Management > Green Ethernet > Properties**.
- STEP 2** Enter the values for the following fields:

- **Energy Detect Mode**—Disabled by default. Click the checkbox to enable.
- **Short Reach**—Globally enable or disable Short Reach mode if there are GE ports on the device.

NOTE If Short Reach is enabled, EEE must be disabled.

- **Power Savings**—Displays the percentage of power saved by running Green Ethernet and Short Reach. The power savings displayed is only relevant to the power saved by Short Reach and Energy Detect modes. The EEE power savings is dynamic by nature since it is based on port utilization and is therefore not taken into consideration. The power saving calculation is performed by comparing the maximum power consumption without power savings to the current consumption.
- **Cumulative Energy Saved**—Displays the amount of energy saved from the last device reboot. This value is updated each time there is an event that affects power saving.
- **802.3 Energy Efficient Ethernet (EEE)**— Globally enable or disable EEE mode.
- **Port LEDs**—Select to enable the port LEDs. When these are disabled, they do not display link status, activity, etc.

STEP 3 Click **Apply**. The Green Ethernet Properties are written to the Running Configuration file.

Setting Green Ethernet Properties for Ports

The Port Settings page displays the current Green Ethernet and EEE modes per port, and enables configuring Green Ethernet on a port 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.

Note that EEE settings are only displayed for devices that have GE ports. EEE works only when ports are set to Auto negotiation. The exception is that EEE is still functional even when Auto Negotiation is disabled, but the port is at 1GB or higher.

To define per port Green Ethernet settings:

STEP 1 Click **Port Management > Green Ethernet > Port Settings**.

The Port Settings page displays the following:

- **Global Parameter Status**—Describes the enabled features.

For each port the following fields are described:

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

NOTE Short-reach mode is only supported on RJ45 GE ports; it does not apply to Combo ports.

- **802.3 Energy Efficient Ethernet (EEE)**—State of the port regarding the EEE feature:
 - *Administrative*—Displays whether EEE was enabled.
 - *Operational*—Displays whether EEE is currently operating on the local port. This is a function of whether it has been enabled (Administrative Status), whether it has been enabled on the local port and whether it is operational on the local port.
 - *LLDP Administrative*—Displays whether advertising EEE counters through LLDP was enabled.
 - *LLDP Operational*—Displays whether advertising EEE counters through LLDP is currently operating.

- *EEE Support on Remote*—Displays whether EEE is supported on the link partner. EEE must be supported on both the local and remote link partners.

NOTE The window displays the Short Reach, Energy Detect and EEE settings for each port; however, they are not enabled on any port unless they are also enabled globally by using the Properties page. To enable Short Reach and EEE globally, see [Setting Global Green Ethernet Properties](#).

STEP 2 Select a **Port** and click **Edit**.

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 if there are GE ports on the device.

STEP 5 Select to enable or disable 802.3 Energy Efficient Ethernet (EEE) mode on the port if there are GE ports on the device.

STEP 6 Select to enable or disable 802.3 Energy Efficient Ethernet (EEE) LLDP mode on the port (advertisement of EEE capabilities through LLDP) if there are GE ports on the device.

STEP 7 Click **Apply**. The Green Ethernet port settings are written to the Running Configuration file.

Smartport

This document describes the Smartports feature.

It contains the following topics:

- **Overview**
- **What is a Smartport**
- **Smartport Types**
- **Smartport Macros**
- **Macro Failure and the Reset Operation**
- **How the Smartport Feature Works**
- **Auto Smartport**
- **Error Handling**
- **Default Configuration**
- **Relationships with Other Features and Backwards Compatibility**
- **Common Smartport Tasks**
- **Configuring Smartport Using The Web-based Interface**
- **Built-in Smartport Macros**

Overview

The Smartport feature provides a convenient way to save and share common configurations. By applying the same Smartport macro to multiple interfaces, the interfaces share a common set of configurations.

A Smartport macro can be applied to an interface by the Smartport type associated with the macro.

There are two ways to apply a Smartport macro by Smartport type to an interface:

- **Static Smartport**—You manually assign a Smartport type to an interface. The result is the corresponding Smartport macro is applied to the interface.
- **Auto Smartport**—Auto Smartport waits for a device to be attached to the interface before applying a configuration. When a device is detected from an interface, the Smartport macro (if assigned) that corresponds to the Smartport type of the attaching device is automatically applied.

The Smartport feature consists of various components and works in conjunction with other features on the device. These components and features are described in the following sections:

- Smartport, Smartport types and Smartport macros, described in this section.
- Voice VLAN and Smartport, described in the [Voice VLAN](#) section.
- LLDP/CDP for Smartport, described in the [Configuring LLDP](#) and [Configuring CDP](#) sections, respectively.

Additionally, typical work flows are described in the [Common Smartport Tasks](#) section.

What is a Smartport

A Smartport is an interface to which a built-in macro may be applied. These macros are designed to provide a means of quickly configuring the device to support the communication requirements and utilize the features of various types of network devices. The network access and QoS requirements vary if the interface is connected to an IP phone, a printer, or a router and/or Access Point (AP).

Smartport Types

Smartport types refers to the types of devices attached, or to be attached to Smartports. The device supports the following Smartport types:

- Printer

- Desktop
- Guest
- Server
- Host
- IP Camera
- IP phone
- IP Phone+Desktop
- Switch
- Router
- Wireless Access Point

Smartport types are named so that they describe the type of device connected to an interface. Each Smartport type is associated with two Smartport macros. One macro, called "the macro" serves to apply the desired configuration. The other, called "the anti-macro," serves to undo all configuration performed by "the macro" when that interface happens to become a different Smartport type.

The following describes the relationship of Smartport types and Auto Smartport

Smartport and Auto Smartport Types

Smartport Type	Supported by Auto Smartport	Supported by Auto Smartport by default
Unknown	No	No
Default	No	No
Printer	No	No
Desktop	No	No
Guest	No	No
Server	No	No
Host	Yes	No
IP camera	No	No
IP phone	Yes	Yes
IP phone desktop	Yes	Yes

Smartport and Auto Smartport Types

Smartport Type	Supported by Auto Smartport	Supported by Auto Smartport by default
Switch	Yes	Yes
Router	Yes	No
Wireless Access Point	Yes	Yes

Special Smartport Types

There are two special Smartport types; *default* and *unknown*. These two types are not associated with macros, but they exist to signify the state of the interface regarding Smartport.

The following describe these special Smartport types:

- **Default**

An interface that does not (yet) have a Smartport type assigned to it has the Default Smartport status.

If Auto Smartport assigns a Smartport type to an interface and the interface is not configured to be Auto Smartport Persistent, then its Smartport type is re-initialized to Default in the following cases:

- A link down/up operation is performed on the interface.
- The device is restarted.
- All devices attached to the interface have aged out, which is defined as the absence of CDP and/or LLDP advertisement from the device for a specified time period.

- **Unknown**

If a Smartport macro is applied to an interface and an error occurs, the interface is assigned the Unknown status. In this case, the Smartport and Auto Smartport features do not function on the interface until you correct the error and applies the Reset action (performed in the Interface Settings pages) that resets the Smartport status.

See the workflow area in [Common Smartport Tasks](#) section for troubleshooting tips.

NOTE Throughout this section, the term “aged out” is used to describe the LLDP and CDP messages via their TTL. If Auto Smartport is enabled, and persistent status is disabled, and no more CDP or LLDP messages are received on the interface before both TTLs of the most recent CDP and LLDP packets decrease to 0, then the anti-macro is run, and the Smartport type returns to default.

Smartport Macros

A Smartport macro is a script that configure an interface appropriately for a particular network device.

Smartport macros should not be confused with global macros. Global macros configure the device globally, however, the scope of a Smartport macro is limited to the interface on which it is applied.

The macro source may be found by clicking the **View Macro Source** button on the Smartport Type Settings page.

A macro and the corresponding anti-macro are paired together in association with each Smartport type. The macro applies the configuration and the anti-macro removes it.

Two Smartport macros are paired by their names as follows:

- macro_name (for example: printer)
- no_macro_name (for example: no_printer, the anti Smartport macro of Smartport macro printer)

See **Built-in Smartport Macros** for a listing of the built-in Smartport macros for each device type.

Applying a Smartport Type to an Interface

When Smartport types are applied to interfaces, the Smartport types and configuration in the associated Smartport macros are saved in the Running Configuration File. If the administrator saves the Running Configuration File into the Startup Configuration File, the device applies the Smartport types and the Smartport macros to the interfaces after reboot as follows:

- If the Startup Configuration File does not specify a Smartport type for an interface, its Smartport type is set to Default.

- If the Startup Configuration File specifies a static Smartport type, the Smartport type of the interface is set to this static type.
- If the Startup Configuration File specifies a Smartport type that was dynamically assigned by Auto Smartport:
 - If the Auto Smartport Global Operational state, the interface Auto Smartport state, and the Persistent Status are all **Enable**, the Smartport type is set to this dynamic type.
 - Else the corresponding anti-macro is applied and the interfaces status is set to Default.

Macro Failure and the Reset Operation

A Smartport macro might fail if there is a conflict between the existing configuration of the interface and a Smartport macro.

When a Smartport macro fails, a SYSLOG message containing the following parameters is sent:

- Port number
- Smartport type
- The line number of the failed CLI command in the macro

When a Smartport macro fails on an interface, the status of the interface is set to *Unknown*. The reason for the failure can be displayed in the Interface Settings page, **Show Diagnostics** popup.

After the source of the problem is determined and the existing configuration or Smartport macro is corrected, you must perform a reset operation to reset the interface before it can be reapplied with a Smartport type (in the Interface Settings pages). See the workflow area in [Common Smartport Tasks](#) section for troubleshooting tips.

How the Smartport Feature Works

You can apply a Smartport macro to an interface by the Smartport type associated with the macro.

Because support is provided for Smartport types which correspond to devices that do not allow themselves to be discovered via CDP and/or LLDP, these Smartport types must be statically assigned to the desired interfaces. This can be done by navigating to the Smartport Interface Settings page, selecting the radio button of the desired interface, and clicking **Edit**. Then, select the Smartport type you want to assign and adjust the parameters as necessary before clicking **Apply**.

There are two ways to apply a Smartport macro by Smartport type to an interface:

- **Static Smartport**

You manually assign a Smartport type to an interface. The corresponding Smartport macro is applied to the interface. You can manually assign a Smartport type to an interface from the Smartport Interface Settings Page.

- **Auto Smartport**

When a device is detected from an interface, the Smartport macro, if any, that corresponds to the Smartport type of the attaching device is automatically applied. Auto Smartport is enabled by default globally, and at the interface level.

In both cases, the associated anti-macro is run when the Smartport type is removed from the interface, and the anti-macro runs in exactly the same manner, removing all of the interface configuration.

Auto Smartport

In order for Auto Smartport to automatically assign Smartport types to interfaces, the Auto Smartport feature must be enabled globally and on the relevant interfaces which Auto Smartport should be allowed to configure. By default, Auto Smartport is enabled and allowed to configure all interfaces. The Smartport type assigned to each interface is determined by the CDP and LLDP packets received on the each interface respectively.

- If multiple devices are attached to an interface, a configuration profile that is appropriate for all of the devices is applied to the interface if possible.

- If a device is aged out (no longer receiving advertisements from other devices), the interface configuration is changed according to its Persistent Status. If the Persistent Status is enabled, the interface configuration is retained. If not, the Smartport Type reverts to Default.

Enabling Auto Smartport

Auto Smartport can be enabled globally in the Properties page in the following ways:

- **Enabled**—This manually enables Auto Smartport and places it into operation immediately.
- **Enable by Auto Voice VLAN**—This enables Auto Smartport to operate if Auto Voice VLAN is enabled and in operation. Enable by Auto Voice VLAN is the default.

NOTE In addition to enabling Auto Smartport globally, you must enable Auto Smartport at the desired interface as well. By default, Auto Smartport is enabled at all the interfaces.

See **Voice VLAN** for more information on enabling Auto Voice VLAN

Identifying Smartport Type

If Auto Smartport is globally enabled (in the Properties page), and at an interface (in the Interface Settings page), the device applies a Smartport macro to the interface based on the Smartport type of the attaching device. Auto Smartport derives the Smartport types of attaching devices based on the CDP and/or LLDP the devices advertise.

If, for example, an IP phone is attached to a port, it transmits CDP or LLDP packets that advertise its capabilities. After reception of these CDP and/or LLDP packets, the device derives the appropriate Smartport type for phone and applies the corresponding Smartport macro to the interface where the IP phone attaches.

Unless Persistent Auto Smartport is enabled on an interface, the Smartport type and resulting configuration applied by Auto Smartport is removed if the attaching device(s) ages out, links down, reboots, or conflicting capabilities are received. Aging out times are determined by the absence of CDP and/or LLDP advertisements from the device for a specified time period.

Using CDP/LLDP Information to Identify Smartport Types

The device detects the type of device attached to the port, based on the CDP/LLDP capabilities.

This mapping is shown in the following tables:

CDP Capabilities Mapping to Smartport Type

Capability Name	CDP Bit	Smartport Type
Router	0x01	Router
TB Bridge	0x02	Wireless Access Point
SR Bridge	0x04	Ignore
Switch	0x08	Switch
Host	0x10	Host
IGMP conditional filtering	0x20	Ignore
Repeater	0x40	Ignore
VoIP Phone	0x80	ip_phone
Remotely-Managed Device	0x100	Ignore
CAST Phone Port	0x200	Ignore
Two-Port MAC Relay	0x400	Ignore

LLDP Capabilities Mapping to Smartport Type

Capability Name	LLDP Bit	Smartport Type
Other	1	Ignore
Repeater IETF RFC 2108	2	Ignore
MAC Bridge IEEE Std. 802.1D	3	Switch
WLAN Access Point IEEE Std. 802.11 MIB	4	Wireless Access Point
Router IETF RFC 1812	5	Router
Telephone IETF RFC 4293	6	ip_phone

LLDP Capabilities Mapping to Smartport Type (Continued)

Capability Name	LLDP Bit	Smartport Type
DOCSIS cable device IETF RFC 4639 and IETF RFC 4546	7	Ignore
Station Only IETF RFC 4293	8	Host
C-VLAN Component of a VLAN Bridge IEEE Std. 802.1Q	9	Switch
S-VLAN Component of a VLAN Bridge IEEE Std. 802.1Q	10	Switch
Two-port MAC Relay (TPMR) IEEE Std. 802.1Q	11	Ignore
Reserved	12-16	Ignore

NOTE If only the IP Phone and Host bits are set, then the Smartport type is `ip_phone_desktop`.

Multiple Devices Attached to the Port

The device derives the Smartport type of a connected device via the capabilities the device advertises in its CDP and/or LLDP packets.

If multiple devices are connected to the device through one interface, Auto Smartport considers each capability advertisement it receives through that interface in order to assign the correct Smartport type. The assignment is based on the following algorithm:

- If all devices on an interface advertise the same capability (there is no conflict) the matching Smartport type is applied to the interface.
- If one of the devices is a switch, the *Switch* Smartport type is used.
- If one of the devices is an AP, the *Wireless Access Point* Smartport type is used.
- If one of the devices is an IP phone and another device is a host, the *ip_phone_desktop* Smartport type is used.
- If one of the devices is an IP phone desktop and the other is an IP phone or host, the *ip_phone_desktop* Smartport type is used.
- In all other cases the default Smartport type is used.

For more information about LLDP/CDP refer to the [Configuring LLDP](#) and [Configuring CDP](#) sections, respectively.

Persistent Auto Smartport Interface

If the Persistent status of an interface is enabled, its Smartport type and the configuration that is already applied dynamically by Auto Smartport remains on the interface even after the attaching device ages out, the interface goes down, and the device is rebooted (assuming the configuration was saved). The Smartport type and the configuration of the interface are not changed unless Auto Smartport detects an attaching device with a different Smartport type. If the Persistent status of an interface is disabled, the interface reverts to the default Smartport type when the attaching device to it ages out, the interface goes down, or the device is rebooted. Enabling Persistent status on an interface eliminates the device detection delay that otherwise occurs.

NOTE The persistence of the Smartport types applied to the interfaces are effective between reboots only if the running configuration with the Smartport type applied at the interfaces is saved to the startup configuration file.

Error Handling

When a smart port macro fails to apply to an interface, you can examine the point of the failure in the Interface Settings page and reset the port and reapply the macro after the error is corrected from the Interface Settings and Interface Settings Edit pages.

Default Configuration

Smartport is always available. By default, Auto Smartport is enabled by Auto Voice VLAN, relies on both CDP and LLDP to detect attaching device's Smartport type, and detects Smartport type IP phone, IP phone + Desktop, Switch, and Wireless Access Point.

See [Voice VLAN](#) for a description of the voice factory defaults.

Relationships with Other Features and Backwards Compatibility

Auto Smartport is enabled by default and may be disabled. Telephony OUI cannot function concurrently with Auto Smartport, and Auto Voice VLAN. Auto Smartport must be disabled before enabling Telephony OUI.

Common Smartport Tasks

This section describes some common tasks to setup Smartport and Auto Smartport.

Workflow1: To globally enable Auto Smartport on the device, and to configure a port with Auto Smartport, perform the following steps:

-
- STEP 1** To enable the Auto Smartport feature on the device, open the Smartport > Properties page. Set **Administrative Auto Smartport** to **Enable** or **Enable by Voice VLAN**.
 - STEP 2** Select whether the device is to process CDP and/or LLDP advertisements from connected devices.
 - STEP 3** Select which type of devices are to be detected in the **Auto Smartport Device Detection** field.
 - STEP 4** Click **Apply**
 - STEP 5** To enable the Auto Smartport feature on one or more interfaces, open the Smartport > Interface Settings page.
 - STEP 6** Select the interface, and click **Edit**.
 - STEP 7** Select Auto Smartport in the **Smartport Application** field.
 - STEP 8** Check or uncheck **Persistent Status** if desired.
 - STEP 9** Click **Apply**.

Workflow2: To configure an interface as a static Smartport, perform the following steps:

-
- STEP 1** To enable the Smartport feature on the interface, open the Smartport > Interface Settings page.
- STEP 2** Select the interface, and click **Edit**.
- STEP 3** Select the Smartport type that is to be assigned to the interface in the **Smartport Application** field.
- STEP 4** Set the macro parameters as required.
- STEP 5** Click **Apply**.
-

Workflow3: To adjust Smartport macro parameter defaults, perform the following steps:

Through this procedure you can accomplish the following:

- View the macro source.
 - Change parameter defaults.
 - Restore the parameter defaults to the factory settings.
1. Open the Smartport > Smartport Type Settings page.
 2. Select the Smartport Type.
 3. Click **View Macro Source** to view the current Smartport macro that is associated with the selected Smartport Type.
 4. Click **Edit** to open a new window in which you can modify the default values of the parameters in the macros bound to that Smartport type. These parameter default values are used when Auto Smartport applies the selected Smartport type (if applicable) to an interface.
 5. In the Edit page, modify the fields.
 6. Click **Apply** to rerun the macro if the parameters were changed, or **Restore Defaults** to restore default parameter values to built-in macros if required.

Workflow4: To rerun a Smartport macro after it has failed, perform the following steps:

-
- STEP 1** In the Interface Settings page, select an interface with Smartport type Unknown.
 - STEP 2** Click **Show Diagnostics** to see the problem.
 - STEP 3** Troubleshoot, then correct the problem. Consider the troubleshooting tip below.
 - STEP 4** Click **Edit**. A new window appears in which you can click **Reset** to reset the interface.
 - STEP 5** Return to the main page and reapply the macro using either **Reapply** (for devices that are not switches, routers or APs) or **Reapply Smartport Macro** (for switches, routers or APs) to run the Smartport Macro on the interface.

A second method of resetting single or multiple unknown interfaces is:

-
- STEP 1** In the Interface Settings page, select the Port Type equals to checkbox.
 - STEP 2** Select *Unknown* and click **Go**.
 - STEP 3** Click **Reset All Unknown Smartports**. Then reapply the macro as described above.

TIP The reason that the macro failed might be a conflict with a configuration on the interface made prior to applying the macro (most often encountered with security and storm-control settings), a wrong port type, a typo or an incorrect command within the user-defined macro, or an invalid parameter setting. Parameters are checked for neither type nor boundary prior to the attempt to apply the macro, therefore, an incorrect or invalid input to a parameter value will almost assuredly cause failure when applying the macro.

Configuring Smartport Using The Web-based Interface

The Smartport feature is configured in the Smartport > Properties, Smartport Type Settings and Interface Settings pages.

For Voice VLAN configuration, see [Voice VLAN](#).

For LLDP/CDP configuration, see the [Configuring LLDP](#) and [Configuring CDP](#) sections, respectively.

Smartport Properties

To configure the Smartport feature globally:

STEP 1 Click **Smartport > Properties**.

STEP 2 Enter the parameters.

- **Administrative Auto Smartport**—Select to globally enable or disable Auto Smartport. The following options are available:
 - *Disable*—Select to disable Auto Smartport on the device.
 - *Enable*—Select to enable Auto Smartport on the device.
 - *Enable by Auto Voice VLAN*—This enables Auto Smartport, but puts it in operation only when Auto Voice VLAN is also enabled and in operation. Enable by Auto Voice VLAN is the default.
- **Auto Smartport Device Detection Method**—Select whether incoming CDP, LLDP, or both types of packets are used to detect the Smartport type of the attaching device(s). At least one must be checked in order for Auto Smartport to identify devices.
- **Operational CDP Status**—Displays the operational status of CDP. Enable CDP if Auto Smartport is to detect the Smartport type based on CDP advertisement.
- **Operational LLDP Status**—Displays the operational status of LLDP. Enable LLDP if Auto Smartport is to detect the Smartport type based on LLDP/LLDP-MED advertisement.
- **Auto Smartport Device Detection**—Select each type of device for which Auto Smartport can assign Smartport types to interfaces. If unchecked, Auto Smartport does not assign that Smartport type to any interface.

STEP 3 Click **Apply**. This sets the global Smartport parameters on the device.

Smartport Type Settings

Use the Smartport Type Settings page to edit the Smartport Type settings and view the Macro Source.

By default, each Smartport type is associated with a pair of built-in Smartport macros. See [Smartport Types](#) for further information on macro versus anti-macro. Built-in or user-defined macros can have parameters. The built-in macros have up to three parameters.

Editing these parameters for the Smartport types applied by Auto Smartport from the Smartport Type Settings page configures the default values for these parameters. These defaults are used by Auto Smartport.

NOTE Changes to Auto Smartport types cause the new settings to be applied to interfaces which have already been assigned that type by Auto Smartport. In this case, binding an invalid macro or setting an invalid default parameter value causes all ports of this Smartport type to become unknown.

STEP 1 Click **Smartport > Smartport Type Settings**.

STEP 2 To view the Smartport macro associated with a Smartport type, select a Smartport type and click **View Macro Source**.

STEP 3 To modify the parameters of a macro, select a Smartport type and click **Edit**.

STEP 4 Enter the fields.

- **Port Type**—Select a Smartport type.
- **Macro Name**—Displays the name of the Smartport macro currently associated with the Smartport type.
- **Macro Parameters**—Displays the following fields for three parameters in the macro:
 - *Parameter Name*—Name of parameter in macro.
 - *Parameter Value*—Current value of parameter in macro. This can be changed here.
 - *Parameter Description*—Description of parameter.

You can restore the default parameter values by clicking **Restore Defaults**.

STEP 5 Click **Apply** to save the changes to the running configuration. If the Smartport macro and/or its parameter values associated with the Smartport type are modified, Auto Smartport automatically reapplies the macro to the interfaces

currently assigned with the Smartport type by Auto Smartport. Auto Smartport does not apply the changes to interfaces that were statically assigned a Smartport type.

NOTE There is no method to validate macro parameters because they do not have a type association. Therefore, any entry is valid at this point. However, invalid parameter values may cause errors to occur when the Smartport type is assigned to an interface, applying the associated macro.

Smartport Interface Settings

Use the Interface Settings page to perform the following tasks:

- Statically apply a specific Smartport type to an interface with interface specific values for the macro parameters.
- Enable Auto Smartport on an interface.
- Diagnose a Smartport macro that failed upon application, and caused the Smartport type to become Unknown.
- Reapply a Smartport macro after it fails for one of the following types of interfaces: switch, router and AP. It is expected that the necessary corrections have been made prior to clicking **Reapply**. See the workflow area in [Common Smartport Tasks](#) section for troubleshooting tips.
- Reapply a Smartport macro to an interface. In some circumstances, you may want to reapply a Smartport macro so that the configuration at an interface is up to date. For instance, reapplying a switch Smartport macro at a device interface makes the interface a member of the VLANs created since the last macro application. You have to be familiar with the current configurations on the device and the definition of the macro to determine if a reapplication has any impact on the interface.
- Reset unknown interfaces. This sets the mode of Unknown interfaces to Default.

To apply a Smartport macro:

STEP 1 Click **Smartport > Interface Settings**.

Reapply the associated Smartport macro in the following ways:

- Select a group of Smartport types (switches, routers or APs) and click **Reapply Smartport Macro**. The macros are applied to all selected interface types.
- Select an interface that is UP and click **Reapply** to reapply the last macro that was applied to the interface.

The **Reapply** action also adds the interface to all newly-created VLANs.

STEP 2 Smartport Diagnostic.

If a Smartport macro fails, the Smartport Type of the interface is Unknown. Select an interface which is of unknown type and click **Show Diagnostic**. This displays the command at which application of the macro failed. See the workflow area in **Common Smartport Tasks** section for troubleshooting tips. Proceed to reapply the macro after correcting the problem.

STEP 3 Resetting all Unknown interfaces to Default type.

- Select the *Port Type equals to* checkbox.
- Select *Unknown* and click **Go**.
- Click **Reset All Unknown Smartports**. Then reapply the macro as described above. This performs a reset on all interfaces with type Unknown, meaning that all interfaces are returned to the Default type. After correcting the error in the macro or on the current interface configuration or both, a new macro may be applied.

NOTE Resetting the interface of unknown type does not reset the configuration performed by the macro that failed. This clean up must be done manually.

To assign a Smartport type to an interface or activate Auto Smartport on the interface:

STEP 1 Select an interface and click **Edit**.

STEP 2 Enter the fields.

- **Interface**—Select the port or LAG.

- **Smartport Type**—Displays the Smartport type currently assigned to the port/LAG.
 - **Smartport Application**—Select the Smartport type from the Smartport Application pull-down.
 - **Smartport Application Method**— If Auto Smartport is selected, Auto Smartport automatically assigns the Smartport type based on the CDP and/or LLDP advertisement received from the connecting devices as well as applying the corresponding Smartport macro. To statically assign a Smartport type and apply the corresponding Smartport macro to the interface, select the desired Smartport type.
 - **Persistent Status**—Select to enable the Persistent status. If enabled, the association of a Smartport type to an interface remains even if the interface goes down, or the device is rebooted. Persistent is applicable only if the Smartport Application of the interface is Auto Smartport. Enabling Persistent at an interface eliminates the device detection delay that otherwise occurs.
 - **Macro Parameters**—Displays the following fields for up to three parameters in the macro:
 - *Parameter Name*—Name of parameter in macro.
 - *Parameter Value*—Current value of parameter in macro. This can be changed here.
 - *Parameter Description*—Description of parameter.
- STEP 3** Click **Reset** to set an interface to Default if it is in Unknown status (as a result of an unsuccessful macro application). The macro can be reapplied on the main page.
- STEP 4** Click **Apply** to update the changes and assign the Smartport type to the interface.

Built-in Smartport Macros

The following describes the pair of built-in macros for each Smartport type. For each Smartport type there is a macro to configure the interface and an anti macro to remove the configuration.

Macro code for the following Smartport types are provided:

- **desktop**
- **printer**

- **guest**
- **server**
- **host**
- **ip_camera**
- **ip_phone**
- **ip_phone_desktop**
- **switch**
- **router**
- **ap**

desktop

```
[desktop]
#interface configuration, for increased network security and reliability when
connecting a desktop device, such as a PC, to a switch port.
#macro description Desktop
#macro keywords $native_vlan $max_hosts
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#                          $max_hosts: The maximum number of allowed devices on
the port
#Default Values are
#$native_vlan = Default VLAN
#$max_hosts = 10
#
#the port type cannot be detected automatically
#
#the default mode is trunk
smartport switchport trunk native vlan $native_vlan
#
port security max $max_hosts
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_desktop

```
[no_desktop]
#macro description No Desktop
#
no smartport switchport trunk native vlan
smartport switchport trunk allowed vlan remove all
#
no port security
no port security mode
no port security max
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

printer

```
[printer]
#macro description printer
#macro keywords $native_vlan
#
#macro key description: $native_vlan: The untag VLAN which will be configured
on the port
#Default Values are
#$native_vlan = Default VLAN
#
#the port type cannot be detected automatically
#
switchport mode access
switchport access vlan $native_vlan
#
#single host
port security max 1
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_printer

```
[no_printer]
#macro description No printer
```

```
#
no switchport access vlan
no switchport mode
#
no port security
no port security mode
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

guest

```
[guest]
#macro description guest
#macro keywords $native_vlan
#
#macro key description:  $native_vlan: The untag VLAN which will be
configured on the port
#Default Values are
#$native_vlan = Default VLAN
#
#the port type cannot be detected automatically
#
switchport mode access
switchport access vlan $native_vlan
#
#single host
port security max 1
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_guest]]

```
[no_guest]
#macro description No guest
#
no switchport access vlan
no switchport mode
```

```
#
no port security
no port security mode
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

server

```
[server]
#macro description server
#macro keywords $native_vlan $max_hosts
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#                          $max_hosts: The maximum number of allowed devices on
the port
#Default Values are
#$native_vlan = Default VLAN
#$max_hosts = 10
#
#the port type cannot be detected automatically
#
#the default mode is trunk
smartport switchport trunk native vlan $native_vlan
#
port security max $max_hosts
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_server

```
[no_server]
#macro description No server
#
no smartport switchport trunk native vlan
smartport switchport trunk allowed vlan remove all
#
no port security
```

```

no port security mode
no port security max
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
#
spanning-tree portfast auto
#
@

```

host

```

[host]
#macro description host
#macro keywords $native_vlan $max_hosts
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#
#                               $max_hosts: The maximum number of allowed devices on
the port
#Default Values are
#$native_vlan = Default VLAN
#$max_hosts = 10
#
#the port type cannot be detected automatically
#
#the default mode is trunk
smartport switchport trunk native vlan $native_vlan
#
port security max $max_hosts
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@

```

no_host

```

[no_host]
#macro description No host
#
no smartport switchport trunk native vlan
smartport switchport trunk allowed vlan remove all
#
no port security
no port security mode

```



```
no port security max
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

ip_camera

```
[ip_camera]
#macro description ip_camera
#macro keywords $native_vlan
#
#macro key description:  $native_vlan: The untag VLAN which will be
configured on the port
#Default Values are
#$native_vlan = Default VLAN
#
switchport mode access
switchport access vlan $native_vlan
#
#single host
port security max 1
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_ip_camera

```
[no_ip_camera]
#macro description No ip_camera
#
no switchport access vlan
no switchport mode
#
no port security
no port security mode
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
```

```
#
spanning-tree portfast auto
#
@
```

ip_phone

```
[ip_phone]
#macro description ip_phone
#macro keywords $native_vlan $voice_vlan $max_hosts
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#
#                               $voice_vlan: The voice VLAN ID
#                               $max_hosts: The maximum number of allowed devices on
the port
#Default Values are
#$native_vlan = Default VLAN
#$voice_vlan = 1
#$max_hosts = 10
#
#the default mode is trunk
smartport switchport trunk allowed vlan add $voice_vlan
smartport switchport trunk native vlan $native_vlan
#
port security max $max_hosts
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_ip_phone

```
[no_ip_phone]
#macro description no ip_phone
#macro keywords $voice_vlan
#
#macro key description:    $voice_vlan: The voice VLAN ID
#
#Default Values are
#$voice_vlan = 1
#
smartport switchport trunk allowed vlan remove $voice_vlan
no smartport switchport trunk native vlan
smartport switchport trunk allowed vlan remove all
```

```
#
no port security
no port security mode
no port security max
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

ip_phone_desktop

```
[ip_phone_desktop]
#macro description ip_phone_desktop
#macro keywords $native_vlan $voice_vlan $max_hosts
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#
#                               $voice_vlan: The voice VLAN ID
#                               $max_hosts: The maximum number of allowed devices on
the port
#Default Values are
#$native_vlan = Default VLAN
#$voice_vlan = 1
#$max_hosts = 10
#
#the default mode is trunk
smartport switchport trunk allowed vlan add $voice_vlan
smartport switchport trunk native vlan $native_vlan
#
port security max $max_hosts
port security mode max-addresses
port security discard trap 60
#
smartport storm-control broadcast level 10
smartport storm-control include-multicast
smartport storm-control broadcast enable
#
spanning-tree portfast
#
@
```

no_ip_phone_desktop

```
[no_ip_phone_desktop]
#macro description no ip_phone_desktop
#macro keywords $voice_vlan
#
```

```
#macro key description:    $voice_vlan: The voice VLAN ID
#
#Default Values are
#$voice_vlan = 1
#
smartport switchport trunk allowed vlan remove $voice_vlan
no smartport switchport trunk native vlan
smartport switchport trunk allowed vlan remove all
#
no port security
no port security mode
no port security max
#
no smartport storm-control broadcast enable
no smartport storm-control broadcast level
no smartport storm-control include-multicast
#
spanning-tree portfast auto
#
@
```

switch

```
[switch]
#macro description switch
#macro keywords $native_vlan $voice_vlan
#
#macro key description:    $native_vlan: The untag VLAN which will be
configured on the port
#                        $voice_vlan: The voice VLAN ID
#Default Values are
#$native_vlan = Default VLAN
#$voice_vlan = 1
#
#the default mode is trunk
smartport switchport trunk allowed vlan add all
smartport switchport trunk native vlan $native_vlan
#
spanning-tree link-type point-to-point
#
@
```

no_switch

```
[no_switch]
#macro description No switch
#macro keywords $voice_vlan
#
#macro key description:    $voice_vlan: The voice VLAN ID
#
no smartport switchport trunk native vlan
```

```
smartport switchport trunk allowed vlan remove all
#
no spanning-tree link-type
#
@
```

router

```
[router]
#macro description router
#macro keywords $native_vlan $voice_vlan
#
#macro key description:  $native_vlan: The untag VLAN which will be
configured on the port
#                        $voice_vlan: The voice VLAN ID
#
#Default Values are
#$native_vlan = Default VLAN
#$voice_vlan = 1
#
#the default mode is trunk
smartport switchport trunk allowed vlan add all
smartport switchport trunk native vlan $native_vlan
#
smartport storm-control broadcast level 10
smartport storm-control broadcast enable
#
spanning-tree link-type point-to-point
#
@
```

no_router

```
[no_router]

#macro description No router

#macro keywords $voice_vlan

#

#macro key description:  $voice_vlan: The voice VLAN ID

#

no smartport switchport trunk native vlan

smartport switchport trunk allowed vlan remove all

#

no smartport storm-control broadcast enable
```

```
no smartport storm-control broadcast level
```

```
#
```

```
no spanning-tree link-type
```

```
#
```

```
@
```

ap

```
[ap]
```

```
#macro description ap
```

```
#macro keywords $native_vlan $voice_vlan
```

```
#
```

```
#macro key description: $native_vlan: The untag VLAN which will be  
configured on the port
```

Port Management: PoE

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

This section describes how to use the PoE feature.

It covers the following topics:

- [PoE on the Device](#)
- [Configuring PoE Properties](#)
- [Configuring PoE Settings](#)

PoE on the Device

A PoE device 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.

See [Device Models](#) for information concerning PoE support on various models.

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 device agrees to supply is limited to the value the system administrator configures, regardless of the Classification result.
- **Class Power Limit**—The maximum power the device 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.

NOTE Changing the mode from Class Limit to Port limit and vice versa when the device is operational forces the Powered Device to reboot.

- 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 device than the configured allocation allows (no matter if the device is in Class Limit or Port Limit mode), the device 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



CAUTION Consider the following when connecting switches capable of supplying PoE:

The PoE models of the Sx200, Sx300, and Sx500 series switches are PSE (Power Sourcing Equipment) that are capable of supplying DC power to attaching PD (Powered Devices). These devices include VoIP phones, IP cameras, and wireless access points. The PoE switches can detect and supply power to pre-standard legacy PoE Powered Devices. Due to the support of legacy PoE, it is possible that a PoE device acting as a PSE may mistakenly detect and supply power to an attaching PSE, including other PoE switches, as a legacy PD.

Even though Sx200/300/500 PoE switches are PSE, and as such should be powered by AC, they could be powered up as a legacy PD by another PSE due to false detection. When this happens, the PoE device may not operate properly and

may not be able to properly supply power to its attaching PDs.

To prevent false detection, you should disable PoE on the ports on the PoE switches that are used to connect to PSEs. You should also first power up a PSE device before connecting it to a PoE device. When a device is being falsely detected as a PD, you should disconnect the device from the PoE port and power recycle the device with AC power before reconnecting its PoE ports.

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 device and monitor current power usage:

STEP 1 Click **Port Management > PoE > Properties**.

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.

NOTE When you change from Port Limit to Class Limit or vice versa, you must disable PoE ports, and enable them after changing the power configuration.

- **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 for each device:

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

STEP 3 Click **Apply** to save the PoE properties.

Configuring PoE Settings

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.

Click **Port Management > PoE > Settings**.

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.

PoE priority example:

Given: A 48 port device is supplying a total of 375 watts.

The administrator configures all ports to allocate up to 30 watts. This results in 48 times 30 ports equaling 1440 watts, which is too much. The device cannot provide enough power to each port, so it provides power according to the priority.

The administrator sets the priority for each port, allocating how much power it can be given.

These priorities are entered in the PoE Settings page.

See [Device Models](#) for a description of the device models that support PoE and the maximum power that can be allocated to PoE ports.

To configure PoE port settings:

- STEP 1** Click **Port Management > PoE > Settings**. The list of fields below is for Port Limit Power Mode. The fields are slightly different if the Power Mode is Class Limit.
- STEP 2** Select a port and click **Edit**. The list of fields below is for Port Limit Power Mode. The fields are slightly different if the Power Mode is Class Limit.
- STEP 3** Enter the value for the following field:
 - **Interface**—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.
 - **Administrative Power Allocation**—This field appears only if the Power Mode set in the PoE Properties page is Port Limit. If the Power mode is Power Limit, enter the power in milliwatts allocated to the port.
 - **Max Power Allocation**—Displays the maximum amount of power permitted on this port.
 - **Class**—This field appears 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 Device Port
0	15.4 watt
1	4.0 watt
2	7.0 watt
3	15.4 watt
4	30.0 watt

- **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 written to the Running Configuration file.

VLAN Management

This section covers the following topics:

- **VLANs**
- **Configuring Default VLAN Settings**
- **Creating VLANs**
- **Configuring VLAN Interface Settings**
- **Defining VLAN Membership**
- **Voice VLAN**

VLANs

A VLAN is a logical group of ports that enables devices associated with it 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 untagged VLAN and can be a member of several tagged 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. The tag contains a VLAN ID between 1 and 4094, and a VLAN Priority Tag (VPT) between 0 and 7. See [Quality of Service](#) 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

All VLAN traffic (Unicast/Broadcast/Multicast) remains within its VLAN. Devices attached to different VLANs do not have direct connectivity to each other over the Ethernet MAC layer.

Device VLANs can only be created statically.

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:** For more information refer to the Configuring IP Information section.

QinQ

QinQ provides isolation between service provider networks and customers' networks. The device is a provider bridge that supports port-based c-tagged service interface.

With QinQ, the device adds an ID tag known as Service Tag (S-tag) to forward traffic over the network. The S-tag is used to segregate traffic between various customers, while preserving the customer VLAN tags.

Customer traffic is encapsulated with an S-tag with TPID 0x8100, regardless of whether it was originally c-tagged or untagged. The S-tag allows this traffic to be treated as an aggregate within a provider bridge network, where the bridging is based on the S-tag VID (S-VID) only.

The S-Tag is preserved while traffic is forwarded through the network service provider's infrastructure, and is later removed by an egress device.

An additional benefit of QinQ is that there is no need to configure customers' edge devices.

QinQ is enabled in the VLAN Management > Interface Settings page.

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 VLAN-related configuration for ports and enable QinQ on an interface using the **Configuring VLAN Interface Settings** section.
4. Assign interfaces to VLANs by using the **Configuring Port to VLAN** section or the **Configuring VLAN Membership** section.
5. View the current VLAN port membership for all the interfaces in the **Configuring VLAN Membership** section.

Configuring Default VLAN Settings

When using factory default settings, the device 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. This is only relevant for OUI-enabled voice VLAN.
- If a port is no longer a member of any VLAN, the device 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.

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

- 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 device. 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**.

STEP 2 Enter the value for the following field:

- **Current Default VLAN ID**—Displays the current default VLAN ID.
- **Default VLAN ID After Reboot**—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 device.

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 200 Series device supports up to 256 VLANs, including the default VLAN.

Each VLAN must be configured with a unique VID (VLAN ID) with a value from 1 to 4094. The device reserves VID 4095 as the Discard VLAN. All packets classified to the Discard VLAN are discarded at ingress, and are not forwarded to a port.

To create a VLAN:

STEP 1 Click **VLAN Management > Create VLAN**.

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

- **VLAN ID**—User-defined VLAN ID.
- **VLAN Name**—User-defined VLAN name.
- **Type**—VLAN type:
 - *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 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. When using the **Range** function, the maximum number of VLANs you can create at one time is 100.

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.

To configure the VLAN settings:

STEP 1 Click **VLAN Management > Interface Settings**.

STEP 2 Select an interface type (Port or LAG), and click **Go**. Ports or LAGs and their VLAN parameters are displayed.

STEP 3 To configure a Port or LAG, select it and click **Edit**.

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.
 - *Customer*—Selecting this option places the interface in QinQ mode. This enables you to use your own VLAN arrangements (PVID) across the provider network. The device is in Q-in-Q mode when it has one or more customer ports. See [QinQ](#).

- **Administrative 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.

STEP 5 Click **Apply**. The parameters are written to the Running Configuration file.

Defining VLAN Membership

The Port to VLAN and Port VLAN Membership pages display the VLAN memberships of the ports in various presentations. You can use them 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 packets properly, intermediate VLAN-aware devices that carry VLAN traffic along the path between end nodes must be manually configured.

Untagged port membership between two VLAN-aware devices with no intervening VLAN-aware devices, must 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.

Frames that are VLAN-tagged can pass through other network devices that are VLAN-aware or VLAN-unaware. 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.

Configuring Port to VLAN

Use the Port to VLAN page to display and configure the ports within a specific VLAN.

To map ports or LAGs to a VLAN:

STEP 1 Click **VLAN Management > Port to VLAN**.

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 appears with its current port mode (Access, Trunk or General) configured from the Interface Settings page.

Each port or LAG appears 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. 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 when the VLAN is newly created.
- **Tagged**—The interface is a tagged member of the 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.

STEP 4 Click **Apply**. The interfaces are assigned to the VLAN, and written to the Running Configuration file.

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

Configuring VLAN Membership

The Port VLAN Membership page displays all ports on the device along with a list of VLANs to which each port belongs.

If the port-based authentication method for an interface is 802.1x and the Administrative Port Control is Auto, then:

- Until the port is authenticated, it is excluded from all VLANs, except guest and unauthenticated ones. In the VLAN to Port page, the port is marked with an upper case P.
- When the port is authenticated, it receives membership in the VLAN in which it was configured.

To assign a port to one or more VLANs:

STEP 1 Click **VLAN Management > Port VLAN Membership**.

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.
- **Administrative VLANs**—Drop-down list that displays all VLANs of which the interface might be a member.
- **Operational VLANs**—Drop-down list that displays all VLANs of which the interface is currently 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.

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:

- **Forbidden**—The interface is not allowed to join the VLAN. 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 when the VLAN is newly created.
- **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 device 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 written to the Running Configuration file.

STEP 6 To see the administrative and operational VLANs on an interface, click **Details**.

Voice VLAN

In a LAN, voice devices, such as IP phones, VoIP endpoints, and voice systems are placed into the same VLAN. This VLAN is referred as the voice VLAN. If the voice devices are in different voice VLANs, IP (Layer 3) routers are needed to provide communication.

This section covers the following topics:

- [Voice VLAN Overview](#)
- [Configuring Voice VLAN](#)

Voice VLAN Overview

This section covers the following topics:

- [Dynamic Voice VLAN Modes](#)
- [Auto Voice VLAN, Auto Smartports, CDP, and LLDP](#)

- **Voice VLAN QoS**
- **Voice VLAN Constraints**
- **Voice VLAN Workflows**

The following are typical voice deployment scenarios with appropriate configurations:

- **UC3xx/UC5xx hosted:** All Cisco phones and VoIP endpoints support this deployment model. For this model, the UC3xx/UC5xx, Cisco phones and VoIP endpoints reside in the same voice VLAN. The voice VLAN of UC3xx/UC5xx defaults to VLAN 100.
- **Third-party IP PBX-hosted:** Cisco SBTG CP-79xx, SPA5xx phones and SPA8800 endpoints support this deployment model. In this model, the VLAN used by the phones is determined by the network configuration. There may or may not be separate voice and data VLANs. The phones and VoIP endpoints register with an on-premise IP PBX.
- **IP Centrex/ITSP hosted:** Cisco CP-79xx, SPA5xx phones and SPA8800 endpoints support this deployment model. For this model, the VLAN used by the phones is determined by the network configuration. There may or may not be separate voice and data VLANs. The phones and VoIP endpoints register with an off-premise SIP proxy in “the cloud”.

From a VLAN perspective, the above models operate in both VLAN-aware and VLAN-unaware environments. In the VLAN-aware environment, the voice VLAN is one of the many VLANs configured in an installation. The VLAN-unaware scenario is equivalent to a VLAN-aware environment with only one VLAN.

The device always operates as a VLAN-aware switch.

The device supports a single voice VLAN. By default, the voice VLAN is VLAN 1. The voice VLAN is defaulted to VLAN 1. A different voice VLAN can be manually configured. It can also be dynamically learned when Auto Voice VLAN is enabled.

Ports can be manually added to the voice VLAN by using basic VLAN configuration described in the Configuring VLAN Interface Setting section, or by manually applying voice-related Smartport macro to the ports. Alternatively, they can be added dynamically if the device is in Telephony OUI mode, or has Auto Smartports enabled.

Dynamic Voice VLAN Modes

The device supports two dynamic voice VLAN modes: Telephony OUI (Organization Unique Identifier) mode and Auto Voice VLAN mode. The two modes affect how voice VLAN and/or voice VLAN port memberships are configured. The two modes are mutually exclusive to each other.

- **Telephony OUI**

In Telephony OUI mode, the voice VLAN must be a manually-configured VLAN, and cannot be the default VLAN.

When the device is in Telephony OUI mode and a port is manually configured as a candidate to join the voice VLAN, the device dynamically adds the port to the voice VLAN if it receives a packet with a source MAC address matching to one of the configured telephony OUIs. An OUI is the first three bytes of an Ethernet MAC address. For more information about Telephony OUI, see [Configuring Telephony OUI](#).

- **Auto Voice VLAN**

In Auto Voice VLAN mode, the voice VLAN can be either the default voice VLAN, manually configured, or learned from external devices such as UC3xx/5xx and from switches that advertise voice VLAN in CDP or VSDP. VSDP is a Cisco defined protocol for voice service discovery.

Unlike Telephony OUI mode that detects voice devices based on telephony OUI, Auto Voice VLAN mode depends on Auto Smartport to dynamically add the ports to the voice VLAN. Auto Smartport, if enabled, adds a port to the voice VLAN if it detects an attaching device to the port that advertises itself as a phone or media end points through CDP and/or LLDP-MED.

Voice End-Points

To have a voice VLAN work properly, the voice devices, such as Cisco phones and VoIP endpoints, must be assigned to the voice VLAN where it sends and receives its voice traffic. Some of the possible scenarios are as follows:

- A phone/endpoint may be statically configured with the voice VLAN.
- A phone/endpoint may obtain the voice VLAN in the boot file it downloads from a TFTP server. A DHCP server may specify the boot file and the TFTP server when it assigns an IP address to the phone.
- A phone/endpoint may obtain the voice VLAN information from CDP and LLDP-MED advertisements it receives from their neighbor voice systems and switches.

The device expects the attaching voice devices to send voice VLAN, tagged packets. On ports where the voice VLAN is also the native VLAN, voice VLAN untagged packets are possible.

Auto Voice VLAN, Auto Smartports, CDP, and LLDP

Defaults

By factory defaults, CDP, LLDP, and LLDP-MED on the device are enabled, auto Smartport mode is enabled, Basic QoS with trusted DSCP is enabled, and all ports are members of default VLAN 1, which is also the default Voice VLAN.

In addition, Dynamic Voice VLAN mode is the default to Auto Voice VLAN with enabling based on trigger, and Auto Smartport is the default to be enabled depending on Auto Voice VLAN.

Voice VLAN Triggers

When the Dynamic Voice VLAN mode is Enable Auto Voice VLAN, Auto Voice VLAN becomes operational only if one or more triggers occur. Possible triggers are static voice VLAN configuration, voice VLAN information received in neighbor CDP advertisement, and voice VLAN information received in the Voice VLAN Discovery Protocol (VSDP). If desired, you can activate Auto Voice VLAN immediately without waiting for a trigger.

When Auto Smartport is enabled, depending on Auto Voice VLAN mode, Auto Smartport is enabled when Auto Voice VLAN becomes operational. If desired, you can make Auto Smartport independent of Auto Voice VLAN.

NOTE The default configuration list here applies to switches whose firmware version supports Auto Voice VLAN out of the box. It also applies to unconfigured switches that have been upgraded to the firmware version that supports Auto Voice VLAN.

NOTE The defaults and the voice VLAN triggers are designed to have no effect on any installations without a voice VLAN and on switches that have already been configured. You may manually disable and enable Auto Voice VLAN and/or Auto Smartport to fit your deployment if needed.

Auto Voice VLAN

Auto Voice VLAN is responsible to maintain the voice VLAN, but depends on Auto Smartport to maintain the voice VLAN port memberships. Auto Voice VLAN performs the following functions when it is in operation:

- It discovers voice VLAN information in CDP advertisements from directly connected neighbor devices.
- If multiple neighbor switches and/or routers, such as Cisco Unified Communication (UC) devices, are advertising their voice VLAN, the voice VLAN from the device with the lowest MAC address is used.

NOTE If connecting the device to a Cisco UC device, you may need to configure the port on the UC device using the *switchport voice vlan* command to ensure the UC device advertises its voice VLAN in CDP at the port.

- It synchronizes the voice VLAN-related parameters with other Auto Voice VLAN-enabled switches, using Voice Service Discovery Protocol (VSDP). The device always configures itself with the voice VLAN from the highest priority source it is aware of. The priority is based on the source type and MAC address of the source providing the voice VLAN information. Source type priority from high to low are static VLAN configuration, CDP advertisement, and default configuration based on changed default VLAN, and default voice VLAN. A numeric low MAC address is of higher priority than a numeric high MAC address.
- It maintains the voice VLAN until a new voice VLAN from a higher priority source is discovered or until the Auto Voice VLAN is restarted by the user. When restarted, the device resets the voice VLAN to the default voice VLAN and restarts the Auto Voice VLAN discovery.
- When a new voice VLAN is configured/discovered, the device automatically creates it, and replaces all the port memberships of the existing voice VLAN to the new voice VLAN. This may interrupt or terminate existing voice sessions, which is expected when network topology is altered.

Auto Smartport works with CDP/LLDP to maintain the port memberships of the voice VLAN when voice end-points are detected from the ports:

- When CDP and LLDP are enabled, the device sends out CDP and LLDP packets periodically to advertise the voice VLAN to the voice endpoints to use.
- When a device attaching to a port advertises itself as a voice endpoint through CDP and/or LLDP, the Auto Smartport automatically adds the port to the voice VLAN by applying the corresponding Smartport macro to the port (if there is no other devices from the port advertising a conflicting or superior capability). If a device advertises itself as a phone, the default Smartport macro is phone. If a device advertises itself as a phone and host or phone and bridge, the default Smartport macro is phone+desktop.

Voice VLAN QoS

Voice VLAN can propagate the CoS/802.1p and DSCP settings by using LLDP-MED Network policies. The LLDP-MED is set by default to response with the Voice QoS setting if an appliance sends LLDP-MED packets. MED-supported devices must send their voice traffic with the same CoS/802.1p and DSCP values, as received with the LLDP-MED response.

You can disable the automatic update between Voice VLAN and LLDP-MED and use his own network policies.

Working with the OUI mode, the device can additionally configure the mapping and remarking (CoS/802.1p) of the voice traffic based on the OUI.

By default, all interfaces are CoS/802.1p trusted. The device applies the quality of service based on the CoS/802.1p value found in the voice stream. For Telephony OUI voice streams, you can override the quality of service and optionally remark the 802.1p of the voice streams by specifying the desired CoS/802.1p values and using the remarking option under Telephony OUI.

Voice VLAN Constraints

The following constraints exist:

- Only one Voice VLAN is supported.
- A VLAN that is defined as a Voice VLAN cannot be removed

In addition the following constraints are applicable for Telephony OUI:

- The Voice VLAN cannot be VLAN1 (the default VLAN).

- The Voice VLAN cannot be Smartport enabled.
- The Voice VLAN QoS decision has priority over any other QoS decision, except for the Policy decision.
- A new VLAN ID can be configured for the Voice VLAN only if the current Voice VLAN does not have candidate ports.
- The interface VLAN of a candidate port must be in General or Trunk mode.
- 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 Forwarding Database (FDB). (If there is no free space in FDB, no action occurs).

Voice VLAN Workflows

The device default configuration on Auto Voice VLAN, Auto Smartports, CDP, and LLDP cover most common voice deployment scenarios. This section describes how to deploy voice VLAN when the default configuration does not apply.

Workflow1: To configure Auto Voice VLAN:

-
- STEP 1** Open the VLAN Management > Voice VLAN > Properties page.
- STEP 2** Select the Voice VLAN ID. It cannot be set to VLAN ID 1 (this step is not required for dynamic Voice VLAN).
- STEP 3** Set **Dynamic Voice VLAN** to Enable Auto Voice VLAN.
- STEP 4** Select the **Auto Voice VLAN Activation** method.
- NOTE** If the device is currently in Telephony OUI mode, you must disable it before you can configure Auto Voice Vlan
- STEP 5** Click **Apply**.
- STEP 6** Configure Smartports as described in the **Common Smartport Tasks** section.
- STEP 7** Configure LLDP/CDP as described in the **Configuring LLDP** and **Configuring CDP** sections, respectively.
- STEP 8** Enable the Smartport feature on the relevant ports using the Smartport > Interface Settings page.

NOTE Step 7 and Step 8 are optional as they are enabled by default.

Workflow2: To configure the Telephony OUI Method

STEP 1 Open the VLAN Management > Voice VLAN > Properties page. Set **Dynamic Voice VLAN** to Enable Telephony OUI.

NOTE If the device is currently in Auto Voice VLAN mode, you must disable it before you can enable Telephony OUI.

STEP 2 Configure Telephony OUI in the Telephony OUI page.

STEP 3 Configure Telephony OUI VLAN membership for ports in the Telephony OUI Interface page.

Configuring Voice VLAN

This section describes how to configure voice VLAN. It covers the following topics:

- **Configuring Voice VLAN Properties**
- **Displaying Auto Voice VLAN Settings**
- **Configuring Telephony OUI**

Configuring Voice VLAN Properties

Use the Voice VLAN Properties page for the following:

- View how voice VLAN is currently configured.
- Configure the VLAN ID of the Voice VLAN.
- Configure voice VLAN QoS settings.
- Configure the voice VLAN mode (Telephony OUI or Auto Voice VLAN).
- Configure how Auto Voice VLAN is triggered.

To view and configure Voice VLAN properties:

STEP 1 Click **VLAN Management > Voice VLAN > Properties**.

- The voice VLAN settings configured on the device are displayed in the **Voice VLAN Settings (Administrative Status)** block.
- The voice VLAN settings that are actually being applied to the voice VLAN deployment are displayed in the **Voice VLAN Settings (Operational Status)** block.

STEP 2 Enter values for the following fields:

- **Voice VLAN ID**—Enter the VLAN that is to be the Voice VLAN.

NOTE Changes in the voice VLAN ID, CoS/802.1p, and/or DSCP cause the device to advertise the administrative voice VLAN as a static voice VLAN. If the option *Auto Voice VLAN Activation* triggered by external Voice VLAN is selected, then the default values need to be maintained.

- **CoS/802.1p**—Select a CoS/802.1p value that to be used by LLDP-MED as a voice network policy. Refer to *Administration > Discovery > LLDP > LLDP MED Network Policy* for additional details.
- **DSCP**—Selection of DSCP values that to be used by the LLDP-MED as a voice network policy. Refer to *Administration > Discovery > LLDP > LLDP MED Network Policy* for additional details.
- **Dynamic Voice VLAN**—Select this field to disable or enable voice VLAN feature in one of the following ways:
 - *Enable Auto Voice VLAN*—Enable Dynamic Voice VLAN in Auto Voice VLAN mode.
 - *Enable Telephony OUI*—Enable Dynamic Voice VLAN in Telephony OUI mode.
 - *Disable*—Disable Auto Voice Vlan or Telephony OUI.
- **Auto Voice VLAN Activation**—If Auto Voice VLAN was enabled, select one of the following options to activate Auto Voice VLAN:
 - *Immediate*—Auto Voice VLAN on the device is to be activated and put into operation immediately if enabled.
 - *By External Voice VLAN Trigger*—Auto Voice VLAN on the device is activated and put into operation only if the device detects a device advertising the voice VLAN.

NOTE Manually re-configuring the voice VLAN ID, CoS/802.1p, and/or DSCP from their default values results in a static voice VLAN, which has higher priority than auto voice VLAN that was learned from external sources.

STEP 3 Click **Apply**. The VLAN properties are written to the Running Configuration file.

Displaying Auto Voice VLAN Settings

If Auto Voice VLAN mode is enabled, use the Auto Voice VLAN page to view the relevant global and interface parameters.

You can also use this page to manually restart Auto Voice VLAN, by clicking **Restart Auto Voice VLAN**. After a short delay, this resets the voice VLAN to the default voice VLAN and restarts the Auto Voice VLAN discovery and synchronization process on all the switches in the LAN that are Auto Voice VLAN enabled.

NOTE This only resets the voice VLAN to the default voice vlan if the Source Type is in the *Inactive* state.

To view Auto Voice VLAN parameters:

STEP 1 Click **VLAN Management > Voice VLAN > Auto Voice VLAN**.

The Operation Status block on this page shows the information about the current voice VLAN and its source:

- **Auto Voice VLAN Status**—Displays whether Auto Voice VLAN is enabled.
- **Voice VLAN ID**—The identifier of the current voice VLAN
- **Source Type**—Displays the type of source where the voice VLAN is discovered by the root device.
- **CoS/802.1p**—Displays CoS/802.1p values to be used by the LLDP-MED as a voice network policy.
- **DSCP**—Displays DSCP values to be used by the LLDP-MED as a voice network policy.
- **Root Switch MAC Address**—The MAC address of the Auto Voice VLAN root device that discovers or is configured with the voice VLAN from which the voice VLAN is learned.

- **Switch MAC Address**—Base MAC address of the device. If the device's Switch MAC address is the Root Switch MAC Address, the device is the Auto Voice VLAN root device.
- **Voice VLAN ID Change Time**—Last time that voice VLAN was updated.

STEP 2 Click **Restart Auto Voice VLAN** to reset the voice VLAN to the default voice VLAN and restart Auto Voice VLAN discovery on all the Auto-Voice-VLAN-enabled switches in the LAN.

The Voice VLAN Local Table displays voice VLAN configured on the device, as well as any voice VLAN configuration advertised by directly-connected neighbor devices. It contains the following fields:

- **Interface**—Displays the interface on which voice VLAN configuration was received or configured. If N/A appears, the configuration was done on the device itself. If an interface appears, a voice configuration was received from a neighbor.
- **Source MAC Address**— MAC address of a UC from which the voice configuration was received.
- **Source Type**— Type of UC from which voice configuration was received. The following options are available:
 - *Default*—Default voice VLAN configuration on the device
 - *Static*—User-defined voice VLAN configuration defined on the device.
 - *CDP*—UC that advertised voice VLAN configuration is running CDP.
 - *LLDP*—UC that advertised voice VLAN configuration is running LLDP.
 - *Voice VLAN ID*—The identifier of the advertised or configured voice VLAN
- **Voice VLAN ID**—The identifier of the current voice VLAN.
- **CoS/802.1p**—The advertised or configured CoS/802.1p values that are used by the LLDP-MED as a voice network policy.
- **DSCP**—The advertised or configured DSCP values that are used by the LLDP-MED as a voice network policy.
- **Best Local Source**—Displays whether this voice VLAN was used by the device. The following options are available:

- **Yes**—The device uses this voice VLAN to synchronize with other Auto Voice VLAN-enabled switches. This voice VLAN is the voice VLAN for the network unless a voice VLAN from a higher priority source is discovered. Only one local source is the best local source.
- **No**—This is not the best local source.

STEP 3 Click **Refresh** to refresh the information on the page

Configuring Telephony OUI

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 cause 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.

This section covers the following topics:

- **Adding OUIs to the Telephony OUI Table**
- **Adding Interfaces to Voice VLAN on Basis of OUIs**

Adding OUIs to the Telephony OUI Table

Use the Telephony OUI page to configure Telephony OUI QoS properties. In addition, the Auto Membership Aging time can be configured. If the specified time period passes with no telephony activity, the port is removed from the Voice VLAN.

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

To configure Telephony OUI and/or add a new Voice VLAN OUI:

STEP 1 Click **VLAN Management > Voice VLAN > Telephony OUI**.

The Telephony OUI page contains the following fields:

- **Telephony OUI Operational Status**—Displays whether OUIs are used to identify voice traffic.
- **CoS/802.1p**—Select the CoS queue to be assigned to voice traffic.

- **Remark CoS/802.1p**—Select whether to remark egress traffic.
- **Auto Membership Aging Time**—Enter the time delay to remove a port from the voice VLAN after all of the MAC addresses of the phones detected on the ports have aged out.

STEP 2 Click **Apply** to update the Running Configuration of the device with these values.

The Telephony OUI table appears:

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

STEP 3 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 4 To add a new OUI, click **Add**.

STEP 5 Enter the values for the following fields:

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

STEP 6 Click **Apply**. The OUI is added to the Telephony OUI Table.

Adding Interfaces to Voice VLAN on Basis of OUIs

The QoS attributes can be assigned per port to the voice packets in one of the following 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.
- **Telephony Source MAC Address (SRC)**—The QoS values configured for the Voice VLAN are applied to any incoming frame that is classified to the Voice VLAN and contains an OUI in the source MAC address that matches a configured telephony OUI.

Use the Telephony OUI Interface page to add an interface to the voice VLAN on the basis of the OUI identifier and to configure the OUI QoS mode of voice VLAN.

To configure Telephony OUI on an interface:

STEP 1 Click **VLAN Management > Voice VLAN > Telephony OUI Interface**.

The Telephony OUI Interface page contains voice VLAN OUI parameters for all interfaces.

STEP 2 To configure an interface to be a candidate port of the telephony OUI-based voice VLAN, click **Edit**.

STEP 3 Enter the values for the following fields:

- **Interface**—Select an interface.
- **Telephony OUI VLAN Membership**—If enabled, the interface is a candidate port of the telephony OUI based voice VLAN. When packets that match one of the configured telephony OUI are received, the port is added to the voice VLAN.
- **Voice VLAN QoS Mode**—Select one of the following options:
 - *All*—QoS attributes are applied on all packets that are classified to the Voice VLAN.
 - *Telephony Source MAC Address*—QoS attributes are applied only on packets from IP phones.

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

Spanning Tree

This section describes the Spanning Tree Protocol (STP) (IEEE802.1D and IEEE802.1Q) and covers the following topics:

- **STP Flavors**
- **Configuring STP Status and Global Settings**
- **Defining Spanning Tree Interface Settings**
- **Configuring Rapid Spanning Tree Settings**

STP Flavors

STP 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 stop transferring user data. After the topology changes so that the data transfer is made possible, the links are automatically re-activated.

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

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

The device 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.

NOTE The 200 series switches do not support MSTP.

Configuring STP Status and Global Settings

The STP Status and Global Settings page contains parameters for enabling STP or RSTP.

Use the STP Interface Settings page and RSTP Interface Settings page to configure ports with these modes, respectively.

To set the STP status and global settings:

STEP 1 Click **Spanning Tree > STP Status & Global Settings**.

STEP 2 Enter the parameters.

Global Settings:

- **Spanning Tree State**—Enable or disable STP on the device.
- **STP Operation Mode**—Select an STP mode.
- **BPDU Handling**—Select how Bridge Protocol Data Unit (BPDU) packets are managed when STP is disabled on the port or the device. 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 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.
- **Max Age**—Set the interval (in seconds) that the device 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 device.
- **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 appears in a days/hours/minutes/seconds format.

STEP 3 Click **Apply**. The STP Global settings are written to the Running Configuration file.

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 defined configuration entered is valid for all flavors of the STP protocol.

To configure STP on an interface:

STEP 1 Click **Spanning Tree > STP Interface Settings**.

STEP 2 Select an interface and click **Edit**.

STEP 3 Enter the parameters

- **Interface**—Select the Port 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 on a port, the port is automatically set to 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.

NOTE It is recommended to set the value to Auto so that the device sets the port to fast link mode if a host is connected to it, or sets it as a regular STP port if connected to another device. This helps avoid loops.

- **Root Guard**—Enables or disables Root Guard on the device. The Root Guard option provides a way to enforce the root bridge placement in the network.

Root Guard ensures that the port on which this feature is enabled is the designated port. Normally, all root bridge ports are designated ports, unless two or more ports of the root bridge are connected. If the bridge receives superior BPDUs on a Root Guard-enabled port, Root Guard moves this port to a root-inconsistent STP state. This root-inconsistent state is effectively equal to a listening state. No traffic is forwarded across this port. In this way, Root Guard enforces the position of the root bridge.

- **BPDU Guard**—Enables or disables the Bridge Protocol Data Unit (BPDU) Guard feature on the port.

The BPDU Guard enables you to enforce the STP domain borders and keep the active topology predictable. The devices behind the ports that have BPDU Guard enabled cannot influence the STP topology. At the reception of BPDUs, the BPDU guard operation disables the port that has BPDU configured. In this case, a BPDU message is received, and an appropriate SNMP trap is generated.

- **BPDU Handling**—Select how BPDU packets are managed when STP is disabled on the port or the device. BPDUs are used to transmit spanning tree information.
 - *Use Global Settings*—Select to use the settings defined in the STP Status and Global Settings page.
 - *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**—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.

- **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 written to the Running Configuration file.

Configuring Rapid Spanning Tree Settings

Rapid Spanning Tree Protocol (RSTP) enables 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 .

To enter RSTP settings:

STEP 1 Click **Spanning Tree > STP Status and Global Settings**. Enable **RSTP**.

STEP 2 Click **Spanning Tree > RSTP Interface Settings**. The RSTP Interface Settings page appears:

STEP 3 Select a port.

NOTE Activate Protocol Migration is only available after selecting the port that is 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. 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, the device communicates with it using RSTP.

STEP 5 Select an interface, and click **Edit**.

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 an RSTP edge port when this feature is enabled, and is brought 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 high speed.
 - *Auto*—Automatically determines the device status by using RSTP BPDUs.
- **Point to Point Operational Status**—Displays the Point-to-Point operational status if the **Point to Point Administrative Status** is set to Auto.
- **Role**—Displays the role of the port that was 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, which 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. This provides a configuration in which two ports are connected in a loop by a point-to-point link. Backup ports are also used when a LAN has two or more established connections 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 Running Configuration file is updated.

Managing MAC Address Tables

This section describe how to add MAC addresses to the system. It covers the following topics:

- **Configuring Static MAC Addresses**
- **Managing Dynamic MAC Addresses**
-

Types of MAC Addresses

There are two types of MAC addresses—static and dynamic. Depending on their type, MAC addresses are either stored in the *Static Address* table or in the *Dynamic Address* table, along with VLAN and port information.

Static addresses are configured by the user, and therefore, they do not expire.

A new source MAC address that appears in a frame arriving at the device is added to the Dynamic Address table. This MAC address is retained for a configurable period of time. If another frame with the same source MAC address does not arrive at the device before that time period expires, the MAC entry is aged (deleted) from the table.

When a frame arrives at the device, the device searches for a corresponding/ matching destination MAC address entry in the static or dynamic table. If a match is found, the frame is marked for egress on a the port specified in the table. If frames are sent to a MAC address that is not found in the tables, they are transmitted/broadcasted to all the ports on the relevant VLAN. Such frames are referred to as unknown Unicast frames.

The device supports a maximum of 8K static and dynamic MAC addresses.

Configuring Static MAC Addresses

Static MAC addresses are assigned to a specific physical interface and VLAN on the device. If that address is detected on another interface, it is ignored, and is not written to the address table.

To define a static address:

STEP 1 Click **MAC Address Tables > Static Addresses**.

The Static Addresses page contains the currently defined static addresses.

STEP 2 Click **Add**.

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 system never removes this MAC address. If the static MAC address is saved in the Startup Configuration, it is retained after rebooting.
 - *Delete on reset*—The static MAC address is deleted when the device is reset.
 - *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 (see [Configuring Port Security](#)).

STEP 4 Click **Apply**. A new entry appears in the table.

Managing Dynamic MAC Addresses

The Dynamic Address Table (bridging table) contains the MAC addresses acquired by monitoring the source addresses of frames entering the device.

To prevent this table from overflowing and to make room for new MAC addresses, an address is deleted if no corresponding traffic is received for a certain period. This period of time is the aging interval.

Configuring Dynamic MAC Address Aging Time

To configure the aging interval for dynamic addresses:

-
- STEP 1** Click **MAC Address Tables > Dynamic Address Settings**.
 - 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 aging time is updated.
-

Querying Dynamic Addresses

To query dynamic addresses:

-
- STEP 1** Click **MAC Address Tables > Dynamic Addresses**.
 - STEP 2** In the *Filter* block, you can 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 unit/slot, ports, or LAGs.
 - STEP 3** Enter the **Dynamic Address Table Sort Key** field by which the table is sorted. The address table can be sorted by VLAN ID, MAC address, or interface.
 - STEP 4** Click **Go**. The Dynamic MAC Address Table is queried and the results are displayed.

To delete all of the dynamic MAC addresses, click **Clear Table**.

Multicast

This section describes the Multicast Forwarding feature, and covers the following topics:

- **Multicast Forwarding**
- **Defining Multicast Properties**
- **Adding MAC Group Address**
- **Adding IP Multicast Group Addresses**
- **Configuring IGMP Snooping**
- **MLD Snooping**
- **Querying IGMP/MLD IP Multicast Group**
- **Defining Multicast Router Ports**
- **Defining Forward All Multicast**
- **Defining Unregistered Multicast Settings**

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 device 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 device, which 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 device 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 from which it received the Join messages that wants to receive a specific Multicast stream. The Mrouter forwards the requested Multicast stream to the interface.

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 device 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 device 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 is the process of listening and responding to Multicast registration protocols. The available protocols are IGMP for IPv4 and MLD for IPv6.

When IGMP/MLD snooping is enabled in a device on a VLAN, it analyzes the IGMP/MLD packets it receives from the VLAN connected to the device and Multicast routers in the network.

When a device learns that a host is using IGMP/MLD messages to register to receive a Multicast stream, optionally from a specific source, the device adds the registration to its Multicast Forwarding Data Base (MFDB).

IGMP/MLD snooping can effectively reduce Multicast traffic from streaming bandwidth-intensive IP applications. A device 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 device, and also reduces the workload of 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

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 that 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 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 ports 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. 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 saved as (*,G).

The following are ways of forwarding Multicast frames:

- **MAC Group Address**—Based on the destination MAC address in the Ethernet frame.

NOTE As mentioned before, one or more IP Multicast group addresses can be mapped to a MAC group address. Forwarding, based on the MAC group address, can result in an IP Multicast stream being forwarded 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 device 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**.

STEP 2 Enter the parameters.

- **Bridge Multicast Filtering Status**—Select to enable filtering.
- **VLAN ID**—Select the VLAN ID to set its forwarding method.
- **Forwarding Method for IPv6**—Set one of the following forwarding methods for IPv6 addresses: MAC Group Address, IP Group Address, or Source Specific IP Group Address.
- **Forwarding Method for IPv4**—Set one of the following forwarding methods for IPv4 addresses: MAC Group Address, IP Group Address, or Source Specific IP Group Address.

STEP 3 Click **Apply**. The Running Configuration file is updated.

Adding MAC Group Address

The device 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 it is 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 MFDB, 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 the MFDB that provide static forwarding information, based on MAC destination addresses.
- Display a list of all ports/LAGs that are a member of 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**.

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 contains 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.

Entries that were created both in this page and in the IP Multicast Group Address page are displayed. For those created in the IP Multicast Group Address page, the IP addresses are converted to MAC addresses.

STEP 4 Click **Add** to add a static MAC Group Address.

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 saved to the Running Configuration file.

To configure and display the registration for the interfaces within the group, select an address, and click **Details**.

The page contains:

- **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 not allowed to join 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 Running Configuration file is updated.

NOTE Entries that were created in the IP Multicast Group Address page cannot be deleted in this page (even if they are selected).

Adding IP Multicast Group Addresses

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 page contains 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 the 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.

STEP 4 Click **Add** to add a static IP Multicast Group Address.

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.

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 VLAN ID, IP Version, IP Multicast Group Address, and Source IP Address selected are displayed as read-only in the top of the window. You can select the filter type:

- **Interface Type equals to**—Select whether to display ports or LAGs.

STEP 8 For each interface, select its association type. The options are as follows:

- **Static**—Attaches the interface to the Multicast group as a static member.
- **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. This is selected by default until Static or Forbidden is selected.

STEP 9 Click **Apply**. The Running Configuration file is updated.

Configuring IGMP Snooping

To support selective Multicast forwarding (IPv4), Bridge Multicast filtering must be enabled (in the Properties page), and IGMP Snooping must be enabled globally and for each relevant VLAN (in the IGMP Snooping page).

By default, a Layer 2 device forwards Multicast frames to all ports of the relevant VLAN, essentially treating the frame as if it were a Broadcast. With IGMP Snooping the device forwards Multicast frames to ports that have registered Multicast clients.

NOTE The device 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 (Mrouter) that are generating IGMP queries.
- Which ports are receiving PIM, DVMRP, or IGMP query protocols.

These 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 Data Base.

To enable IGMP Snooping and identify the device as an IGMP Snooping Querier on a VLAN:

STEP 1 Click **Multicast > IGMP Snooping**.

STEP 2 Enable or disable the IGMP Snooping status.

When IGMP Snooping is enabled globally, the device monitoring network traffic can determine which hosts have requested to receive Multicast traffic.

The device only performs IGMP Snooping if both IGMP snooping and Bridge Multicast filtering are enabled.

STEP 3 Select a VLAN, and click **Edit**.

STEP 4 Enter the parameters.

- **VLAN ID**—Select the VLAN ID on which IGMP snooping is defined.
- **IGMP Snooping Status**—Enable or disable the monitoring of network traffic for the selected VLAN.
- **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 device 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 device 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 device assumes there are no more members for the group, if the device is 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 device cannot read Max Response Time value from group-specific queries 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.

STEP 5 Click **Apply**. The Running Configuration file is updated.

MLD Snooping

Hosts use the MLD protocol to report their participation in Multicast sessions, and the device uses MLD snooping to build Multicast membership lists. It uses these lists to forward Multicast packets only to device ports where there are host nodes that are members of the Multicast groups. The device does not support MLD Querier.

Hosts use the MLD protocol to report their participation in Multicast sessions.

The device 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 device from stations to an upstream Multicast router and vice versa. This facility enables a device 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. Only static definitions are preserved when the system is rebooted.

To enable MLD Snooping:

STEP 1 Click **Multicast > MLD Snooping**.

STEP 2 Enable or disable **MLD Snooping Status**. When MLD Snooping is globally enabled, the device monitoring network traffic can determine which hosts have requested to receive Multicast traffic. The device performs MLD Snooping only if both MLD snooping and Bridge Multicast filtering are enabled.

STEP 3 Select a VLAN, and click **Edit**.

STEP 4 Enter the parameters.

- **VLAN ID**—Select the VLAN ID.
- **MLD Snooping Status**—Enable or disable MLD snooping on the VLAN. The device monitors network traffic to determine which hosts have asked to be sent Multicast traffic. The device performs MLD snooping only when MLD snooping and Bridge Multicast filtering are both enabled
- **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 device 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 value to be used by the device if the device 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 device 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 device 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 device 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 device port.

STEP 5 Click **Apply**. The Running Configuration file is updated.

Querying IGMP/MLD IP Multicast Group

The IGMP/MLD IP Multicast Group page displays the IPv4 and IPv6 group address learned from IGMP/MLD messages.

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**.

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 destination ports for the Multicast stream.
 - **Excluded Ports**—The list of ports not included in the group.
 - **Compatibility Mode**—The oldest IGMP/MLD version of registration from the hosts the device receives on the IP group address.
-

Defining Multicast Router Ports

A Multicast router (Mrouter) port is a port that connects to a Multicast router. The device includes the Multicast router port(s) numbers when it forwards the Multicast streams and IGMP/MLD registration messages. This is required so that the Multicast routers can, in turn, forward the Multicast streams and propagate the registration messages to other subnets.

To statically configure or see dynamically-detected ports connected to the Multicast router:

STEP 1 Click **Multicast > Multicast Router Port**.

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.
- **IP Version 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 port or LAG, select its association type. The options are as follows:

- **Static**—The port is statically configured as a Multicast router port.
- **Dynamic**—(Display only) 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 Forbidden is enabled on a port, Mrouter is not learned on this port (i.e. MRouter Ports Auto-Learn is not enabled on this port).
- **None**—The port is not currently a Multicast router port.

STEP 5 Click **Apply** to update the device.

Defining Forward All Multicast

The Forward All page enables and displays the configuration of the ports and/or LAGs that are to receive Multicast streams from a specific VLAN. This feature requires that Bridge Multicast filtering in the Properties page be enabled. If it is disabled, then all Multicast traffic is flooded to ports in the device.

You can statically (manually) configure a port to Forward All, if the devices connecting to the port do not support IGMP and/or MLD.

IGMP or MLD messages are not forwarded to ports 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**.

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 port/LAG that is to be defined as Forward All by using the following methods:

- **Static**—The port receives all Multicast streams.
- **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 Running Configuration file is updated.

Defining Unregistered Multicast Settings

Multicast frames are generally forwarded to all ports in the VLAN. If IGMP/MLD Snooping is enabled, the device 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.

The device 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 device (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**.

STEP 2 Define the following:

- **Interface Type equals to**—The view as all ports or all LAGs.
- **Port/LAG**—Displays the port or LAG 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 **Apply**. The settings are saved, and the Running Configuration file is updated.

IP Configuration

IP interface addresses can be configured manually by the user, or automatically configured by a DHCP server. This section provides information for defining the device IP addresses, either manually or by making the device a DHCP client.

This section covers the following topics:

- [Overview](#)
- [IPv4 Management and Interfaces](#)
- [Domain Name](#)

Overview

Layer 2 IP Addressing

The device has up to one IPv4 address and up to two IPv6 interfaces (either “native” interface or Tunnel) in the management VLAN. This IP address and the default gateway can be configured manually, or by DHCP. The static IP address and default gateway are configured on the IPv4 Interface page. The device uses the default gateway, if configured, to communicate with devices that are not in the same IP subnet as the device. By default, VLAN 1 is the management VLAN, but this can be modified. The device can only be reached at the configured IP address through its management VLAN.

The factory default setting of the IPv4 address configuration is *DHCPv4*. This means that the device acts as a DHCPv4 client, and sends out a DHCPv4 request during boot up.

If the device receives a DHCPv4 response from the DHCPv4 server with an IPv4 address, it sends Address Resolution Protocol (ARP) packets to confirm that the IP address is unique. If the ARP response shows that the IPv4 address is in use, the device sends a DHCPDECLINE message to the offering DHCP server, and sends another DHCPDISCOVER packet that restarts the process.

If the device does not receive a DHCPv4 response in 60 seconds, it continues to send DHCPDISCOVER queries, and adopts the default IPv4 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 device.

When a VLAN is configured to use dynamic IP addresses, the device issues DHCPv4 requests until it is assigned an IPv4 address from a DHCPv4 server. The management VLAN can be configured with a static or dynamic IP address.

The IP address assignment rules for the device are as follows:

- Unless the device is configured with a static IPv4 address, it issues DHCPv4 queries until a response is received from a DHCPv4 server.
- If the IP address on the device is changed, the device issues gratuitous ARP packets to the corresponding VLAN to check IP address collisions. This rule also applies when the device 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 device 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.
- With factory default settings, when no statically-defined or DHCP-acquired IP address is available, the default IP address is used. When the other IP addresses become available, the addresses are automatically used. The default IP address is always on the management VLAN.

IPv4 Management and Interfaces

Defining an IPv4 Interface

To manage the device by using the web-based configuration utility, the IPv4 device management IP address must be defined and known. The device IP address can be manually configured or automatically taken from a DHCP server.

To configure the IPv4 device IP address:

STEP 1 Click **Administration > Management Interface > IPv4 Interface**.

STEP 2 Enter values for the following fields:

- **Management VLAN**—Select the Management VLAN used to access the device 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.

NOTE DHCP Option 12 (Host Name option) is supported when the device is an DHCP client. If DHCP Option 12 is received from a DHCP server, it is saved as the server's host name. DHCP option 12 will not be requested by the device. The DHCP server must be configured to send option 12 regardless of what is requested in order to make use of this feature.

If a static IP address is used, configure the following fields.

- **IP Address**—Enter the IP address, and configure one of the following **Mask** fields:
 - **Network Mask**—Select and enter the IP address mask.
 - **Prefix Length**—Select and enter the length of the IPv4 address prefix.
- **Administrative 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 device 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 those of the following fields that are enabled:

- **Renew IP Address Now**—The device dynamic IP address can be renewed any time after it is assigned by a DHCP server. Note that depending on your DHCP server configuration, the device might receive a new IP address after the renewal that requires setting the web-based configuration utility to the new IP address.
- **Auto Configuration via DHCP**—Displays status of Auto Configuration feature. You can configure this from *Administration > File Management > DHCP Auto Configuration*.

STEP 3 Click **Apply**. The IPv4 interface settings are written to the Running Configuration file.

ARP

The device maintains an ARP (Address Resolution Protocol) table for all known devices that reside in the IP subnets directly connected to it. A directly-connected IP subnet is the subnet to which an IPv4 interface of the device is connected. When the device is required 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 addresses are manually configured and do not age out. The device creates dynamic addresses from the ARP packets it receives. Dynamic addresses age out after a configured time.

NOTE The IP/MAC address mapping in the ARP Table is used to forward traffic originated by the device.

To define the ARP tables:

STEP 1 Click **IP Configuration > IPv4 Management and Interfaces > ARP**.

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 only returns when it is relearned.
- **Clear ARP Table Entries**—Select the type of ARP entries to be cleared from 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.

STEP 3 Click **Apply**. The ARP global settings are written to the Running Configuration file.

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 4 Click **Add**.

STEP 5 Enter the parameters:

- **IP Version**—The IP address format supported by the host. Only IPv4 is supported.
- **VLAN**—In Layer 2, displays the management VLAN ID.

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.

- **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 saved to the Running Configuration file.

IPv6 Global Configuration

To define IPv6 global parameters and DHCPv6 client settings:

STEP 1 Click **Administration > Management Interface > IPv6 Global Configuration**.

STEP 2 Enter values for the following fields:

- **ICMPv6 Rate Limit Interval**—Enter how often the ICMP error messages are generated.
- **ICMPv6 Rate Limit Bucket Size**—Enter the maximum number of ICMP error messages that can be sent by the device per interval.

DHCPv6 Client Settings

- **Unique Identifier (DUID) Format**—This is the identifier of the DHCP client that is used by the DHCP server to locate the client. It can be in one of the following formats:
 - *Link-Layer*—(Default). If you select this option, the MAC address of the device is used.
 - *Enterprise Number*—If you select this option, enter the following fields.
- **Enterprise Number**—The vendors registered Private Enterprise number as maintained by IANA.
- **Identifier**—The vendor-defined hex string (up to 64 hex characters). If the number of the character is not even, a zero is added at the right. Each 2 hex characters can be separated by a period or colon.
- **DHCPv6 Unique Identifier (DUID)**—Displays the identifier selected.

IPv6 Interface

An IPv6 interface can be configured on a port, LAG, VLAN, or tunnel.

A tunnel interface is configured with an IPv6 address based on the settings defined in the IPv6 Tunnel page.

To define an IPv6 interface:

STEP 1 Click **Administration > Management Interface > IPv6 Interfaces**.

STEP 1

STEP 2 Click **Add** to add a new interface on which interface IPv6 is enabled.

STEP 3 Enter the field:

- **Pv6 Interface**—Select a specific port, LAG, VLAN, or ISATAP tunnel for the IPv6 address.

STEP 4 To configure the interface as a DHCPv6 client, meaning to enable the interface to receive information from the DHCPv6 server, such as: SNTP configuration and DNS information, enter the **DHCPv6 Client** fields:

- **Stateless**—Select to enable the interface as a stateless DHCPv6 client.
- **Minimum Information Refresh Time**—This value is used to put a floor on the refresh time value. If the server sends a refresh time option that is less than this value, this value is used instead. Select either **Infinite** (no refresh unless the server sends this option) or **User Defined** to set a value.
- **Information Refresh Time**—This value indicates how often the device will refresh information received from the DHCPv6 server. If this option is not received from the server, the value entered here is used. Select either **Infinite** (no refresh unless the server sends this option) or **User Defined** to set a value.

STEP 5 To configure additional IPv6 parameters, enter the following fields:

- **IPv6 Address Auto Configuration**—Select to enable automatic address configuration from router advertisements sent by neighbors.

NOTE The device does not support stateful address auto configuration from a DHCPv6 server.

- **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 a new Unicast IPv6 address before it is 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.

- **Send ICMPv6 Messages**—Enable generating unreachable destination messages.

STEP 6 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 7 Click **IPv6 Address Table** to manually assign IPv6 addresses to the interface, if required. This page is described in the [Defining IPv6 Addresses](#) section.

STEP 8 Press the **Restart** button to initiate refresh of the stateless information received from the DHCPv6 server.

DHCPv6 Client Details

The **DHCPv6 Client Details** button displays information received on the interface from a DHCPv6 server.

It is active when the interface selected is defined as a DHCPv6 stateless client.

When the button is pressed, it displays the following fields (for the information that was received from the DHCP server):

- **DHCPv6 Operational Mode**—This displays Enabled if the following conditions are fulfilled:
 - The interface is Up.
 - IPv6 is enabled on it.
 - DHCPv6 stateless client is enabled on it.
- **Stateless Service**—Is the client defined as stateless (receives configuration information from a DHCP server) or not.
- **DHCPv6 Server Address**—Address of DHCPv6 server.
- **DHCPv6 Server DUID**—Unique identifier of the DHCPv6 server.
- **DHCPv6 Server Preference**—Priority of this DHCPv6 server.
- **Information Minimum Refresh Time**— See above.
- **Information Refresh Time**—See above.

- **Received Information Refresh Time**—Refresh time received from DHCPv6 server.
- **Remaining Information Refresh Time**—Remaining time until next refresh.
- **DNS Servers**—List of DNS servers received from the DHCPv6 server.
- **DNS Domain Search List**—List of domains received from the DHCPv6 server.
- **SNTP Servers**—List of SNTP servers received from the DHCPv6 server.
- **POSIX Timezone String**—Timezone received from the DHCPv6 server.
- **Configuration Server**—Server containing configuration file received from the DHCPv6 server.
- **Configuration Path Name**—Path to configuration file on the configuration server received from the DHCPv6 server.

IPv6 Tunnel

Tunnels enable transmission of IPv6 packets over IPv4 networks. Each tunnel has a source IPv4 address and a destination IPv4 address. The IPv6 packet is encapsulated between these addresses.

ISATAP Tunnels

The type of tunnel that can be configured on the device is called an Intra-Site Automatic Tunnel Addressing Protocol (ISATAP) tunnel, which is a point-to-multi-point tunnel. The source address is the IPv4 address of the device.

When configuring an ISATAP tunnel, the destination IPv4 address is provided by the router. 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, the ISATAP host name-to-address mapping is searched for 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.

Configuring Tunnels

NOTE To configure a tunnel, first configure an IPv6 interface as a tunnel in the IPv6 Interfaces page.

To configure an IPv6 tunnel:

STEP 1 Click **Administration > Management Interface > IPv6 Tunnel**.

STEP 2 Enter values for the following fields:

- **Tunnel Number**—Displays the automatic tunnel router domain number.
- **Tunnel Type**—Always ISATAP.
- **Source IPv4 Address**—The IPv4 address of the selected interface on the current device used to form part of the IPv6 address.
 - *Auto*—Automatically selects the lowest IPv4 address from among all of its configured IPv4 interfaces on the device. This option is equivalent to the Interface option in Layer 3, because in Layer 2 there is only one interface.
- **ISATAP Router 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.
- **ISATAP Solicitation Interval**—The number of seconds between ISATAP router solicitations messages, when there is no active ISATAP router. The interval can be the default value or a user defined interval.
- **ISATAP Robustness**—Used to calculate the interval for the DNS or router solicitation queries. The larger the number, the more frequent the queries.

NOTE The ISATAP tunnel is not operational if the underlying IPv4 interface is not in operation.

STEP 3 Click **Apply**. The tunnel is saved to the Running Configuration file.

Defining IPv6 Addresses

To assign an IPv6 address to an IPv6 Interface:

STEP 1 Click **Administration > Management Interface > IPv6 Addresses**

STEP 1

STEP 2 To filter the table, select an interface name, and click **Go**. The interface appears in the IPv6 Address Table.

Click **Add**.

STEP 3 Enter values for the fields.

- **IPv6 Interface**—Displays the interface on which the IPv6 address is to be defined. If an * is displayed, this means that the IPv6 interface is not enabled but has been configured.
- **IPv6 Address Type**—Select the type of the IPv6 address to add.
 - *Link Local*—An IPv6 address that 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*—An IPv6 address that is a global Unicast IPV6 type that is visible and reachable from other networks.
- **IPv6 Address**—In Layer 2, the device supports one IPv6 interface. In addition 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.**Prefix Length**—The length of the Global IPv6 prefix is a 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 4 Click **Apply**. The Running Configuration file is updated.

To define prefixes to be advertised on the interfaces of the device:

STEP 5

IPv6 Default Router List

The IPv6 Default Router List page enables configuring and viewing the default IPv6 router addresses. This list contains the routers that are candidates to become the device default router for non-local traffic (it may be empty). The device randomly selects a router from the list. The device supports one static IPv6 default router. Dynamic default routers are routers that have sent router advertisements to the device 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 appears after an attempt is made to insert more than a single user-defined address.
- An alert message appears when attempting to insert a non-link local type address, meaning 'fe80:'.

To define a default router:

STEP 1 Click **Administration > Management Interface > IPv6 Default Router List**.

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*.

- *Unreachable*—Positive confirmation was not 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 device 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.

STEP 3 Enter the following fields:

- **Link Local Interface**—Displays the outgoing Link Local interface.
- **Default Router IPv6 Address**—The IP address of the default router

STEP 4 Click **Apply**. The default router is saved to the Running Configuration file.

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 device. This is the IPv6 equivalent of the IPv4 ARP Table. When the device needs to communicate with its neighbors, the device uses the IPv6 Neighbor Table to determine the MAC addresses based on their 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 Click **Administration > Management Interface > IPv6 Neighbors**

STEP 1

STEP 2 You can 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.
- **Router**—Specifies whether the neighbor is a router (**Yes** or **No**).

STEP 3 To add a neighbor to the table, click **Add**.

STEP 4 Enter 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 Running Configuration file is updated.

STEP 6 To change the type of an IP address from **Dynamic** to **Static**, select the address, click **Edit** and use the Edit IPv6 Neighbors page.

Viewing IPv6 Route Tables

The IPv6 Forwarding Table contains the various routes that have been configured. One of these routes is a 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 device. In addition to the default route, the table also contains dynamic routes that are ICMP redirect routes received from IPv6 routers by using ICMP redirect messages. This could happen when the default router the device uses is not the router for traffic to which the IPv6 subnets that the device wants to communicate.

To view IPv6 routes:

STEP 1 Click **Administration > Management Interface > IPv6 Routes**.

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. It can be one of the following types.
 - *Link Local*—An IPv6 interface and IPv6 address that 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*—An IPv6 address that is a global Unicast IPV6 type that is visible and reachable from other networks.
- *Point-to-Point*—A Point-to-point tunnel.
- **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.
- **Lifetime**—Time period during which 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*—A directly-connected network whose prefix is derived from a manually-configured device's IPv6 address.
 - *Dynamic*—The destination is an indirectly-attached (remote) IPv6 subnet address. The entry was obtained dynamically via the ND or ICMP protocol.
 - *Static*—The entry was manually configured by a user.

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Domain Name

The Domain Name System (DNS) translates domain names into IP addresses for the purpose of locating and addressing hosts.

As a DNS client, the device resolves domain names to IP addresses through the use of one or more configured DNS servers.

DNS Settings

Use the DNS Settings page to enable the DNS feature, configure the DNS servers and set the default domain used by the device.

STEP 1 Click **IP Configuration** > **Domain Name** > **DNS Settings**.

STEP 2 Enter the parameters.

- **DNS**—Select to designate the device as a DNS client, which can resolve DNS names into IP addresses through one or more configured DNS servers.
- **Polling Retries**—Enter the number of times to send a DNS query to a DNS server until the device decides that the DNS server does not exist.
- **Polling Timeout**—Enter the number of seconds that the device will wait for a response to a DNS query.
- **Polling Interval**—Enter how often (in seconds) the device sends DNS query packets after the number of retries has been exhausted.
 - *Use Default*—Select to use the default value.
$$\text{This value} = 2 * (\text{Polling Retries} + 1) * \text{Polling Timeout}$$
 - *User Defined*—Select to enter a user-defined value.
- **Default Parameters**—Enter the following default parameters:
 - **Default Domain Name**—Enter the DNS domain name used to complete unqualified host names. The device appends this to all non-fully qualified domain names (NFQDNs) turning them into FQDNs.
NOTE Do not include the initial period that separates an unqualified name from the domain name (like cisco.com).
 - **DHCP Domain Search List**—Click **Details** to view the list of DNS servers configured on the device.

STEP 3 Click **Apply**. The Running Configuration file is updated.

DNS Server Table: The following fields are displayed for each DNS server configured:

- **DNS Server**—The IP address of the DNS server.
- **Preference**—Each server has a preference value, a lower value means a higher chance of being used.

- **Source**—Source of the server's IP address (static or DHCPv4 or DHCPv6)
- **Interface**—Interface of the server's IP address.

STEP 4 Up to eight DNS servers can be defined. To add a DNS server, click **Add**.

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 the interface through which it is received.
- **DNS Server IP Address**—Enter the DNS server IP address.
- **DNS Server State**—Select to activate the new DNS server.

STEP 5 Click **Apply**. The DNS server is saved to the Running Configuration file.

Search List

The search list can contain one static entry defined by the user the DNS Settings page and dynamic entries received from DHCPv4 and DHCPv6 servers.

To view the domain names that have been configured on the device:

STEP 1 Click **IP Configuration > Domain Name > Search List**.

The following fields are displayed for each DNS server configured on the device.

- **Domain Name**—Name of domain that can be used on the device.
- **Source**—Source of the server's IP address (static or DHCPv4 or DHCPv6) for this domain.

- **Interface**—Interface of the server's IP address for this domain.
- **Preference**—This is the order in which the domains are used (from low to high). This effectively determines the order in which unqualified names are completed during DNS queries.

Host Mapping

Host name/IP address mappings are stored in the Host Mapping Table (DNS cache).

This cache can contain the following type of entries:

- **Static Entries**—These are mapping pairs that were manually added to the cache. There can be up to 64 static entries.
- **Dynamic Entries**—These are mapping pairs that were either added by the system as a result of being used by the user, or and an entry for each IP address configured on the device by DHCP. There can be 256 dynamic entries.

Name resolution always begins by checking static entries, continues by checking the dynamic entries, and ends by sending requests to the external DNS server.

Eight IP addresses are supported per DNS server per host name.

To add a host name and its IP address:

STEP 1 Click **IP Configuration > Domain Name System > Host Mapping**.

STEP 2 You can select a **Clear Table** option to clear some or all of the entries in the Host Mapping Table.

- **Static Only**—Deletes the static hosts.
- **Dynamic Only**—Deletes the dynamic hosts.
- **All Dynamic & Static**—Deletes the static and dynamic hosts.

The Host Mapping Table displays the following fields:

- **Host Name**—User-defined host name or fully-qualified name.
- **IP Address**—The host IP address.
- **Type**—Is this a **Dynamic** or **Static** entry to the cache.
- **Status**— Displays the results of attempts to access the host

- *OK*—Attempt succeeded.
- *Negative Cache*—Attempt failed, do not try again.
- *No Response*—There was no response, but system can try again in future.
- **TTL**— If this is a dynamic entry, how long will it remain in the cache.
- **Remaining TTL**— If this is a dynamic entry, how much longer will it remain in the cache.

STEP 3 To add a host mapping, click **Add**.

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 the interface through which it is received.
- **Host Name**—Enter a user-defined host name or fully-qualified name. Host names are restricted to the ASCII letters A through Z (case-insensitive), the digits 0 through 9, the underscore and the hyphen. A period (.) is used to separate labels.
- **IP Address(es)**—Enter a single address or up to eight associated IP addresses (IPv4 or IPv6).

Security

This section describes device security and access control. The system handles various types of security.

The following list of topics describes the various types of security features described in this section. 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.

Permission to administer the device is described in the following sections:

- **Defining Users**
- **Configuring RADIUS**
- **Configuring Management Access Authentication**
- **Defining Management Access Method**
- **SSL Server**
- **SSL Server**

Protection from attacks directed at the device CPU is described in the following sections:

- **Configuring TCP/UDP Services**
- **Defining Storm Control**

Access control of end-users to the network through the device is described in the following sections:

- **Configuring Management Access Authentication**
- **Defining Management Access Method**
- **Configuring RADIUS**
- **Configuring Port Security**
- **Configuring 802.1X**

Protection from other network users is described in the following sections. These are attacks that pass through, but are not directed at, the device.

- [Denial of Service Prevention](#)
- [SSL Server](#)
- [Defining Storm Control](#)
- [Configuring Port Security](#)

Defining Users

The default username/password is **cisco/cisco**. The first time that you log in with the default username and password, you are required to enter a new password. Password complexity is enabled by default. If the password that you choose is not complex enough (**Password Complexity Settings** are enabled in the Password Strength page), you are prompted to create another password.

Setting User Accounts

The User Accounts page enables entering additional users that are permitted to access to the device (read-only or read-write) or changing the passwords of existing users.

After adding a user (as described below), the default user is removed from the system.

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**.

This page displays the users defined in the system and their user privilege level.

STEP 2 Select **Password Recovery Service** to enable this feature. When this is enabled, an end user, with physical access to the console port of the device, can enter the boot menu and trigger the password recovery process. When the boot system process ends, you are allowed to login to the device without password authentication. Entering the device is allowed only via the console and only when the console is connected to the device with physical access.

When password recovery mechanism is disabled, accessing the boot menu is still allowed and you can trigger the password recovery process. The difference is that in this case, all configuration and user files are removed during the system boot process, and a suitable log message is generated to the terminal.

STEP 3 Click **Add** to add a new user or click **Edit** to modify a user.

STEP 4 Enter the parameters.

- **User Name**—Enter a new username between 0 and 20 characters. UTF-8 characters are not permitted.
- **Password**—Enter a password (UTF-8 characters are not permitted). If the password strength and complexity is defined, the user password must comply with the policy 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 5 Click **Apply**. The user is added to the Running Configuration file of the device.

Setting Password Complexity Rules

Passwords are used to authenticate users accessing the device. Simple passwords are potential security hazards. Therefore, password complexity requirements are enforced by default and may be configured as necessary. Password complexity requirements are configured on the **Password Strength** page reached through the Security drop-down menu. Additionally, password aging time may be configured on this page.

To define password complexity rules:

STEP 1 Click **Security > Password Strength**.

STEP 2 Enter the following aging parameters for passwords:

- **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 is prompted to change the password.

NOTE Password aging also applies to zero-length passwords (no password).

STEP 3 Select **Password Complexity Settings** to enable complexity rules for passwords.

If password complexity is enabled, new passwords must conform to the following default settings:

- Have a minimum length of eight characters.
- Contain characters from at least three character classes (uppercase letters, lowercase letters, numbers, and special characters available on a standard keyboard).
- Are different from the current password.
- Contain no character that is repeated more than three times consecutively.
- Do not repeat or reverse the users name or any variant reached by changing the case of the characters.
- Do not repeat or reverse the manufacturers name or any variant reached by changing the case of the characters.

STEP 4 If the **Password Complexity Settings** are enabled, the following parameters may be configured:

- **Minimal Password Length**—Enter the minimal number of characters required for passwords.

NOTE A zero-length password (no password) is allowed, and can still have password aging assigned to it.
- **Allowed Character Repetition**—Enter the number of times that a character can be repeated.
- **Minimal Number of Character Classes**—Enter the number of character classes which must be present in a password. Character classes are lower case (1), upper case (2), digits (3), and symbols 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 upon a password change.

STEP 5 Click **Apply**. The password settings are written to the Running Configuration file.

Configuring RADIUS

Remote Authorization Dial-In User Service (RADIUS) servers provide a centralized 802.1X or MAC-based network access control. The device is a RADIUS client that can use a RADIUS server to provide centralized security.

An organization can establish a Remote Authorization Dial-In User Service (RADIUS) server to provide centralized 802.1X or MAC-based network access control for all of its devices. In this way, authentication and authorization can be handled on a single server for all devices in the organization.

The device can act as a RADIUS client that uses the RADIUS server for the following services:

- **Authentication**—Provides authentication of regular and 802.1X users logging onto the device 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.
- **Accounting**—Enable accounting of login sessions using the RADIUS server. This enables a system administrator to generate accounting reports from the RADIUS server.

Accounting Using a RADIUS Server

The user can enable accounting of login sessions using either a RADIUS or TACACS+ server.

The user-configurable, TCP port used for RADIUS server accounting is the same TCP port that is used for RADIUS server authentication and authorization.

Defaults

The following defaults are relevant to this feature:

- No default RADIUS server is defined by default.
- If you configure a RADIUS server, the accounting feature is disabled by default.

Interactions With Other Features

You cannot enable accounting on both a RADIUS and TACACS+ server.

Radius Workflow

To use a RADIUS server, do the following:

-
- STEP 1** Open an account for the device on the RADIUS server.
- STEP 2** Configure that server along with the other parameters in the RADIUS and ADD RADIUS Server pages.

NOTE If more than one RADIUS server has been configured, the device uses the configured priorities of the available RADIUS servers to select the RADIUS server to be used by the device.

To set the RADIUS server parameters:

-
- STEP 1** Click **Security > RADIUS**.
- STEP 2** Enter the default RADIUS parameters if required. Values entered in the Default Parameters are applied to all servers. If a value is not entered for a specific server (in the Add RADIUS Server page) the device uses the values in these fields.
- **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 device 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 between the device 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. The key can be entered in **Encrypted** or **Plaintext** form. If you do not have an encrypted key string (from another device), enter the key string in plaintext mode and click **Apply**. The encrypted key string is generated and displayed.

This overrides the default key string if one has been defined.

STEP 3 Click **Apply**. The RADIUS default settings for the device are updated in the Running Configuration file.

To add a RADIUS server, click **Add**.

STEP 4 Enter the values in the fields for each RADIUS server. To use the default values entered in the RADIUS page, select **Use Default**.

- **Server Definition**—Select whether to specify the RADIUS server by IP address or name.
 - **IPv6 Address Type**—Displays that IPv6 address type is Global.
 - **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.
 - **Server IP Address/Name**—Enter the RADIUS server by IP address or name.
 - **Priority**—Enter the priority of the server. The priority determines the order the device attempts to contact the servers to authenticate a user. The device starts with the highest priority RADIUS server first. Zero is the highest priority.
- Key String**—Enter the key string used for authenticating and encrypting communication between the device and the RADIUS server. This key must match the key configured on the RADIUS server. It can be entered in **Encrypted** or **Plaintext** format. If **Use Default** is selected, the device attempts to authenticate to the RADIUS server by using the default Key String.
- **Timeout for Reply**—Enter the number of seconds the device waits for an answer from the RADIUS server before retrying the query, or switching to the next server if the maximum number of retries were made. If **Use Default** is selected, the device uses the default timeout value.

- **Authentication Port**—Enter the UDP port number of the RADIUS server port for authentication requests.
- **Retries**—Enter the number of requests that are sent to the RADIUS server before a failure is considered to have occurred. If **Use Default** is selected, the device uses 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. If **Use Default** is selected, the device uses 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 ask to administer the device.
 - *802.1X*—RADIUS server is used for 802.1x authentication.
 - *All*—RADIUS server is used for authenticating user that ask to administer the device and for 802.1X authentication.

STEP 5 To display sensitive data in plaintext form in the configuration file, click **Display Sensitive Data As Plaintext**.

STEP 6 Click **Apply**. The RADIUS server definition is added to the Running Configuration file of the device.

Configuring Management Access Authentication

You can assign authentication methods to the various management access methods, such as SSH, console, HTTP, and HTTPS. The authentication can be performed locally or on a RADIUS server.

For the RADIUS server to grant access to the web-based configuration utility, the RADIUS server must return `cisco-avpair = shell:priv-lvl= 15`.

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 device. In other words, if authentication fails at an authentication method, the device stops the authentication attempt; 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**.

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.
- *None*—User is allowed to access the device without authentication.
- *Local*—Username and password are checked against the data stored on the local device. 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.

Defining Management Access Method

Access profiles determine how to authenticate and authorize users accessing the device through various access methods. Access Profiles can limit management access from specific sources.

Only users who pass both the active access profile and the management access authentication methods are given management access to the device.

There can only be a single access profile active on the device at one time.

Access profiles 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 device:
 - 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 are denied access to the web-based configuration utility.
- **Source IP Address**—IP addresses or subnets that are allowed access.

Active Access Profile

The Access Profiles page displays the access profiles that are defined and enables selecting one access profile to be the active one.

When a user attempts to access the device through an access method, the device looks to see if the active access profile explicitly permits management access to the device through this method. If no match is found, access is denied.

When an attempt to access the device is in violation of the active access profile, the device generates a SYSLOG message to alert the system administrator of the attempt.

For more information see [Defining Profile Rules](#).

Use the Access Profiles page to create an access profile and to add its first rule. If the access profile only contains a single rule, you are finished. To add additional rules to the profile, use the Profile Rules page.

STEP 1 Click **Security > Mgmt Access Method > Access Profiles**.

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 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 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.
- STEP 5** Enter the **Access Profile Name**. This name can contain up to 32 characters.
- STEP 6** Enter the parameters.
- **Rule Priority**—Enter the rule priority. When the packet is matched to a rule, user groups are either granted or denied access to the device. 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. The options are:
 - *All*—Assigns all management methods to the rule.
 - *HTTP*—Users requesting access to the device that meets the HTTP access profile criteria, are permitted or denied.
 - *Secure HTTP (HTTPS)*—Users requesting access to the device that meets the HTTPS access profile criteria, are permitted or denied.
 - *SNMP*—Users requesting access to the device that meets 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 device if the user matches the settings in the profile.
 - *Deny*—Denies access to the device 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 to selected interface.
 - **Interface**—Enter the interface number if User Defined was 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 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 7 Click **Apply**. The access profile is written to the Running Configuration file. 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 device, and the access methods that may be used.

Each rule in an access profile contains an action and 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 device from all IP addresses except IP addresses that are allocated to the IT management center. In this way, the device can still be managed and has gained another layer of security.

To add profile rules to an access profile:

STEP 1 Click **Security > Mgmt Access Method > Profile Rules**.

STEP 2 Select the Filter field, and an access profile. Click **Go**.

The selected access profile appears in the Profile Rule Table.

STEP 3 Click **Add** to add a rule.

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 device. 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.
 - *HTTP*—Assigns HTTP access to the rule. Users requesting access to the device that meets the HTTP access profile criteria, are permitted or denied.
 - *Secure HTTP (HTTPS)*—Users requesting access to the device that meets the HTTPS access profile criteria, are permitted or denied.
 - *SNMP*—Users requesting access to the device that meets the SNMP access profile criteria are permitted or denied.
- **Action**—Select **Permit** to permit the users that attempt to access the device 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.
- **Interface**—Enter the interface number.
- **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.

SSL Server

This section describes the Secure Socket Layer (SSL) feature.

SSL Overview

The Secure Socket Layer (SSL) feature is used to open an HTTPS session to the device.

An HTTPS session may be opened with the default certificate that exists on the device.

Some browsers generate warnings when using a default certificate, since this certificate is not signed by a Certification Authority (CA). It is best practice to have a certificate signed by a trusted CA.

To open an HTTPS session with a user-created certificate, perform the following actions:

1. Generate a certificate.
2. Request that the certificate be certified by a CA.
3. Import the signed certificate into the device.

Default Settings and Configuration

By default, the device contains a certificate that can be modified.

HTTPS is enabled by default.

SSL Server Authentication Settings

It may be required to generate a new certificate to replace the default certificate found on the device.

To create a new certificate, modify an existing one, or import a certificate:

STEP 1 Click **Security > SSL Server > SSL Server Authentication Settings**.

Information appears for certificate 1 and 2 in the SSL Server Key Table. These fields are defined in the **Edit** page except for the following fields:

- **Valid From**—Specifies the date from which the certificate is valid.
- **Valid To**—Specifies the date up to which the certificate is valid.
- **Certificate Source**—Specifies whether the certificate was generated by the system (Auto Generated) or the user (User Defined).

STEP 2 Select an active certificate.

STEP 3 You can perform one of the following actions by clicking the relevant button:

- **Edit**—Select one of the certificates and enter the following fields for it:
 - *Regenerate RSA Key*—Select to regenerate the RSA key.
 - *Key Length*—Enter the length of the RSA key to be generated.
 - *Common Name*—Specifies the fully-qualified device URL or IP address. If unspecified, defaults to the lowest IP address of the device (when the certificate is generated).
 - *Organization Unit*—Specifies the organization-unit or department name.
 - *Organization Name*—Specifies the organization name.
 - *Location*—Specifies the location or city name.
 - *State*—Specifies the state or province name.
 - *Country*—Specifies the country name.

- *Duration*—Specifies the number of days a certification is valid.
 - **Generate Certificate Request**—Generate a certificate request to be signed by a CA.
 - Enter the fields for the certificate (same as fields in **Edit** page).
- STEP 4** Click **Generate Certificate Request**. This creates a key that must be entered on the CA.
- **Import Certificate**—When the approval is received from the CA, enter the following:
 - *Certificate ID*—Select the active certificate.
 - *Certificate*—Copy in the received certificate.
 - *Import RSA KEY-Pair*—Select to enable copying in the new RSA key-pair.
 - *Public Key*—Copy in the RSA public key.
 - *Private Key (Encrypted)*—Select and copy in the RSA private key in encrypted form.
 - *Private Key (Plaintext)*—Select and copy in the RSA private key in plain text form.
 - *Display Sensitive Data as Encrypted*—Click this button to display this key as encrypted. When this button is clicked, the private keys are written to the configuration file in encrypted form (when Apply is clicked).
 - **Details**—Displays the certificate and RSA key pair. This is used to copy the certificate and RSA key-pair to another device (using copy/paste). When you click **Display Sensitive Data as Encrypted**, the private keys are displayed in encrypted form.
- STEP 5** Click **Apply** to apply the changes to the Running Configuration.
-

Configuring TCP/UDP Services

The TCP/UDP Services page enables TCP or UDP-based services on the device, usually for security reasons.

The device offers the following TCP/UDP services:

- **HTTP**—Enabled by factory default
- **HTTPS**—Enabled by factory default
- **SNMP**—Disabled by factory default
- **SSH**—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**.

STEP 2 Enable or disable the following TCP/UDP services on the displayed services.

- **HTTP Service**—Indicates whether the HTTP service is enabled or disabled.
- **HTTPS Service**—Indicates whether the HTTPS service is enabled or disabled.
- **SNMP Service**—Indicates whether the SNMP service is enabled or disabled.
- **SSH Service**—Indicates whether the SSH server service is enabled or disabled.

The TCP Service Table displays the following fields for each service:

- **Service Name**—Access method through which the device is offering the TCP service.
- **Type**—IP protocol the service uses.
- **Local IP Address**—Local IP address through which the device is offering the service.
- **Local Port**—Local TCP port through which the device 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**—Access method through which the device is offering the UDP service.

- **Type**—IP protocol the service uses.
- **Local IP Address**—Local IP address through which the device is offering the service.
- **Local Port**—Local UDP port through which the device is offering the service.
- **Application Instance**—The service instance of the UDP service. (For example, when two senders send data to the same destination.)

STEP 3 Click **Apply**. The services are written to the Running Configuration file.

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 traffic storm.

Storm protection enables you to limit the number of frames entering the device and to define the types of frames that are counted towards this limit.

When the rate of Broadcast, Multicast, or Unknown Unicast frames is higher than the user-defined threshold, frames received beyond the threshold are discarded.

To define Storm Control:

STEP 1 Click **Security > Storm Control**.

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**.

STEP 3 Enter the parameters.

- **Interface**—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. The default for this threshold is 10,000 for FE devices and 100,000 for GE devices.
- **Storm Control Mode**—Select one of the modes:
 - *Unknown Unicast, Multicast & Broadcast*—Counts unknown Unicast, Broadcast, and Multicast traffic towards the bandwidth threshold.
 - *Multicast & Broadcast*—Counts Broadcast and Multicast traffic towards the bandwidth threshold.
 - *Broadcast Only*—Counts only Broadcast traffic towards the bandwidth threshold.

STEP 4 Click **Apply**. Storm control is modified, and the Running Configuration file 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 four 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 device learns MAC addresses up to the configured limit of allowed addresses. After the limit is reached, the device does not learn additional addresses. In this mode, the addresses are subject to aging and re-learning.
- **Secure Permanent**—Keeps the current dynamic MAC addresses associated with the port and learns up to the maximum number of addresses allowed on the port (set by Max No. of Addresses Allowed). Relearning and aging are disabled.

- **Secure Delete on Reset**—Deletes the current dynamic MAC addresses associated with the port after reset. New MAC addresses can be learned as Delete-On-Reset ones up to the maximum addresses allowed on the port. Relearning and aging are disabled.

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 To use 802.1X on a port, it must be in multiple host or multi session modes. Port security on a port cannot be set if the port is in single mode (see the 802.1x, Host and Session Authentication page).

To configure port security:

STEP 1 Click **Security > Port Security**.

STEP 2 Select an interface to be modified, and click **Edit**.

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 *Interface Status* 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.
- *Secure Permanent*—Keeps the current dynamic MAC addresses associated with the port and learns up to the maximum number of addresses allowed on the port (set by **Max No. of Addresses Allowed**). Relearning and aging are enabled.
- *Secure Delete on Reset*—Deletes the current dynamic MAC addresses associated with the port after reset. New MAC addresses can be learned as Delete-On-Reset ones up to the maximum addresses allowed on the port. Relearning and aging are disabled.
- **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 number 0 indicates 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 device 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 Running Configuration file is updated.

Configuring 802.1X

Port-based access control has the effect of creating two types of access on the device ports. One type of access enables uncontrolled communication, regardless of the authorization state (*uncontrolled port*). The other type of access authorizes communication between a host and the device.

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 it permitted to send data to the port. Otherwise, the authenticator discards the supplicant data .

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:**
 - **Single-session/single host**—In this mode, the device, as an authenticator, supports a single 802.1x session and grants permission to use the port to the authorized supplicant. All access by 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.
 - **Single session/multiple hosts**—This follows the 802.1x standard. In this mode, the device as an authenticator allows any device to use a port as long as it has been granted permission.
- **Multi-Session 802.1X**—Every device (supplicant) connecting to a port must be authenticated and authorized by the device (authenticator) separately in a different 802.1x session.

The device supports the 802.1x authentication mechanism, as described in the standard, to authenticate and authorize 802.1x supplicants.

802.1X Parameters Workflow

Define the 802.1X parameters as follows:

- (Optional) 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.
- Define 802.1X settings for each port by using the Edit Port Authentication page.

Note the following:

- You can select the Guest VLAN field to have untagged incoming frames go to the guest VLAN.
- Define host authentication parameters for each port using the Port Authentication page.
- 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 and define how ports are authenticated. 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**.

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.

STEP 3 Click **Apply**. The 802.1X properties are written to the Running Configuration file.

Defining 802.1X Port Authentication

The Port Authentication page enables configuration of 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 host authentication, it is 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**.

This page displays authentication settings for all ports.

STEP 2 Select a port, and click **Edit**.

STEP 3 Enter the parameters.

- **Interface**—Select a port.
- **User Name**—Displays the username.
- **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 device does not provide authentication services to the client through the interface.
 - *Auto*—Enables port-based authentication and authorization on the device. The interface moves between an authorized or unauthorized state based on the authentication exchange between the device and the client.
 - *Force Authorized*—Authorizes the interface without authentication.

- **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.
 - **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:
 - *Initialize*—In process of coming up.
 - *Force-Authorized*—Controlled port state is set to Force-Authorized (forward traffic).
- NOTE** If the port is not in 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.
- **Quiet Period**—Enter the number of seconds that the device remains in the quiet state following a failed authentication exchange.
 - **Resending EAP**—Enter the number of seconds that the device 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 device resends a request to the authentication server.
 - **Termination Cause**—Displays the reason for which port authentication was terminated, if applicable.

STEP 4 Click **Apply**. The port settings are written to the Running Configuration file.

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 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 the 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**.

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.
 - *No Single Host*—Port control is *Auto* and Multiple Hosts mode is enabled. At least one client 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**.

STEP 3 Enter the parameters.

- **Interface**—Enter a port number for which host authentication is enabled.
- **Host Authentication**—Select one of the modes. These modes are described above in *Defining Host and Session Authentication*.

The following fields are only relevant if you select Single in the Host Authentication field.

Single Host Violation Settings:

- **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:
 - *Protect (Discard)*—Discards the packets.
 - *Restrict (Forward)*—Forwards the packets.
 - *Shutdown*—Discards the packets and shuts down the port. The ports remains shut down until reactivated, or until the device is rebooted.
- **Traps (on single host violation)**—Select to enable traps.
- **Trap Frequency (on Single Host Violation)**—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 written to the Running Configuration file.

Viewing Authenticated Hosts

To view details about authenticated users:

STEP 1 Click **Security > 802.1X > Authenticated Hosts**.

This page displays the following fields:

- **User Name**—Supplicant names that were authenticated on each port.
- **Port**—Number of the port.
- **Session Time (DD:HH:MM:SS)**—Amount of time 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.

Denial of Service Prevention

A Denial of Service (DoS) attack is a hacker attempt to make a device unavailable to its users.

DoS attacks saturate the device with external communication requests, so that it cannot respond to legitimate traffic. These attacks usually lead to a device CPU overload.

Secure Core Technology (SCT)

One method of resisting DoS attacks employed by the device is the use of SCT. SCT is enabled by default on the device and cannot be disabled.

The Cisco device is an advanced device that handles management traffic, protocol traffic and snooping traffic, in addition to end-user (TCP) traffic.

SCT ensures that the device receives and processes management and protocol traffic, no matter how much total traffic is received. This is done by rate-limiting TCP traffic to the CPU.

There are no interactions with other features.

SCT can be monitored in the Denial of Service > Denial of Service Prevention > Security Suite Settings page (**Details** button).

Types of DoS Attacks

A Denial of Service attack can be caused in the following ways (among others):

- **TCP SYN Packets**—A flood of TCP SYN packets, often with a false sender address, can signify an attack. Each of these packets causes the device to spawn a half-open connection, by sending back a TCP/SYN-ACK packet (Acknowledge), and waiting for a packet in response from the sender

address (response to the ACK Packet). However, because the sender address is false, the response never comes. These half-open connections saturate the number of available connections the device is able to make, keeping it from responding to legitimate requests. In addition, the potential number of packets to the CPU is limited and the attack traffic might consume this number of packets.

These packets can be blocked in the SYN Protection page.

- TCP SYN-FIN Packets— SYN packets are sent to create a new TCP connection. TCP FIN packets are sent to close a connection. A packet in which both SYN and FIN flags are set should never exist. Therefore these packets might signify an attack on the device and should be blocked.

A definition of what constitutes a SYN attack can be set in the SYN Protection page. When the device identifies such an attack on an interface, it is reported in this page.

Defense Against DoS Attacks

The Denial of Service (DoS) Prevention feature assists the system administrator in resisting DoS attacks in the following ways:

- Enable TCP SYN protection. If this feature is enabled, reports are issued when a SYN packet attack is identified. A SYN attack is identified if the number of SYN packets per second exceeds a user-configured threshold.
- SYN-FIN packets can be blocked.

Dependencies Between Features

There is no dependency between this feature and other features.

Default Configuration

The DoS Prevention feature has the following defaults:

- The DoS Prevention feature is disabled by default.
- SYN-FIN protection is enabled by default (even if DoS Prevention is disabled).
- If SYN protection is enabled, the default is Report. The default threshold is 30 SYN packets per second.

- All other DoS Prevention features are disabled by default.

Configuring DoS Prevention

The following pages are used to configure this feature.

Security Suite Settings

To configure DoS Prevention global settings and monitor SCT:

- STEP 1** Click **Security > Denial of Service Prevention > Security Suite Settings**. The *Security Suite Settings* displays.

CPU Protection Mechanism: Enabled indicates that SCT is enabled.

- STEP 2** Click **Details** beside **CPU Utilization** to go to the CPU Utilization page and view CPU resource utilization information.

- STEP 3** Click **Edit** beside **TCP SYN Protection** to go to the SYN Protection page and enable this feature.

SYN Protection

The network ports might be used by hackers to attack the device in a SYN attack, which consumes TCP resources (buffers) and CPU power.

Since the CPU is protected using SCT, TCP traffic to the CPU is limited. However, if one or more ports are attacked with a high rate of SYN packets, the CPU receives only the attacker packets, thus creating Denial-of-Service.

When using the SYN protection feature, the CPU counts the SYN packets ingressing from each network port to the CPU per second.

If the number is higher than the threshold, a SYSLOG message is generated, but the packets are not blocked.

To configure SYN protection:

- STEP 1** Click **Security > Denial of Service Prevention > SYN Protection**.

- STEP 2** Enter the parameters.

- **Block SYN-FIN Packets**—Select to enable the feature. If TCP packets with both SYN and FIN flags are detected, a SYSLOG message is generated.
- **SYN Protection Mode**—Select between three modes:

- *Disable*—The feature is disabled on a specific interface.
- *Report*—Generates a SYSLOG message. The status of the port is changed to **Attacked** when the threshold is passed.
- **SYN Protection Threshold**—Number of SYN packets per second before SYN packets will be blocked (deny SYN with MAC-to-me rule will be applied on the port).
- **SYN Protection Period**—Time in seconds before unblocking the SYN packets (the deny SYN with MAC-to-me rule is unbound from the port).

STEP 3 Click **Apply**. SYN protection is defined, and the Running Configuration file is updated.

The SYN Protection Interface Table displays the following fields for every port or LAG (as requested by the user)

- **Current Status**—Interface status. The possible values are:
 - *Normal*—No attack was identified on this interface.
 - *Attacked*—Attack was identified on this interface.
- **Last Attack**—Date of last SYN-FIN attack identified by the system and the system action (**Reported**).

Security: SSH Client

This section describes the device when it functions as an SSH client.

It covers the following topics:

- **Secure Copy (SCP) and SSH**
- **Protection Methods**
- **SSH Server Authentication**
- **SSH Client Authentication**
- **Before You Begin**
- **Common Tasks**
- **SSH Client Configuration Through the GUI**

Secure Copy (SCP) and SSH

Secure Shell or SSH is a network protocol that enables data to be exchanged on a secure channel between an SSH client (in this case, the device) and an SSH server.

SSH client helps the user manage a network composed of one or more switches in which various system files are stored on a central SSH server. When configuration files are transferred over a network, Secure Copy (SCP), which is an application that utilizes the SSH protocol, ensures that sensitive data, such as username/password cannot be intercepted.

Secure Copy (SCP) is used to securely transfer firmware, boot image, configuration files, language files, and log files from a central SCP server to a device.

With respect to SSH, the SCP running on the device is an SSH client application and the SCP server is a SSH server application.

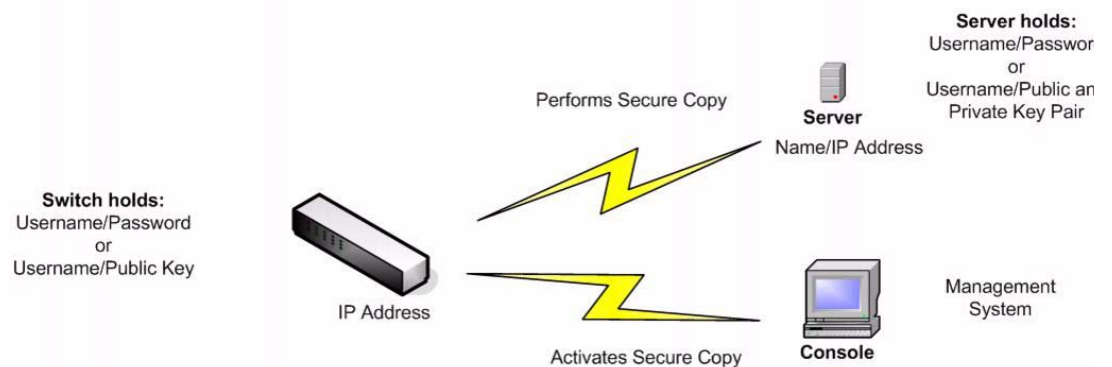
When files are downloaded via TFTP or HTTP, the data transfer is unsecured.

When files are downloaded via SCP, the information is downloaded from the SCP server to the device via a secure channel. The creation of this secure channel is preceded by authentication, which ensures that the user is permitted to perform the operation.

Authentication information must be entered by the user, both on the device and on the SSH server, although this guide does not describe server operations.

The following illustrates a typical network configuration in which the SCP feature might be used.

Typical Network Configuration



Protection Methods

When data is transferred from an SSH server to a device (client), the SSH server uses various methods for client authentication. These are described below.

Passwords

To use the password method, first ensure that a username/password has been established on the SSH server. This is not done through the device's management system, although, after a username has been established on the server, the server password can be changed through the device's management system.

The username/password must then be created on the device. When data is transferred from the server to the device, the username/password supplied by the device must match the username/password on the server.

Data can be encrypted using a one-time symmetric key negotiated during the session.

Each device being managed must have its own username/password, although the same username/password can be used for multiple switches.

The password method is the default method on the device.

Public/Private Keys

To use the public/private key method, create a username and public key on the SSH server. The public key is generated on the device, as described below, and then copied to the server. The actions of creating a username on the server and copying the public key to the server are not described in this guide.

RSA and DSA default key pairs are generated for the device when it is booted. One of these keys is used to encrypt the data being downloaded from the SSH server. The RSA key is used by default.

If the user deletes one or both of these keys, they are regenerated.

The public/private keys are encrypted and stored in the device memory. The keys are part of the device configuration file, and the private key can be displayed to the user, in encrypted or plaintext form.

Since the private key cannot be copied directly to the private key of another device, an import method exists that enables copying private keys from device to device (described in [Import Keys](#)).

Import Keys

In the key method, individual public/private keys must be created for each individual device, and these private keys cannot be copied directly from one device to another because of security considerations.

If there are multiple switches in the network, the process of creating public/private keys for all the switches might be time-consuming, because each public/private key must be created and then loaded onto the SSH server.

To facilitate this process, an additional feature enables secure transfer of the encrypted private key to all switches in the system.

When a private key is created on a device, it is also possible to create an associated *passphrase*. This passphrase is used to encrypt the private key and to import it into the remaining switches. In this way, all the switches can use the same public/private key.

SSH Server Authentication

A device, as an SSH client, only communicates with a trusted SSH server. When SSH server authentication is disabled (the default setting), any SSH server is considered trusted. When SSH server authentication is enabled, the user must add an entry for the trusted servers to the Trusted SSH Servers Table. This table stores the following information per each SSH Trusted server for a maximum of 16 servers, and contains the following information:

- Server IP address/host name
- Server public key fingerprint

When SSH server authentication is enabled, the SSH client running on the device authenticates the SSH server using the following authentication process:

- The device calculates the fingerprint of the received SSH server's public key.
- The device searches the SSH Trusted Servers table for the SSH server's IP address/host name. One of the following can occur:
 - If a match is found, both for the server's IP address/host name and its fingerprint, the server is authenticated.
 - If a matching IP address/host name is found, but there is no matching fingerprint, the search continues. If no matching fingerprint is found, the search is completed and authentication fails.
 - If no matching IP address/host name is found, the search is completed and authentication fails.
- If the entry for the SSH server is not found in the list of trusted servers, the process fails.

SSH Client Authentication

SSH client authentication by password is enabled by default, with the username/password being “anonymous”.

The user must configure the following information for authentication:

- The authentication method to be used.
- The username/password or public/private key pair.

In order to support auto configuration of an out-of-box device (device with factory default configuration), SSH server authentication is disabled by default.

Supported Algorithms

When the connection between a device (as an SSH client) and an SSH server is established, the client and SSH server exchange data in order to determine the algorithms to use in the SSH transport layer.

The following algorithms are supported on the client side:

- Key Exchange Algorithm-diffie-hellman
- Encryption Algorithms
 - aes128-cbc
 - 3des-cbc
 - arcfour
 - aes192-cbc
 - aes256-cbc
- Message Authentication Code Algorithms
 - hmac-sha1
 - hmac-md5

NOTE Compression algorithms are not supported.

Before You Begin

The following actions must be performed before using the SCP feature:

- When using the password authentication method, a username/password must be set up on the SSH server.
- When using public/private keys authentication method, the public key must be stored on the SSH server.

Common Tasks

This section describes some common tasks performed using the SSH client. All pages referenced are pages found under the SSH Client branch of the menu tree.

Workflow1: To configure SSH client and transfer data to/from an SSH server, perform the following steps:

-
- STEP 1** Decide which method is to be used: password or public/private key. Use the SSH User Authentication page.
- STEP 2** If the password method was selected, perform the following steps:
- a. Create a global password in the SSH User Authentication page, or create a temporary one in the Upgrade/Backup Firmware/Language or Backup Configuration/Log pages, when you actually activate the secure data transfer.
 - b. Upgrade the firmware, boot image or language file, using SCP, by selecting the **via SCP (over SSH)** option in the Upgrade/Backup Firmware/Language page. The password can be entered in this page directly, or the password entered in the SSH User Authentication page can be used.
 - c. Download/backup the configuration file, using SCP, by selecting the **via SCP (over SSH)** option in the Download/Backup Configuration/Log page. The password can be entered in this page directly, or the password entered in the SSH User Authentication page can be used.
- STEP 3** Set up a username/password on the SSH server or modify the password on the SSH server. This activity depends on the server and is not described here.

- STEP 4** If the public/private key method is being used, perform the following steps:
- Select whether to use an RSA or DSA key, create a username and then generate the public/private keys.
 - View the generated key by clicking the **Details** button, and transfer the username and public key to the SSH server. This action depends on the server and is not described in this guide.
 - Upgrade/backup the firmware or language file, using SCP, by selecting the **via SCP (over SSH)** option in the Upgrade/Backup Firmware/Language page.
 - Download/backup the configuration file, using SCP, by selecting the **via SCP (over SSH)** option in the Download/Backup Configuration/Log page.

Workflow2: To import the public/private keys from one device to another:

- STEP 1** Generate a public/private key in the SSH User Authentication page.
- STEP 2** Set the SSD properties and create a new local passphrase in the Secure Sensitive Data Management > Properties page.
- STEP 3** Click **Details** to view the generated, encrypted keys, and copy them (including the Begin and End footers) from the Details page to an external device. Copy the public and private keys separately.
- STEP 4** Log on to another device and open the SSH User Authentication page. Select the type of key required and click **Edit**. Paste in the public/private keys.
- STEP 5** Click **Apply** to copy the public/private keys onto the second device.

Workflow3: To define a trusted server:

- STEP 1** Enable SSH server authentication in the SSH Server Authentication page.
- STEP 2** Click **Add** to add a new server and enter its identifying information.
- STEP 3** Click **Apply** to add the server to the Trusted SSH Servers table.

Workflow4: To change your password on an SSH server:

- STEP 1** Identify the server in the Change User Password on SSH Server page.
- STEP 2** Enter the new password.
- STEP 3** Click **Apply**.

SSH Client Configuration Through the GUI

This section describes the pages used to configure the SSH Client feature.

SSH User Authentication

Use this page to select an SSH user authentication method, set a username and password on the device, if the password method is selected or generate an RSA or DSA key, if the public/private key method is selected.

To select an authentication method, and set the username/password/keys.

-
- STEP 1** Click **Security > SSH Client > SSH User Authentication**.
- STEP 2** Select an **SSH User Authentication Method**. This is the global method defined for the secure copy (SCP). Select one of the options:
- **By Password**—This is the default setting. If this is selected, enter a password or retain the default one.
 - **By RSA Public Key**—If this is selected, create an RSA public and Private key in the **SSH User Key Table** block.
 - **By DSA Public Key**—If this is selected, create a DSA public/private key in the **SSH User Key Table** block.
- STEP 3** Enter the **Username** (no matter what method was selected) or user the default username. This must match the username defined on the SSH server.
- STEP 4** If the *By Password* method was selected, enter a password (**Encrypted** or **Plaintext**) or leave the default encrypted password.
- STEP 5** Perform one of the following actions:
- **Apply**—The selected authentication methods are associated with the access method.
 - **Restore Default Credentials**—The default username and password (anonymous) are restored.
 - **Display Sensitive Data As Plaintext**—Sensitive data for the current page appears as plaintext.

The **SSH User Key Table** contains the following fields for each key:

- **Key Type**—RSA or DSA.

- **Key Source**—Auto Generated or User Defined.
- **Fingerprint**—Fingerprint generated from the key.

STEP 6 To handle an RSA or DSA key, select either RSA or DSA and perform one of the following actions:

- **Generate**—Generate a new key.
- **Edit**—Display the keys for copying/pasting to another device.
- **Delete**—Delete the key.
- **Details**—Display the keys.

SSH Server Authentication

To enable SSH server authentication and define the trusted servers:

STEP 1 Click **Security > SSH Client > SSH Server Authentication**.

STEP 2 Select **Enable** to enable SSH server authentication.

STEP 3 Click **Add** and enter the following fields for the SSH trusted server:

- **Server Definition**—Select one of the following ways to identify the SSH server:
 - *By IP Address*—If this is selected enter the IP address of the server in the fields below.
 - *By Name*—If this is selected enter the name of the server in the **Server IP Address/Name** field.
- **Fingerprint**—Enter the fingerprint of the SSH server (copied from that server).

STEP 4 Click **Apply**. The trusted server definition is stored in the Running Configuration file.

Modifying the User Password on the SSH Server

To change the password on the SSH server:

STEP 1 Click **Security > SSH Client > Change User Password on SSH Server**.

STEP 2 Enter the following fields:

- **Server Definition**—Define the SSH server by selecting either **By IP Address** or **By Name**. Enter the server name or IP address of the server in the **Server IP Address/Name** field.
- **IP Version**—If you selected to specify the SSH server by IP address, select whether that IP address is an IPv4 or IPv6 address.
- **IP Address Type**—If the SSH server IP address is an IPv6 address, select the IPv6 address type. 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 from the list of interfaces.
- **Server IP Address/Name**—Enter either the IP address of the SSH server or its name, depending on what was selected in **Server Definition**.
- **Username**—This must match the username on the server.
- **Old Password**—This must match the password on the server.
- **New Password**—Enter the new password and confirm it in the **Confirm Password** field.

STEP 3 Click **Apply**. The password on the SSH server is modified.

Security: Secure Sensitive Data Management

Secure Sensitive Data (SSD) is an architecture that facilitates the protection of sensitive data on a device, such as passwords and keys. The facility makes use of passphrases, encryption, access control, and user authentication to provide a secure solution to managing sensitive data.

The facility is extended to protect the integrity of configuration files, to secure the configuration process, and to support SSD zero-touch auto configuration.

- **Introduction**
- **SSD Rules**
- **SSD Properties**
- **Configuration Files**
- **SSD Management Channels**
- **Menu CLI and Password Recovery**
- **Configuring SSD**

Introduction

SSD protects sensitive data on a device, such as passwords and keys, permits and denies access to sensitive data encrypted and in plain text based on user credentials and SSD rules, and protects configuration files containing sensitive data from being tampered with.

In addition, SSD enables the secure backup and sharing of configuration files containing sensitive data.

SSD provides users with the flexibility to configure the desired level of protection on their sensitive data; from no protection with sensitive data in plaintext, minimum protection with encryption based on the default passphrase, and better protection with encryption based on user-defined passphrase.

SSD grants read permission to sensitive data only to authenticated and authorized users, and according to SSD rules. A device authenticates and authorizes management access to users through the user authentication process.

Whether or not SSD is used, it is recommended that an administrator should secure the authentication process by using the local authentication database, and/or secure the communication to external authentication server (RADIUS and TACACS) used in the user authentication process.

In summary, SSD protects sensitive data on a device with SSD rules, SSD properties, and user authentication. And SSD rules, SSD properties, and user authentication configurations of the device are themselves sensitive data protected by SSD.

SSD Management

SSD management includes a collection of configuration parameters that define the handling and security of sensitive data. The SSD configuration parameters themselves are sensitive data and are protected under SSD.

All configuration of SSD is performed through the SSD pages that are only available to users with the correct permissions (see [SSD Rules](#)).

SSD Rules

SSD rules define the read permissions and default read mode given to a user session on a management channel.

An SSD rule is uniquely identified by its user and SSD management channel. Different SSD rules might exist for the same user but for different channels, and conversely, different rules might exist for the same channel but for different users.

Read permissions determine how sensitive data can be viewed: in only encrypted form, in only plaintext form, in both encrypted or plaintext, or no permission to view sensitive data. The SSD rules themselves are protected as sensitive data.

A device can support a total of 32 SSD rules.

A device grants a user the SSD read permission of the SSD rule that best matches the user identity/credential and the type of management channel from which the user is/will access the sensitive data.

A device comes with a set of default SSD rules. An administrator can add, delete, and change SSD rules as desired.

NOTE A device may not support all the channels defined by SSD.

Elements of an SSD Rule

An SSD rule includes the following elements:

- **User type**—The user types supported in order of most preference to least preference are as follows: (If a user matches multiple SSD rules, the rule with the most preference User Type will be applied).
 - **Specific**—The rule applies to a specific user.
 - **Default User (cisco)**—The rule applies to the default user (cisco).
 - **Level 15**—The rule applies to users with privilege level 15.
 - **All**—The rule applies to all users.
- **User Name**—If user type is Specific, a user name is required.
- **Channel**. Type of SSD management channel to which the rule is applied. The channel types supported are:
 - **Secure**—Specifies the rule applies only to secure channels. Depending on the device, it may support some or all of the following secure channels:
Console port interface, SCP, SSH, and HTTPS.
 - **Insecure**—Specifies that this rule applies only to insecure channels. Depending on the device, it may support some or all of the following insecure channels:
Telnet, TFTP, and HTTP.
 - **Secure XML SNMP**—Specifies that this rule applies only to XML over HTTPS or SNMPv3 with privacy. A device may or may not support all of the secure XML and SNMP channels.
 - **Insecure XML SNMP**—Specifies that this rule applies only to XML over HTTP or SNMPv1/v2 and SNMPv3 without privacy. A device may or may not support all of the secure XML and SNMP channels.
- **Read Permission**—The read permissions associate with the rules. These can be the following:
 - (Lowest) **Exclude**—Users are not permitted to access sensitive data in any form.
 - (Middle) **Encrypted Only**—Users are permitted to access sensitive data as encrypted only.

- (Higher) **Plaintext Only**—Users are permitted to access sensitive data in plaintext only. Users will also have read and write permission to SSD parameters as well.
- (Highest) **Both**—Users have both encrypted and plaintext permissions and are permitted to access sensitive data as encrypted and in plaintext. Users will also have read and write permission to SSD parameters as well.

Each management channel allows specific read permissions. The following summarizes these.

Table 1 Read Permissions Allowed per Management Channel

Management Channel	Read Permission Options Allowed
Secure	Both, Encrypted Only
Insecure	Both, Encrypted Only
Secure XML SNMP	Exclude, Plaintext Only
Insecure XML SNMP	Exclude, Plaintext Only

- **Default Read Mode**—All default read modes are subjected to the read permission of the rule. The following options exist, but some might be rejected, depending on the read permission. If the user-defined read permission for a user is Exclude (for example), and the default read mode is Encrypted, the user-defined read permission prevails.
 - **Exclude**—Do not allow reading sensitive data.
 - **Encrypted**—Sensitive data is presented in encrypted form.
 - **Plaintext**—Sensitive data is presented in plaintext form.

Each management channel allows specific read presumptions. The following summarizes these.

Table 2 Default Read Modes for Read Permissions

Read Permission	Default Read Mode Allowed
Exclude	Exclude
Encrypted Only	*Encrypted
Plaintext Only	*Plaintext

Table 2 Default Read Modes for Read Permissions

Read Permission	Default Read Mode Allowed
Both	*Plaintext, Encrypted

* The Read mode of a session can be temporarily changed in the SSD Properties page if the new read mode does not violate the read permission.

NOTE Note the following:

- The default Read mode for the Secure XML SNMP and Insecure XML SNMP management channels must be identical to their read permission.
- Read permission Exclude is allowed only for Secure XML SNMP and Insecure XML SNMP management channels; Exclude is not allowed for regular secure and insecure channels.
- Exclude sensitive data in secure and Insecure XML-SNMP management channels means that the sensitive data is presented as a 0 (meaning null string or numeric 0). If the user wants to view sensitive data, the rule must be changed to plaintext.
- By default, an SNMPv3 user with privacy and XML-over-secure channels permissions is considered to be a level-15 user.
- SNMP users on Insecure XML and SNMP (SNMPv1,v2, and v3 with no privacy) channel are considered as All users.
- SNMP community names are not used as user names to match SSD rules.
- Access by a specific SNMPv3 user can be controlled by configuring an SSD rule with a user name matching the SNMPv3 user name.
- There must always be at least one rule with read permission: Plaintext Only or Both, because only users with those permissions are able to access the SSD pages.
- Changes in the default read mode and read permissions of a rule will become effective, and will be applied to the affected user(s) and channel of all active management sessions immediately, excluding the session making the changes even if the rule is applicable. When a rule is changed (add, delete, edit), a system will update all the affected CLI/GUI sessions.

NOTE When the SSD rule applied upon the session login is changed from within that session, the user must log out and back in to see the change.

NOTE When doing a file transfer initiated by an XML or SNMP command, the underlying protocol used is TFTP. Therefore, the SSD rule for insecure channel will apply.

SSD Rules and User Authentication

SSD grants SSD permission only to authenticated and authorized users and according to the SSD rules. A device depends on its user authentication process to authenticate and authorize management access. To protect a device and its data including sensitive data and SSD configurations from unauthorized access, it is recommended that the user authentication process on a device is secured. To secure the user authentication process, you can use the local authentication database, as well as secure the communication through external authentication servers, such as RADIUS and TACACS servers. The configuration of the secure communication to the external authentication servers are sensitive data and are protected under SSD.

NOTE The user credential in the local authenticated database is already protected by a non SSD related mechanism

If a user from a channel issues an action that uses an alternate channel, the device applies the read permission and default read mode from the SSD rule that match the user credential and the alternate channel. For example, if a user logs in via a secure channel and starts a TFTP upload session, the SSD read permission of the user on the insecure channel (TFTP) is applied

Default SSD Rules

The device has the following factory default rules:

Table 3 Default SSD Rules

Rule Key		Rule Action	
User	Channel	Read Permission	Default Read Mode
Level 15	Secure XML SNMP	Plaintext Only	Plaintext
Level 15	Secure	Both	Encrypted
Level 15	Insecure	Both	Encrypted
All	Insecure XML SNMP	Exclude	Exclude

Table 3 Default SSD Rules

Rule Key		Rule Action	
User	Channel	Read Permission	Default Read Mode
All	Secure	Encrypted Only	Encrypted
All	Insecure	Encrypted Only	Encrypted

The default rules can be modified, but they cannot be deleted. If the SSD default rules have been changed, they can be restored.

SSD Default Read Mode Session Override

The system contains sensitive data in a session, as either encrypted or plaintext, based on the read permission and the default read mode of the user.

The default read mode can be temporarily overridden as long it does not conflict with the SSD read permission of the session. This change is effective immediately in the current session, until one of the following occurs:

- User changes it again.
- Session is terminated.
- The read permission of the SSD rule that is applied to the session user is changed and is no longer compatible with the current read mode of the session. In this case, the session read mode returns to the default read mode of the SSD rule.

SSD Properties

SSD properties are a set of parameters that, in conjunction with the SSD rules, define and control the SSD environment of a device. The SSD environment consists of these properties:

- Controlling how the sensitive data is encrypted.
- Controlling the strength of security on configuration files.
- Controlling how the sensitive data is viewed within the current session.

Passphrase

A passphrase is the basis of the security mechanism in the SSD feature, and is used to generate the key for the encryption and decryption of sensitive data. Sx200, Sx300, Sx500, and SG500X/ESW2-550X series switches that have the same passphrase are able to decrypt each other's sensitive data encrypted with the key generated from the passphrase.

A passphrase must comply with the following rules:

- **Length**—Between 8-16 characters.
- **Character Classes**—The passphrase must have at least one upper case character, one lower case character, one numeric character, and one special character e.g. #,\$.

Default and User-defined Passphrases

All devices come with a default, out-of-the box passphrase that is transparent to users. The default passphrase is never displayed in the configuration file or in the CLI/GUI.

If better security and protection are desired, an administrator should configure SSD on a device to use a user-defined passphrase instead of the default passphrase. A user-defined passphrase should be treated as a well-guard secret, so that the security of the sensitive data on the device is not compromised.

A user-defined passphrase can be configured manually in plain text. It can also be derived from a configuration file. (See [Sensitive Data Zero-Touch Auto Configuration](#)). A device always displays user-defined passphrases encrypted.

Local Passphrase

A device maintains a local passphrase which is the passphrase of its Running Configuration. SSD normally performs encryption and decryption of sensitive data with the key generated from the local passphrase.

The local passphrase can be configured to be either the default passphrase or a user-defined passphrase. By default, the local passphrase and default passphrase are identical. It can be changed by administrative actions from either the Command Line Interface (if available) or the web-based interface. It is

automatically changed to the passphrase in the startup configuration file, when the startup configuration becomes the running configuration of the device. When a device is reset to factory default, the local passphrase is reset to the default passphrase.

Configuration File Passphrase Control

File passphrase control provides additional protection for a user-defined passphrase, and the sensitive data that are encrypted with the key generated from the user-defined passphrase, in text-based configuration files.

The following are the existing passphrase control modes:

- **Unrestricted** (default)—The device includes its passphrase when creating a configuration file. This enables any device accepting the configuration file to learn the passphrase from the file.
- **Restricted**—The device restricts its passphrase from being exported into a configuration file. Restricted mode protects the encrypted sensitive data in a configuration file from devices that do not have the passphrase. This mode should be used when a user does not want to expose the passphrase in a configuration file.

After a device is reset to the factory default, its local passphrase is reset to the default passphrase. As a result, the device will be not able to decrypt any sensitive data encrypted based on a user-defined passphrase entered from a management session (GUI/CLI), or in any configuration file with restricted mode, including the files created by the device itself before it is reset to factory default. This remains until the device is manually reconfigured with the user-defined passphrase, or learns the user-defined passphrase from a configuration file.

Configuration File Integrity Control

A user can protect a configuration file from being tampered or modified by creating the configuration file with Configuration File Integrity Control. It is recommended that Configuration File Integrity Control be enabled when a device uses a user-defined passphrase with Unrestricted Configuration File Passphrase Control.



CAUTION

Any modification made to a configuration file that is integrity protected is considered tampering.

A device determines whether the integrity of a configuration file is protected by examining the File Integrity Control command in the file's SSD Control block. If a file is integrity protected but a device finds the integrity of the file is not intact, the device rejects the file. Otherwise, the file is accepted for further processing.

A device checks for the integrity of a text-based configuration file when the file is downloaded or copied to the Startup Configuration file.

Read Mode

Each session has a Read mode. This determines how sensitive data appears. The Read mode can be either Plaintext, in which case sensitive data appears as regular text, or Encrypted, in which sensitive data appears in its encrypted form.

Configuration Files

A configuration file contains the configuration of a device. A device has a Running Configuration file, a Startup Configuration file, a Mirror Configuration file (optionally), and a Backup Configuration file. A user can manually upload and download a configuration file to and from a remote file-server. A device can automatically download its Startup Configuration from a remote file server during the auto configuration stage using DHCP. Configuration files stored on remote file servers are referred to as remote configuration files.

A Running Configuration file contains the configuration currently being used by a device. The configuration in a Startup Configuration file becomes the Running Configuration after reboot. Running and Startup Configuration files are formatted in internal format. Mirror, Backup, and the remote configuration files are text-based files usually kept for archive, records, or recovery. During copying, uploading, and downloading a source configuration file, a device automatically transforms the source content to the format of the destination file if the two files are of different formats.

File SSD Indicator

When copying the Running or Startup Configuration file into a text-based configuration file, the device generates and places the file SSD indicator in the text-based configuration file to indicate whether the file contains encrypted sensitive data, plaintext sensitive data or excludes sensitive data.

- The SSD indicator, if it exists, must be in the configuration header file.

- A text-based configuration that does not include an SSD indicator is considered not to contain sensitive data.
- The SSD indicator is used to enforce SSD read permissions on text-based configuration files, but is ignored when copying the configuration files to the Running or Startup Configuration file.

The SSD indicator in a file is set according to the user's instruction, during copy, to include encrypted, plaintext or exclude sensitive data from a file.

SSD Control Block

When a device creates a text-based configuration file from its Startup or Running Configuration file, it inserts an SSD control block into the file if a user requests the file is to include sensitive data. The SSD control block, which is protected from tampering, contains SSD rules and SSD properties of the device creating the file. A SSD control block starts and ends with "ssd-control-start" and "ssd-control-end" respectively.

Startup Configuration File

The device currently supports copying from the Running, Backup, Mirror, and Remote Configuration files to a Startup Configuration file. The configurations in the Startup Configuration are effective and become the Running Configuration after reboot. A user can retrieve the sensitive data encrypted or in plaintext from a startup configuration file, subject to the SSD read permission and the current SSD read mode of the management session.

Read access of sensitive data in the startup configuration in any forms is excluded if the passphrase in the Startup Configuration file and the local passphrase are different.

SSD adds the following rules when copying the Backup, Mirror, and Remote Configuration files to the Startup Configuration file:

- After a device is reset to factory default, all of its configurations, including the SSD rules and properties are reset to default.
- If a source configuration file contains encrypted sensitive data, but is missing an SSD control block, the device rejects the source file and the copy fails.
- If there is no SSD control block in the source configuration file, the SSD configuration in the Startup Configuration file is reset to default.

- If there is a passphrase in the SSD control block of the source configuration file, the device will reject the source file, and the copy fails if there is encrypted sensitive data in the file not encrypted by the key generated from the passphrase in the SSD control block.
- If there is an SSD control block in the source configuration file and the file fails the SSD integrity check, and/or file integrity check, the device rejects the source file and fails the copy.
- If there is no passphrase in the SSD control block of the source configuration file, all the encrypted sensitive data in the file must be encrypted by either the key generated from the local passphrase, or the key generated from the default passphrase, but not both. Otherwise, the source file is rejected and the copy fails.
- The device configures the passphrase, passphrase control, and file integrity, if any, from the SSD Control Block in the source configuration file to the Startup Configuration file. It configures the Startup Configuration file with the passphrase that is used to generate the key to decrypt the sensitive data in the source configuration file. Any SSD configurations that are not found are reset to the default.
- If there is an SSD control block in the source configuration file and the file contains plaintext, sensitive data excluding the SSD configurations in the SSD control block, the file is accepted.

Running Configuration File

A Running Configuration file contains the configuration currently being used by the device. A user can retrieve the sensitive data encrypted or in plaintext from a running configuration file, subject to the SSD read permission and the current SSD read mode of the management session. The user can change the Running Configuration by copying the Backup or Mirror Configuration files through other management actions via CLI, XML,SNMP, and so on.

A device applies the following rules when a user directly changes the SSD configuration in the Running Configuration:

- If the user that opened the management session does not have SSD permissions (meaning read permissions of either Both or Plaintext Only), the device rejects all SSD commands.
- When copied from a source file, File SSD indicator, SSD Control Block Integrity, and SSD File Integrity are neither verified nor enforced.

- When copied from a source file, the copy will fail if the passphrase in the source file is in plaintext. If the passphrase is encrypted, it is ignored.
- When directly configuring the passphrase, (non file copy), in the Running Configuration, the passphrase in the command must be entered in plaintext. Otherwise, the command is rejected.
- Configuration commands with encrypted sensitive data, that are encrypted with the key generated from the local passphrase, are configured into the Running Configuration. Otherwise, the configuration command is in error, and is not incorporated into the Running Configuration file.

Backup and Mirror Configuration File

A device periodically generates its Mirror Configuration file from the Startup Configuration file if auto mirror configuration service is enabled. A device always generates a Mirror Configuration file with encrypted sensitive data. Therefore, the File SSD Indicator in a Mirror Configuration file always indicates that the file contains encrypted sensitive data.

By default, auto mirror configuration service is enabled. To configure auto mirror configuration to be enabled or disabled, click **Administration > File Management > Configuration File Properties**.

A user can display, copy, and upload the complete mirror and backup configuration files, subject to SSD read permission, the current read mode in the session, and the file SSD indicator in the source file as follows:

- If there is no file SSD indicator in a mirror or backup configuration file, all users are allowed to access the file.
- A user with Both read permission can access all mirror and backup configuration files. However, if the current read mode of the session is different than the file SSD indicator, the user is presented with a prompt indicating that this action is not allowed.
- A user with Plaintext Only permission can access mirror and backup configuration files if their file SSD Indicator shows Exclude or Plaintext Only sensitive data.
- A user with Encrypted Only permission can access mirror and backup configuration files with their file SSD Indicator showing Exclude or Encrypted sensitive data.

- A user with Exclude permission cannot access mirror and backup configuration files with their file SSD indicator showing either encrypted or plaintext sensitive data.

The user should not manually change the file SSD indicator that conflicts with the sensitive data, if any, in the file. Otherwise, plaintext sensitive data may be unexpectedly exposed.

Sensitive Data Zero-Touch Auto Configuration

SSD Zero-touch Auto Configuration is the auto configuration of target devices with encrypted sensitive data, without the need to manually pre-configure the target devices with the passphrase whose key is used to encrypted the sensitive data.

The device currently supports Auto Configuration, which is enabled by default. When Auto Configuration is enabled on a device and the device receives DHCP options that specify a file server and a boot file, the device downloads the boot file (remote configuration file) into the Startup Configuration file from a file server, and then reboots.

NOTE The file server may be specified by the bootp siaddr and sname fields, as well as DHCP option 150 and statically configured on the device.

The user can safely auto configure target devices with encrypted sensitive data, by first creating the configuration file that is to be used in the auto configuration from a device that contains the configurations. The device must be configured and instructed to:

- Encrypt the sensitive data in the file
- Enforce the integrity of the file content
- Include the secure, authentication configuration commands and SSD rules that properly control and secure the access to devices and the sensitive data

If the configuration file was generated with a user passphrase and SSD file passphrase control is Restricted, the resulting configuration file can be auto-configured to the desired target devices. However, for auto configuration to succeed with a user-defined passphrase, the target devices must be manually pre-configured with the same passphrase as the device that generates the files, which is not zero touch.

If the device creating the configuration file is in Unrestricted passphrase control mode, the device includes the passphrase in the file. As a result, the user can auto configure the target devices, including devices that are out-of-the-box or in factory default, with the configuration file without manually pre-configuring the target devices with the passphrase. This is zero touch because the target devices learn the passphrase directly from the configuration file.

NOTE Devices that are out-of-the-box or in factory default states use the default anonymous user to access the SCP server.

SSD Management Channels

Devices can be managed over management channels such as telnet, SSH, and web. SSD categorizes the channels into the following types based on their security and/or protocols: secured, insecure, secure-XML-SNMP, and insecure-XML-SNMP.

The following describes whether SSD considers each management channel to be secure or insecure. If it is insecure, the table indicates the parallel secure channel.

Security of Management Channels

Management Channels		
Management Channel	SSD Management Channel Type	Parallel Secured Management Channel
GUI/HTTP	Insecure	GUI/HTTPS
GUI/HTTPS	Secure	
XML/HTTP	Insecure-XML-SNMP	XML/HTTPS
XML/HTTPS	Secure-XML-SNMP	
SNMPv1/v2/v3 without privacy	Insecure-XML-SNMP	Secure-XML-SNMP
SNMPv3 with privacy	Secure-XML-SNMP (level-15 users)	
TFTP	Insecure	SCP
SCP (Secure Copy)	Secure	

HTTP based file transfer	Insecure	HTTPS-based file transfer
HTTPS based file transfer	Secure	

Menu CLI and Password Recovery

The Menu CLI interface is only allowed to users if their read permissions are Both or Plaintext Only. Other users are rejected. Sensitive data in the Menu CLI is always displayed as plaintext.

Password recovery is currently activated from the boot menu and allows the user to log on to the terminal without authentication. If SSD is supported, this option is only permitted if the local passphrase is identical to the default passphrase. If a device is configured with a user-defined passphrase, the user is unable to activate password recovery.

Configuring SSD

The SSD feature is configured in the following pages:

- SSD properties are set in the Properties page.
- SSD rules are defined in the SSD Rules page.

SSD Properties

Only users with SSD read permission of Plaintext-only or Both are allowed to set SSD properties.

To configure global SSD properties:

STEP 1 Click **Security > Secure Sensitive Data Management > Properties**. The following field appears:

- **Current Local Passphrase Type**—Displays whether the default passphrase or a user-defined passphrase is currently being used.

STEP 2 Enter the following **Persistent Settings** fields:

- **Configuration File Passphrase Control**—Select an option as described in [Configuration File Passphrase Control](#).
- **Configuration File Integrity Control**—Select to enable this feature. See [Configuration File Integrity Control](#).

STEP 3 Select a Read mode for the current session (see [Elements of an SSD Rule](#)).

To change the local passphrase:

STEP 4 Click **Change Local Passphrase**, and enter a new **Local Passphrase**:

- **Default**—Use the devices default passphrase.
- **User Defined (Plaintext)**—Enter and confirm a new passphrase.

SSD Rules

Only users with SSD read permission of Plaintext-only or Both are allowed to set SSD rules.

To configure SSD rules:

STEP 1 Click **Security > Secure Sensitive Data Management > SSD Rules**.

The currently-defined rules are displayed.

STEP 2 To add a new rule, click **Add**. Enter the following fields:

- **User**—This defines the user(s) to which the rule applies: Select one of the following options:
 - *Specific User*—Select and enter the specific user name to which this rule applies (this user does not necessarily have to be defined).
 - *Default User (cisco)*—Indicates that this rule applies to the default user.
 - *Level 15*—Indicates that this rule applies to all users with privilege level 15.
 - *All*—Indicates that this rule applies to all users.
- **Channel**—This defines the security level of the input channel to which the rule applies: Select one of the following options:

- *Secure*—Indicates that this rule applies only to secure channels (console, SCP, SSH and HTTPS), not including the SNMP and XML channels.
- *Insecure*—Indicates that this rule applies only to insecure channels (Telnet, TFTP and HTTP), not including the SNMP and XML channels.
- *Secure XML SNMP*—Indicates that this rule applies only to XML over HTTPS and SNMPv3 with privacy.
- *Insecure XML SNMP*—Indicates that this rule applies only to XML over HTTP or and SNMPv1/v2 and SNMPv3 without privacy.
- **Read Permission**—The read permissions associated with the rule. These can be the following:
 - *Exclude*—Lowest read permission. Users are not permitted to get sensitive data in any form.
 - *Plaintext Only*—Higher read permission than above ones. Users are permitted to get sensitive data in plaintext only.
 - *Encrypted Only*—Middle read permission. Users are permitted to get sensitive data as encrypted only.
 - *Both (Plaintext and Encrypted)*—Highest read permission. Users have both encrypted and plaintext permissions and are permitted to get sensitive data as encrypted and in plaintext
- **Default Read Mode**—All default read modes are subjected to the read permission of the rule. The following options exist, but some might be rejected, depending on the rule's read permission.
 - *Exclude*—Do not allow reading the sensitive data.
 - *Encrypted*—Sensitive data is presented encrypted.
 - *Plaintext*—Sensitive data is presented as plaintext.

STEP 3 The following actions can be performed:

- **Restore to Default**—Restore a user-modified default rule to the default rule.
- **Restore All Rules to Default**—Restore all user-modified default rules to the default rule and remove all user-defined rules.

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 section covers the following topics:

- **QoS Features and Components**
- **Configuring QoS - General**
- **Managing QoS Statistics**

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.
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. See [Configuring QoS Queues](#).
- **Other Traffic Class-Handling Attribute**—Applies QoS mechanisms to various classes, including bandwidth management.

QoS Operation

When using the QoS feature, all traffic of the same class receives the same treatment, which consists of a 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 device trusts this external assigned QoS value. The external assigned QoS value of a packet determines its traffic class and QoS.

The type of header field to be trusted is entered in the Global Settings page. For every value of that field, an egress queue is assigned, indicating through which queue 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).

QoS Workflow

To configure general QoS parameters, perform the following:

-
- STEP 1** Enable QoS by using the QoS Properties page to select the trust mode. Then enable QoS on ports by using the Interface Settings page.
 - STEP 2** Assign each interface a default CoS or DSCP priority by using the QoS Properties page.
 - STEP 3** Assign the schedule method (Strict Priority or WRR) and bandwidth allocation for WRR to the egress queues by using the Queue page.
 - STEP 4** Designate an egress queue to each IP DSCP/TC value with the DSCP to Queue page. If the device is in DSCP trusted mode, incoming packets are put into the egress queues based on the their DSCP/TC value.
 - STEP 5** Designate an egress queue to each CoS/802.1p priority. If the device is in CoS/802.1 trusted mode, all incoming packets are 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.
 - STEP 6** 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.

Configuring QoS - General

The QoS Properties Page contains fields for enabling QoS and selecting the trust mode to be used. In addition, the default CoS priority or DSCP value for each interface can be defined.

Setting QoS Properties

To enable QoS:

-
- STEP 1** Click **Quality of Service > General > QoS Properties**.
 - STEP 2** Enable QoS on the device.

STEP 3 Select a trust mode (CoS/802.1p or DSCP) and click **Apply**.

STEP 4 If you selected DSCP, proceed to **STEP 6**; if you selected CoS, proceed to the next step.

STEP 5 Select **Port/LAG** and click **GO** to display/modify all ports/LAGs on the device 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 if Trust CoS is selected.

Select **Restore Defaults** to restore the factory CoS default setting for this interface.

STEP 6 Click **DSCP Override Table** to enter the DSCP values.

STEP 7 DSCP In displays the DSCP value of the incoming packet that needs to be re-marked to an alternative value. Select the new DSCP value to override the incoming value.

Select Restore Defaults to restore the factory DSCP values.

STEP 8 Click **Apply**. The Running Configuration file is updated.

To set QoS on an interface, select it, and click **Edit**.

STEP 1 Enter the parameters.

- **Interface**—Select the port or LAG.
- **Default CoS**—Select the default CoS (Class-of-Service) value to be assigned for incoming packets (that do not have a VLAN tag).

STEP 2 Click **Apply**. The interface default CoS value is saved to Running Configuration file.

Interface QoS Settings

The Interface Settings page enables configuring QoS on each port of the device, 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 > General > Interface Settings**.

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**.

STEP 4 Select **the Port** or **LAG** interface.

STEP 5 Click to enable or disable **QoS State** for this interface.

STEP 6 Click **Apply**. The Running Configuration file is updated.

Configuring QoS Queues

The device supports either 4 or 8 queues for each interface (selected in the System Mode and Stack Management page). Queue number four or eight 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 there are a maximum of four queues possible and 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 or Queue 8 (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**.

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 Running Configuration file 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 is the default CoS/802.1p priority assigned to the ingress ports.

Default Mapping for 4 Queues

802.1p Values (0-7, 7 being the highest)	Queue (4 queues 1-4, 4 being the highest priority)		Notes
0	1		Background
1	1		Best Effort
2	2		Excellent Effort
3	3		Critical Application - LVS phone SIP
4	3		Video
5	4		Voice - Cisco IP phone default
6	4		Interwork Control - LVS phone RTP
7	4		Network Control

Default Mapping for 8 Queues

802.1p Values (0-7, 7 being the highest)	Queue (8 queues 1-8, 8 is the highest priority) Standalone	7 Queues (8 is the highest priority used for stack control traffic) (stack)	Notes
0	1	1	Background
1	2	1	Best Effort
2	3	2	Excellent Effort
3	6	5	Critical Application - LVS phone SIP
4	5	4	Video
5	8	7	Voice - Cisco IP phone default
6	8	7	Interwork Control LVS phone RTP
7	7	6	Network Control

By changing the CoS/802.1p to Queue mapping (CoS/802.1p to Queue) and the Queue schedule method and bandwidth allocation (Queue page), it is possible to achieve the desired quality of service in a network.

CoS/802.1p to Queue mapping is applicable only if CoS/802.1p is the trusted mode and the packets belong to flows that are CoS trusted.

Queue 1 has the lowest priority, queue 4 or 8 has the highest priority.

To map CoS values to egress queues:

STEP 1 Click **Quality of Service > General > CoS/802.1p to Queue**.

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. Either four or eight egress queues are supported, where Queue 4 or Queue 8 is the highest priority egress queue and Queue 1 is the lowest priority.

STEP 3 For each 802.1p priority, select the Output Queue to which it is mapped.

STEP 4 Click **Apply**. 802.1p priority values to queues are mapped, and the Running Configuration file is updated.

Mapping DSCP to Queue

The DSCP (IP Differentiated Services Code Point) to Queue page maps DSCP values 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.

DSCP to Queue mapping is applicable to IP packets if DSCP is the trusted mode.

Non-IP packets are always classified to the best-effort queue.

The following tables describe the default DSCP to queue mapping for a 4 and 8 queue systems:

Table 4 DSCP to Queue Default Mapping – 4 Queues System

DSCP	63	55	47	39	31	23	15	7
Queue	3	3	4	3	3	2	1	1
DSCP	62	54	46	38	30	22	14	6
Queue	3	3	4	3	3	2	1	1
DSCP	61	53	45	37	29	21	13	5
Queue	3	3	4	3	3	2	1	1
DSCP	60	52	44	36	28	20	12	4
Queue	3	3	4	3	3	2	1	1

Table 4 DSCP to Queue Default Mapping – 4 Queues System

DSCP	59	51	43	35	27	19	11	3
Queue	3	3	4	3	3	2	1	1
DSCP	58	50	42	34	26	18	10	2
Queue	3	3	4	3	3	2	1	1
DSCP	57	49	41	33	25	17	9	1
Queue	3	3	4	3	3	2	1	1
DSCP	56	48	40	32	24	16	8	0
Queue	3	3	4	3	3	2	1	1

Table 5 DSCP to Queue Default Mapping – 8 Queues System (7 is highest and 8 is used for stack control purposes)

DSCP	63	55	47	39	31	23	15	7
Queue	6	6	7	5	4	3	2	1
DSCP	62	54	46	38	30	22	14	6
Queue	6	6	7	5	4	3	2	1
DSCP	61	53	45	37	29	21	13	5
Queue	6	6	7	5	4	3	2	1
DSCP	60	52	44	36	28	20	12	4
Queue	6	6	7	5	4	3	2	1
DSCP	59	51	43	35	27	19	11	3
Queue	6	6	7	5	4	3	2	1
DSCP	58	50	42	34	26	18	10	2
Queue	6	6	7	5	4	3	2	1
DSCP	57	49	41	33	25	17	9	1

Table 5 DSCP to Queue Default Mapping – 8 Queues System (7 is highest and 8 is used for stack control purposes)

Queue	6	6	7	5	4	3	2	1
DSCP	56	48	40	32	24	16	8	0
Queue	6	6	6	7	6	6	1	1

Table 6 DSCP to Queue Default Mapping – 8 Queues System (8 is highest)

DSCP	63	55	47	39	31	23	15	7
Queue	7	7	8	6	5	4	3	1
DSCP	62	54	46	38	30	22	14	6
Queue	7	7	8	6	5	4	3	1
DSCP	61	53	45	37	29	21	13	5
Queue	7	7	8	6	5	4	3	1
DSCP	60	52	44	36	28	20	12	4
Queue	7	7	8	6	5	4	3	1
DSCP	59	51	43	35	27	19	11	3
Queue	7	7	8	6	5	4	3	1
DSCP	58	50	42	34	26	18	10	2
Queue	7	7	8	6	5	4	3	1
DSCP	57	49	41	33	25	17	9	1
Queue	7	7	8	6	5	4	3	1
DSCP	56	48	40	32	24	16	8	0
Queue	7	7	7	8	7	7	1	2

To map DSCP to queues:

STEP 1 Click **Quality of Service > General > DSCP to Queue**.

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 Running Configuration file is updated.

Configuring Bandwidth

The Bandwidth page enables users to define two values, Ingress Rate Limit and Egress Shaping Rate, which 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 Size (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 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**.

STEP 3 Select the **Port or 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.

NOTE The two **Ingress Rate Limit** fields do not appear when the interface type is LAG.

- **Ingress Committed Burst Size (CBS)**—Enter the maximum burst size of data for the ingress interface in bytes of data. This amount can be sent even if it temporarily increases the bandwidth beyond the allowed limit. This field is only available if the interface is a port.
- **Egress Shaping Rate**—Select to enable egress shaping on the interface.
- **Committed Information Rate (CIR)**—Enter the maximum bandwidth for the egress interface.
- **Egress 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 written to the Running Configuration file.

Configuring Egress Shaping per Queue

In addition to limiting transmission rate per port, which is done in the Bandwidth page, the device 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 device 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 displays the rate limit and burst size for each queue.

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

STEP 3 Select a Port/LAG, and click **Edit**.

This page enables shaping the egress for up to eight 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 written to the Running Configuration file.

Managing QoS Statistics

From this page you can manage the view queues statistics.

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 device 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**.

This page displays the following fields:

- **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.
- **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**.

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**—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 4 Click **Add**.

STEP 5 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 6 Click **Apply**. The Queue Statistics counter is added, and the Running Configuration file is updated.

SNMP

This section describes the Simple Network Management Protocol (SNMP) feature that provides a method for managing network devices.

It covers the following topics:

- **SNMP Versions and Workflow**
- **Model OIDs**
- **SNMP Engine ID**
- **Configuring SNMP Views**
- **Creating SNMP Groups**
- **Managing SNMP Users**
- **Defining SNMP Communities**
- **Defining Trap Settings**
- **Notification Recipients**
- **SNMP Notification Filters**

SNMP Versions and Workflow

The device functions as SNMP agent and supports SNMPv1, v2, and v3. It also reports system events to trap receivers using the traps defined in the supported MIBs (Management Information Base).

SNMPv1 and v2

To control access to the system, a list of community entries is defined. Each community entry consists of a *community string* and its access privilege. The system responds only to SNMP messages specifying the community which has the correct permissions and correct operation.

SNMP agents maintain a list of variables that are used to manage the device. These variables are defined in the *Management Information Base* (MIB).

NOTE Due to the security vulnerabilities of other versions, it is recommended to use SNMPv3.

SNMPv3

In addition to the functionality provided by SNMPv1 and v2, SNMPv3 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-DES) is used for encryption. Either authentication alone can be enabled on an SNMP message, or both authentication and privacy can be 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 device supports SNMP notification filters based on *Object IDs* (OID). OIDs are used by the system to manage device features.

SNMP Workflow

NOTE For security reasons, SNMP is disabled by default. Before you can manage the device via SNMP, you must turn on SNMP on the Security > TCP/UDP Services page.

The following is the recommended series of actions for configuring SNMP:

If you decide to use SNMPv1 or v2:

-
- STEP 1** Navigate to the SNMP -> Communities page and click **Add**. The community can be associated with access rights and a view in Basic mode or with a group in Advanced mode. There are two ways to define access rights of 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 by selecting a view (defined in the Views page).
 - **Advanced Mode**—The access rights of a community are defined by a group (defined in the Groups page). You can configure the group with a specific security model. The access rights of a group are Read, Write, and Notify.
- STEP 2** Choose whether to restrict the SNMP management station to one address or allow SNMP management from all addresses. If you choose to restrict SNMP management to one address, then input the address of your SNMP Management PC in the IP Address field.
- STEP 3** Input the unique community string in the Community String field.
- STEP 4** Optionally, enable traps by using the Trap Settings page.
- STEP 5** Optionally, define a notification filter(s) by using the Notification Filter page.
- STEP 6** Configure the notification recipients on the Notification Recipients SNMPv1,2 page.
-

If you decide to use SNMPv3:

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- STEP 1** Define the SNMP engine by using the Engine ID page. Either create a unique Engine ID or use the default Engine ID. Applying an Engine ID configuration clears the SNMP database.
- STEP 2** Optionally, define SNMP view(s) by using the Views page. This limits the range of OIDs available to a community or group.
- STEP 3** Define groups by using the Groups page.
- STEP 4** Define users by using the SNMP Users page, where they can be associated with a group. If the SNMP Engine ID is not set, then users may not be created.
- STEP 5** Optionally, enable or disable traps by using the Trap Settings page.
- STEP 6** Optionally, define a notification filter(s) by using the Notification Filter page.

STEP 7 Define a notification recipient(s) by using the Notification Recipients SNMPv3 page.

Supported MIBs

For a list of supported MIBs, visit the following URL and navigate to the download area listed as **Cisco MIBS**:

www.cisco.com/cisco/software/navigator.html

Model OIDs

The following are the device model *Object IDs* (OIDs):

Smart Switch Models

Model Name	Description	Object ID
SG200-18	16 GE ports + 2 GE special-purpose combo ports	9.6.1.88.18.1
SG200-26	24 GE ports + 2 GE special-purpose combo-ports	9.6.1.88.26.1
SG200-26P	24 GE ports + 2 GE special-purpose combo-ports	9.6.1.88.26.2
SG200-50	48 GE ports + 2 GE special-purpose combo-ports	9.6.1.88.50.1
SG200-50P	48 GE ports + 2 GE special-purpose combo-ports	9.6.1.88.50.2
SF200-24	24 FE ports + 2 GE special-purpose combo-ports	9.6.1.87.24.1
SF200-24P	24 FE ports + 2 GE special-purpose combo-ports	9.6.1.87.24.2
SF200-48	48 FE ports + 2 GE special-purpose combo-ports	9.6.1.87.48.1
SF200-48P	FE1-FE48, GE1-GE4. 48 FE ports + 2 GE special-purpose combo-ports	9.6.1.87.48.2

The private Object IDs are placed under:
enterprises(1).cisco(9).otherEnterprises(6).ciscosb(1).switch001(101).

SNMP Engine ID

The Engine ID is 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. The default SNMP Engine ID is comprised of the enterprise number and the default MAC address. This engine ID must be unique for the administrative domain, so that no two devices in a network have the same engine ID.

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**.

STEP 2 Choose which to use for **Local Engine ID**.

- **Use Default**—Select to use the device-generated engine ID. The default engine ID is based on the device 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 device.
- **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.

All remote engine IDs and their IP addresses are displayed in the Remote Engine ID table.

STEP 3 Click **Apply**. The Running Configuration file is updated.

The Remote Engine ID table shows the mapping between IP addresses of the engine and Engine ID. To add the IP address of an engine ID:

STEP 4 Click **Add**. Enter the following fields:

- **Server Definition**—Select whether to specify the Engine ID server by IP address or name.
- **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.
- **Server IP Address/Name**—Enter the IP address or domain name of the log server.
- **Engine ID**—Enter the Engine ID.

STEP 5 Click **Apply**. The Running Configuration file is updated.

Configuring SNMP Views

A view is a user-defined label for a collection of MIB subtrees. Each subtree ID is defined by the *Object ID* (OID) of the root of the relevant subtrees. Either 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 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 or to a community which employs basic access mode through the Communities page.

To define SNMP views:

STEP 1 Click **SNMP > Views**.

STEP 2 Click **Add** to define new views.

STEP 3 Enter the parameters.

- **View Name**—Enter a view name between 0-30 characters)
- **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 parent and siblings; press the *Down* arrow to descend to the level of the selected node's children. Click nodes in the view to pass from one node to its sibling. Use the scrollbar to bring siblings in view.
 - *User Defined*—Enter an OID not offered in the *Select from list* option.

STEP 4 Select or deselect **Include in view**. If this is selected, the selected MIBs are included in the view, otherwise they are excluded.

STEP 5 Click **Apply**.

STEP 6 In order to verify your view configuration, 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.
-

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 an SNMP agent. However, neither the frames nor the community string are encrypted. Therefore, SNMPv1 and SNMPv2 are not secure.

In SNMPv3, the following security mechanisms can be configured.

- **Authentication**—The device checks that the SNMP user is an authorized system administrator. This is done for each frame.
- **Privacy**—SNMP frames can carry encrypted data.

Thus, in SNMPv3, there are three levels of security:

- No security (No authentication and no privacy)
- Authentication (Authentication and no privacy)
- Authentication and privacy

SNMPv3 provides a means of controlling the content each user can read or write and the notifications they receive. A group defines read/write privileges and a level of security. It becomes operational when it is associated with an SNMP user or community.

NOTE To associate a non-default view with a group, first create the view in the Views page.

To create an SNMP group:

STEP 1 Click **SNMP > Groups**.

This page contains the existing SNMP groups and their security levels.

STEP 2 Click **Add**.

STEP 3 Enter the parameters.

- **Group Name**—Enter a new group name.

- **Security Model**—Select the SNMP version attached to the group, SNMPv1, v2, or v3.

Three types of views with various security levels can be defined. For each security level, select the views for Read, Write and Notify by entering the following fields:

- **Enable**—Select this field to enable the Security Level.
- **Security Level**—Define the security level attached to the group. SNMPv1 and SNMPv2 support neither authentication nor privacy. If SNMPv3 is selected, choose one of the following:
 - *No Authentication and No Privacy*—Neither the Authentication nor the Privacy security levels are assigned to the group.
 - *Authentication and No Privacy*—Authenticates SNMP messages, and ensures the SNMP message origin is authenticated but does not encrypt them.
 - *Authentication and Privacy*—Authenticates SNMP messages, and encrypts them.
- **View**—Associating a view with the read, write, and notify access privileges of the group limits the scope of the MIB tree to which the group has read, write, and notify access.
 - *View*—Select a previously-defined view for Read, Write and Notify.
 - *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*—Limits the available content of the traps to those included in the selected view. Otherwise, there is no restriction on the contents of the traps. This can only be selected for SNMPv3.

STEP 4 Click **Apply**. The SNMP group is saved to the Running Configuration file.

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.

The configured user have the attributes of its group, having the access privileges configured within the associated view.

Groups enable network managers to assign access rights to a group of users instead of to a single user.

A user can only belong to a single group.

To create an SNMPv3 user, the following must first exist:

- An engine ID must first be configured on the device. This is done in the Engine ID page.
- An SNMPv3 group must be available. An SNMPv3 group is defined in the Groups page.

To display SNMP users and define new ones:

STEP 1 Click **SNMP > Users**.

This page contains existing users.

STEP 2 Click **Add**.

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 inform messages and request information, you must define both a local and remote user.
 - *Local*—User is connected to the local device.
 - *Remote IP Address*—User is connected to a different SNMP entity besides the local device. 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 group to which the SNMP user belongs. SNMP groups are defined in the Add Group page.

NOTE Users, who belong to groups which have been deleted, remain, but they are inactive.

- **Authentication Method**—Select the Authentication method that varies according to the Group Name assigned. If the group does not require authentication, then the user cannot configure any authentication. The options are:
 - *None*—No user authentication is used.
 - *MD5 Password*—A password that is used for generating a key by the MD5 authentication method.
 - *SHA Password*—A password that is used for generating a key by the SHA (Secure Hash Algorithm) authentication method.
- **Authentication Password**—If authentication is accomplished by either a MD5 or a SHA password, enter the local user password in either **Encrypted** or **Plaintext**. Local user passwords are compared to the local database, and can contain up to 32 ASCII characters.
- **Privacy Method**—Select one of the following options:
 - *None*—Privacy password is not encrypted.
 - *DES*—Privacy password is encrypted according to the Data Encryption Standard (DES).
- **Privacy Password**—16 bytes are required (DES encryption key) if the DES privacy method was selected. This field must be exactly 32 hexadecimal characters. The **Encrypted** or **Plaintext** mode can be selected.

STEP 4 Click **Apply** to save the settings.

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 SNMPv3 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 by selecting a view (defined in the SNMP Views page).
- **Advanced Mode**—The access rights of a community are defined by a group (defined in the Groups page). You can configure the group with a specific security model. The access rights of a group are Read, Write, and Notify.

To define SNMP communities:

STEP 1 Click **SNMP > Communities**.

This page contains a table of configured SNMP communities and their properties.

STEP 2 Click **Add**.

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. 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 a VLAN or ISATAP.
 - **IP Address**—Enter the SNMP management station IP address.
 - **Community String**—Enter the community name 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 (Read Only, Read Write, or SNMP 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. SNMP Admin is equivalent to Read Write for all MIBs except for the SNMP MIBs. SNMP 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 Running Configuration is updated.

Defining Trap Settings

The Trap Settings page enables configuring whether SNMP notifications are sent from the device, and for which cases. The recipients of the SNMP notifications can be configured in the Notification Recipients SNMPv1,2 page, or the Notification Recipients SNMPv3 page.

To define trap settings:

-
- STEP 1** Click **SNMP > Trap Settings**.
 - STEP 2** Select **Enable** for **SNMP Notifications** to specify that the device 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 written to the Running Configuration file.
-

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 device. A list of notification recipients are 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 is 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 Notification Recipient Table.

The Notification Recipients SNMPv1,2 page and the Notification Recipients SNMPv3 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 device 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 Recipients SNMPv1,2**.

This page contains recipients for SNMPv1,2.

STEP 2 Click **Add**.

STEP 3 Enter the parameters.

- **Server Definition**—Select whether to specify the remote log server by IP address or name.
- **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 a VLAN or ISATAP.
- **Recipient IP Address/Name**—Enter the IP address or server name of where the traps are sent.
- **UDP Port**—Enter the UDP port used for notifications on the recipient device.
- **Notification Type**—Select whether to send Traps or Informs. If both are required, two recipients must be created.
- **Timeout**—Enter the number of seconds the device waits before re-sending informs.

- **Retries**—Enter the number of times that the device resends an inform request.
- **Community String**—Select from the pull-down the community string of the trap manager. Community String names are generated from those listed in the Community page.
- **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 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).

STEP 4 Click **Apply**. The SNMP Notification Recipient settings are written to the Running Configuration file.

Defining SNMPv3 Notification Recipients

To define a recipient in SNMPv3:

STEP 1 Click **SNMP > Notification Recipients SNMPv3**.

This page contains recipients for SNMPv3.

STEP 2 Click **Add**.

STEP 3 Enter the parameters.

- **Server Definition**—Select whether to specify the remote log server by IP address or name.
- **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 pull-down list.
- **Recipient IP Address/Name**—Enter the IP address or server name of where the traps are sent.
- **UDP Port**—Enter the UDP port used to for notifications on the recipient device.
- **Notification Type**—Select whether to send traps or informs. If both are required, two recipients must be created.
- **Timeout**—Enter the amount of time (seconds) the device waits before re-sending informs/traps. Timeout: Range 1-300, default 15
- **Retries**—Enter the number of times that the device resends an inform request. Retries: Range 1-255, default 3
- **User Name**—Select from the drop-down list the user to whom SNMP notifications are sent. In order to receive notifications, this user must be defined on the SNMP User page, and its engine ID must be remote.
- **Security Level**—Select how much authentication is applied to the packet.

NOTE The Security Level here depends on which User Name was selected. If this User Name was configured as No Authentication, the Security Level is No Authentication only. However, if this User Name has assigned Authentication and Privacy on the User page, the security level on this screen can be either No Authentication, or Authentication Only, or Authentication and Privacy.

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 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).

STEP 4 Click **Apply**. The SNMP Notification Recipient settings are written to the Running Configuration file.

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 Notification Recipients SNMPv1,2 page, and Notification Recipients SNMPv3 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 contains notification information for each filter. The table is able to filter notification entries by Filter Name.

STEP 2 Click **Add**.

STEP 3 Enter the parameters.

- **Filter Name**—Enter a name between 0-30 characters.
- **Object ID Subtree**—Select the node in the MIB tree that is included or excluded in the selected SNMP filter. 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 parent and siblings; press the *Down* arrow to descend to the level of the selected node's children. Click nodes in the view to pass from one node to its sibling. Use the scrollbar to bring siblings in view.

- If *Object ID* is used, the **entered object identifier** is included in the view if the **Include in filter** option is selected.

STEP 4 Select or deselect **Include in filter**. If this is selected, the selected MIBs are included in the filter, otherwise they are excluded.

STEP 5 Click **Apply**. The SNMP views are defined and the running configuration is updated.
